LUMMI NATION
WETLAND MITIGATION BANKING
ASSESSMENT REPORT

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EXECUTIVE SUMMARY

Wetlands on the Lummi Indian Reservation (Reservation) have cultural and spiritual significance to tribal members and serve a number of important ecological and economic functions. The quantity and quality of Reservation waters, including wetlands, affect the environmental quality and economic production of the Reservation. In order to protect wetlands, the Lummi Nation is developing a Wetland Management Program that includes a technical background document, a wetland ordinance, and wetland regulations that reflect Lummi cultural values and that will protect wetland functions on the Reservation. Wetland mitigation banking may be a useful regulatory tool to help protect wetland functions. The purpose of this *Wetland Mitigation Banking Assessment Report* (WMBAR) is to review current mitigation banking experience, identify important characteristics of successful wetland mitigation banks, and evaluate the potential for wetland mitigation banking on the Reservation.

Mitigation banking is intended to help resolve contentious situations where growth and development pressures conflict with wetland protection efforts. Under current policy and practice, the requirement for compensatory mitigation generates a potential demand for mitigation banking. Cost and uncertainty appear to have been the biggest impediments to widespread use of mitigation banks. Replacing complex ecological functions through wetland restoration, enhancement, or creation can quickly become expensive because of the cumulative costs of land surveys, wetland delineation, functional assessment, purchase of interests in land and perhaps water, construction, planting, maintenance, and monitoring. While this is also true of on-site, project-specific mitigation, it is even more important for wetland mitigation banks, which are usually attempting mitigation at a much larger scale with some degree of uncertainty about when, or even if, credits will be used (ELI 1994).

On 28 November 1995, the "Federal Guidance for the Establishment, Use, and Operation of Mitigation Banks" (United States 1995; hereafter Federal Guidance) was filed in the *Federal Register*.[1] Since the Federal Guidance was released, the number of wetland mitigation banks has greatly increased. As of September 2001, at least 200 approved wetland mitigation banks are estimated to exist in the United States, as well as at least 115 banks awaiting regulatory approval. In addition, there are at least 27 umbrella agreements for wetland mitigation that have permitted the use of over 220 individual bank sites (ELI 2001).

The Federal Guidance (United States 1995; p. 58606) describes wetland mitigation banking as:

> wetland restoration, creation, enhancement, and, in exceptional circumstances, preservation undertaken expressly for the purpose of compensating for unavoidable wetland losses in advance of development actions, when such compensation cannot be achieved at the development site or would not be as environmentally beneficial.

The perceived differences between wetland mitigation banking and on-site mitigation are summarized in the following list of advantages of wetland mitigation banking over individual mitigation projects (United States 1995). These advantages include the ability of banks to:

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[1] *Federal Register*, Vol. 60, No. 228, 28 November 1995, pp. 58605-58614

(1) Consolidate compensatory mitigation into a single large parcel or contiguous parcels;

(2) Bring together financial resources, planning, and scientific expertise that are not practicable to many project-specific compensatory mitigation proposals;

(3) Reduce permit-processing times and provide more cost-effective compensatory mitigation opportunities;

(4) Implement mitigation and function in advance of project impacts, thereby reducing temporal losses of aquatic functions and uncertainty over whether the mitigation will be successful in offsetting project impacts;

(5) Increase the efficiency of limited agency resources in the review and compliance-monitoring of mitigation projects because of consolidation, and thus improve the reliability of efforts to restore, create, or enhance wetlands for mitigation purposes; and

(6) Contribute towards attainment of the goal of no overall net loss of wetlands by providing opportunities to compensate for authorized impacts when mitigation might not otherwise be appropriate or practicable.

Wetland banking has been relatively successful during the past decade. While several banks have failed to meet expectations or achieve the correct type and amount of wetland area, there has been minimal net loss of wetland area associated with wetland mitigation banks (Tabatabai and Brumbaugh 1998). Several factors contributed to minimizing net losses (Driscoll and Granger 2001):

- Few banks allowed complete up-front debiting of credits;
- Contingency actions were implemented to improve the success of banks;
- Debiting of credits was deferred until ecological gains were realized; and
- Entire bank sites were permanently protected even when only part of the bank was able to be debited.

These banking mechanisms should continue to reduce the level of net loss of wetland area and function compared to other mitigation practices. Wetland mitigation banks are also more likely to have higher success rates than concurrent mitigation for the following reasons (Driscoll and Granger 2001):

- Banks receive early and detailed technical review;
- Banks generally have greater amounts of baseline information available;
- Bank sponsors have economic incentives to ensure site success; and
- Several risk management mechanisms, such as financial assurances, phased credit release, and monitoring requirements, may be implemented for wetland banks.

Wetland mitigation banking is viewed by many as a more consistently effective method of mitigation than the concurrent mitigation programs implemented over the past two decades

(Castelle et al. 1992b; ELI 1994, 2002; Driscoll and Granger 2001). As such, it should provide a better balance between the need for protection and restoration of wetland areas and the need for land development. The primary benefits foreseen for mitigation banking include:

- Benefits for Watershed Restoration;
- Sustainable Wetland Systems;
- Reduction of Cumulative Adverse Effects;
- Reduction of Temporal Losses;
- Higher Success Rates for Mitigation;
- Improved Salmonid Habitat;
- Efficient Use of Permitting Agency Resources; and
- A More Streamlined Permit Process.

Critics of mitigation banking point to the potential for increased wetland impacts and losses, greater relocation and replacement by type of wetland resources, and large-scale mitigation failures (Castelle et al. 1992b; ELI 1994; Driscoll and Granger 2001).

Many factors have been identified as important to the success of wetland mitigation banks, including (Castelle et al. 1992b; ELI 1994, 2002; Zinn 1997; Driscoll and Granger 2001):

(1) Sufficient demand for credits within the service area of the bank;

(2) Integration with landscape-level planning;

(3) Selection of an appropriate site, based on ecologically and hydrologically desirable characteristics, including buffers, ecosystem connectivity, and watershed integration;

(4) Baseline information that confirms the appropriateness of the site;

(5) Early and detailed technical review of the bank design by experienced, interdisciplinary scientists and managers;

(6) Detailed plans, performance standards, and enforcement measures in a complete authorizing document that clearly defines responsibilities for implementation;

(7) Favorable credit-conversion rates;

(8) Deferred debiting or phased release of credits until performance standards are realized;

(9) Bank sponsors that have economic incentives to ensure site success;

(10) Financial assurances sufficient for long-term monitoring and remediation;

(11) Implementation of contingency actions as needed to improve bank performance; and

(12) Permanent protection of the wetland status of the bank site through appropriate long-term ownership.

In choosing a potential wetland mitigation bank site on the Lummi Reservation, criteria are needed to compare alternative sites. The following criteria, in no particular order (the importance of each criteria will vary depending on the site and the situation), should be considered:

- Probability of successful implementation;
- Potential ecological value;
- Current or potential hydrologic quality;
- Potential economic value as a wetland bank relative to other possible uses;
- Number of credits potentially generated by the site;
- Availability and cost of acquiring the bank site;
- Size of, or demand within, the service area for the proposed bank; and
- Similarity of the mitigation wetlands to anticipated wetland impacts.

Since all of the Nooksack River delta and much of its floodplain on the Reservation, outside of the Lummi River floodplain, is currently wetland, most mitigation in this area would have to be in the form of enhancement or preservation of these current wetlands. Mitigation in the upland areas of the Reservation would also have to be in the form of enhancement or preservation of current wetlands. However, the Lummi Bay seawall, constructed in the 1920s (Deardorff 1992), and dikes along the Lummi River have restricted or eliminated wetland hydrology in a large portion of the Lummi River delta (Bortelson et al. 1980). Hence, mitigation of large areas in this delta could be accomplished through the restoration of tidal hydrology and reformation of estuarine wetlands. Mitigation in this area is appealing because compensatory restoration has a more favorable replacement ratio than the other possible forms of mitigation.

A 410-acre site along Lummi Bay has been identified as a potential site for an estuarine wetland mitigation bank. The bank could be established by restoring historic saltwater marshes on the site. Based on a 1.5:1 mitigation ratio for restoration, this site could be used to mitigate impacts on approximately 273 acres of wetlands. With an estimated cost of about $1.3 million for land acquisition and development of the mitigation site (Corps 2000), the cost per restored acre would be approximately $3,200. An additional, though less likely, potential site for a mitigation bank has been identified in the Nooksack River delta. A bank could possibly be established in the delta by preserving up to, and possibly more than, 865 acres of riverine and saltwater marsh wetlands. At a 10:1 mitigation ratio for preservation, this site could be used to mitigate impacts on about 86 acres of wetlands.

1. INTRODUCTION

Pursuant to Lummi Indian Business Council (LIBC) resolutions 90-88 and 92-43, the Lummi Nation is developing a Comprehensive Water Resources Management Program (CWRMP) to protect water resources on the Lummi Indian Reservation (Reservation). The Water Resources Division (LWRD) of the Lummi Natural Resources Department (LNR) is responsible for developing and implementing the CWRMP. An integral part of the CWRMP is the Wetland Management Program (WMP). The Wetland Management Program includes a technical background document, a wetland ordinance, and wetland regulations that reflect Lummi cultural values and that will protect wetland functions on the Reservation. The *Lummi Indian Reservation Wetland Management Program Technical Background Document* provides the technical foundation for the program (LWRD 2000a). The technical background document includes an inventory of Reservation wetlands and describes wetland functions, classifications, mitigation, restoration, and protection programs. The document also describes the topography, hydrogeology, soils, water resources, and land use on the Reservation.

Wetlands on the Reservation have cultural and spiritual significance to tribal members and serve a number of important ecological and economic functions. The quantity and quality of Reservation waters, including wetlands, affect the environmental quality and economic production of the Reservation. Wetland mitigation banking may be a useful regulatory tool to help protect wetland functions. The purpose of this *Wetland Mitigation Banking Assessment Report* (WMBAR) is to review current mitigation banking experience, identify important characteristics of successful wetland mitigation banks, and evaluate the potential for wetland mitigation banking on the Reservation.

This report was created through a review of the pertinent available literature on wetland mitigation banking and a review of information available on the Internet. This review included the currently recorded mitigation banking activity in the Pacific Northwest, the effects of mitigation banking foreseen by wetland specialists and observers of the field, and the characteristics of wetland mitigation banking anticipated to be important for the success of a bank site. Finally, criteria for banking success were compiled and suggestions for potential bank sites on the Reservation are presented.

This report is divided into seven sections:

- Section 1 is this introduction.
- Section 2 describes federal wetland mitigation and wetland mitigation banking.
- Section 3 summarizes mitigation banking activity in the Pacific Northwest.
- Section 4 describes the effects of wetland mitigation banking.
- Section 5 discusses the potential for mitigation banking on the Lummi Reservation.
- Section 6 summarizes this report.
- Section 7 lists the references cited in this report, followed by a list of the acronyms and abbreviations used in this report.

2. FEDERAL WETLAND MITIGATION AND WETLAND MITIGATION BANKING

The U.S. Army Corps of Engineers (Corps) and the U.S. Environmental Protection Agency (EPA) are responsible (i.e., have not delegated authority) under the federal Clean Water Act and Rivers and Harbors Act for issuing permits for certain activities that affect wetlands on the Reservation. In its lead role, the Corps has retained primary authority for wetland permitting in all jurisdictions across the United States. The EPA certifies wetland permits approved by the Corps as meeting water-quality standards, and will delegate certification authority to states or tribes, but has not yet done so for the Lummi Reservation.

The objective of the federal Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the “waters of the United States.”[2] Section 404 of the CWA specifically protects wetlands by regulating the dredging or filling of waters of the United States, including wetlands. Under § 404, the Corps issues permits for dredging and filling activities that affect wetlands. Under § 401 of the CWA, the EPA must certify that proposed projects will not cause violation of water-quality standards. When the Lummi Nation is authorized to administer § 401 of the CWA and adopts water-quality standards, the LNR will be responsible for certifying that proposed projects will not cause violations of water-quality standards. Section 401 also applies to all waters of the United States, including wetlands. The CWA and other federal regulations applicable to wetlands on the Reservation are described in more detail in the *Lummi Nation Wetland Ordinance Literature Review* (LWRD 2001) and elsewhere (ELI 1994; Corps 1997, 1998; Ecology 1988; and EPA 1993).

Pursuant to § 404(b)(1) of the CWA, the EPA promulgated regulations in 1980 that the Corps uses to evaluate the environmental effects of proposed discharges to wetlands. Under these § 404(b)(1) Guidelines[3] (hereafter “Guidelines”), the Corps cannot issue an individual wetland permit unless it determines that the proposed project complies with the Guidelines. The Guidelines state that “no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.”[4] In the analysis of alternatives under the Guidelines, consideration is given to whether the proposed discharge is the least environmentally damaging practicable alternative. When a non-water-dependent activity is proposed for wetlands, the Guidelines create a presumption that there are practicable alternatives. To overcome this presumption, applicants must "clearly demonstrate" that there is no practicable alternative that would have less adverse impact on the aquatic environment. The Guidelines also require that a permit not be issued if the proposed discharge would (1) violate other environmental statutes/regulations or (2) cause or contribute, either individually or collectively, to significant degradation of wetlands or other waters of the United States. Finally, the Guidelines require that the discharger undertake all appropriate and practicable mitigation in order to minimize or compensate for any potential harm to the aquatic ecosystem. In addition to mitigating for direct and unavoidable impacts to wetlands, permit applicants have provided compensatory mitigation to comply with the “significant degradation” provision of the Guidelines (ELI 1994).

[2] 33 USC 1251 et seq.
[3] 40 Code of Federal Regulations (CFR), Section 230
[4] 40 CFR § 230.10[a]

2.1 OVERVIEW OF FEDERAL WETLAND MITIGATION

To standardize mitigation requirements under the Guidelines, the Corps and EPA signed a Memorandum of Agreement (MOA) in February 1990.[5] Though it was developed as a clarification of existing policy rather than the creation of new policy, the mitigation MOA has had a significant impact upon the § 404 permitting process. The mitigation MOA condensed an earlier definition of mitigation into three phases: avoidance, minimization, and compensation. Further, the MOA clarified that each of these steps should be evaluated in sequence (the "sequencing requirement"). Thus, applicants for § 404 permits are required to demonstrate that (1) adverse effects on wetlands and other aquatic resources have been and will be avoided to the maximum extent practicable; (2) potential adverse effects on wetlands will be minimized; and (3) compensation for any remaining unavoidable effects will be provided through wetland restoration, enhancement, or creation activities. The MOA applies to standard (individual) permits, but does not apply to general permits (ELI 1994).

