THE STATUS OF FRESHWATER COMPENSATORY WETLAND MITIGATION IN WASHINGTON STATE

by

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ABSTRACT

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Patricia Ann Johnson

Numerous studies over the past decade or so have investigated the effectiveness of compensatory wetland mitigation. The main contention involves whether the loss of one wetland can be compensating for by creating or enhancing another wetland. Can wetland area and functions be replaced, or is a net loss of acreage and function occurring?

Some studies focused on successful compliance with regulatory requirements. Other studies evaluated the biological success of the compensation wetlands and whether wetland acreage and functions were being replaced. The results of these studies indicate that very few compensatory wetlands are fully effective. In particular, a study from King County Washington revealed that 97% of compensatory wetlands were unsuccessful. In response to the abysmal results of the King County study, the Washington Department of Ecology initiated a two-phase study to determine the effectiveness of compensatory wetlands in Washington State. The results of the two phases of this study form the basis of this thesis.

The first phase of the study examined the level of compliance with regulatory requirements. Forty-five projects were randomly selected from over 800 projects permitted between 1992 and 1997. Compliance was based on whether projects were installed; were installed according to their approved mitigation plans; and were meeting their performance standards. Forty-two projects (92%) were installed; 23 projects (51%) were installed according to plan; and 12 projects met all their performance standards. Thirteen projects (29%) achieved all three parameters and were in compliance overall.

The second phase of the study examined the level of ecological success. Ecological success was based on two factors, each with its own criteria. The first, achievement of ecologically relevant measures, included wetland acreage, attainment of ecologically significant performance standards, and attainment of goals and objectives. The second, adequate compensation for the loss of wetlands, included contribution of the compensation activity to wetland functions and a comparison of the functions provided by the compensatory wetland with what was lost. A subset of 24 projects was selected from the original 45. Three projects (13%) were found to be fully successful; eight (33%) were moderately successful; eight (33%) were minimally successful; and five projects (21%) were not successful.

Success was contingent upon establishing wetland acreage and providing sufficient wetland functions to compensate for wetland losses. The low level of success therefore indicates that compensatory wetland mitigation in Washington State is resulting in a net loss of wetland area and functions. However, the author believes that improvements can be made, particularly by providing regulatory follow-up (e.g., writing letters, calling applicants, visiting sites) for all projects.

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Preface

When people ask me what I do for a living, I tell them that I review and assess compensatory wetland mitigation projects. The majority of people then look at me with a blank stare and ask what that means.

Well, let's say that you are planning to build a new Wal-Mart store in a pasture in Clark County, Washington. More than likely that pasture is entirely or at least partially wetland. First, you, as the developer, must ensure that the wetlands have been delineated and mapped. If you are a smart developer you will design your super-store, parking lot, and stormwater treatment areas to avoid filling or adversely altering any wetlands. If so, you will have saved yourself the trouble of delving further into the realm of wetland regulation.

However, if your development footprint will result in the direct loss of wetland acreage, function, or both; then in order to get the necessary permission (permits) to construct your vision of consumerism, you will have to come up with a plan for how you will compensate for the lost wetland acreage and functions. The local, state, and federal agencies regulating the project must then approve this plan. Plans developed to compensate for wetland loss (compensatory wetland mitigation plans) will typically propose to create a new wetland area; restore an area that was previously wetland; enhance some aspect of a degraded, existing wetland; preserve a high quality existing wetland; or some combination.

Once the regulatory agencies approve your compensatory-wetland mitigation plan and issue the necessary permits, you are free to build your Wal-Mart and install your compensatory-wetland mitigation project. Since your project is in Clark County, you will probably enhance the remaining degraded, pasture wetland located behind the parking lot. And in a few years I will come to look at your wetland compensation project and see how effective it is.

I started looking at wetland compensation projects about four years ago. Since that time I have visited nearly a hundred projects of varying sizes, designs, and levels of effectiveness. For example, one project proposed to create a wetland dominated by shrubs and emergent vegetation. At the time of my site visit the wetland compensation project had a very strong resemblance to a relatively dry gravel road. It was devoid of vegetation and organic matter, but it had an abundance of compacted gravel. That was over three years ago, and things could have improved. I haven't been back to check.

Last year I visited a wetland in eastern Washington that had been restored, Schmick Meadows. A number of ditches in an old pasture were plugged to prevent the water from rapidly draining into a channel to be whisked downstream. Plugging the ditches allowed the water to be held in the soil of this valley site throughout the summer. The site provided nesting and foraging habitat for several wetland dependent birds and amphibians as well as supporting a variety of native plant species. The site is open to the public as a historic homestead and bird watching attraction.

From the descriptions of these projects you may surmise that one wetland compensation project (the gravel road) was not very effective, while the other project (Schmick Meadows) was very effective. These examples, however, represent the extreme projects. The vast majority of projects are not so obviously bad or good. But how does one make that assessment? A person reviewing or assessing a site often uses his or her own best professional judgment. But what if my judgment is different from your judgment?

Best professional judgment, though influenced by education and experience, is based on values and opinions. For example, I like plants; I value plants. An unvegetated site does not impress me. However, mudflats are often unvegetated, and they provide important habitat for invertebrates and birds as well as providing other important functions. Another example is open water ponds. Open water has an aesthetic that many people value and therefore, compensation wetlands are frequently designed to provide open water. Yet few naturally occurring wetlands in Washington support permanent open water. Wetland professionals who believe in compensating for wetland losses with natural wetland types may look unfavorably at sites dominated by open water.

The preceding examples are meant to illustrate some of the problems with relying on best professional judgment when determining the effectiveness of a compensatory-wetland mitigation project. How then does one assess the effectiveness of compensatory-wetland mitigation?

Before delving into an answer to this question, it is important to note that there are two main aspects of compensatory-wetland mitigation effectiveness: whether the project performs as it was proposed and required to perform (i.e., compliance); and whether the project provides functional compensation for wetlands lost (referred to as ecological success in this thesis). Ideally, these are the same thing. However, identifying measurable, achievable, and enforceable requirements for functional replacement is not as easy as it sounds.

There are also two scales at which effectiveness can be determined, at the project level and at the program level. For example, your wetland compensation project may be assessed as a whopping success. This is rather meaningless unless we understand how all projects permitted within a certain timeframe and region are doing as a whole.

Each of the aspects of effectiveness can be assessed, determined, or measured in a variety of ways. First and foremost is installing the required wetland compensation project. Both compliance and ecological success are dependent upon project installation. This is ridiculously obvious for a project specific review, but it is critical for understanding how compensatory-wetland mitigation is doing on a program level. The percentage of projects not installed affects how future projects will be permitted and managed. It should be equally obvious that just because a project (or all projects) is installed does not automatically mean that it is effective (i.e., performing as expected or intended).

Achieving the required acreage of wetland creation, restoration, enhancement, or preservation is also a necessary part of both compliance and ecological success. On a programmatic level, the main concern is whether the acreage of wetland compensation is equal to or greater than the permitted acreage of wetland loss. The goal has been to maintain the current wetland resource base and avoid any further net loss of wetland acreage. Assessing how effective compensatory wetland mitigation is in general can also be accomplished through an analysis of replacement ratios – the acreage of wetland required to compensate for a given acreage of wetland loss.

Compliance often depends on meeting specific structural criteria, or performance standards, but these can also have a bearing on ecological success. Furthermore, performance of specific functions may be a requirement of a permit, but measurement or assessment of the functions that a wetland performs is imperative if you are interested in the ecological success of a compensation wetland.

In an attempt to understand how effective freshwater, compensatory-wetland mitigation is in Washington State, this thesis examines both aspects – compliance and ecological success – and both scales of evaluation – project specific and programmatic – to determine if a net loss of wetlands are occurring in terms of both acreage and function.

Chapter 1 –Background and Literature Review

Introduction

This thesis investigates the effectiveness of freshwater, compensatory-wetland mitigation to determine if this practice is resulting in a net loss of wetland acreage, functions, or both in the state of Washington. Before delving into a literature review on this topic, it is important to understand what wetlands are, and why they are important.

What are wetlands?