The first mitigation step, avoidance, is synonymous with the practicable alternatives test established by the § 404(b)(1) Guidelines. The Guidelines provide that an alternative discharge site is practicable if it is "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes."[6] An alternative site not owned by the applicant may be considered "available" if it "could reasonably be obtained, utilized, expanded, or managed in order to fulfill the basic purpose of the proposed activity." Other important issues in the avoidance step include how the "basic purpose" is defined, which will determine the range of alternatives to be considered, and whether the project purpose and alternatives should be judged from the viewpoint of the applicant or the public interest. The Corps is responsible for establishing the basic project purpose as it develops the record for each permit review. Interpretation of this requirement has varied over time (ELI 1994).

The second step of the mitigation sequence, minimization, requires applicants to look for ways to locate, design, or phase projects to reduce wetland impacts. The Guidelines list a number of actions to be evaluated in the context of minimizing the adverse effects of discharges.[7]

The third step, compensation, requires replacement of unavoidable losses of wetland functions and values. Compensatory measures must be "appropriate and practicable." "Appropriate" mitigation is based on the ecological value of the affected wetland. Determination of "practicable" requires consideration of "cost, existing technology, and logistics in light of overall project purposes."[8] The sequencing requirements apply to all individual permits, regardless of the type or ecological value of the affected wetland, though the evaluation of compliance "will vary to reflect the seriousness of the potential for adverse impacts on the aquatic ecosystems posed by specific…activities"[9] (ELI 1994).

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[5] "Memorandum of Agreement Between the Environmental Protection Agency and the Department of Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines," 6 February 1990
[6] 40 CFR § 230.10(a)(2)
[7] 40 CFR § 230.70
[8] 40 CFR § 230.3(q) or § 230.10(a)(2)?
[9] 40 CFR § 230.10; see also §§ 230.6(a), (b)

The mitigation MOA provides for deviations from the sequencing requirements when the requirements have been incorporated in a Corps- and EPA-approved comprehensive plan, when necessary to avoid environmental harm (e.g., from salt water intrusion or chemical contamination), or when EPA and the Corps agree that a proposed discharge "can reasonably be expected to result in environmental gain or insignificant environmental losses" (ELI 1994).

The mitigation MOA specifies a clear preference for on-site, in-kind replacement of wetland functions and values, and establishes a minimum one-to-one ratio as a rule of thumb for replacement. Mitigation banks are recognized as an "acceptable form of compensatory mitigation under specific criteria designed to insure an environmentally successful bank." However, the MOA notes that simple purchase or "preservation" of existing wetlands will not be considered adequate compensation except in "exceptional circumstances" (ELI 1994).

2.2 Overview of Wetland Mitigation Banking

Wetland mitigation banking has been a concept since the 1970s, but did not generate much activity until the late 1980s. During the late 1980s and early 1990s, several mitigation banks were established on an *ad hoc* basis with regulatory agencies. In 1992, there were only 46 existing wetland mitigation banks and an additional 64 proposed mitigation banks. Nearly 75 percent of the existing banks in 1992 were single-user, public-works mitigation banks, and the majority of these were operated by state departments of transportation to mitigate for highway projects (ELI 1994). At that time, one primary factor limiting wetland mitigation banking in general and private entrepreneurial banks in particular was uncertainty in the federal regulatory status of wetland mitigation banks.

Mitigation banking is intended to help resolve contentious situations where growth and development pressures conflict with wetland protection efforts. Under current policy and practice, the requirement for compensatory mitigation generates a potential demand for mitigation banking. Cost and uncertainty appear to have been the biggest impediments to widespread use of mitigation banks. Replacing complex ecological functions through wetland restoration, enhancement, or creation can quickly become expensive because of the cumulative costs of land surveys, wetland delineation, functional assessment, purchase of interests in land and perhaps water, construction, planting, maintenance, and monitoring. While this is also true of on-site, project-specific mitigation, it is even more important for wetland mitigation banks, which are usually attempting mitigation at a much larger scale with some degree of uncertainty about when, or even if, credits will be used (ELI 1994).

On 23 August 1993, the Corps and EPA issued a Joint Memorandum: Corps Regulatory Guidance Letter 93-2. The memorandum endorsed the establishment and use of wetland mitigation banks under the § 404 program. It specified that wetland mitigation banks should generally be in place and functioning before credits may be used to offset permitted wetland losses. However, it also stated that it may be appropriate to allow incremental distribution of credits corresponding to the appropriate stage of successful establishment of wetland functions. The memorandum also prescribed the development of a formal written agreement concerning creation of the bank and use of a § 404 permit for this purpose (ELI 1994).

On 28 November 1995, the “Federal Guidance for the Establishment, Use, and Operation of Mitigation Banks” (United States 1995; hereafter Federal Guidance) was filed in the *Federal Register*.[10] This Federal Guidance was developed by the Corps, EPA, Natural Resource Conservation Service (NRCS), U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS) in response to the need for a unified federal policy on wetland mitigation banking. The Federal Guidance was designed to clarify the manner in which mitigation banks could be used to satisfy the mitigation requirements of the CWA § 404 program and the Food Security Act (the “Swampbuster” program). Since the Federal Guidance was released, the number of wetland mitigation banks has greatly increased. As of September 2001, at least 200 approved wetland mitigation banks are estimated to exist in the United States, as well as at least 115 banks awaiting regulatory approval. In addition, there are at least 27 umbrella agreements for wetland mitigation that have permitted the use of over 220 individual bank sites (ELI 2001).

The Federal Guidance (United States 1995; p. 58606) describes mitigation banking as:

> wetland restoration, creation, enhancement, and, in exceptional circumstances, preservation undertaken expressly for the purpose of compensating for unavoidable wetland losses in advance of development actions, when such compensation cannot be achieved at the development site or would not be as environmentally beneficial.

The Federal Guidance discusses several policy issues, including:

- planning considerations, including goal-setting, site selection, technical feasibility, role of preservation, inclusion of upland areas, and banking in a watershed context;

- the process for establishing banks, including contents of the prospectus and the banking instrument, the roles of agencies, bank sponsors, public input, and dispute resolution procedures;

- criteria for using mitigation banking, including project applicability, relationships between banking and mitigation (including deciding between on-site mitigation or banking), using the same or different wetlands and the extent of the bank service area, timing of withdrawals, and credit and debit procedures; and

- long-term management and monitoring, including the operational life of the bank, the role of remedial actions, and commitments to long-term management, monitoring, and financing (Zinn 1997).

Wetland mitigation banks have two components: a physical place where wetland “credits” are generated by restoring, creating, enhancing, and/or preserving wetlands; and an organization (or part of an organization) that creates the overall management structure (bank instrument) for the mitigation bank and provides the management for the physical place. (Unless otherwise noted, the term “banking” refers to wetland mitigation banks or a program of wetland mitigation banking and does not refer to financial institutions.) Credits can be used (debited) to compensate for unavoidable impacts to wetlands within a designated geographic area (service area). The service area of a bank is the area in which

[10] *Federal Register*, Vol. 60, No. 228, 28 November 1995, pp. 58605-58614

credits may be used or sold for use and is generally determined based on the area in which the wetland functions provided by the bank can reasonably be expected to replace those lost to unavoidable impacts. Projects that use bank credits as compensation are called "debit projects." Wetlands and surrounding uplands within mitigation banks are protected in perpetuity and have a designated long-term manager. Bank sponsors generally must post financial assurances to guarantee the full success of the bank and to provide for the long-term management of the bank site(s) (Driscoll and Granger 2001).

Withdrawals (or debits) from a mitigation bank are considered when an unavoidable impact to a wetland within the service area is proposed. The permitting agencies determine if the bank credits provide adequate compensation for the losses. Factors that are considered when determining the appropriate use of credits include whether on-site mitigation for the debit project is practicable and appropriate, if off-site mitigation is ecologically preferable, and whether the bank provides similar wetland functions to those affected by the debit project. If approved during the permitting process, the client (i.e., the party responsible for a wetland impact) withdraws or purchases credits from the bank as compensation for the authorized wetland impacts. Credits are then deducted (debited) from the bank. This debit process can be repeated as long as the mitigation bank has available credits (Driscoll and Granger 2001).

There are three types of wetland mitigation banks: public banks, private banks, and entrepreneurial banks. Each of these types may be subdivided by whether credits will be used by single clients or multiple clients. These types are defined by who the sponsor(s) and client(s) of the bank are.

Public banks are established by public organizations, commonly for infrastructure projects such as roads, utilities, ports, and storm-water facilities. A single-user bank is developed by a single agency to compensate for wetland impacts from their own projects. Common examples around the United States are banks established by transportation departments to mitigate impacts from highway projects. A multiple-user bank is developed by one or more agencies to provide mitigation for multiple public and/or private users. A public bank could also be a joint-venture bank in which a public entity, usually a local government, jointly establishes a bank with a private entity in order to provide compensatory mitigation alternatives for residential and commercial development (Driscoll and Granger 2001).

Private and entrepreneurial banks are both established by the private sector. A private bank may be sponsored by a single developer or corporation to provide for their own long-term mitigation needs. Alternatively, a group of developers may sponsor a multi-user private bank to combine resources and reduce the costs for wetland mitigation. A private individual or firm establishes an entrepreneurial bank in order to sell credits for profit to clients needing mitigation within the specified service area. Clients of an entrepreneurial bank may be private individuals, companies, and/or public organizations (Driscoll and Granger 2001).

In response to a National Research Council (NRC) report on the effectiveness of wetland mitigation (NRC 2001) and ten years of experience after the 1990 MOA, the Corps released a Regulatory Guidance Letter (RGL) on 31 October 2001 (Corps 2001). However, the Corps received complaints from the EPA and environmental groups regarding the RGL and, in December 2001, opened the RGL for comment by other federal agencies. Since March 2002, an interagency workgroup has been working with the Corps to address concerns about the RGL, and it is anticipated that the Corps will issue a revised guidance letter. In addition, an interagency group has been working to develop a comprehensive response to many of the deficiencies identified in recent evaluations of compensatory mitigation. The interagency group expects to release a "National Mitigation Action Plan" during the fall of 2002. The plan will identify specific tasks that the agencies will complete jointly over the next three years to address important weaknesses in compensatory mitigation (ELI 2002).

3. WETLAND MITIGATION BANKING ACTIVITY IN THE PACIFIC NORTHWEST

As of November 2001, a total of six wetland mitigation banks and banking programs existed in Washington State (Driscoll and Granger 2001):

- Washington State Department of Transportation (three sites under development);
- Pierce County Public Works Department;
- Paine Airfield, Snohomish County;
- King County (one bank site and administrative rules);
- Meadowlands Bank, Clark County; and
- McHugh Estuarine Wetland Demonstration Bank, Pacific County

There are at least four wetland mitigation banks in Oregon (Driscoll and Granger 2001):

- Astoria Airport Mitigation Bank, Oregon Division of State Lands, Clatsop Co.;
- West Eugene Wetland Mitigation Bank, City of Eugene Public Works, Lane Co.;
- Henderson Marsh Mitigation Plan, Weyerhauser Company, Ceros Bay, Coos Co.;
- Weathers Wetland Mitigation Bank, Harley Weathers, Willamette River, Marion Co.

The Idaho Department of Transportation has three wetland mitigation banks in Idaho that were permitted by the Corps District Office in Walla Walla, WA (Driscoll and Granger 2001). As of December 2001, there were also two mitigation banks pending in Washington and 11 banks pending in Oregon (ELI 2002).

3.1 EXISTING PUBLIC MITIGATION BANKS

The Washington State Department of Transportation (WSDOT) initiated the first effort to establish wetland mitigation banking in Washington. In 1992 the WSDOT began negotiations on a memorandum of agreement with federal and state regulatory agencies. The memorandum of agreement, which was completed and signed in 1994, addresses how WSDOT will establish and operate a wetland mitigation-banking program to meet transportation-related wetland compensation needs. The memorandum contains information on agency coordination, bank site selection, debiting ratios, and monitoring requirements for WSDOT banks (Driscoll and Granger 2001).

The WSDOT has a wetland mitigation bank under construction and a second bank being planned in the Chehalis River basin. These banks are designed to provide compensatory mitigation for impacts from the proposed upgrade of Interstate 5. The WSDOT also has a bank located in Moses Lake (Grant County), which was developed to mitigate for highway impacts in the Columbia Basin (Driscoll and Granger 2001).

The Pierce County Public Works Department began a wetland mitigation-banking program in 1994. The banking program consists of several sites located in various sub-basins in the county. In several cases the sites were selected to provide compensatory mitigation for specific projects, but were designed to provide more mitigation than was needed for the initial project. The extra credits produced at the bank sites are used by the county for local permit requirements and occasionally are used to meet federal permit conditions for public works projects. Although the program is primarily a single-user public bank system, WSDOT has been able to purchase credits out of the county bank system (Driscoll and Granger 2001).

The Paine Airfield wetland mitigation bank, established in 1996, was designed to provide wetland mitigation for impacts anticipated under a 20-year airport expansion plan. This bank is a multiple-user bank. It also provides mitigation for other public agencies affecting wetlands in the service area of the bank. The Snohomish County Public Works Department and the WSDOT have both used the bank to meet mitigation obligations for road improvements associated with airport operations (Driscoll and Granger 2001).

King County developed administrative rules to regulate wetland mitigation banking and, in 1996, established a mitigation bank on the Issaquah Plateau. This multiple-user bank was established to provide mitigation for public projects. Although managed by King County, credit ownership among users is based on the respective cost-share for the project (Driscoll and Granger 2001).

The West Eugene Wetland Mitigation Bank in Oregon is another example of a multiple-user public bank. The City of West Eugene oversees and manages the bank, which was designed as part of a comprehensive land-use planning effort. Public or private clients located within the service area of the bank may purchase credits to meet permit requirements (Driscoll and Granger 2001).

3.2 Existing Entrepreneurial Mitigation Banks

The interest in privately established and managed wetland mitigation banks has increased dramatically during the past few years. Several factors have probably contributed to this increase. First, there has been a decline in small family farms with a concurrent rise in land costs and tax burdens in agricultural areas that are located near developing areas. As a result, farmers are looking for alternative methods for generating income and preserving their lands. Second, the increasing recognition that wetland systems provide significant public services has increased their economic and social value. Third, increasing growth, particularly in the Puget Sound area, southwestern Washington, and the Tri-Cities and Spokane areas, provides a consistent level of demand for compensatory wetland mitigation. Finally, there is a perceived opportunity to produce significant profits from a wetland mitigation bank. Developers are willing to pay significant sums in order to provide compensation for their impacts and obtain development approvals. It is not unusual for concurrent compensatory mitigation to cost tens of thousands of dollars per acre, excluding land costs (King and Bohlen 1994). In commercially zoned areas, mitigation costs are especially prohibitive and can exceed hundreds of thousands of dollars per acre when land costs are included (Perkins et al. 1997). Therefore, developers may choose buying credits from a wetland mitigation bank over creating their own compensatory mitigation (Driscoll and Granger 2001).