Wetlands are transitional areas between upland and deepwater aquatic ecosystems. In most cases, wetlands are characterized by three inter-related criteria (Ecology 1997, Mitsch and Gosselink 2001):

1. Water.
2. Hydric soils.
3. Hydrophytic vegetation.

Wetlands have standing water or saturated soils long enough during the growing season to result in a lack of oxygen in the soil (i.e., anaerobic conditions). This in turn causes the reduction of soil minerals such as iron, manganese, and sulfur. The presence of water and anaerobic soil conditions create challenges for the establishment and growth of plants. Typically only plants that are adapted to such conditions are able to survive. Adaptations include physical structures (e.g., adventitious roots, aerenchyma, etc.) and metabolic processes (e.g., oxygenation of the rhizosphere) for capturing oxygen and absorbing nutrients (Lambers et al. 1998).

Wetlands exhibit great diversity in where they occur, in their source of water, vegetation communities, and soil characteristics. Colloquial terms, such as bog, marsh, swamp, or fen have been used to describe various wetland types. But why are wetlands important?

Why should wetlands be protected?

Wetlands are important and have therefore received special protection because of the functions that they provide, many of which are valued by society. Wetland functions, such as retention of sediments, reduction of peak flows, and habitat for breeding amphibians, involve a multitude of physical, biotic, and abiotic processes. For example, a seasonally-inundated wetland with clay soils has the physical, biological, and chemical properties to provide water quality improvement through the transformation of nitrogen and the retention of phosphorus, toxic organic compounds, and heavy metals. However, wetlands provide functions to varying degrees, and not all wetlands provide all functions (Novitzki et al. 1996). For instance, a closed depressional wetland will perform sediment, nutrient, and toxicant removal to a higher degree than a wetland on a slope, while a wetland without organic or clay soils may not retain heavy metals or toxic organic chemicals.

A wetland value is something provided by a wetland that is worthwhile, desirable, or of benefit to society (Novitzki et al. 1996). Some wetlands are valued because they offer abundant recreational activities, such as hunting, fishing, or bird watching. All of these recreational activities are based on a wetland providing wildlife habitat functions. Wetlands are also valued for an ability to prevent downstream flooding due to their ability to reduce peak flows, another wetland function. Wetland values are therefore dependent upon wetlands providing particular wetland functions.

Since wetlands are valuable ecosystems, how are they being protected?

It has only been in the past few decades that a scientific understanding of the functions and values provided by wetlands produced enough concern to warrant the protection of federal laws, regulations, and policies (Mitsch and Gosselink 2000). Prior to that, Dahl (1990) estimated that European settlement reduced wetland acreage in the conterminous United States by over half. Since the 1970s numerous layers of regulation have emerged to try to protect wetlands.

The primary federal mechanism for wetland protection is "Section 404 of the Federal Water Pollution Control Act (FWPCA) amendments of 1972 (PL 92-500) and subsequent amendments (also known as the Clean Water Act). Section 404 required that anyone dredging or filling in 'waters of the United States' must request a permit from the U.S. Army Corps of Engineers" (Mitsch and Gosselink 2000).

In the state of Washington there are essentially three layers of potential protection for wetlands: federal, state, and local. The state reviews federal applications for permits through Section 401 of the federal Clean Water Act. This process certifies that projects applying for a Section 404 permit comply with state water quality standards (McMillan 1998). Federal jurisdiction, however, is restricted to waters of the U.S. In 2001 a U.S. Supreme Court decision (*SWANCC Vs. USACOE*) limited the interpretation of waters of the U.S. Wetlands that are isolated and not connected to a navigable body of water are no longer within federal jurisdiction (http://www.epa.gov/owow/wetlands/2001supremecourt.pdf).

The state regulates wetlands that are not within the jurisdiction of the US Army Corps of Engineers through the State Water Pollution Control Act (Chapter 90.48 RCW) (http://www.ecy.wa.gov/pubs/0106020.pdf). The implementing rules for this statute contain an antidegradation policy (Chapter 173-201A-070 WAC) that enables wetland protection in order to ensure that "existing beneficial uses shall be maintained and protected and no further degradation which would interfere with or become injurious to existing beneficial uses shall be allowed." Additional regulatory oversight of wetlands by the state is provided through the Shoreline Management Act (Chapter 90.58 RCW). Jurisdiction is, however, limited to wetlands within 200 feet of the shoreline or wetlands that are associated with regulated water bodies (McMillan 1998).

Finally, local jurisdictions, such as a counties, cities, or municipalities regulate wetlands through the Growth Management Act (GMA) (Chapter 36.70A RCW). GMA requires local jurisdictions to designate and protect critical areas, which include wetlands. A Critical Area Ordinance, which is adopted by a local jurisdiction, specifies the permit requirements and standards for wetland protection that will be employed in that particular jurisdiction (Washington State Department of Ecology 1994).

How are all of these layers of regulation used to protect wetlands?

It is generally acknowledged, particularly today, that development is not going to stop. When wetland regulations emerged, a permit applicant had to document that there was no practicable alternative and that every effort had been made to minimize damage to wetlands (as required by the National Environmental Policy Act (NEPA) of 1969). This made the Section 404 permit process lengthy and time consuming. In a 1980 revision to the Section 404(b)(1) guidelines, restoration and habitat creation were mentioned as a mitigation measure to compensate for habitat destruction (National Research Council 2001).

Mitigation is a process of reducing the severity of an action or situation. Wetland mitigation is a process used to reduce the severity of activities that detrimentally affect wetlands. So, when a land use project proposes to fill-in or to otherwise adversely alter a wetland the federal, state, local or all applicable agencies regulating the wetland will initiate the process of mitigation.

According to the Washington State Environmental Policy Act (Chapter 197-11 WAC), wetland mitigation involves the following steps that are performed sequentially:

1. "Avoiding the impact altogether by not taking a certain action or parts of an action;
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;
3. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;
5. Compensating for the impact by replacing, enhancing, or providing substitute resources or environments; and/or
6. Monitoring the impact and taking appropriate corrective measures."

Step number five, "compensating for the impact," (or compensatory mitigation) typically involves producing new area, functions, or both as compensation for wetlands that have been or will be lost due to a permitted activity. Compensation generally entails restoring wetland conditions to an area, creating new wetland areas and functions, enhancing functions at an existing wetland or preserving a high quality wetland and protecting it from future development.

The use of compensatory mitigation for wetland loss emerged in the 1980's (Roberts 1993, NRC 2001) when developers and permit applicants lobbied for regulatory reforms to speed up the permitting process. Compensatory mitigation was seen as a way to speed up an arduous process of documenting avoidance and minimization. Creating or restoring wetland area to compensate for permitted wetland losses was viewed and publicized as a way to allow development while preventing a net loss of wetland area (Roberts 1993). However, just because regulations require wetland compensation does not mean that it is being done or that it is effective.

Are these regulations working to prevent a net loss of wetland area and functions?

By the late 1980's studies of the effectiveness of compensatory mitigation produced mixed results primarily indicating that replacing or replicating a natural wetland was difficult, if not impossible (Kusler and Kentula 1990). However, some wetland types and functions could be approximated given the proper conditions (Kusler and Kentula 1990, National Research Council 2001).

A decade or more has passed since the initial studies of compensatory mitigation were conducted. The remainder of this chapter summarizes the findings of studies conducted primarily since 1990 regarding the effectiveness of compensatory wetland mitigation. Effectiveness was evaluated in terms of success, regulatory compliance, achievement of the goal of no net loss, and performance of wetland functions.

Table of Citations

To simplify the data tables in this chapter, each source is represented by a reference number. Table 1.1 contains a list of citations and their corresponding reference numbers.

Table 1.1 Table of Citations and their Reference numbers

Citation (source)	Reference #
Allen and Feddema 1996	1
Balzano et al. 2002	2
Brown and Veneman 2001	3
De Weese 1998	4
Erwin 1991	5
Gwin and Kentula 1990	6
Holland and Kentula 1992	7
Holland and Bossert 1994	8
Cole and Shafer 2002	9
Sudol and Ambrose 2002	10
Jones and Boyd 2000	11

Citation (source)	Reference #
Kentula et al. 1992	12
Kunz et al. 1988	13
McKinstry and Anderson 1994	14
Michigan Department of Environmental Quality 2000	15
Mockler et al. 1998	16
Morgan and Roberts 1999	17
Robb 2002	18
Shaich and Franklin 1995	19
Storm and Stellini 1994	20
Torok et al. 1996	21
Wilson and Mitsch 1996	22
Morgan and Roberts 2003	23
Minkin and Ladd 2003	24

Success

Compensatory-mitigation success is a poorly defined and often contentious term (Kentula 1999). The literature refers to legal success, biological success, ecosystem success (Wilson and Mitsch 1996), functional success (Mockler et al. 1998), or some combination of these. Legal success is generally the same as compliance. It is evaluated by comparing the actual on-the-ground, or as-built, conditions against what was required in the permit. Biological, ecosystem, or functional success involved evaluation of the factors that characterize a wetland (e.g., hydroperiod, vegetation, soils), the performance of functions, or both. The other types of success were evaluated using best professional judgment, or a variety of function assessment methods.

It is important to note that a mitigation site can successfully comply with all permit requirements and not replace the functions or values of the wetland that was lost. On the other hand, a mitigation site may fail to become the type of wetland it was proposed to be and still be a functioning wetland. In this case, a site may fail to meet some of its goals or performance standards, yet still provide a variety of important wetland functions. Furthermore, a mitigation site may fail to meet criteria for compliance or success at the particular time of an evaluation and later meet all relevant criteria. (Studies describing legal success will be discussed in the next section on Compliance).

Rather than judging the success or failure of a compensatory wetland mitigation project at a single point in time, Zedler and Callaway (2000) proposed evaluating how a project progresses over time. The authors suggest that a focus on progress would encourage proponents to acknowledge problems occurring at a site and look for solutions. The regulatory framework currently in place, however, does not support this method of evaluation.

There are as many ways to determine compensatory wetland mitigation success as there are ways to define it. The methods used to evaluate the success of compensatory wetland mitigation projects varied from best professional judgment (Storm and Stellini 1994, Sudol and Ambrose 2002) to function assessments (Wilson and Mitsch 1996, Balzano et al. 2002, Minkin and Ladd 2003) to quantitative measures of vegetation cover and survival (Allen and Feddema 1996) or some combination (Michigan Department of Environmental Quality 2000). Though the studies varied in the methods employed, most studies considered similar variables such as: wetland area, hydrologic conditions, wildlife suitability, vegetation, and soils.

The results of the studies also varied. However, the results (Table 1.2) suggest that most compensation projects had an intermediate level of success: neither fully successful nor completely unsuccessful. The studies found that a range from three to 43 percent of projects achieved full success. However, the majority of studies found that at least 25 percent of projects were not successful.

Table 1.2 Results of studies examining the success of compensatory mitigation

Location of study and reference #	# of projects	Level of success	Criteria
Washington/ King County (16)	38	3% successful 97% not successful	Replacing functions
Western Washington (20)	17	23% functioned well ecologically 65% functioned poorly 12% were not completed	Vegetation diversity, non-native plant dominance, structural diversity, wildlife use, adjacent land uses, vegetation cover vs. open

Location of study and reference #	# of projects	Level of success	Criteria
			water.
California/ southern (1)	75	32 were successful 9 were mostly successful 10 were half successful 5 were unsuccessful 8 were under construction 5 were not initiated 6 did not require mitigation	Project installed according to plan; percent cover of vegetation (dead, living, and invasive).
California/ Orange County (10)	55	16% successful 58% partially successful 26% failures	Qualitative evaluation based on habitat quality (e.g., veg. Density and diversity, invasive species, tree height).
Ohio (22)	5	1 was high 2 were medium-to-high 1 was medium 1 was medium-to-low	WETII evaluation (Adamus et al.1989) - hydrology, soils, vegetation, wildlife, water quality.
New Jersey (2)	74	Wetland Mitigation Quality Assessment scores were indexed from 0 (low) to 1 (high). The average score was 0.51, and the range was 0.25 to 0.83.	Hydrology, soils, vegetation, wildlife suitability, site characteristics, and landscape features.
Michigan (15)	69	22% were successful overall 78% were unsuccessful overall	Project's legal rating (permit compliance) and its biological rating (wetland acreage). Does not include enhancement.
New England (24)	60	17% provided functional replacement 61% no functional replacement 22% not enough information	Function assessment, wetland acreage, soils, vegetation, hydrology, water quality, wildlife usage.

Compliance

Most studies that examined compliance, or legal success, investigated how well a compensatory-wetland-mitigation project satisfied or is satisfying the legal requirements and obligations identified in a permit. Several of these studies only reported the results of overall evaluations. Others reported how well projects complied with individual requirements, such as, whether the project was installed, installed according to plan, achieving required wetland area, meeting performance objectives, monitored and maintained as required, and followed-up after a permit was issued (each of these aspects of compliance will be reviewed individually in the following pages).

Twelve studies evaluated overall compliance with regulatory requirement for compensatory wetland mitigation projects (Table 1.3). In Washington State two studies evaluating compliance have been conducted (Storm and Stellini 1994, Mockler et al. 1998), and two in Oregon (Gwin and Kentula 1990, Shaich and Franklin 1995). The studies in Washington found that less than 20 percent of compensation projects complied with their regulatory requirements. Oregon studies revealed that compliance of projects ranged from zero to 36 percent.

The studies from other states demonstrated much more variability in levels of compliance. Permit requirements, however, vary by state and over time. Therefore, not all compliance evaluations considered the same criteria or requirements. Where specified, the requirements evaluated by a given study were identified (Table 1.3). Results ranged from less than 20 percent of projects to about 80 percent of projects in compliance (Holland and Bossert 1994, De Weese 1998, Morgan and Roberts 1999, Michigan Department of Environmental Quality 2000, Veneman 2001, Balzano et al., Sudol, Brown, and Ambrose 2002, Minkin and Ladd 2003).

Table 1.3 Level of compliance overall

Location and reference #	# of projects	Level of compliance	Criteria
Washington/ western (20)[1]	17	18%	Installation of both development and compensatory mitigation projects as required.
Washington/King County (16)[2]	29 (38)	21% (16%)	1. meeting performance standards (project installed)
Oregon/Portland	72	36%	1. project installed 2. upland buffer area/vegetation requirements

[1] Compliance not determined for 53% of projects - lack of information
[2] 38 projects examined- 9 not installed. Parentheses = compliance info for 38 projects.

Location and reference #	# of projects	Level of compliance	Criteria
metro area (19)[3]			3. requirements for timing of project construction 4. wetland vegetation requirements 5. hydrology requirements 6. requirements for water control structures 7. fencing requirements
Oregon/Portland metro area (6)	11	0%	1. construction plans matched permit specs; 2. as-built matches permit specs-wetland area/shape 3. actual slopes matched planned slopes 4. vegetation established as planned
California/ Orange County (10)[4]	57	53%	1. project installed 2. meeting performance standards/permit conditions
California/ vernal pools (4)	25	83%	Attaining performance standards required by Corps
Massachusetts (3)[5]	109 (7)	43% (100%)	1. project installed 2. compensation project of required size 3. water inputs sufficient for wetland conditions 4. at least 75% cover wetland plants
Tennessee (17)	50	12%	1. establish required acreage of wetland 2. meet performance standards.
Michigan (15)[6]	74	18%	1. mitigation acreage requirement 2. implementation of approved mitigation plan 3. conservation easement 4. submittal of as-built plans 5. monitoring 6. placement of elevated wildlife structures 7. construction schedule w/ specified completion date 8. prohibited actions 9. corrective measures identified 10. financial assurances
Louisiana (8)	9	78%	Meeting Corps of Engineer permit conditions.
New Jersey (2)[7]	88	48% weighted average	1. Grading (56% concurrence) 2. Hydrology (47% concurrence) 3. Soil (51% concurrence) 4. Vegetation cover (39% concurrence) 5. Vegetation survival (28% concurrence) 6. Design (56% concurrence)

[3] Not all projects had requirements for all criteria (e.g., only 8% had requirement for fencing).
[4] Calculated from data provided.
[5] 5 projects did not result in wetland impact and were subtracted from the project total. Results were recalculated from the data provided. Parentheses = data for variance projects (received more oversight).
[6] Permit conditions from criteria list were considered if specified in permit.

Location and reference #	# of projects	Level of compliance	Criteria
New England (24)	60	67%	Meeting performance standards and Corps of Engineer permit conditions.