The Meadowlands Bank, constructed in 1996, was the first entrepreneurial wetland mitigation bank established in Washington State. This bank has provided mitigation for a number of development projects in the rapidly developing Salmon Creek basin of Clark County. Clark County approved the bank to provide compensatory mitigation required under the local critical areas regulation. The bank did not receive approvals on the state or federal levels. However, the Corps and Ecology have elected to allow use of the bank for compensation required under the Clean Water Act on a case-by-case basis (Driscoll and Granger 2001).

The McHugh Estuarine Wetland Demonstration Bank is a six-acre, restored estuarine wetland in Pacific County. It provides mitigation credits for local projects and has also been used to meet Corps requirements under a Section 404 authorization. This demonstration bank was approved by Pacific County. The McHugh bank could not be approved on the state level because of the timing of the state rule development for mitigation banking. The bank was developed to demonstrate the feasibility of developing estuarine banks and restoring estuarine wetlands. Because of its relatively small size, the Corps did not elect to approve the site as a federal wetland mitigation bank. However, they have accepted use of credits from the demonstration bank as compensatory mitigation required under the Section 404 permitting program (Driscoll and Granger 2001).

4. EFFECTS OF WETLAND MITIGATION BANKING

This section discusses the primary potential advantages and disadvantages of wetland mitigation banking that have been identified in studies of wetland mitigation banking. The benefits of banking that have been identified by regulatory agencies, developers, and/or wetland advocates are described first, followed by potential negative effects of mitigation banks. Finally, wetland mitigation banking is compared to on-site, concurrent mitigation.

4.1 POTENTIAL BENEFITS OF WETLAND MITIGATION BANKING

Wetland mitigation banking is viewed by many as a more effective method of mitigation than the concurrent mitigation programs implemented over the past two decades. As such, it should provide a better balance between the need for protection and restoration of wetland areas and the need for land development. This section describes the primary benefits of wetland mitigation banking, including benefits for watershed restoration, sustainable wetland systems, reduction of cumulative adverse effects, reduction of temporal losses, higher success rates for mitigation, improved salmonid habitat, efficient use of permitting agency resources, and a more streamlined permit process.

4.1.1 Benefits for Watershed Restoration

Watershed plans are often developed to address the restoration of watershed processes and resources that have been degraded over time and/or to guide future development in an environmentally sound manner. The Federal Guidance (United States 1995) states that decisions regarding the design and location of wetland mitigation banks “are most appropriately made within the context of a comprehensive watershed plan.” By providing functions that are limited within a watershed or by restoring watershed processes, a wetland mitigation bank can improve both ecological and hydrologic conditions within a watershed (NRC 2001; Driscoll and Granger 2001).

Despite the landscape-level effect of land-use decisions, larger ecological (or hydrologic) considerations are rarely included in land-use planning decisions (Dale et al. 2000). While ecological processes occur over the whole landscape, resource decisions, particularly wetland management decisions, are generally made at the site scale. Individual decision-making focused at the site level often conflicts with the landscape approach to resource management (Race and Fonseca 1996). This is presumably true for compensatory mitigation, which has relied more upon opportunistic development of compensation sites than determining the site selection and design of mitigation sites in the larger context of watershed functioning and restoration. The emphasis of concurrent mitigation has often been on attempting to replace functions and area at the site level, generally ignoring considerations of whether the compensation will provide ecologically significant benefits to the larger landscape (Driscoll and Granger 2001).

Watershed planning efforts may identify and prioritize restoration and preservation sites based on the identified needs in a watershed and the level of ecological benefit that can be provided by the sites. However, these sites may not be available for restoration or use as compensation sites. Also, the small size that is typical of required compensation often does not provide sufficient incentive for applicants to obtain and/or restore high priority sites. Additionally, the funding to complete compensation actions (including acquisition and construction activities) is generally limited, and local jurisdictions may lack sufficient funds to implement the priority restoration activities. Hence, while watershed plans may identify priority sites necessary for restoring or preserving watershed functions, concurrent mitigation practices have not been very successful at providing compensation at those sites (Driscoll and Granger 2001).

The larger scale of wetland mitigation banking and its potential for landscape-level evaluation of wetland replacement increases the chance that watershed-scale processes will be considered during wetland mitigation planning. Wetland mitigation banking can also complement watershed planning by providing a mechanism for implementing restoration activities on or preserving priority sites in the watershed. Banks can be used to direct the replacement of wetland losses (e.g., compensatory mitigation) to priority sites where the replacement wetlands will improve the ecological and hydrologic functioning of the watershed. In addition, ongoing efforts in watershed planning could benefit from the establishment of a wetland mitigation bank on priority restoration sites that may have land costs or land ownership issues that preclude non-regulatory restoration activities (Driscoll and Granger 2001).

Wetland mitigation banks that are developed within the context of watershed planning will reduce the risks associated with wetland mitigation through the following mechanisms (Driscoll and Granger 2001):

- Site selection will be based on a landscape perspective and will most likely include restoration elements;
- Greater amounts of baseline data are often available in watershed planning areas;
- Disruptions to watershed processes may be identified;
- Limiting functions in the watershed may be identified; and
- Watershed plans may include or reference comprehensive land-use plans that identify the types and locations of wetlands that are likely to be affected by future development.

By being able to predict what types of wetlands and associated functions are likely to be lost in a developing watershed, bank sponsors can site and design their banks to meet anticipated compensation needs. Sponsors can then be more confident that agencies will allow use of their banks because the location and design of the banks will provide ecological benefits that are important within the watershed (Driscoll and Granger 2001).

4.1.2 Sustainable Wetland Systems

In the context of wetlands, sustainability usually refers to the ability of a wetland to persist on the landscape without loss or decline, its ability to continue to provide functions, and its ability to rebound from episodic disturbances (Dale et al. 2000). When compensatory mitigation sites are unsuccessful and cease to perform functions for which they were designed, net losses of wetland area and function will occur. Ensuring that sites are sustainable requires that the processes and systems of the surrounding watershed and ecosystem are considered during site location and design. Since wetland banks tend to be larger than individual mitigation sites and are more readily designed in the context of the surrounding watershed and ecosystem, wetland banks tend to be more sustainable than individual mitigation sites (Driscoll and Granger 2001).

Except for requirements to permanently protect a compensatory mitigation site, the long-term sustainability of an individual mitigation site was previously only superficially addressed during the permitting process. Consequently, a large majority of mitigation sites are located in highly developed areas and tend to receive more storm-water runoff and accumulate more pollutants than wetlands in rural areas. With increased storm-water runoff, the hydrologic regime of a wetland becomes flashier, with more rapid, larger, and more frequent increases and decreases in the depth and volume of water in the wetland. Vegetation communities respond to these hydrologic changes by becoming less diverse, and the habitat suitability of the site is significantly reduced (Azous and Horner 1997). Additionally, the isolation of many individual mitigation sites hinders the ability of the animal and plant populations at the site to recover from catastrophic events because other populations are either too far away to re-colonize the site or are blocked from accessing the site. If disease or another natural disturbance process (e.g., fire or flood) greatly reduces or eliminates populations at a mitigation site, its connectivity to other natural areas and populations is critical for the recolonization of the site (Diamond 1975).

Certified wetland mitigation banks are more likely than concurrent mitigation to result in sustainable wetland ecosystems because of the following expected or potential advantages (Driscoll and Granger 2001):

- The emphasis on using a landscape perspective when selecting suitable locations for banks;
- The integration of wetland mitigation banks with watershed and land-use planning;
- The larger size of the compensatory mitigation, which provides an economy of scale for collecting and analyzing watershed information to guide decision-making regarding site selection and design that is not feasible with small, on-site mitigation projects;

- The prioritized use of restoration (over other forms of compensation), which reduces the degree of human manipulation necessary to establish wetland conditions; and

- The greater efficiency and probability of success in performing restoration activities on the larger wetland bank sites.

The integration of wetland mitigation banks with watershed management and land-use plans should result in banks being located on sites that are important for the maintenance and restoration of watershed functions. Features such as credit determination, service area, and an expedited review process may be used as incentives for bank sponsors to integrate their banks with existing watershed plans. Banks that are established in areas where watershed analyses have been completed should benefit from a good understanding of what the natural disturbance regimes are and can be designed (and have performance standards developed) to anticipate future disturbances (e.g., flooding, channel migration, or mass wasting) (Driscoll and Granger 2001).

Restoration of wetland systems is encouraged over creation, enhancement, and preservation through the use of better conversion rates for the generation of credits. In many cases, restoration of wetland systems cannot be done on a small scale, and the larger size of banks enables a sponsor to undertake restoration that would not likely occur under concurrent mitigation.

In addition, oversight by a technical review team during permitting will help ensure that the proposed site (Driscoll and Granger 2001):

- Has the biological, physical, and chemical characteristics necessary to support wetland conditions;

- Can contribute to the restoration of ecological processes and functions in a watershed;

- Is surrounded by land uses that are compatible with the maintenance of wetland systems; and

- Can be protected from future degradation produced by actions occurring off-site.

Such oversight should produce larger buffer areas that will increase the ecological values and functions generated by the bank site. Bank sites with larger buffers and that provide connectivity to other habitat areas may receive better conversion rates for their credits (Driscoll and Granger 2001).

In addition, the amount of information that is required by a technical review team for a bank is much greater than is required for most individual projects. This more complete information on watershed conditions and ecological functions provides a defensible basis for regulators to consider and approve off-site mitigation options that result in greater improvements in watershed conditions (Scodari and Shabman 2001).

4.1.3 Reduction of Cumulative Adverse Effects

Wetland mitigation banks can provide significant benefits by addressing the cumulative effects from minor impacts in a relatively efficient and cost-effective manner. The Federal Guidance on mitigation banking states that:

> … watershed planning efforts often identify categories of activities having minimal adverse effects on the aquatic ecosystem and that, therefore, could be authorized under a general permit. In order to reduce the potential cumulative effects of such activities, it may be appropriate to offset these types of impacts through the use of a mitigation bank established in conjunction with a watershed plan. (United States 1995; p. 58609)

Bedford (1996) noted that (as cited in Driscoll and Granger 2001, with emphases added):

> From a policy perspective, ***the central issue in wetland mitigation is not effects on a single site but the cumulative effects of numerous mitigation decisions on landscapes.*** Mitigation must be recognized as a policy that has the potential to reconfigure the kinds and spatial distribution of wetland ecosystems over large geographic areas. Within that policy, choices are made to allow some wetland ecosystems to be destroyed; others are created or restored. The patterns of destruction are not random (Dahl 1990, 2000; Dahl and Johnson 1991), nor are the patterns of replacement. Palustrine forested wetlands suffered the greatest losses from the mid-1970s to mid-1980s. Some types of wetlands (e.g., salt marshes and freshwater emergent marshes) are preferentially restored or created. Other types of wetlands are seldom, if ever replaced (e.g., bogs, fens, forested wetlands) (Kusler and Kentula 1990; Zedler and Weller 1990). Habitats of endangered species are frequently affected (Kentula et al. 1992). The net effect is the loss of wetland diversity in terms of both hydrologic functions and biological communities, and a consequent homogenization of wetland landscapes. ***One way to avoid such cumulative effects is to make decisions about individual projects within a framework focused at larger scales*** (Lee and Gosselink 1988).

The past patterns of wetland mitigation have resulted in the loss, transfer, or tradeoff of wetland functions and biological communities. For example, several studies of wetland mitigation show that created wetland mitigation has resulted in an increase of wetland habitats that include open water (Gwin et al. 1999; Johnson et al. 2001). The design of these sites focused on ensuring sufficient hydrology and establishing vegetated wetlands along the gradient from open water to uplands (Kentula et al. 1992). This and other relatively simple creation or restoration choices have reduced wetland diversity over the landscape. Further, under existing practices such as the federal Nationwide Permit program and local ordinances, minor wetland impacts occur without the need for compensation. Part of the reason behind such regulation is that the impacts themselves were believed to have minimal effect. Another reason is that the small scale of compensatory mitigation necessary was cost-prohibitive and too ecologically insignificant to justify a requirement for replacement. However, the cumulative effect of these minor impacts has been significant (Driscoll and Granger 2001).

As development has occurred, the cumulative effect of small individual losses includes disruptions in watershed processes and the ecosystems supported by those processes. Studies have shown that disruptions to watershed processes, such as the delivery and routing of water and woody debris, can have detrimental effects. These include a reduction in the number of species that can be supported by an area (Azous and Horner 1997) and in the quality and diversity of habitat niches provided (Dale et al. 2000; Beechie and Bolton 1999). The listing of Pacific salmonids under the Endangered Species Act clearly illustrates that the cumulative effect of development in urbanizing watersheds has been significant (Driscoll and Granger 2001).

Mitigation banks can potentially provide a relatively efficient and cost-effective means to mitigate for small, unavoidable losses of wetlands. Where mitigation banks are available, applicants having minor impacts to wetlands would be able to simply purchase bank credits to meet their compensation requirements instead of hiring a consultant to figure out how to create (or force) the necessary mitigation onto their development site. An example is the Meadowlands bank in southwestern Washington, which provided a successful in-basin mitigation alternative for small impacts occurring in the Salmon Creek basin of Clark County (Driscoll and Granger 2001).

As noted above, part of the reason for not requiring mitigation for minor impacts has been the consideration of the financial hardship that would be imposed on homeowners and small landowners if they were required to provide compensation for small impacts. The presence of a wetland mitigation bank may encourage some local jurisdictions to minimize additional cumulative effects by requiring mitigation for impacts to small, low quality wetlands that are currently exempt from regulation. Additionally, some local jurisdictions may choose to incorporate wetland banking in their land-use planning in order to balance economic and environmental needs and address cumulative impacts. The listing of salmonids as an endangered species in the Pacific Northwest has provided additional incentive for some jurisdictions to address continuing cumulative losses. By providing wetland functions lost in the past or anticipated to be lost in the future, wetland mitigation banks can help to address cumulative losses in a watershed (Driscoll and Granger 2001).

4.1.4 Reduction of Temporal Losses

If an existing wetland is affected before the compensatory mitigation for the impact is fully developed, then a temporal loss of wetland function occurs. Under existing regulatory frameworks, significant temporal losses of wetland functions can occur. These losses occur because wetland impacts usually occur before the construction of a compensatory wetland mitigation site. Additional temporal losses occur because mitigation sites may take several years after construction to develop and provide some of their wetland functions. The time required for a compensatory wetland to fully perform wetland functions varies considerably based on the type and location of the wetland (Castelle et al. 1992a; King et al. 1993). In the Salmon River estuary of Oregon, an estuarine wetland was fully vegetated eight years after restoration of tidal influence, but the plant community had changed considerably in diversity and species during that time (Frenkel 1997) and could potentially change further before stabilizing. Decades may pass before a newly planted wetland area is mature enough to function as a forested wetland (Driscoll and Granger 2001).

Concurrent wetland mitigation practices often require increased compensatory ratios for area replacement to account for temporal losses of functions (McMillan 1998; Castelle et al. 1992a). However, unavoidable wetland impacts are generally allowed to occur regardless of the functional status of the compensatory wetland (Driscoll and Granger 2001).

Temporal losses of wetland functions may still occur with wetland mitigation banking, but wetland banking will result in reduced temporal losses compared to concurrent mitigation. The primary reason that temporal losses will be reduced in mitigation banking is the phased release of credits. Phased release means that the credits from a bank are released over time, as the bank site matures, instead of being immediately available, as is the case with concurrent mitigation. Some credits from a bank may be released when the bank site is initially constructed, but the majority of the credits are not released until the bank begins to attain specific performance standards. These performance standards are designed to serve as indicators of the successful development of a wetland ecosystem at the bank site (Driscoll and Granger 2001).

In addition to the phasing of credit releases, additional reductions in temporal losses are expected when credits are not used immediately after they are released. When a credit is released, it means that the bank sponsor can use or sell the credit. Impacts do not occur until a credit is used for compensation. This means that a bank may have a balance of released credits that have not been used for compensation. The net result is a temporal gain in wetland functions since impacts have not yet occurred. This temporal gain has occurred in Florida. According to the Florida Department of Environmental Protection, only 58 percent of the credits that have been released and are available for use have been used to meet compensation requirements. In addition, most of the existing banks in Florida have only had a portion of the total potential credits released (Bersok 2001). This means that a significant number of acres in wetland mitigation banks have been constructed and are maturing before the impacts that they will offset have occurred (Driscoll and Granger 2001).

4.1.5 Higher Success Rates for Mitigation

In general, concurrent compensatory mitigation has not been as successful as hoped or intended (Storm and Stellini 1994; Kunz et al. 1998; Mockler et al. 1998; Gwin et al. 1999; Johnson et al. 2000; Johnson et al. 2001). A higher success rate is expected using wetland mitigation banks.

There are two main reasons to expect wetland mitigation banks to have higher levels of success. First, banks are subject to significant, early, technical review by a multi-agency team. Second, bank sponsors have an economic incentive to ensure the success of the site. The opportunity to choose desirable locations for banks and the typically larger size of wetlands in mitigation banks are also reasons to expect a higher success rate.

As described in the Federal Guidance (United States 1995), mitigation banks are rigorously reviewed by a multi-agency review board. Bank proposals are examined for their site-selection rationale, design, and technical feasibility. Bank proposals are also required to include a large amount of baseline information addressing the ability of the site to support wetland conditions. With concurrent mitigation, baseline information for mitigation sites is often minimal (Driscoll and Granger 2001).

The economic incentive for bank sponsors is based on the provision that a bank sponsor can sell or use all potential credits only after the successful development of the bank site. Credits may be held back until the site meets specified success criteria. By tying the ability to sell credits to the attainment of success at the bank, the regulator provides a strong incentive for a bank to be successful. If a wetland mitigation bank is not ecologically successful, it will not generate the necessary credits to justify the investment in the bank (Driscoll and Granger 2001).

Additionally, mitigation banking includes other factors that are expected to increase the likelihood of success for banks. Because banks are intended to provide mitigation over larger areas, they can be integrated into watershed management planning, which increases the probability of the bank benefiting from its surroundings. Banks are also generally created at a larger scale, which is conducive to wetland restorations that are unattainable under individual project mitigation. The integration of bank-site selection and design with larger scale, watershed needs and priorities can result in banks that are located in the right place on the landscape and that are sustainable over the long term. When mitigation sites are located in appropriate places, such as where wetlands can be restored through management activities, the banks have a greater likelihood of success than mitigation that is forced on to a development site (Driscoll and Granger 2001).

Finally, mechanisms to manage the risk of unsuccessful mitigation can be included in the permit for a wetland bank. These include (Driscoll and Granger 2001):

- Requirements for financial assurances for short- and long-term management of the bank site; and
- Credit releases that are tied to the results of monitoring, which provides incentives for sponsors to monitor the site and to implement adaptive management activities if necessary.

4.1.6 Improved Salmonid Habitat

Over the last century, Pacific salmon have disappeared from about 40 percent of their historical spawning and rearing habitat (NRC 1996). Starting in the early 1990s, several species of salmonids in Washington State have been listed as threatened or endangered under the federal Endangered Species Act. The declines in salmon populations are largely due to human impacts on the environment that have resulted from development and urbanization, agriculture, forestry, dams, and fishing (NRC 1996).

Development activities that affect wetlands and their upland buffer areas often affect salmonid habitat as well. When riparian and floodplain wetlands are lost to development, coho salmon lose over-wintering and rearing habitat. Estuarine wetland losses remove critical transition and rearing habitat for coho, chum, chinook, bull trout, and sea-run cutthroat trout. Historical losses in the Puget Sound region range from 25 percent of estuarine wetlands in the Skagit River estuary to 98 percent of wetlands in the highly developed Duwamish River estuary (NRC 1996). Since 1887, estuarine wetland losses in the Lummi River delta have been estimated to be approximately 94 percent; in the Nooksack River delta, the total estuarine wetland area was estimated to have increased slightly because wetland losses have been matched by wetland gains as the delta has prograded over time (Bortelson et al. 1980).

Changes in riverine wetlands due to diking, draining, and agricultural uses reduce native marshes and simplify watercourses into primary channels that lack the habitat complexity of side and braided channels. The habitats provided by marshes and side channels are important for juvenile fish (NRC 1996). Lower river valleys, which historically were the most productive spawning and rearing habitat, have had larger wetland losses because of agricultural exemptions. These areas are under increasing development pressure as more agricultural producers go out of business and sell farmland for residential or commercial development (Driscoll and Granger 2001).

There has recently been a shift from simply replacing structural elements of an ecosystem to a broader, landscape-based approach of understanding and repairing processes within a watershed (Kauffman et al. 1997; Beechie and Bolton 1999). As the National Research Council noted in their study on Pacific salmon (NRC 1996),

> "…rehabilitating watershed processes to the extent possible given human development, including the re-establishment of riparian functions – such as providing shading, organic matter, and large woody debris – is probably more effective in improving salmon habitat over the long-term…"

When unavoidable wetland impacts are authorized, wetland mitigation banks can help salmonid species by mitigating the effects of development projects that affect salmon habitats. Banks can be established that (Driscoll and Granger 2001):

- Restore estuarine wetlands and mudflat habitats, which are important for out-migrating juvenile salmonids, food chain support, and habitats for salmon prey species;
- Restore upper watershed wetlands, which provide storage of surface flows, reduce downstream erosion and scour, and recharge groundwater sources that provide temperature moderation and maintenance of base flows for streams;
- Restore riverine wetlands, which provide refuge from high flows, flood storage, and production export;
- Protect and restore riparian areas that provide recruitment of large woody debris, shade, detritus, bank stabilization, and reduced downstream erosion; and
- Restore access to spawning and rearing areas.

While wetland mitigation banking cannot change the trends in losses, it can provide a mechanism through which watershed processes are restored. For instance, large parcels of floodplain can be reconnected with river systems and restored to higher levels of ecological functioning. Banking can provide the incentive and capital necessary to retain these areas and restore them to natural conditions rather than have them developed in a piecemeal fashion. Banks can restore salmonid habitat, create new habitat areas, and provide water-quality and -quantity functions that enhance the ability of water bodies to support salmon. Additionally, banks can address the cumulative effects of many small wetland impacts as well as providing ecologically significant replacement of various functions. Several aspects of mitigation banking, including site selection criteria, integration with watershed plans, site design, use of credits, and preservation criteria, support the establishment of banks that contribute to achieving properly functioning conditions for salmon in a watershed (Driscoll and Granger 2001).

4.1.7 Efficient Use of Permitting Agency Resources

When a project is required to provide compensatory mitigation for unavoidable impacts, the staff of the permitting agency reviews the proposed mitigation plan and determines whether the proposal is likely to be successful and to provide adequate replacement of impacts. However, because most staff resources for regulatory programs at the state and federal levels are dedicated to permit processing and limited funds are available to perform enforcement and follow-up actions, comprehensive enforcement of wetland permit requirements has been effectively prevented (NRC 2001). While the Corps does complete a close-out visit on compensatory wetland mitigation sites that were required under Section 404 permits, Washington State does not regularly check progress or complete close-out visits for mitigation projects required as a part of a state water quality certification. With a low probability of enforcement actions for lack of performance, little impetus exists for project applicants to ensure the success of the compensatory mitigation or to implement adaptive measures (Storm and Stellini 1994; Driscoll and Granger 2001).

Wetland mitigation banking requires extensive agency review and participation during the development of a bank instrument. While the initial permitting for a bank will require more resources than the level committed to site-specific mitigation, agencies should save significant time during the enforcement and follow-up stage of permitting for banks relative to site-specific mitigation (Driscoll and Granger 2001).

Banking differs from concurrent compensatory mitigation in several significant ways. First, the bank sponsor shoulders the burden for achieving a successful wetland site. Since most banking scenarios call for partial or phased releases of credits, it is in the economic self-interest of the bank sponsor to ensure that the site is as successful as possible.

Second, because the design, implementation, and monitoring of mitigation were found to be the most critical factors for successful functioning of compensation projects (Castelle et al. 1992a), the emphasis of wetland mitigation banking is on these areas. The existing focus of concurrent mitigation is on obtaining the permit to affect wetland resources.

Third, mitigation banks more effectively use regulatory and compliance staff time. For example, review processes for wetland banks in Washington and other states have involved extensive preliminary negotiation between the applicant and the regulatory agencies. By determining factors such as site selection, how credits will be determined, and service areas before a bank is developed, a form and process for what formerly was an ad hoc review of wetland mitigation proposals will be implemented and should reduce overall staff time. However, the majority of regulatory streamlining may come in the debit-project stage. Rather than reviewing many individual mitigation plans, agencies will only need to follow the design and development of one bank. Since the staff will only need to determine if the bank provides the appropriate functions and wetland types, rather than needing to determine if an individual mitigation site is likely to be successful, evaluating the adequacy of compensatory mitigation will be much simpler. The number of plans and designs that staff will need to evaluate for small impacts will be reduced if bank credits are used instead of project-specific mitigation. Finally, agencies will have to devote less time for enforcement staff to follow-up on a consolidated wetland mitigation bank than would be necessary to follow-up on all of the individual mitigation sites that would have been developed in lieu of the bank (Driscoll and Granger 2001).

4.1.8 Streamlined Permit Process

The responsibility for coordinating the regulatory review of a mitigation bank lies with the bank sponsor. The bank sponsor must meet with each of the appropriate regulatory agencies to develop an agreement for a bank. While the Federal Guidance provides some direction, there are still significant elements of each bank that must be negotiated on a case-by-case basis. Under a proposed mitigation banking rule for Washington State (currently on hold because funding is not available), Ecology, rather than the applicant, will facilitate agency review of bank proposals that fall under state jurisdiction. Additionally, a Memorandum of Agreement between the state and federal agencies is being developed to allow bank sponsors to obtain local, state, and federal review and approval of a bank proposal through a single permit process (Driscoll and Granger 2001). Though the state does not have jurisdiction on the Reservation, an application to federal agencies for a mitigation bank on the Reservation could benefit from this process at the federal level.

The proposed state rule clearly identifies the bank elements that require decisions from a review team and the considerations that a review team should address. If the permit process for a bank on the Reservation is similar, bank sponsors would be able to anticipate agency expectations and then design their proposals accordingly. This transparency in the decision-making process would bring an increased level of predictability to the regulatory process and thus remove some of the financial risk associated with banking. While the permit process for a bank requires a significant investment of time during the development of the proposal, significant time savings can be realized by both applicants and agencies during the review process for development projects using the bank as compensation (Driscoll and Granger 2001).

Banks that implement watershed plans and priorities should experience a streamlined permit process. This is partly because, in such cases, significant baseline information exists on the bank site and the surrounding watershed. Other areas in which the review of banks in watershed planning areas could be expedited include determinations of service areas and allowable credits. In cases where function assessment and resource prioritization activities have occurred, the credit determination methodology may already be developed, which would reduce the time necessary for a review team to agree upon the types and number of credits to be generated by the bank (Driscoll and Granger 2001).

Wetland mitigation banking provides economic benefits for debit-project proponents and resource agencies. Once an impact is determined to be unavoidable, banks allow faster permit-processing and decision-making for debit projects. The permitting time is reduced because the compensation element is completed in advance. The agencies can see what they are receiving in terms of wetland resources at the bank, and therefore the agencies and the applicant do not need to spend time designing and negotiating the specifics of a compensatory mitigation site. Once the agencies agree to the use of bank credits for compensation, the debit-project proponent only needs to finalize purchase of the bank credits and provide documentation of the purchase in order to satisfy permit requirements. Economies of scale are inherent in wetland mitigation banking, especially for developers, such as transportation agencies, with wide-ranging impacts. Thus, it is normally less costly to establish and manage one large wetland unit than many small compensatory wetland areas (Driscoll and Granger 2001).

4.2 Potential Negative Effects of Wetland Mitigation Banking

Possible negative effects of wetland mitigation banking include potentially increased wetland impacts and losses; potential relocation and replacement of wetland resources; and potential large-scale mitigation failures.

4.2.1 Increased Wetland Impacts and Losses

Wetland mitigation presents the difficult challenge of creating, restoring, or enhancing complex wetland ecosystems. Many wetlands have evolved over thousands of years, with animal and plant communities that reflect various relationships between wet and dry conditions. As described by Zinn in a report for Congress (Zinn 1997), opponents of mitigation and mitigation banking are concerned that it is difficult to determine how fully these complex ecosystems can be reestablished or replicated in a short time or whether they can be reestablished at all. As mitigation banking is relatively recent and untried for many types of wetland ecosystems, bank sponsors may not recognize current or potential problems. If a banking site fails to maintain the promised value of the credits, then a double loss results: at the bank and at the purchaser's project site. In addition, if preservation of existing wetlands is allowed as mitigation, then a net wetland loss will result (Zinn 1997).