Project Installed

A number of studies inventoried or randomly selected mitigation projects from a permitting database to determine whether mitigation was installed. Three studies were conducted in Washington. Six other states, including Oregon, also investigated mitigation projects. Results indicated that the majority of projects are being installed (Table 1.4). The studies done in Washington found that 74 to 88 percent completion. Studies from most other states show similar results, 64 to 99 percent completion. However, studies performed in Florida and Tennessee revealed that less than half of the compensatory-wetland-mitigation projects had been installed (Erwin 1991, Morgan and Roberts 1999).

Table 1.4 Percent of compensatory-mitigation projects that were installed

Location and (reference #)	# of projects	Percent of Projects installed
Washington/ King County (16)	38	76%
Washington/ western (20)	17	88%* calculated from data provided
Washington (13)	35	74%
Oregon/ Portland metro area (19)	90	99%
California/ Orange County (10)	57	96% * calculated from data provided
Michigan (15)	159	85%
Indiana (18)	333	64%
Massachusetts (3)[8]	109	77%
Tennessee (17)	100	47%
Florida (5)	NA	~40%[9]

[7] Evaluated concurrence with applicable criteria. Percent = average concurrence score for 88 projects. Average concurrence score for each criterion provided in parentheses.
[8] 5 projects did not result in wetland impact, and were subtracted from the project total. Results were re-calculated from the data provided.
[9] "Out of more than 100 permitted projects requiring wetland mitigation only 40 had undertaken any mitigation activity."

Installed according to plan

Another aspect of determining mitigation compliance is evaluating whether a mitigation project has been implemented according to its approved plan. When compensatory wetland mitigation is necessary to offset proposed wetland losses, regulatory staff generally requires a wetland mitigation plan report to provide specific information about project construction, including detailed design drawings. Approval of a permit for wetland loss is usually contingent upon acceptance of the wetland mitigation plan/report.

Two studies evaluated whether mitigation projects were implemented according to plan. Results from New Jersey indicated that more than half of the compensatory-mitigation projects were installed according to requirements. A study in Oregon, however, determined that none of the projects were implemented according to plan (Gwin and Kentula 1990). Both studies mentioned grading and vegetation as the elements of the plan/design that were not implemented correctly.

Establishing the Required Wetland Acreage

Compensatory wetland mitigation is required to compensate for the loss of wetland area and functions. Establishing required acreage is a critical aspect of regulatory compliance. Twelve studies examined compensatory-wetland-mitigation sites to determine if they established the acreage of wetlands required by their permits (Table 1.5). Studies presented data in a couple of ways:

- Percentage of projects establishing the required wetland acreage (the number of projects that actually met their wetland acreage requirement as a percentage of the total number of projects considered).
- Percentage of the required wetland acreage actually established (the total acreage of wetland compensation that was established as a percentage of the total acreage required for all the projects considered).

Only three studies found that less than 30 percent of projects met their acreage requirements (McKinstry and Anderson 1994, Balzano et al. 2002, Morgan and Roberts 2003). And in New Jersey only seven percent of projects met their wetland acreage requirements (Balzano et al. 2002). In terms of the percentage of acreage established, most studies indicated that compensation efforts established between two-thirds and three-quarters of the required wetland area. One study, however, found that less than half of the required wetland area was actually provided (Robb 2002).

Table 1.5 Percent of compensatory-mitigation projects establishing the required acreage of wetland, AND the acreage of wetland compensation that was established as a percentage of the wetland acreage required.

Location and reference #	# of projects	% of projects achieving required wetland area	% of required wetland area that was established
Oregon/ Portland metro area (19)[10]	72	53% (*calculated from data provided)	NA
Oregon/ Portland metro area (6)	11	NA	71%
California/ southern (1)[11]	75	NA	69%
California/ Orange County (10)	55	52%	NA
Wyoming (14)	64	14% (*calculated from data provided)	NA
New Jersey (2)	85	7%	63%
Tennessee (23)	50	28%	74%
Ohio (22)	5	40%	66%
Indiana (18)	31	NA	44%
Michigan (15)	159	50%	NA
Massachusetts (3)[12]	109	46%	NA
Florida (5)	NA	NA	74%
New England (24)	60	NA	98%

NA= information not available

[10] Compensation wetlands were 16 acres short of required acreage.
[11] Projects >8.5 acres resulted in a net gain of wetland area, while projects <8.5 acres resulted in a net loss of almost 25 acres.
[12] Five projects did not result in wetland impact, and were subtracted from the project total. Results were re-calculated from the data provided.

Goals, Objectives, and Performance Standards

Another critical component of compliance for a compensatory wetland mitigation project is determining whether the project has met its goals, objectives, and/or performance standards. Goals, objectives, and performance standards are generally included as part of an approved wetland mitigation plan. Goals and objectives provide a blueprint for what the project was proposed to accomplish in terms of a target ecosystem, specific habitat, functions, and/or values. The performance standards provide measurable criteria to determine if in fact the project has accomplished its goals and objectives (Hruby, et al. 1994, Ossinger 1999).

Three studies reviewed for this document provided some information regarding compliance and performance standards and/or goals and objectives (Table 1.6). Two separate factors were investigated: whether a project had performance standards or goals, and whether projects were meeting performance standards or goals.

Data indicated that about three-fourths of projects had goals (Erwin 1991, Storm and Stellini 1994). However, only ten percent of projects met their goals (Erwin 1991).

Performance standards were specified less frequently than goals and objectives, though at least half of the projects had them (Erwin 1991, Storm and Stellini 1994, Cole and Shafer 2002). The percentage of projects attaining their performance standards varied from 21 percent of projects (Mockler et al. 1998) to 62 percent of projects (Cole and Shafer 2002).

Table 1.6 Percent of projects with goals, objectives and performance standards; and percent of project achieving goals, objectives and performance standards

Location and reference #	% projects w/ goals or objectives	% projects w/ performance standards	% projects meeting goals or objectives	% projects meeting performance standards
Washington/ King County (16)	NA	NA	NA	21%
Washington/ western (20)	76%	53%	NA	NA
Pennsylvania (9)	NA	57%	NA	62%
Florida (5)	85%	60%	10%	NA

NA = information not available.

Monitoring Requirements

To determine if a compensatory wetland mitigation project is in compliance it is necessary to monitor the project over time. The duration, frequency, and methods of monitoring depend on the goals, objectives, and performance standards for the project.

Five studies investigated whether compensatory wetland mitigation projects were required to be monitored, and/or whether projects actually were monitored (Table 1.7). Data from three of the studies indicates that monitoring was required for at least three-fourths of projects (Erwin 1991, Morgan and Roberts 1999 Michigan Department of Environmental Quality 2000). The remaining two studies found that monitoring was required for about half or less of projects (Holland and Kentula 1992, Storm and Stellini 1994).

The studies concluded that fewer than half, and in one case less than ten percent of projects (Cole and Shafer 2002), appeared to have been monitored. A few studies mentioned difficulty finding project information, or incomplete project information (Storm and Stellini 1994, Morgan and Roberts 1999). It is therefore possible that a project was monitored and a report submitted, but due to bureaucratic errors it was never formally acknowledged.

Table 1.7 Percent of projects required to be monitored and actually monitored

Location and reference #	% of projects requiring monitoring	% of projects that were monitored
Washington/ western (20)	53%	18%
California (7)	32%	NA
Michigan (15)	87%	35%
Pennsylvania (9)	NA	<10%
Tennessee (17)	89%	43%
Florida (5)	98%	38%[13] (62%)[14]

Maintenance Requirements

Compensatory wetland mitigation sites require maintenance to help ensure that performance standards and goals will be achieved. Maintenance often includes implementing

[13] Represents projects that were adequately monitored.
[14] Calculated from Erwin (1991) indicating the percentage of projects that received some level of monitoring.

contingency plans or corrective actions to rectify problems, such as an insufficient water supply or an invasive species infestation that may result in non-compliance.

Not all compensatory-wetland-mitigation projects were required to be maintained. Studies discovered that permits required site maintenance for only 41 to 78 percent of projects (Erwin 1991, Storm and Stellini 1994, Michigan Department of Environmental Quality 2000).

However, even fewer projects complied with their maintenance requirements. Studies found that only 20 to 60 percent of projects complied with their requirements for maintenance (Erwin 1991, Michigan Department of Environmental Quality 2000).