One concern about wetland mitigation banking is that it will be used to justify avoidable impacts to wetlands, thereby resulting in more wetland losses. This concern derives from the belief that, if bank credits are available, regulators will jump to compensation of wetland impacts without requiring applicants to go through the initial sequence of mitigation (i.e., avoidance and minimization). The presence of a wetland mitigation bank does not relieve an applicant of the requirement to first avoid and minimize impacts to wetlands. As mitigation banking becomes more accessible, increasingly efficient, and relatively simple, it will present a tempting alternative to regulators and developers alike. Another concern is that wetland losses could increase because of pressure on agencies to use credits from a bank that is experiencing financial difficulties because of a lack of demand for its credits. These concerns should be alleviated by the requirements to apply mitigation sequencing to all proposed projects. The use of credits from a mitigation bank will not be allowed until the compensation phase of mitigation sequencing for a project is reached. However, losses of wetlands will continue to occur as a result of unavoidable impacts from growth and development, regardless of whether a wetland mitigation bank exists in an area (Driscoll and Granger 2001).

At the federal level, mitigation sequencing is applied to all projects. However, at the local level, mitigation sequencing is not always rigorously enforced, either by rule or implementation, and compliance with local ordinances does not equal compliance with federal regulations. Many local ordinances provide exemptions for impacts to very small wetlands or for impacts from single-family dwellings. In addition, land-use decisions and the political weight of private property-rights issues often influence local permitting decisions (Race 1996). Accordingly, some local jurisdictions may choose to bypass avoidance and minimization requirements and go directly to compensating with bank credits. This practice would result in increased wetland impacts for (typically small) wetlands that do not fall under federal regulation or are exempted from federal mitigation requirements.

4.2.2 Relocation and Replacement of Wetland Resources

This section discusses the potential effects of off-site mitigation and out-of-kind mitigation for wetland impacts. Off-site mitigation means that the replacement wetlands are not provided on or near the project that requires mitigation. Off-site mitigation is often only allowed if mitigation on the project site is not practicable or if off-site mitigation is environmentally preferable to on-site mitigation. Out-of-kind mitigation means that the compensatory wetlands and their associated functions are of a different kind than those that were lost. Out-of-kind mitigation is a common practice; an example is when the affected wetlands are highly degraded (e.g., wet pastures dominated by exotic species) and are replaced by a native scrub-shrub wetland. The relocation and/or replacement of wetland functions and values on the landscape can happen when compensation/mitigation occurs off-site or out-of-kind because the wetland resources that existed at the project site are not replaced in-place or in-kind (Driscoll and Granger 2001).

4.2.2.1 Off-site Compensation

Federal policies on compensatory wetland mitigation emphasize on-site replacement of impacted wetlands. This has resulted in the construction of many wetland mitigation sites where the conditions necessary to support wetlands do not naturally occur. In such cases, mitigation requirements guide the design of the compensation rather than the site conditions guiding the wetland design. Consequently, requirements for wetland areas have frequently resulted in site designs that ensure the establishment of wetlands by emphasizing open water areas that are ringed by vegetation (Driscoll and Granger 2001; Kentula et al. 1992).

While the majority of wetland mitigation does occur on or near the site of the project affecting wetlands (Mockler et al. 1998), much of the mitigation to date does not provide adequate compensation for the functions that are lost (Johnson et al. 2001; National Research Council 2001). In a study of 45 wetland mitigation projects in Washington State, Ecology found that only 55 percent were implemented to plan and, of the 34 that could be assessed, only 35 percent were meeting performance standards (Johnson et al. 2000). From an ecological perspective, only three out of 24 projects were fully successful in providing adequate compensation for the loss of wetlands (Johnson et al. 2001). In King County, over 75 percent of mitigation projects failed to meet their performance standards (Mockler et al. 1998). In addition, on-site mitigation has resulted in wetland sites that are often referred to as “postage-stamp” mitigation. These mitigation sites are often isolated from other natural areas and wetlands by roads and commercial and residential development. Their isolation from native seed sources and wildlife populations limit their functional value and could affect their ability to recolonize after catastrophic disturbances (Driscoll and Granger 2001).

Another problem associated with on-site mitigation in urban and developing areas is the increased nature and frequency of human disturbances and inputs of toxins and pollutants. Many on-site mitigation sites serve as sinks for sediment and waterborne contaminants that wash off surrounding impervious surfaces. These sites are often located within urbanizing areas and are degraded along with remaining remnant wetlands because of hydrologic alterations and inputs of contaminants, excess nutrients, and disturbances (Booth 2000; Azous and Horner 1997; Driscoll and Granger 2001). Increases in impervious surfaces and reductions in infiltration and storage capacity in the upper parts of basins result in widely fluctuating hydrologic regimes and decreased plant and animal diversity. A smaller number of species that are able to tolerate large variations in depth and duration of inundation tend to replace the diverse native species in these wetland communities (Azous and Horner 1997; Driscoll and Granger 2001).

Because land in urban areas is economically more valuable for development than as wetlands, and because land in rural areas is less expensive, the use of wetland mitigation banks could result in a relocation of wetlands to rural areas. The potential effects of a relocation of wetlands to more rural areas include the following:

- Net losses of wetlands in urban sub-basins and net gains in rural areas;
- Alterations of hydrologic patterns;
- Loss of aesthetic values and recreational opportunities for urban dwellers;
- Loss of open space areas and wildlife habitat in urban areas; and
- Small wetlands replaced by credits generated from large wetland systems.

Pressures that tend to result in the loss of urban wetlands may be especially apparent in designated urban growth areas. Space is at a premium in urban growth areas and therefore land costs can be prohibitive for on-site wetland mitigation. As a result, bank credits may be used more frequently than concurrent mitigation in these areas. Since wetland banks may have service areas that cover several sub-basins, the use of wetland banks could also result in wetlands in one sub-basin being replaced by wetlands in a different sub-basin in the same watershed. Consequently, some sub-basins within a service area could have net losses while others would experience net gains in wetland area (Driscoll and Granger 2001).

Because small wetlands may not be replaced by other small wetlands, but may instead be replaced by credits generated from the large wetland systems often used in mitigation banks, small wetlands may become fewer in number. There can be significant impacts to the landscape and unique risks involved in the loss of small wetlands. Collectively, small wetlands can provide significant hydrologic functions, such as reducing downstream erosion, reducing peak flows, and recharging ground water (Loukes 1990; Leschine et al. 1997). These small wetlands can also provide vital habitat for native amphibians (Richter 1996) and serve as habitat islands for birds and urban wildlife. Small wetlands can also provide residents in urban areas with recreational and educational opportunities. It is noted that mitigation banks do not have to consist of large wetland systems. A complex of small wetlands and their adjacent upland areas can comprise a wetland mitigation bank (Driscoll and Granger 2001). Wetland complexes are common on the Reservation (LWRD 2000a) and could be considered for mitigation banking.

While most regulatory compensation has involved on-site mitigation, off-site mitigation has also been used for concurrent mitigation. This use of off-site mitigation and the habitat fragmentation resulting from wetland alterations has resulted in a redistribution of wetland systems at the landscape scale (Gwin et al. 1999; Kelly 2001). The use of mitigation banks will also result in the relocation on the landscape of some wetland functions. Whether that change is desirable depends upon the relationship of human populations to the resultant effects in the donor and the receiving basins (King 1997). King described this relationship in the following passage:

> The landscape context affects different functions and values in different ways. For example, fish and wildlife spawning, breeding, and feeding habitats are provided best by wetlands that are surrounded by healthy ecological landscapes and are relatively inaccessible to humans. Other functions, such as sediment and nutrient trapping, generate more benefits if the wetland is closer to disturbed landscapes where sediment, nutrient, and storm water runoff are a problem. Similarly, certain wetland benefits (such as aesthetics, scientific research, education, and flood protection) require that people reside in nearby proximity to the wetlands, while others (such as endangered species habitat) require the opposite condition (King 1997).

If a wetland function such as reduction of peak flows or reduction of downstream erosion is lost in one basin and replaced in another, the donor basin will experience effects from increased flooding and scour, and those effects would not necessarily be offset by less flooding in a different basin. The exchange would not be desirable in the donor basin, where increased flooding (from the loss of water-quantity functions) could affect populated areas and infrastructures. However, it may be acceptable to relocate the water-quantity functions off-site if, for instance, there were no population centers downstream from where the loss of function occurred and the downstream basin area had sufficient floodplain area available to accommodate more floodwater and thereby preclude increased erosion (Driscoll and Granger 2001).

Adverse effects from the relocation of wetlands and their functions on the landscape can be minimized in two ways. First, the service area of a bank can be based upon the functions provided at the bank and the distance from the bank in which impacts can be adequately offset. This distance could vary depending on the function(s) being mitigated. Second, when debit projects propose to use bank credits, the permitting authority determines whether the use of credits is appropriate. The regulating agency first determines whether to allow off-site mitigation. If it is determined that off-site mitigation is acceptable or desirable, the permitting agency then decides whether the bank provides the appropriate functions to replace those functions lost. If the bank is not appropriate for replacing the necessary functions, then its use is not likely to be authorized. This decision is made on a case-by-case basis, taking into consideration the functions and landscape relationships of the wetlands in the bank versus the unavoidable impacts of the debit project (Driscoll and Granger 2001).

A study by the National Research Council on compensatory wetland mitigation (NRC 2001) supports the use of off-site mitigation when appropriate and concludes "watershed goals may often best be served by placing compensatory wetlands off-site." The study also recommends that:

> Site selection for wetland conservation and mitigation should be conducted on a watershed scale in order to maintain wetland diversity, connectivity, and appropriate proportions of upland and wetland systems needed to enhance the long-term stability of the wetland and riparian systems. Regional watershed evaluation should greatly enhance the protection of wetlands and/or the creation of wetland corridors that mimic natural distributions of wetlands in the landscape.

4.2.2.2 Out-of-Kind Compensation

The traditional regulatory preference for compensatory mitigation focuses on in-kind and on-site wetland replacement. In-kind replacement has generally been construed as meaning of the same Cowardin class (e.g., palustrine forested, estuarine, or riverine wetlands). The preference for in-kind mitigation is based on the assumption that similar wetland types provide similar functions. However, studies in Washington (Johnson et al. 2001), Oregon (Gwin et al. 1999), and elsewhere (Bedford 1996) have shown that compensatory mitigation has often not resulted in replacement of similar wetland types. Presumably, functions have not always been replaced as well. In many cases, created wetlands contain morphology, vegetative communities, and hydrologic regimes that do not exist naturally in the landscape (Driscoll and Granger 2001).

The overall effect of concurrent mitigation has been the gradual replacement of naturally occurring wetland types with more simplified, less diverse, and in some cases, atypical wetland types (Gwin et al. 1999). The policy has resulted in a distinct increase in open water wetland types, as well as atypical wetlands (those that do not occur naturally within hydrogeomorphic subclasses) (Gwin et al. 1999; Bedford 1996). The effects of this reconfiguration of the types and spatial distribution of wetlands include losses of some functions, loss of biodiversity, and altered hydrologic patterns (Bedford 1996; Kentula et al. 1992).

Several types of out-of-kind trades could occur with wetland mitigation banking. These potential exchanges include the following (Driscoll and Granger 2001):

- Compensation of wetland impacts in which the wetland functions represented by bank credits are not the same as the functions to be lost;
- Compensation of impacts to wetlands with credits generated by upland portions of bank sites;
- Shifts in the size distribution of wetlands when impacts to small wetlands are replaced with larger wetland systems; and
- Conversions of wetland type, for example from freshwater, emergent wetlands to estuarine or forested wetland systems (or vice versa).

Whether exchanges of type and/or functions of wetlands are ecologically appropriate will depend upon the context in which the exchange occurs. When impacts occur to a highly degraded and altered wetland, compensatory mitigation is often designed to provide higher quality wetlands rather than to exactly replace the lost wetlands. One example of guidance is the Washington State Alternative Mitigation Policy (Ecology et al. 2000), which states that out-of-kind mitigation is acceptable when it will provide an overall net gain for the resources of the watershed (Driscoll and Granger 2001).

Mitigation banking may change the types of wetlands that persist in the landscape and the functions they provide. Some banks may include a variety of wetland types while other banks may focus on a single wetland type. Because the precise impacts to wetlands that will use the bank are not known, some wetland types may be exchanged during the use of the bank. This is particularly true if the regulating agency allows the use of credits from a bank that provides different functions or different wetland types than those that were lost (Driscoll and Granger 2001).

A potential weakness of mitigation banking is that in order in maximize potential credits or profits from a wetland bank, sponsors will be tempted to create easily designed wetland systems rather than developing more complex wetland systems. Some wetland types have been easier to recreate than others. For instance, estuarine marshes have been relatively easy to replace, while forested wetlands and groundwater-driven wetland systems are successfully developed less frequently (Kusler and Kentula 1990; NRC 2001). Some systems such as bogs and fens may not be reproducible at all because of the complex physical and chemical processes that define these systems (Ecology 1993; NRC 2001). Sponsors will want to minimize their risks by developing banks where the proposed mitigation activities (e.g., restoration, creation, and/or enhancement) have a high likelihood of success. Hence, sponsors are unlikely to develop banks that depend upon the development of a bog system and instead may opt to breach a dike to restore tidal marshes (Driscoll and Granger 2001).

In situations where credits are not allowed for upland areas within a bank, replication of a naturally occurring mosaic of wetlands and uplands may be less likely in mitigation banks. These wetland and upland mosaics may be ecologically significant ecosystems for a particular area. However, economic considerations would compel bank designers to maximize the wetland areas that generate marketable credits. Therefore, a sponsor may maximize the creation of wetlands at the bank site, eliminating the use of uplands as part of a wetland/upland mosaic. Maximizing the wetland areas at bank sites may result in more large wetland systems and fewer mosaics of wetlands and uplands (Driscoll and Granger 2001).

Upland areas within a bank may be allowed to generate credits if these areas contribute to the ecological functions performed by the wetlands in the bank. While the use of credits from such a bank to mitigate for impacts to wetlands could result in a net loss of wetland area, the benefits gained would ideally include the establishment of a sustainable wetland ecosystem that is representative of historical wetlands in the watershed (Bedford 1996). In areas where local regulations require compensation for impacts to wetland buffers or upland habitats, net losses of wetlands would be reduced if bank credits from a mosaic bank are used to compensate for upland impacts as well as wetland impacts (Driscoll and Granger 2001).

Clear rules in the bank instrument on the use of bank credits should reduce the potential for losses in specific functions and types of wetlands in a watershed. Generally, banks that do not provide functions similar to those that are lost in a watershed may not see their credits approved for use as compensation. Thus, bank sponsors will want to develop banks that will provide adequate function exchange in order to minimize their risk of financial losses (Driscoll and Granger 2001).