Regulatory follow-up

Once compensatory-wetland mitigation is required, it is up to the regulatory agency initially approving the project to track it over time and determine if it is in compliance. A regulatory agency can follow-up on compensatory-mitigation projects by:

- Ensuring that required monitoring reports are submitted and accurate.
- Performing site visits.
- Requiring maintenance actions to be undertaken.
- Ensuring that appropriate contingency measures are initiated if performance standards are not met.

A study in Oregon indicated that about half of compensatory wetland mitigation projects received some regulatory follow-up (e.g., site visits, phone calls, letters) (Kentula et al. 1992). In Michigan only about a quarter of projects received any kind of follow-up after the permit was issued (Michigan Department of Environmental Quality 2000).

A couple of studies also examined the effect of regulatory follow-up on project compliance, success, or both. Robb (2002) alluded to the fact that the high number of non-compliant compensation projects resulted from a lack of follow-up and enforcement actions. A study conducted in New Jersey observed, "The most ecologically successful sites were generally those that had received follow-up work in the form of maintenance, replanting, or improvements to grading or water control structures in accordance with recommendations made by NJDEP [New Jersey Department of Environmental Protection] and other regulatory agencies after initial compliance inspections revealed problems" (Balzano et al. 2002).

Summary of Compliance

To summarize the information in this section, most compensatory-wetland-mitigation projects are being installed, but compliance declines as other permit requirements are considered. Every study found that the amount of compensatory-wetland acreage fell short of what was required. Less than two-thirds of compensation projects were meeting their required performance standards. And few of the projects that were required to perform monitoring and maintenance complied with those requirements. Though few studies examined the effect of regulatory follow-up, those that did suggested that follow-up had a positive influence on the level of compliance and success for compensatory-wetland-mitigation projects.

Types of Compensatory Mitigation

As mentioned in the introduction of this chapter, compensatory mitigation can entail any of four types of activities: restoration, creation, enhancement, preservation, or some combination. Because each type of compensation involves different actions and varying degrees of site disturbance, it is important to investigate each of these types of compensation to understand the pros and cons of each and to determine if any one is more or less effective than the others.

When discussing compensatory mitigation it is important to have a common understanding of the types of compensation that can be used to mitigate for wetland losses. This is difficult because the various agencies and organizations often define the types of compensation differently (Morgan and Roberts 1999).

This section describes the different definitions for restoration, creation, enhancement, preservation, and projects involving a mixture of compensatory mitigation types. This section also summarizes how frequently each of the mitigation types is used in addition to a summary of its relative effectiveness.

Restoration

Of the types of compensatory mitigation, restoration has the widest variety of definitions. The most general is the re-establishment of wetland conditions (i.e., area, functions, and values) at a location where they no longer exist (Jones and Boyd 2000). Activities associated with this definition could include removing fill material, plugging ditches, and/or breaking drain tiles. Other definitions involve returning a site to some historic condition. Examples of these definitions include:

- Reestablishing historic hydrologic processes (National Research Council 2001). Activities associated with this definition typical involve removing a levee or breaching a dike to reconnect an area to the floodplain or to tidal influence.
- "Return of an ecosystem to a close approximation of its condition prior to disturbance [NRC 1992]. Restoration requires knowledge of the wetland type prior to disturbance and has the goal of returning the wetland to that type" (Gwin et al., 1999).
- Returning an altered wetland "to a previous, although altered condition [Lewis 1990]" (Gwin et al., 1999).
- "The process, or the result of the process of returning an area or ecosystem to some specific former condition" (Munro, 1991).

Perhaps as a result of the numerous definitions, confusion about what is restoration versus other types of compensatory mitigation can occur in regulatory permits and mitigation plans. The bottom three definitions in the list could just as easily describe enhancement activities. For example, planting trees in a degraded wet pasture could be an attempt to return an ecosystem (the pasture) to an approximation of its prior condition (forested wetland).

Morgan and Roberts (1999), in their study of compensatory mitigation projects in Tennessee, mentioned that several projects were classified as restoration. Based on the activities specified, however, enhancement would have been a more appropriate term. Similar confusion occurred between creation and restoration.

Use of Restoration

Restoration is frequently used as a non-regulatory conservation tool. And, for compensatory mitigation, restoration is often cited as the highest priority or most recommended type of mitigation "because it offers the highest probability of success

[Krucznyski 1990, Kusler and Kentula 1990, USDA-SCS 1992]" (Morgan and Roberts 1999).

However, this priority is not reflected in the number of compensatory restoration projects implemented on the ground. Restoration tends to be one of the least utilized compensatory mitigation types (Jones and Boyd 2000). In fact, two studies of compensatory mitigation projects mentioned that none of the projects evaluated involved restoration (Shaich and Franklin 1995, Gwin, Kentula et al. 1999).

One study found that 20 percent of projects involved some restoration of wetland acreage (Morgan and Roberts 2003). Another study found that seven percent of projects used restoration as a component of a compensation package, while only two percent of projects employed restoration as the sole form of compensatory mitigation (Shaich and Franklin 1995).

In a departure from the other studies, Holland and Kentula (1992) found that 65 percent of permits required restoration. However, 42 percent of the compensatory wetlands they looked at were estuarine or marine. If estuarine and marine projects are subtracted, the percentage of restored, freshwater wetlands is similar to the other studies.

Morgan and Roberts (1999) suggest that the lack of compensatory wetland restoration projects is due to the fact that "most suitable restoration sites are 'prior converted' farmland and because sizable acreages are being restored under the Wetland Reserve Program . . . sites available for compensatory mitigation may be limited." In Washington, it is believed that restoration is not used very frequently because the majority of wetland impacts are relatively small (<2 acres), and it is very difficult to find restoration opportunities for one or two acres that are not cost prohibitive. Restoration is typically most feasible and cost effective if done over a large area. (Andy McMillan, Washington State Department of Ecology, personal communication, 2002).

Effectiveness of Restoration

Due to the limited use of restoration for compensatory mitigation, there is a substantial lack of data with which to evaluate its effectiveness as a type of compensation. Only one study discussed the effectiveness of restoration. In Florida, Erwin (1991) found that restoration successfully established 88 acres more wetland area than was required.

Creation

Creation entails converting an upland area (i.e., an area without wetland conditions) into a wetland by means of human-induced modification (National Research Council 2001). "Typically, a wetland is created by excavation of upland soils to elevations that will support the growth of wetland species through the establishment of an appropriate hydroperiod [Kruczynski 1990, Lewis 1990]" (Gwin et al. 1999). Gwin et al. (1999) made a distinction between creating a wetland that is isolated from existing wetlands (creation) and creating a wetland that is immediately adjacent to an existing wetland, thereby enlarging the existing wetland (expansion). No other studies made this distinction.

Use of creation

Five studies discussed how frequently creation was required as compensatory wetland mitigation. All studies noted that at least 30 percent and in some cases more than half of compensatory wetland projects were created or involved some creation (Holland and Kentula 1992, Shaich and Franklin 1995, Gwin et al. 1999, Morgan and Roberts 1999, Jones and Boyd 2000).

Effectiveness of creation

The two studies that examined the effectiveness of created wetlands observed numerous problems involving failure to establish wetland area and vegetation (Erwin 1991, Morgan and Roberts 1999). Creation projects in Florida failed to establish 527 acres of required wetland area (Erwin 1991). In Tennessee Morgan and Roberts (2003) determined that only six percent[15] of creation projects met all their permit requirements.

Enhancement/Exchange

Enhancement involves modifying a specific structural feature of an existing degraded wetland to improve one or more functions or values based on management objectives (Gwin et al. 1999). Enhancement typically consists of planting vegetation; controlling non-native, invasive species; modifying site elevations or the proportion of open water.

[15] Percentage calculated from data provided in Morgan and Roberts 2003.

Gwin et al. (1999) defined exchange as, "Enhancement taken to the extreme (Kruczynski 1990), with most or all of the wetland converted from one type to a different type. For example, resource managers may intend to enhance habitat value for waterfowl by excavating an area of open water within an existing emergent marsh. However, if the open water area replaces the emergent wetland or a large proportion of it, wetland types have been exchanged."

Because enhancement involves altering an existing wetland to compensate for the loss of other wetlands, the scientific literature mentions three main concerns regarding its use.