The failures of existing compensatory mitigation projects to replace function and area (NRC 2001; Johnson et al. 2001) are already resulting in trade-offs in wetland functions. An Ecology study (Johnson et al. 2001) showed that existing on-site mitigation is resulting in some replacement of water-quality and -quantity functions, but is failing to replace habitat losses. Wetland mitigation banks can be used to offset wildlife habitat losses and can result in sites that are more connected with other natural areas, migration corridors, and other wetland habitats. Additionally, wetland banking provides a context for making conscious decisions on trade-offs of functions rather than the unplanned trade-offs that occur now. Designing more sustainable compensatory wetland mitigation should reduce the chance that future net losses will occur from failed or degraded mitigation sites (Driscoll and Granger 2001).

The mix of functions and values provided by impacted wetlands may be impossible to recreate because of ecological differences, the location of the bank in the watershed, or surrounding land uses. The differences between impacted and compensatory wetlands are often subtle, yet have a substantial effect on the value of the resource. Critics contend that these differences should be accounted for in the credit system, and that any uncertainty about how to value the credits and debits should err in favor of protecting wetland resources (Zinn 1997). Some opponents also believe that the diversity of species supported by the impacted wetland should be fully replaced. They argue that even when replacement is attempted, identical habitat may not be readily established at another site, resulting in declines, or the potential loss, of some species and in less diversity in the ecosystem (Zinn 1997).

The Federal Guidance addresses this issue by stating that in-kind compensation of wetland impacts should generally be required and that requests for out-of-kind mitigation will be addressed on a case-by-case basis (United States, 1995). Requests for out-of-kind mitigation are supposed to be approved only when it is a part of an area-wide management plan designed to address a specific resource objective. Critics wonder whether federal agencies can be counted on to vigorously monitor these requirements (Zinn 1997).

4.2.3 Large-Scale Mitigation Failures

Since wetland mitigation banks are generally larger than on-site mitigation sites, failures of banks would potentially result in greater losses of wetlands. Though knowledge of wetland ecosystems and restoration techniques has increased, sites do not always turn out as planned (Zedler and Calloway 1999). As noted above, the 35 percent success rate for compensatory mitigation in Washington is low. Technical problems at mitigation sites have included inappropriate hydrology; inadequate or incorrect baseline information on hydrology, soils, and elevations; invasive species; and unenforceable performance standards (Marble and Riva 2001). Administrative problems have included lack of follow-through by agencies, lack of contingency plans or actions, and lack of monitoring requirements (Storm and Stellini 1994). Because many of the same factors that have resulted in failures of project-specific mitigation sites could affect the success of wetland mitigation banks, it will be important to use past experience, careful planning, and effective monitoring to avoid failures of mitigation banks.

In contrast to the relatively low success rate of concurrent, compensatory wetland mitigation efforts, wetland mitigation banking has been relatively successful during the past decade. While several banks have failed to meet expectations or achieve the correct type and amount of wetland area, there has been minimal net loss of wetland area (Tabatabai and Brumbaugh 1998). Several factors contributed to minimizing net losses (Driscoll and Granger 2001):

- Few banks allowed complete up-front debiting of credits;
- Contingency actions were implemented to improve the success of banks;
- Debiting of credits was deferred until ecological gains were realized; and
- Entire bank sites were permanently protected even when only part of the bank was able to be debited.

These banking mechanisms should continue to reduce the level of net loss of wetland area and function compared to current mitigation practices. Wetland banks are also more likely to have higher success rates than concurrent mitigation for the following reasons (Driscoll and Granger 2001):

- Banks receive early and detailed technical review;
- Banks generally have greater amounts of baseline information available;
- Bank sponsors have economic incentives to ensure site success; and

- Several risk management mechanisms, such as financial assurances, phased credit release, and monitoring requirements, may be implemented for wetland banks.

A technical review team can review the site-selection rationale for a bank as well as the technical feasibility of the design proposed for the bank. This level of review will often far exceed the level that is normally provided for all but the largest projects with significant wetland impacts. Since bank credits are generated by net gains in wetland functions, banks must have detailed information on existing site conditions and an assessment of the potential level of wetland functions already being performed on the site before the mitigation project begins. Hence, baseline information for a bank will generally be more complete than for concurrent mitigation. In addition, since bank credits may not be released until performance standards are reached, the credits may not be used as compensatory mitigation until the mitigation bank is successful. Bank sponsors will thus have a vested interest in following the development of the wetland bank and in applying remedial actions when necessary. This factor should again result in a lower net loss of wetland compared to concurrent mitigation. Further, the risk management mechanisms recommended for mitigation banks have frequently not been implemented for concurrent mitigation projects (Driscoll and Granger 2001).

A report from the Institute of Water Resources, Corps of Engineers, concluded that net wetland losses from mitigation bank failures has been minimized primarily because only a portion of credits were released up front and because the bank sponsors either performed adaptive management activities to correct problems or the total number of credits generated at the bank was adjusted to account for the reduced performance of the banks (Tabatabai and Brumbaugh 1998). Combined with the other factors discussed above, large-scale failures of wetland banks that result in net wetland losses should be largely avoidable (Driscoll and Granger 2001).

4.3 Comparison to Concurrent On-site Wetland Mitigation

Evaluations concluding that on-site mitigation has performed poorly have helped gain support for mitigation banking. Several reviews of on-site mitigation efforts found extensive failure (Johnson et al. 2000, 2001; NRC 2001). In addition, a study for the South Florida Water Management District (Erwin 1991) found that wetland mitigation had been completed for only 40 percent of permitted projects for which mitigation was required. Only four of the completed mitigation projects were considered successful. Among the deficiencies cited were poor site selection, improper or insufficient monitoring and evaluation, lack of wetland persistence, poor hydrologic design, sparse vegetative cover, inadequate management, and insufficient wildlife utilization. Other deficiencies identified by different evaluators include delays in construction and lack of maintenance. Many view wetland mitigation banking as having the potential to overcome these problems with on-site mitigation efforts (Zinn 1997).

The poor record for on-site mitigation should not be a surprise since, with few exceptions, applicants seek least-cost solutions that meet minimum acceptable standards and avoid legal actions or further costs. They have no incentive to exceed these standards, even when added commitments are necessary for an ecological success. The relatively high cost of conducting mitigation on some sites has also dampened applicant enthusiasm. Average mitigation costs per acre tend to increase as the size of the site decreases. In this environment, applicants have little incentive to create and maintain high quality sites (Zinn 1997).

The perceived differences between wetland mitigation banking and concurrent on-site mitigation are summarized in the following list of advantages of mitigation banking over individual mitigation projects (United States 1995). These advantages include the ability of banks to:

(1) Consolidate compensatory mitigation into a single large parcel or contiguous parcels;

(2) Bring together financial resources, planning, and scientific expertise that are not practicable to many project-specific compensatory mitigation proposals;

(3) Reduce permit-processing times and provide more cost-effective compensatory mitigation opportunities;

(4) Implement mitigation and function in advance of project impacts, thereby reducing temporal losses of aquatic functions and uncertainty over whether the mitigation will be successful in offsetting project impacts;

(5) Increase the efficiency of limited agency resources in the review and compliance-monitoring of mitigation projects because of consolidation, and thus improve the reliability of efforts to restore, create, or enhance wetlands for mitigation purposes; and

(6) Contribute towards attainment of the goal of no overall net loss of wetlands by providing opportunities to compensate for authorized impacts when mitigation might not otherwise be appropriate or practicable.

5. POTENTIAL WETLAND MITIGATION BANKING ON THE LUMMI RESERVATION

The large number of existing, formerly existing, and degraded wetlands on the Lummi Reservation provide an opportunity for wetland mitigation banking. This section will (1) review important characteristics of wetland mitigation banks that have been identified in studies of mitigation banking; (2) suggest criteria for ranking potential mitigation banking sites on the Reservation; and (3) list potential mitigation bank sites on the Reservation.

5.1 IMPORTANT CHARACTERISTICS OF SUCCESSFUL WETLAND MITIGATION BANKS

Wetland mitigation banking has been relatively successful during the past decade. While several banks have failed to meet expectations or achieve the correct type and amount of wetland area, there has been minimal net loss of wetland area (Tabatabai and Brumbaugh 1998). The following primary factors have been identified as important to the success of wetland mitigation banks (Castelle et al. 1992b; ELI 1994, 2002; Zinn 1997; Driscoll and Granger 2001):

(1) Sufficient demand for credits within the service area of the bank;

(2) Integration with landscape-level planning;

(3) Selection of an appropriate site, based on ecologically and hydrologically desirable characteristics, including buffers, ecosystem connectivity, and watershed integration;

(4) Baseline information that confirms the appropriateness of the site;

(5) Early and detailed technical review of the bank design by experienced, interdisciplinary scientists and managers;

(6) Detailed plans, performance standards, and enforcement measures in a complete authorizing document that clearly defines responsibilities for implementation;

(7) Favorable credit-conversion rates;

(8) Deferred debiting or phased release of credits until performance standards are realized;

(9) Bank sponsors that have economic incentives to ensure site success;

(10) Financial assurances sufficient for long-term monitoring and remediation;

(11) Implementation of contingency actions as needed to improve bank performance; and

(12) Permanent protection of the wetland status of the bank site through appropriate long-term ownership.

A successful wetland mitigation bank must have enough clients (i.e., wetland developers) to provide sufficient demand for the credits produced by the mitigation bank. The level of demand for credits is determined by the level of wetland impacts in the service area for the bank and by how those wetlands will be regulated and delineated in the future. Uncertainty in the regulatory treatment of wetlands creates uncertainty regarding the future demand for bank credits (ELI 1994). A recent example of such uncertainty is the effects of the decision by the U.S. Supreme Court in *Solid Waste Agency of Northern Cook County vs. United States Army Corps of Engineers* (SWANCC; 9 January 2001). This decision restricted the CWA regulatory jurisdiction of the Corps over "nonnavigable, isolated, and intrastate" waters. Thus, the demand for wetland mitigation may be reduced since developers will no longer need a federal permit to fill nonnavigable, isolated, and intrastate wetlands. Since navigable waters, interstate waters, their tributaries, and wetlands adjacent to each remain fully regulated (ELI 2001), and because wetlands on the Reservation generally fall into this category, the SWANCC decision should have little effect on the potential demand for mitigation on the Reservation.

The demand for a mitigation bank on the Reservation may be increased by the effect of the Regulatory Guidance Letter (RGL) released by the Corps on 31 October 2001 (Corps 2001). The RGL relaxed the preference for on-site mitigation previously advanced through existing Corps policy. The RGL also relaxed the previous position of the Corps on in-kind versus out-of-kind mitigation by stating that "out-of-kind compensation may also be appropriate" and where used it should be "practicable and environmentally equal or preferable to in-kind compensation (i.e., of equal or greater ecological value to a particular region)." However, it is noted that the Corps received complaints from the EPA and environmental groups regarding the RGL and, in December 2001, opened the RGL for comment by other federal agencies. Since March 2002, an interagency workgroup has been working with the Corps to address concerns about the RGL, and it is anticipated that the Corps will issue a revised guidance letter.

Related to demand for its credits, the production of credits by a mitigation bank must be competitive with other routes of compensatory mitigation. In other words, a mitigation bank must be able to generate a sufficient number of credits at a low enough cost such that the cost per credit compares favorably with alternative forms of mitigation available to potential clients of the bank. The number of credits a bank can produce is affected by the method of credit evaluation. If this method evaluates the wetland types in a bank favorably, then the bank will generate more credits per unit area than banks or potential concurrent mitigation sites that are evaluated less favorably.

The long-term success of a mitigation bank must be reasonably assured through monitoring of the bank site. Consequently, sufficient financial assurances to allow for monitoring, evaluation, and remediation of potential failures to achieve wetland functions at the bank site are advisable and may be required.

Given the desirability of creating enforceable legal mechanisms that will ensure a mitigation site is maintained as a wetland for an ecologically useful period, it is important to identify the function of long-term property ownership. The primary function of the long-term property owner is to exclude any other uses of the land that would interfere with its continued existence as a dedicated wetland. Other functions of the property owner could include active monitoring and maintenance of the wetland and financial liability for remedying mitigation failure or any damage to third parties. These functions generally lie with the credit producer, but they can also be assigned or transferred to another party, most often the long-term property owner (ELI 1994).

Many of the characteristics described above should be contained in a bank-enabling instrument/document that clearly defines the roles and responsibilities involved in implementation and oversight of a bank. Other factors that should be included in the bank instrument include the duration of the instrument and the bank; technical specifications for the bank site; the means of dispute resolution; and enforcement implications and mechanisms (ELI 1994).

An appropriate location with a high probability of success must be carefully selected after the study and consideration of both ecological and hydrologic factors. Ecologically desirable locations should generate more credits and more demand for those credits (since off-site compensation should be at a site more ecologically preferable than the site where on-site compensation would occur). Hydrologically preferable locations will simply have a greater probability of long-term mitigation success and therefore more reliable credit production. Even after such careful consideration, long-term success is not guaranteed because all forms of wetland mitigation (i.e., restoration, enhancement, creation, and preservation) have weaknesses that could lead to failure of a mitigation site (ELI 1994; Driscoll and Granger 2001). However, some wetland types are better candidates for mitigation than others. The report by the National Research Council (NRC 1992) on restoration of aquatic ecosystems identified five (nonexclusive) wetland systems as strong candidates for restoration efforts:

(1) **Coastal and estuarine wetlands**, which not only have one of the best records of restoration success, but are also in critical need of replacement; these wetlands support the fishing and shellfishing industries and provide numerous other important and irreplaceable functions;

(2) **Riparian wetlands**, often the most degraded, are common, offer high potential for successful restoration (based on their location), and contribute many important functions worthy of restoration, including improved water quality, flood control, wildlife and fish habitat, and erosion and sedimentation control;

(3) **Depressional, or isolated, wetlands**, which are widespread and may be relatively easily restored, particularly if they were drained rather than filled;

(4) **Agricultural wetlands**, which are common and often relatively simple to restore since wetland soils and hydrology often remain; breaking drainage tiles, filling ditches, and ceasing crop production may be the only mitigation actions required; and

(5) **Freshwater marshes**, which represent the highest percentage of losses as a group and are the subject of many restoration studies.

Other factors involved in selecting a favorable location include choosing a site with adequate buffering from surrounding development or other adverse effects and integrating site selection with watershed management and/or landscape-level planning. Both buffering and watershed integration will increase the long-term probability of success for a bank site.

5.2 Criteria for Ranking Potential Mitigation Bank Sites

In choosing potential wetland mitigation bank sites on the Lummi Reservation, criteria are needed to compare alternative sites. The following criteria, in no particular order (the importance of each criteria will vary depending on the site and the situation), should be considered:

- Probability of successful implementation
- Potential ecological value
- Current or potential hydrologic quality
- Potential economic value as a wetland bank relative to other possible uses
- Number of credits potentially generated by site
- Availability and cost of acquiring the bank site
- Size of, or demand within, the service area for the proposed bank
- Similarity of the mitigation wetlands to anticipated wetland impacts.

5.3 Potential Mitigation Bank Sites on the Lummi Reservation

The Lummi Reservation contains several types of wetlands that comprise a significant proportion of the land base of the Reservation. Figure 5.1 shows the approximate location and areal extent of the wetlands and wetland complexes on the Reservation, based on a reconnaissance-level inventory. Potentially restorable and existing estuarine wetlands occur along Lummi Bay and in the delta of the Nooksack River along Bellingham Bay.

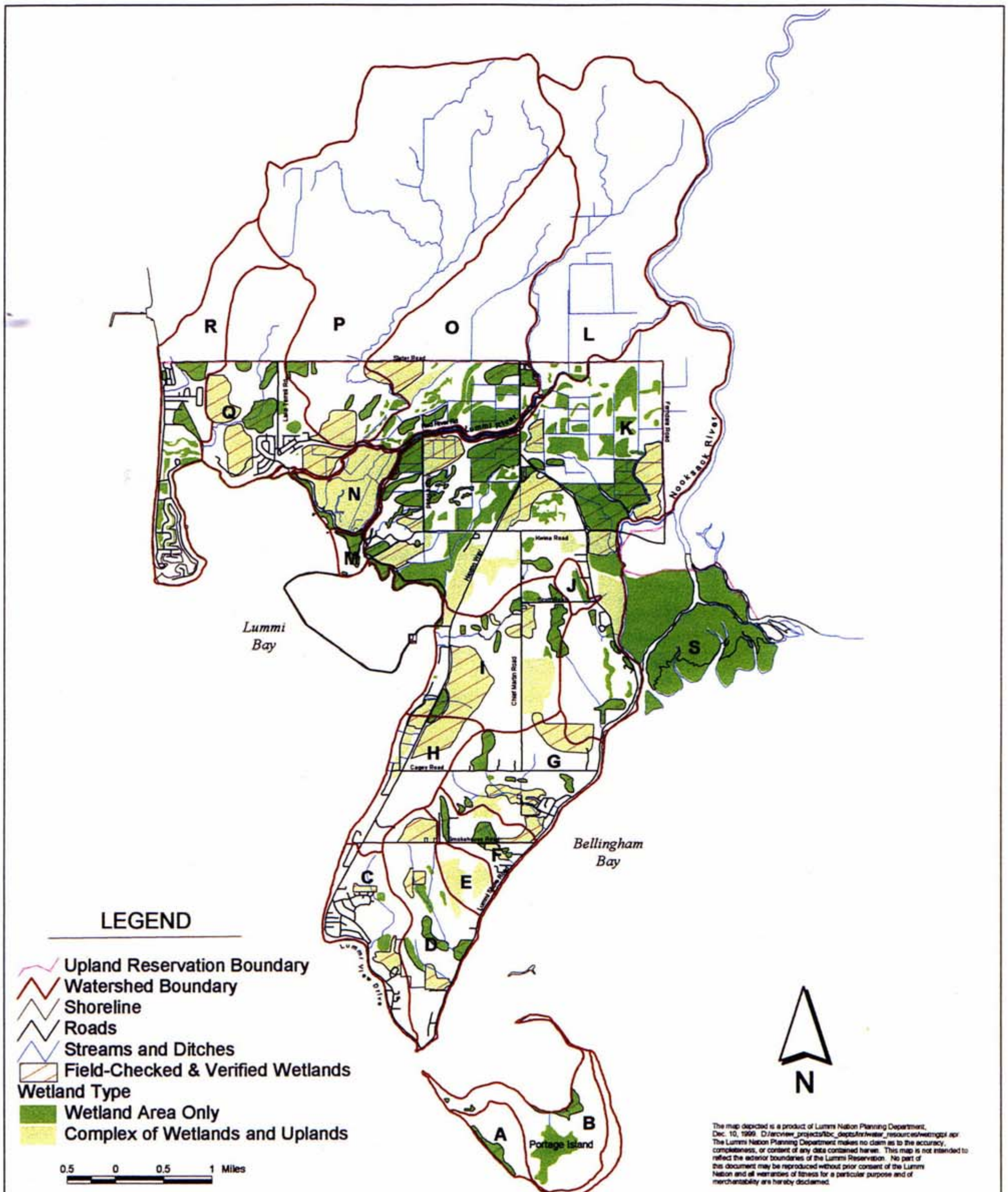

Figure 5.1. Wetlands and Surface Waters of the Lummi Reservation

Existing and potentially restorable riverine wetlands occur along the Lummi and Nooksack rivers. These wetlands in the Lummi and Nooksack river floodplains and deltas represent the majority of wetland area on the Reservation. Large portions of the uplands on the Reservation are also classified as wetlands or wetland complexes, with some of these being forested wetlands typically dominated by second-growth alder. It is noted that the wetland inventory that was used to develop Figure 5.1 was conducted in 1998 (LWRD 2000a) for planning purposes and tends to over-estimate the areal extent of Reservation wetlands.

Since all of the Nooksack River delta and much of its floodplain outside of the Lummi River floodplain is currently wetland, most mitigation in this area would have to be in the form of enhancement or preservation of these current wetlands. Mitigation in the upland areas of the Reservation would also have to be in the form of enhancement or preservation of current wetlands. However, a large portion of the Lummi River delta has restricted or eliminated hydrology because of the Lummi Bay seawall, constructed in the 1920s (Bortleson et al. 1980; Deardorff 1992). Hence, mitigation of large areas here could be accomplished through the reestablishment of tidal hydrology and restoration of estuarine wetlands. Mitigation in the Lummi Bay area is appealing because compensatory restoration generally has a more favorable replacement ratio than the other possible forms of mitigation. Table 5.1 shows the replacement ratios typically used by the Corps.

Table 5.1. Approximate replacement ratios used for wetland compensation (Walker 1999).

Compensation Type	Ratio
Restoration	1.5 : 1
Creation	2 or 3 : 1
Enhancement	6 : 1
Preservation	10 : 1

5.4 Recommendations for Mitigation Banking on the Reservation

Before establishing a wetland mitigation bank, the demand for credits from a potential mitigation bank on the Reservation should be assessed. In general, the combination of a large number of wetlands on the Reservation, Lummi Nation plans for commercial and residential development on the Reservation, and often limited non-wetland alternative sites for development is anticipated to create a substantial demand for wetland mitigation over the coming decades. If an adequate demand for credits from potential mitigation bank sites is determined, then the criteria for ranking potential mitigation sites should be applied to any sites under consideration. Next, the important characteristics of a successful mitigation bank (Section 5.1) should be carefully analyzed and considered during the planning for a bank based on the preferred potential site.

A 410-acre site along Lummi Bay has been identified as a potential site for an estuarine wetland mitigation bank. The bank could be established by restoring historic saltwater marshes on the site. Estuarine wetland ecosystems in general, including saltwater marshes, are considered among the most productive natural ecosystems on earth (in biomass production per unit area). In addition to providing rearing habitat for juvenile salmonids and other species, these ecosystems export a large amount of biomass to estuaries. This biomass can form a large portion, sometimes the majority, of the base of the estuarine food web (Mitsch and Gosselink 1993, as described in LWRD 2000b). The export of a large amount of biomass often represents the primary value of saltwater marshes for salmonids and other species. A small fraction of the historic estuarine marshes in Lummi Bay remains in sheltered fringes of diked areas (Bortleson et al 1980). A lack of estuarine saltmarsh may therefore be one factor limiting production of salmonids from the Nooksack River. The reestablishment of perennial flow from the Nooksack River to the Lummi River would provide more direct access to this potential habitat.

Based on the 1.5:1 mitigation ratio for restoration, the 410-acre site could be used to mitigate impacts on approximately 273 acres of wetlands. With an estimated cost of about $1.3 million for land acquisition and development of the mitigation site (Corps 2000), the cost per restored acre would be about $3,200. To restore this former wetland, the Corps study estimated that (1) the sea wall should be breached in two places, each 200 feet wide; (2) the Lummi River levee should be breached for 120 feet at the confluence with the northern Lummi River distributary; (3) an 1800-foot levee should be built around the Sandy Point Improvement Company golf course; and (4) two concrete tidegates should be demolished. The ground level over the entire site is low enough that it would be submerged by tidal action at least once per day. A cheaper alternative would be to modify and/or construct tidegates along the sea dike to restore a smaller area of intertidal habitat and thereby reduce real estate costs (Corps 2000). Table 5.2 presents an evaluation of the potential for an estuarine wetland mitigation bank on the 410-acre site.

Table 5.2. Evaluation of the Potential Estuarine Mitigation Site in the Lummi River Delta

Criteria	Potential	Comment
Probability of successful implementation	High	▪ Salt marsh habitat historically existed on site (Bortleson et al. 1980) ▪ Hydric soils present ▪ Abundant seed sources ▪ Hydrology easy to reestablish
Potential ecological value	High	▪ Salt marshes have highest biological production ▪ Estuarine wetlands may be limiting to salmonids
Current or potential hydrologic quality	High	▪ Tidal inundation guaranteed by breaches in seawall
Potential economic value as a wetland bank relative to other possible uses	High	▪ Limited current or foreseeable residential or agricultural use
Number of credits potentially generated by site	High	▪ Large area available for bank ▪ Favorable compensation ratio
Availability of the bank site	Moderate	▪ No current use of site; mixed ownership
Cost of acquiring the bank site	Moderate	▪ Current usability of land suggests relatively low cost per acre
Size of, or demand within, the service area for the proposed bank	High	▪ Potential depends upon determination of service area size and use of credits for out-of-kind impacts (if 273 acres of impact are not foreseen in former estuarine wetlands)
Similarity of the mitigation wetlands to anticipated wetland impacts.	High/Low	▪ High if impacts are to historic estuarine wetlands in the Lummi River delta ▪ Low if impacts are to freshwater upland/forested wetlands

To develop either potential site along Lummi Bay as a wetland mitigation bank, the following steps are recommended (assuming that the results of each step are favorable):

(1) Conduct a land survey to (a) identify the boundaries of the site and (b) develop an accurate, high resolution topographic map (base map) using MLLW as an elevation datum;

(2) Delineate and map existing wetlands within the potential mitigation bank area and conduct functional assessments of wetlands encountered;

(3) Identify all property owners within the affected area;

(4) Conduct an appraisal of each separate parcel on the site;

(5) Purchase the land from the existing owners;

(6) Develop more detailed restoration, management, and monitoring plans; and

(7) Solicit input from the Corps and EPA and develop final plans, performance standards, and enforcement measures of a complete authorizing document.

Another potential site for a wetland mitigation bank on the Reservation is located in the Nooksack River delta. Since this area already consists of largely undisturbed wetlands, it could only serve as mitigation in the form of preservation. This type of mitigation is less favorable than restoration, creation, or enhancement because it will result in a net loss of wetlands. Preservation of wetlands as mitigation also has a relatively high compensation ratio and therefore generates fewer credits per acre than other forms of mitigation (see Table 5.1). In addition, the 1990 MOA between the EPA and the Corps of Engineers concerning the determination of mitigation under the CWA Section 404(b)(1) Guidelines notes that the simple purchase or "preservation" of existing wetlands will not be considered adequate compensation unless there are "exceptional circumstances."

The primary block of largely undisturbed wetlands in the Nooksack River delta is about 865 acres (Lynch 2001; Figure 5.1). Based on the 10:1 mitigation ratio for preservation, this area could potentially be used to mitigate impacts on approximately 86 acres of wetlands. An adjacent area of the Nooksack delta, about 280 acres in size, consists of undisturbed wetlands, disturbed wetlands, and wetland complexes (Lynch 2001; Figure 5.1). At the 10:1 ratio for preservation, this area could potentially mitigate impacts on approximately 28 acres of wetlands. If the nonwetland areas in the wetland complexes were not included as mitigation, the mitigation credit produced would be less than 28 acres. However, enhancement of disturbed wetlands in this area could provide mitigation at a more favorable ratio and could result in a higher mitigation credit. Table 5.3 presents an evaluation of the Nooksack delta site as a potential wetland mitigation bank to be achieved through the preservation of the existing combination of riverine and saltwater marsh wetlands.

Table 5.3. Evaluation of the Potential Wetland Mitigation Site in the Nooksack River Delta

Criteria	Potential	Comment
Probability of successful implementation	High	▪ Large, undisturbed habitat currently exists on site (LWRD 2000a)
Potential ecological value	High	▪ Salt marshes have highest biological production ▪ Estuarine and riverine wetlands may be limiting to salmonids
Current or potential hydrologic quality	High	▪ High quality wetlands are mostly undisturbed
Potential economic value as a wetland bank relative to other possible uses	High	▪ No current or foreseeable residential or agricultural use ▪ Flood hazard zone
Number of credits potentially generated by site	Moderate	▪ Large area available for bank ▪ Valuable, high quality wetlands ▪ High compensation ratio for preservation limits potential credits
Availability of the bank site	High	▪ No current use of site ▪ Trust parcels on much of site
Cost of acquiring the bank site	Low	▪ No use of land suggests low cost per acre
Size of, or demand within, the service area for the proposed bank	High	▪ Potential depends upon determination of service area size and potential use of credits for out-of-kind impacts
Similarity of the mitigation wetlands to anticipated wetland impacts.	High/ Moderate	▪ High if impacts are to historic estuarine wetlands in the Lummi River delta or riverine wetlands along the Nooksack River ▪ Moderate if impacts are to freshwater upland/forested wetlands

6. SUMMARY

Several studies have shown that on-site, concurrent mitigation has not been effective at compensating for wetland impacts resulting from development activities. Many wetland professionals consider wetland mitigation banking to be a viable, possibly very desirable, alternative to on-site mitigation. Restoration of estuarine marsh wetlands on the Reservation holds promise and would further the Lummi Nation goal of enhancing salmonid and shellfish habitats on the Reservation. Although pending further consideration and detailed analysis of prospective sites, the potential for a successful estuarine mitigation bank on the Reservation is high. The preservation of wetlands in the Nooksack River delta also presents high potential for success as a mitigation bank, though the number of credits potentially generated per acre would be much less than for restored wetlands. In addition, since the preservation of existing wetlands as mitigation results in a net loss of wetlands, a case would need to be made that preserving this wetland as mitigation represents “exceptional circumstances.” The potential for other types of mitigation banks on the Reservation is less than that for an estuarine wetland bank.

The following quote provides a concise summary of the general potential for the application and success of wetland mitigation banking:

> Ultimately, the risks and costs of mitigation banking should limit effectively its application to those situations in which banking will (1) Contribute to a broad-based ecosystem restoration project that has a high probability of producing significant net environmental benefits and (2) Provide for some meaningful replacement of wetland functions and values lost due to the cumulative adverse effects of many small-scale wetland losses (Goldman-Carter and McCallie 1996).