- Enhancement fails to replace lost wetland area (Shaich and Franklin 1995, Morgan and Roberts 1999). For this reason, the state of Michigan does not allow the use of enhancement (Michigan Department of Environmental Quality 2000).
- Enhancement fails to replace wetland functions, since "a positive change in one wetland function may negatively affect other wetland functions [Kruczynski 1990, Lewis 1990]" (Gwin et al., 1999). In addition, "there commonly is disagreement about whether or not the practice implemented actually enhances conditions at a site" (Morgan and Roberts 1999).
- Enhancement may result in a conversion of HGM and/or Cowardin classes, typically producing a compensation wetland without natural analogues (Shaich and Franklin 1995, Gwin et al. 1999). For example, when enhancement is used for mitigation, "a single Section 404 decision results in the destruction of the wetland for which the permit was issued, along with the conversion of a second wetland to a different, often atypical, HGM type. This 'double whammy' means that exchange [enhancement] explicitly does not fulfill the objective of 'no-net-loss' of wetlands but, instead, ensures loss of wetland area, additional wetland disturbance, and changes in overall ecological function" (Gwin et al. 1999). Refer to sections 1.8 and 1.9.6 for more information on no-net-loss and replacement of HGM classes.

Use of enhancement

Four studies mentioned enhancement and its frequency of use. Most studies found that greater than one-third of projects enhanced existing wetlands as compensatory mitigation (Shaich and Franklin 1995, Gwin et al. 1999, Morgan and Roberts 1999). One study noted that the acreage required for enhancement was five times greater than the acreage required for restoration and one and a half times greater than the acreage required for creation. (Breaux and Serefiddin 1999). However, this could be due to replacement ratios (see section 4.6.5) and not frequency of use.

Effectiveness of enhancement

No studies were found which specifically evaluated the effectiveness of enhanced compensation wetlands.

Preservation

Preservation means "the protection of an existing and well-functioning wetland from prospective future threats" (National Research Council 2001). Preservation, therefore, provides the opportunity to protect wetland areas that might otherwise be in jeopardy. Like enhancement, preservation does not produce any new wetland acreage; for that reason, some concerns have been raised regarding its use.

- Preservation results in a net loss of wetland acreage.
- Preserved wetlands generally are not large enough to protect ecosystems and biodiversity over the long term (Whigham 1999).
- Preserved areas may not be checked by regulatory agencies to verify that they contain the specified acreage of wetland. For example, Morgan and Roberts (1999) observed that one of the larger preserved wetlands in their study was predominantly upland and "did not meet the criteria for being considered a jurisdictional wetland."

However, if an area can be verified as wetland, "Preservation of an existing wetland removes the uncertainty of success inherent in a wetland creation or restoration project and required no construction to complete," (WSDOT, 1999). Preservation eliminates the risk of failure and temporal loss of wetland functions for it is already a mature wetland ecosystem.

Use of Preservation

Six articles discussed the use of preservation. Most of the studies found that preservation was required as compensatory wetland mitigation for less than a one-quarter of projects (Holland and Kentula 1992, Morgan and Roberts 2003, Jones and Boyd 2000).

Preservation generated about 2 percent of the compensatory wetland acreage in a study from San Francisco, California (Breaux and Serefiddin 1999). A report from the Washington State Department of Transportation (1999) mentions that nationwide, "76 percent of state Departments of Transportation use preservation at least as a partial component of compensatory mitigation and 38 percent use preservation as a stand alone element (WSDOT 1998)."

Effectiveness of Preservation

There is a general lack of information about the effectiveness of preservation, thereby reinforcing some of the concerns about its use for compensatory mitigation.

Mixed Compensatory Mitigation

Mixed projects involve more than one type of compensatory mitigation. For example, a common proposal in the Pacific Northwest entails enhancing an existing wetland and creating additional wetland area immediately adjacent to it. Mockler et al. (1998) observed, "most sites consist of creation – a small pool graded for open water and emergents – and enhancement, typically of wetland buffer…" The types of compensation, however, can occur on separate sites, such as a created wetland adjacent to the development site and a preserved wetland some distance away.

Three studies identified mixed compensation projects (Mockler et al. 1998, Gwin et al. 1999, Morgan and Roberts 2003). For their studies of compensation wetlands, Mockler et al. (1998) classified compensation wetlands according to the dominant type of compensation. However, some projects lacked sufficient information to make this determination, while other projects lacked domination by any one type of compensation.

Use of Mixed Compensation Projects

Four studies discussed how frequently mixed compensatory mitigation was required. Results indicated that mixtures were used for less than a third of projects (Holland and Kentula 1992, Shaich and Franklin 1995, Gwin et al. 1999, Morgan and Roberts 2003).

Effectiveness of Mixed Compensation Projects

No studies were found that examined the effectiveness of projects utilizing a mixture of compensation types.

Summary of Types of Compensation

Nearly every type of compensation has a variety of definitions or criteria associated with it. This has led to confusion in permitting and evaluating projects. For instance, comparing the effectiveness of one type of compensation with another is impossible when it is not clear if a project involved creation, restoration, enhancement, or some combination.

Perhaps due to this confusion of types, the studies reviewed for this synthesis, for the most part, did not investigate the effectiveness of compensation types. The information that was available indicated that restoring wetlands is a high priority, but as a type of compensation it is not frequently used. Studies revealed that creation is generally the most frequently used type of compensation, but studies of its effectiveness produced mixed results. Enhancement of wetlands was also frequently used: However, no studies were found examining its effectiveness.

Preservation and a mixture of types, appear to be used occasionally. Studies provided limited information on the effectiveness of these types. The lack of data regarding the effectiveness of preservation is particularly problematic since one of the only studies to look at its effectiveness determined that one large site was predominantly upland habitat (Morgan and Roberts 1999).

No Net Loss?

"No net loss" refers to a goal for the nation and Washington State to ensure there will be no overall net loss in acreage and function of the remaining wetland resource base (The Conservation Foundation 1988, McMillan 1998). The no-net-loss goal "does not mean that no further wetlands will be lost; rather, that mitigation and non-regulatory restoration will offset wetland losses" (McMillan 1998). When wetland losses are permitted, compensatory mitigation of equivalent wetland resources should be required (McMillan 1998).

No-net-loss provides a measurable and consistent method for evaluating and comparing the effectiveness of compensatory mitigation programs (Kusler 1988). The scientific literature contained two types of information on no-net-loss:

- Studies that evaluated how well permitting programs (e.g., Section 404) achieved no-net-loss of wetland acreage. Most of these studies conducted paper evaluations using data from permit files and databases.
- Studies that evaluated how well compensation projects achieved no-net-loss on the ground. These studies were conducted in the field and typically involved wetland delineations.

Programmatic Evaluations and No-Net-Loss

Programmatic evaluations, in contrast to most of the studies mentioned thus far, are not concerned with the effectiveness of individual compensatory mitigation projects. Instead, programmatic evaluations focus on whether a permitting agency or permit program has achieved the goal of no-net-loss of wetlands over a specified period of time.

In a programmatic evaluation no-net-loss is determined by comparing the acreage of wetlands lost, or adversely altered, with the acreage of wetlands required for compensatory mitigation in a specific geographic area. These evaluations typically rely on information from permit files and databases, rather than on-the-ground, as-built verifications.

Six studies looked at the effectiveness of wetland permitting and compensatory mitigation programs (Table 1.8). The earliest study reviewed for this synthesis document reviewed Section 404 permit data from Washington, 1980 to 1986, and Oregon, 1977 to 1987, "to describe how permit decisions affect the wetland resource" (Kentula et al. 1992). Results indicated that in Washington a net loss of 39 acres (16 ha) of wetland occurred, while in Oregon, a net loss of 79 acres (32 ha) of wetland occurred. The authors also observed, "In Washington, approximately 3 percent of the permits issued required compensatory mitigation" (Kentula et al. 1992).

A net loss of 8 acres (3 ha) was observed in a study of Section 404 permitting from southern California (Allen and Feddema 1996). The study also determined that "freshwater wetlands are experiencing a disproportionately greater loss of area and that riparian woodland wetlands are most often used in mitigation efforts. The net result of these accumulated actions is an overall substitution of wetland types throughout the region" (Allen and Feddema 1996).