Although wetland mitigation banking on the Reservation holds promise as an important wetland management tool, it is not a magic bullet that solves all wetland-related issues. The presence of a wetland mitigation bank will not relieve project proponents/applicants from the requirements to first avoid and minimize wetland impacts. In addition, significant effort and capital will be required to establish a wetland mitigation bank. However, establishing a wetland mitigation bank offers numerous benefits and warrants further exploration.

7. REFERENCES

Azous, A. and R. Horner. 1997. Wetlands and Urbanization, Implications for the Future. Washington Department of Ecology, King County Water and Land Resources Division, and the University of Washington, Olympia and Seattle.

Bedford, B.E. 1996. The need to define hydrologic equivalence at the landscape scale for freshwater wetland mitigation. *Ecological Applications.* 6(1):57-68.

Beechie, T. and S. Bolton. 1999. An approach to restoring salmonid habitat-forming processes in Pacific Northwest watersheds. *Fisheries.* 24(4): 6-14.

Booth, D. 2000. Forest Cover, Impervious Surface Area, and the Mitigation of Urbanization Impacts in King County, Washington. University of Washington, Seattle, WA.

Bortleson, G.C., M.J. Chrzastowski, and A.K. Helgerson. 1980. Historical Changes of Shoreline and Wetland at Eleven Major Deltas in the Puget Sound Region, Washington. Hydrologic Investigations Atlas HA-617. U.S. Geological Survey, Reston.

Bersok, C. 2001. Presentation on the status of Florida's wetland banking program, *in Proceedings from the Fourth Annual Mitigation Banking Conference, April 18-20, 2001*. Ft. Lauderdale, FL.

Castelle, A.J., C. Connolly, M. Emers, E.D. Metz, S. Meyer, M. Witter, S. Mauermann, M. Bentley, D. Sheldon, and D. Dole. 1992a. Wetland Mitigation Replacement Ratios: Defining Equivalency. Publication No. 92-08. Adolfson Associates, Inc., for Shorelands and Coastal Zone Management Program, Washington Department of Ecology, Olympia.

Castelle, A.J., S. Luchessa, C. Conolly, M. Emers, E.D. Metz, S. Meyer, and M. Witter. 1992b. Wetlands Mitigation Banking. Publication No. 92-12. Adolfson Associates, Inc., for Shorelands and Coastal Zone Management Program, Washington State Department of Ecology, Olympia.

Dahl, T.E. 1990. Wetlands Losses in the United States, 1780s to 1980s. U.S. Fish and Wildlife Service, Washington, D.C.

Dahl T.E. and C.E. Johnson. 1991. Status and Trends of Wetlands in the Conterminous United States, mid-1970s to mid-1980s. U.S. Fish and Wildlife Service, Washington, D.C.

Dahl, T.E. 2000. Status and Trends of Wetlands in the Conterminous United States, 1986 to 1997. U.S. Fish and Wildlife Service, Washington, D.C.

Dale, V.H., S. Brown, R.A. Haeuber, N.T. Hobbs, N. Huntly, R.J. Naiman, W.E. Riebsame, M.G. Turner, and T.J. Valone. 2000. Ecological principles and guidelines for managing the use of land. *Ecological Applications*. 10(3):639-670.

Deardorff, L. 1992. A Brief History of the Nooksack River's Delta Distributaries. Lummi Nation Fisheries Department. 33 p.

Diamond, J.M. 1975. The island dilemma: lessons of modern biogeographical studies for the design of natural reserves. *Biological Conservation*. 7:129-146.

Driscoll, L. and T. Granger. 2001. Draft Programmatic Environmental Impact Statement: Washington State's Draft Rule on Wetland Mitigation Banking. Publication No. 01-06-022. Washington Department of Ecology, Olympia.

Environmental Law Institute (ELI). 1994. National Wetland Mitigation Banking Study: Wetland Mitigation Banking. Institute for Water Resources Report No. 94-WMB-6. Corps of Engineers, Alexandria, Virginia.

Environmental Law Institute (ELI). 2001. Preliminary Findings of the Environmental Law Institute's Wetland Mitigation Banking Study. ELI, Pennington, NJ. September. Web address: http://www2.eli.org/wmb/wmbinterim.pdf

Environmental Law Institute (ELI). 2002. Banks and Fees: The Status of Off-Site Wetland Mitigation in the United States. ELI, Washington D.C.

Erwin, K. 1991. An Evaluation of Wetland Mitigation within the South Florida Water Management District, Volume1. South Florida Water Management District.

Frenkel, R.E. 1997. Salmon River salt marsh restoration in Oregon: 1978-1995, *in Wetland and Riparian Restoration: Taking a Broader View – Proceedings of a Conference* (K.B. Mcdonald and F. Weinmann, eds.). U.S. Environmental Protection Agency Publication No. 910-R-97-007. University of Washington, Seattle.

Goldman-Carter, J. and G. McCallie. 1996. An environmentalist's perspective - time for a reality check, *in Mitigation Banking Theory and Practice* (L. Marst, ed.). Island Press, Washington D.C.

Gwin, S.E., M.E. Kentula, and P.W. Shaffer. 1999. Evaluating the effects of wetland regulation through hydrogeomorphic classification and landscape profiles. *Wetlands*. 19(3):477-489.

Johnson, P.A., D.L. Mock, E.J. Teachout, and A. McMillan. 2000. Washington State Wetland Mitigation Evaluation Study, Phase 1: Compliance. Publication No. 00-06-016. Washington Department of Ecology, Olympia.

Johnson, P.A., D.L. Mock, A. McMillan, L. Driscoll, and T. Hruby. 2001. Washington State Wetland Mitigation Evaluation Study, Phase 2: Evaluating Success. Draft Publication. Washington Department of Ecology, Olympia.

Kauffman, J.B., R.L. Betschta, N. Otting, and D. Lytjen. 1997. An ecological perspective of riparian and stream restoration in the western United States. *Fisheries*. 22(5):12-24.

Kelly, N.M. 2001. Changes to the landscape pattern of coastal North Carolina wetlands under Clean Water Act, 1984-1992. *Landscape Ecology*. 16:3-16.

Kentula, M.E., J.C. Sifeneos, J.W. Good, M. Rylko, and K. Kunz. 1992. Trends and patterns in Section 404 permitting requiring compensatory mitigation in Oregon and Washington, USA. *Environmental Management*. 16:109-119.

King, D., C. Bohlen, and K. Adler. 1993. Watershed management and wetland mitigation: a framework for determining compensation ratios. Appendix C *in Making Sense of Wetland Restoration Costs*. Draft Report No. UMCEES - CBL-93-098. University of Maryland Center for Environmental and Estuarine Studies, Solomons, MD.

King, D.M. and C. Bohlen. 1994. Estimating the costs of restoration. *National Wetlands Newsletter.* 16(3):3-5.

King, D.M. 1997. Valuing wetlands for watershed planning. *National Wetlands Newsletter.* 19(3):5-10.

Kunz, K., M. Rylko, and E. Somers. 1998. An assessment of wetland mitigation practices in Washington State. *National Wetlands Newsletter.* 10(3):2-5.

Kusler, J. and M. Kentula. 1990. Executive summary, *in Wetland Creation and Restoration: The Status of the Science.* Island Press, Washington, D.C.

Lee, C.L. and J.G. Gosselink. 1988. Cumulative impacts on wetlands: linking scientific assessments and regulatory alternatives. *Environmental Management*. 12:591-602.

Leschine, T.M., K.F. Wellman, and T.H Green. 1997. The Economic Value of Wetlands – Wetlands' Role in Flood Protection in Western Washington. Publication No. 97-100. Washington Department of Ecology, Olympia.

Loukes, O. 1990. Restoration of the pulse control function of wetlands and its relationship to water quality objectives, *in Wetland Creation and Restoration: The Status of the Science*. Island Press, Washington, D.C.

Lummi Water Resources Division (LWRD). 2000a. Lummi Indian Reservation Wetland Management Program Technical Background Document. LIBC, Lummi Reservation.

Lummi Water Resources Division (LWRD). 2000b. Biological Assessment Report: Lummi Nation Casino Project. LIBC, Lummi Reservation.

Lynch, W. 2001. Internal Memorandum: Floodplain and Wetland Acres. Lummi Natural Resources Department. 12 September 2001.

Mitsch, W.J. and J.G. Gosselink. 1993. Wetlands. Van Nostrand Reinhold, New York, NY.

Lummi Water Resources Division (LWRD). 2001. Lummi Nation Wetland Ordinance Literature Review. LIBC, Lummi Reservation. July.

Marble, A.D. and X. Riva. 2001. Guidance for Selecting Compensatory Wetland Mitigation Options. Research Results Digest No. 251. National Cooperative Highway Research Program, Washington, D.C.

McMillan, A. 1998. How Ecology Regulates Wetlands. Publication No. 97-112. Washington Department of Ecology, Olympia.

Mockler, A., L. Casey, M. Bowles, N. Gillen, and J. Hansen. 1998. Results of Monitoring King County Wetland and Stream Mitigation. King County Department of Development and Environmental Services, Renton, WA.

National Research Council (NRC). 1992. Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy. National Academy of Sciences, Washington, D.C.

National Research Council (NRC). 1996. Upstream: Salmon and Society in the Pacific Northwest. U.S. Committee on Protection and Management of Pacific Northwest Anadromous Salmonids, National Academy of Sciences, Washington, D.C.

National Research Council (NRC). 2001. Compensating for Wetland Losses under the Clean Water Act. Committee on Mitigating Wetland Losses, National Academy of Sciences, Washington, D.C.

Perkins, J., R. Murphy, L. Jones, and M. Savage. 1997. Forging the Links: The Report of a Policy Study on Created Wetlands for the Washington State Department of Transportation. Report No. WA-RD 433.1. Olympia, WA.

Race, M.S. and M.S. Fonseca. 1996. Fixing compensatory mitigation: what will it take? *Ecological Applications.* 6(1):94-101.

Richter, K. 1996. Criteria for the Restoration and Creation of Wetland Habitats for Lentic-Breeding Amphibians of the Puget Sound region. Working draft. King County Natural Resources Division, Seattle, WA.

Scodari, P. and L. Shabman. 2001. Rethinking compensatory mitigation strategy. *National Wetlands Newsletter.* 23(1):5-6, 12-13.

Storm, L. and J. Stellini. 1994. Interagency Follow-Through Investigation of Compensatory Wetland Mitigation Sites. Joint Agency Staff Report. U.S. Environmental Protection Agency, Region 10, and U.S. Fish and Wildlife Service, Seattle.

Tabatabai, F. and R. Brumbaugh. 1998. National Wetland Mitigation Banking Study: The Early Mitigation Banks: A Follow-up Review. Institute for Water Resources Report No. 98-WMB-Working Paper. Corps of Engineers, Alexandria, Virginia. http://www.iwr.usace.army.mil/iwr/pdf/wmb_wp_Jan98.pdf

Walker, M. 1999. Personal communication. Seattle District, Corps of Engineers.

Washington State Department of Ecology (Ecology). 1988. Wetland Regulations Guidebook. Publication No. 88-5. Washington Department of Ecology, Olympia. Revised December 1994.

Washington State Department of Ecology (Ecology). 1993. Washington Wetlands Rating System: Western Washington. Second edition. Publication No. 93-74. Washington Department of Ecology, Olympia.

Washington State Department of Ecology (Ecology), Washington Department of Fish and Wildlife, Washington State Department of Transportation. 2000. State of Washington Alternative Mitigation Policy Guidance for Aquatic Permitting Requirements from the

Departments of Ecology and Fish and Wildlife. Washington Department of Ecology, Olympia.

United States. 1995. Federal Guidance for the Establishment, Use, and Operation of Mitigation Banks. *Federal Register*, Vol. 60, No. 228, 28 November 1995, pp. 58605-58614.

U.S. Army Corps of Engineers (Corps). 1997. Wetlands and Agriculture: Section 404 of the Clean Water Act and Swampbuster in the Food Security Act. Corps of Engineers, Washington, D.C. Website: http://wetland.usace.mil/SB.html

U.S. Army Corps of Engineers (Corps). 1998. The Regulatory Permit Program: A Brief Guide from the Sacramento District. Corps of Engineers, Washington, D.C. Website: http://wetland.seace.mil/RPP-bro.html

U.S. Army Corps of Engineers (Corps). 2000. Nooksack River Estuary Recovery Project, Section 22 Planning Study, Lummi Indian Reservation: Final Report on Possible Restoration Alternatives. Corps of Engineers, Seattle District.

U.S. Army Corps of Engineers (Corps). 2001. Guidance for the Establishment and Maintenance of Compensatory Mitigation Projects Under the Corps Regulatory Program Pursuant to Section 404(a) of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. Regulatory Guidance Letter No. 01-1. Corps of Engineers, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1993. Wetlands Fact Sheet No. 7, Clean Water Act Section 404: Overview. Report No. EPA-843-F-93-001g. Office of Wetlands, Oceans, and Watersheds, Washington, D.C.

Zedler, J.B. and M.W. Weller. 1990. Overview and future directions, *in Wetland Creation and Restoration: The Status of the Science* (J.A. Kusler and M.E. Kentula, ed.). Island Press, Washington, D.C.

Zedler, J.B., and J.C. Callaway. 1999. Tracking wetland restoration: do mitigation sites follow desired trajectories? *Restoration Ecology.* 7(1):69-73.

Zinn, J. 1997. Wetland Mitigation Banking: Status and Prospects. CRS Report No. 97-849. Congressional Research Service, Library of Congress, Washington D.C.

LIST OF ACRONYMS AND ABBREVIATIONS

Programs and Terms:	
CFR	Code of Federal Regulations
CWA	Clean Water Act
CWRMP	Comprehensive Water Resources Management Program
ESA	Endangered Species Act
MOA	Memorandum of Agreement
RGL	Regulatory Guidance Letter
SWANCC	Solid Waste Agency of Northern Cook County
USC	United States Code
WMBAR	Wetland Mitigation Banking Assessment Report
WMP	Wetland Management Program

Agencies and Organizations (Parent Organization):	
Corps	U.S. Army Corps of Engineers
Ecology	Department of Ecology, Washington State
ELI	Environmental Law Institute
EPA	US Environmental Protection Agency
LIBC	Lummi Indian Business Council
LNR	Lummi Natural Resources Department
LWRD	Lummi Water Resources Division
NMFS	National Marine Fisheries Service (NOAA)
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NRCS	Natural Resources Conservation Service (USDA) [formerly SCS]
SCS	Soil Conservation Service (USDA)
USDA	US Department of Agriculture
USDI	US Department of the Interior
USFWS	US Fish and Wildlife Service (USDI)
WSDOT	Washington State Department of Transportation