Three of the remaining studies generally found that permitting programs required a net gain from compensatory mitigation (Table 1.8). Gains in acreage ranged from 2.2 acres (0.9 ha) (Cole and Shafer 2002) to nearly 197 acres (80 ha) (Holland and Kentula 1992). However, a study of the effectiveness of the New Jersey Freshwater Wetlands Protection Act (Torok et al. 1996) mentioned compensatory mitigation acreage only for individual permits. It was not clear from the article if any of the 3003 general permits, resulting in over 600 acres of wetland loss, required any compensatory mitigation. Furthermore, two studies noted that data on acreage of impacts and compensation was lacking in 20 to 40 percent of permit files (Holland and Kentula 1992, Cole and Shafer 2002).

The fifth study indicated that new wetland acreage produced by creation or restoration did not fully replace the permitted wetland losses, thereby resulting in a loss of about 260 acres (Jones and Boyd 2000). However, preservation, mitigation bank credits, and substantial in-lieu-fee contributions provided additional compensatory mitigation. If acreages from all types of compensatory mitigation are included, there was a gain of about 1500 acres (Jones and Boyd 2000). Despite the fact that only 24 percent of the permits required compensatory mitigation, the authors concluded that the goal of no net loss was achieved for the Norfolk Corps District (Jones and Boyd 2000).

Table 1.8 Permitted wetland loss compared to required wetland compensation

Location and reference #	# of permits	Wetland area lost	Area of compensation	Comments
Washington (12)	35	61.4 ha	45.5ha (created)	Section 404 permits 1980-1986.
Oregon (12)	58	73.9 ha	41.8ha (created)	Section 404 permits 1977-1987.
California (7)	324	1176.3 ha	1255.9ha	Section 404 permits 1971-1987. Data on acreages was often lacking.
California/	75	80.5 ha	77.3 ha	Section 404 permits 1987-1989.

Location and reference #	# of permits	Wetland area lost	Area of compensation	Comments
southern (1)			completed	Permits required 111.6 ha of compensatory mitigation.
Pennsylvania (9)	18	6.1 ha	7 ha	Section 404 permits 1986-1999 (Baltimore Corps District)
Norfolk Corps District (11)	1692	863.8 ac	538.6 ac created 65.5 ac restored 1537.2 ac preserved 200.8 bank credits $2,574,966 in lieu fee	Section 404 permits 1996-1998.
New Jersey (21)	3003 (107 individual permits)	243.8ha (66.5 ha)	NA (69.2ha created 16.5ha restored)	New Jersey Freshwater Wetlands Protection Act permits 1988-1993. Numbers in parentheses for individual permits; all other numbers for state general permits.

No-Net-Loss and Compensatory-Mitigation Project Evaluations

Studies examining the effectiveness of compensatory-wetland-mitigation projects often assessed whether the projects achieved the goal of no-net-loss. The assessment generally involved determining how much wetland acreage the compensation projects provided. The wetland compensation acreage produced on the ground was then compared to the acreage of wetland loss associated with those projects. If the compensation acreage was less than the wetland acreage lost, a net-loss of wetland occurred. Seven studies analyzed compensatory wetland mitigation project data to determine whether the no net loss goal was achieved.

Four studies either focused on creation or restoration, or they did not mention the type of compensatory mitigation. The studies noted that the acreage of wetland compensation was less than the acreage of wetland loss by as much as 34 percent, thereby resulting in a net loss of up to 8 acres (Gwin and Kentula 1990, Allen and Feddema 1996, Wilson and Mitsch

1996). However, a study conducted for the South Florida Water Management District found that creation and restoration activities resulted in 106 percent of the wetland acreage lost – a net gain of almost 65 acres of wetlands (Erwin 1991).

One issue that emerges when considering no-net-loss is the use of enhancement and preservation as wetland compensation. Two studies noted that enhanced or preserved wetlands accounted for 35 to 61 percent of the required compensatory wetland mitigation acreage (Shaich and Franklin 1995, Morgan and Roberts 2003).

Both studies discounted the acreage provided by enhancement and preservation. Enhancement and preservation are often not included in determining net loss or gain because neither type of compensatory mitigation produces any new wetland acreage (Breaux and Sereffidin 1999). When enhancement and preservation acreages are not included, the two studies noted an overall net loss of wetland area of 30 and acres 8 acres respectively (Shaich and Franklin 1995, Morgan and Roberts 2003). This net loss of wetland acreage accounted for 21 and 58 percent of the originally permitted wetland losses.

So, Is Compensatory Wetland Mitigation Effective?

Based on the results of the studies reviewed, the majority of compensation wetlands are being installed. However, the literature appears to suggest that most compensation wetlands, at best, have an intermediate level of success and compliance. Information on the effectiveness of the different types of compensation is scant to non-existent. Moreover, the data regarding whether a net loss of wetland acreage is occurring indicates that though improvements have been made in terms of what is being required, net losses persist, mainly due to the use of enhancement and preservation of existing wetlands as compensation.

But is a net loss of wetland functions occurring? The following section addresses this question by examining the functions and characteristics provided by created and restored wetlands and comparing that to the functions and characteristics provided by reference wetlands.

Functions and Characteristics Provided by Compensatory and Non-compensatory Wetlands

The results and conclusions of the scientific literature describing the ability of compensatory wetland mitigation projects to perform wetland functions were not noticeably different from the results and conclusions concerning the ability of non-regulatory restoration or creation projects to perform wetland functions. The literature indicates that newly constructed wetland sites face similar challenges and develop in similar ways regardless of whether they were legally required or voluntarily initiated. Therefore, results from studies of compensatory wetland sites were combined with results from studies of non-regulatory creation and restoration projects.

Wildlife Habitat Functions

The majority of studies determined that reference wetlands provided habitat for a greater diversity, density, or abundance of wildlife than created or restored wetlands (Delphey and Dinsmore 1993, Brown et al. 1997, Brown and Smith 1998, Bursey 1998, Dobkin, et al. 1998, McIntosh et al. 1999, Fairchild et al. 2000, Dodson and Lillie 2001, Lehtinen and Galatowitsch 2001, Pechmann et al. 2001). Birds were an exception since half of the studies found no difference between created/restored sites and reference wetlands, particularly for waterfowl (Delphey and Dinsmore 1993, Brown and Smith 1998, Ratti et al. 2001).

A variety of factors appeared to influence the abundance and diversity of wildlife guilds at created or restored wetlands. First, the more well developed the vegetation communities, particularly the emergent community, the greater the abundance, diversity, or both of the invertebrates, amphibians, and birds in the wetland (Bilanger and Couture 1988, Hemesath and Dinsmore 1993, Chovanec 1994, VanRees-Siewert and Dinsmore 1996, Brown et al. 1997, Chovanec and Raab 1997, McIntosh et al. 1999, Fairchild et al. 2000). Second, older created and restored wetlands supported a greater abundance and diversity of invertebrates, amphibians, and birds. This is associated with the development of vegetation communities: vegetation communities are generally better developed at older sites (VanRees-Siewert and Dinsmore 1996, Brown et al. 1997, Fairchild et al. 2000, Dodson and Lillie 2001). In fact, Dodson and Lillie (2001) determined that a newly restored site would require

6.4 years for the zooplankton taxon richness to resemble that of a minimally disturbed reference wetland.

In addition, birds were affected by the availability of a food source. The density and abundance of invertebrates was a main factor found to influence bird populations (Bilanger and Couture 1988, Cooper and Anderson 1996).

Finally, amphibian communities were affected by additional factors, such as, the hydroperiod of the wetland, distance to other wetlands, connectivity between terrestrial and wetland habitats, the presence of fish, and the surrounding land uses (Bursey 1998, Baker and Halliday 1999, Monellow and Wright 1999, Lehtinen and Galatowitsch 2001, Pechmann et al. 2001).

Characteristics of Wetland Vegetation

Results indicated that created and restored wetlands have different vegetative characteristics and plant communities than reference wetlands (Delphey and Dinsmore 1993, Galatowitsch and van der Valk 1995, Galatowitsch and van der Valk 1996, Dobkin et al. 1998, Brown 1999, Magee et al. 1999, Moore et al. 1999). A few studies found that certain plant communities, such as sedge meadows, may require many years to develop if at all (Galatowitsch and van der Valk 1995, VanRees-Siewert and Dinsmore 1996,Dobkin et al. 1998).

Cowardin class, which refers to a method used to categorize wetlands based on the dominant type of vegetation (Cowardin et al. 1979), provides a useful way to evaluate whether compensation wetlands are providing the same or similar physical characteristics as the wetlands being lost, and whether certain classes can be reproduced. A number of studies evaluated compensation wetlands to determine which Cowardin classes were being established and compare this with the type of wetlands being lost. The main Cowardin classes used to categorize freshwater wetlands are emergent, scrub-shrub, forested, aquatic bed, and open water.

Nearly all studies found that compensatory mitigation resulted in more acreage of open water/aquatic bed/deep marsh than was originally lost or required (Kentula et al. 1992, Shaich and Franklin 1995, Bishel Machung et al. 1996, Magee et al. 1999, Cole and Brooks 2000, Michigan Department of Environmental Quality 2000, Balzano et al. 2002, Cole and Shafer 2002, Robb 2002, Minkin and Ladd 2003). For example, in the Portland metropolitan area of Oregon 29 acres of open water were gained (Shaich and Franklin, 1995), and Indiana gained over 3 acres of open water/deep marsh/aquatic bed (Robb 2002). Compensatory-wetland-mitigation projects in New Jersey generated 50 acres more open water than was required (Balzano et al. 2002).

Results for other Cowardin classes indicated losses. For example, studies noted either a loss of forested wetland area (4-8 acres) or an inability to establish this wetland class (Shaich and Franklin 1995, Bishel Machung et al. 1996, Brown and Veneman 2001, Balzano et al. 2002, Cole and Shafer 2002, Robb 2002, Minkin and Ladd 2003).

Variability occurred in the balance of emergent wetlands. A study from the Portland metro area noted a net loss of 35 acres of emergent wetlands (Shaich and Franklin 1995), while studies from other states found that emergent wetlands were established more successfully than other wetland classes (Bishel Machung et al. 1996, Brown and Veneman 2001, Balzano et al. 2002, Cole and Shafer 2002).

Results indicated that compensatory-mitigation is producing more acreage of open water wetlands than was lost. The ability of compensatory-mitigation to produce other Cowardin classes varied.

Several major factors were found to affect vegetation and plant communities, including:

- The age of the wetland (Reinartz and Warne 1993, Magee et al. 1999, Moore et al. 1999, Celedonia 2002). For example, studies found that older created/restored sites had higher percent cover of emergent and woody species than younger sites (Reinartz and Warne 1993, Moore et al. 1999, Celedonia 2002).
- Soil conditions (Brown 1991, Ashworth 1997, Brown and Bedford 1997, Stauffer and Brooks 1997, Brown 1999). Studies noted positive effects on vegetation after adding hydric topsoil (Brown 1991, Brown and Bedford 1997, Stauffer and Brooks 1997).
- Competition (Magee et al. 1999, Budelsky and Galatowitsch 2000, Michigan Department of Environmental Quality 2000, McLeod et al. 2001, Celedonia 2002). For example, studies found that reed canarygrass can be problematic when attempting to establish emergent vegetation (Budelsky and Galatowitsch 2000).
- A source of native seeds or plants can speed up recolonization and increase diversity (Reinartz and Warne 1993, Galatowitsch and van der Valk 1995).

- Human restoration techniques can increase or decrease the percent cover of native species depending on the technique used and objective identified (Clark and Wilson 2001).

Soil Characteristics

Created, restored, and enhanced wetlands had less organic matter than reference wetlands (Brown 1991, Bishel-Machung et al. 1996, Streever et al. 1996, Shaffer and Ernst 1999, Whittecar and Daniels 1999, Stolt et al. 2000). And wetlands covered by standing water for a long duration had less organic matter than a wetland with less inundation (Shaffer and Ernst 1999). This could be due to excavation of surface soil layers during project installation (Shaffer and Ernst 1999). In addition, organic matter at compensation wetlands did not appear to accumulate over time (Bishel-Machung et al. 1996, Shaffer and Ernst 1999).

Likewise, researchers found that soils at created and restored wetlands were sandier, more compacted, and lower in nitrogen than reference wetlands (Bishel-Machung et al. 1996, Whittecar and Daniels 1999, Stolt et al. 2000). The combination of low organic matter with sandy, compacted, low nutrient soil conditions could hinder plant establishment at compensation sites (Whittecar and Daniels 1999, Stolt et al. 2000), as well as denitrification and pollutant trapping (Stolt et al. 2000), thereby influencing microbial activity (Whittecar and Daniels 1999).

Water Quality Functions

Water at created wetlands had higher pH and conductivity than reference wetlands. Researchers hypothesized that this was influenced by the low amount of organic matter in the soil (Streever et al. 1996). However, created and restored wetlands were comparable to reference wetlands at retaining sediments, phosphorus, and nitrogen (Mitsch 1992, Mitsch et al. 1995, Niswander and Mitsch 1995, Moore et al. 1999, White et al. 2000). Factors affecting sediment and nutrient retention included the volume of water flowing into the wetland, the length of time water remains in the wetland, and the size of the wetland compared to the size of the basin (Fennessey et al. 1994, Woltemade 2000).

Water Quantity Functions

Information on the ability of created and restored wetlands to provide water quantity functions related exclusively to water regimes and comparisons with reference wetlands. Studies found compensatory mitigation wetlands produced significantly different water regimes (characterized by hydrogeomorphic classes) than were present in reference wetlands (Gwin et al. 1999, Shaffer et al. 1999, Cole and Shafer 2002). This has resulted in wetlands that have more inundation for a longer duration than reference systems (Shaffer et al. 1999, Cole and Brooks 2000).

What doe the scientific literature indicate about the effectiveness of compensatory wetland mitigation?

It appears that even though the majority of compensation projects are being implemented, few of them are considered successful or fully compliant with all of their permit requirements. A net loss of wetland acreage appears to be occurring despite wetland regulation due to the use of existing wetlands (e.g., enhancement and preservation) for compensation and the inability of many projects to establish the required acreage of wetlands. It also appears that a net loss of wetland function is occurring, particularly in terms of habitat for wildlife and plants. Compensation projects often result in altered wetland water regimes, thereby producing more open water and limiting the accumulation of organic matter. However, research indicates that created and restored wetlands are capable of replicating water quality functions – removing sediments, nutrients, toxic organic compounds, and heavy metals.

So, it appears that there is a problem with compensatory mitigation, but are things any different in Washington? The following chapters describe studies conducted to determine the effectiveness of compensatory wetland mitigation in Washington State.

Chapter 2 – Assessing Compliance

Introduction

Chapter 1 explained that wetlands are important ecosystems providing many functions that are of value to society. For this reason wetlands have been granted special protections. Society has developed several layers of regulation to prevent further losses of wetland area and functions. Compensatory mitigation for wetlands emerged as a way to allow commercial, industrial, or residential development to occur in wetlands without generating a net loss of wetland area, functions, or both. However, as summarized in chapter 1, previous studies in Washington and other states have indicated that compensatory wetland mitigation is less then effective at preventing the loss of wetland acreage and function.

In particular, a study examining wetland compensation sites in King County, Washington (Mockler et al. 1998) noted poor compliance and functional replacement. Within the state of Washington it was believed that King County had highly knowledgeable wetland staff and some of the most stringent wetland regulations and mitigation guidelines. Therefore, if a jurisdiction as competent as King County observed so many inadequate compensation wetlands, how was the rest of the state doing?

In the summer of 1999 the Washington State Department of Ecology (Ecology) initiated a study to determine the effectiveness of freshwater compensatory wetland mitigation in Washington State. The study, which was primarily funded by the Environmental Protection Agency, was initiated in two phases. The first phase assessed the level of compliance of compensation wetlands. The second phase, which will be described in Chapter 3, evaluated the success of compensation wetlands based on their level of ecological functioning.

Chapter 2 describes who was involved with the study, how compensation wetlands were selected, and the methods used to evaluate sites. It reports the results of the site evaluations and explains some of the problems encountered while attempting to determine the level of compliance of freshwater compensation wetlands in Washington State.

Project Roles and Responsibilities

The author and two other Ecology employees began this study in the summer of 1999. Emily Teachout served as the project lead and provided supervision and input on the initial aspects of the study, such as developing methods, selecting sites, and gaining access to compensation sites. She participated in approximately two-thirds of the site visits before accepting another position with the agency. Emily had a background in wetland science, plant identification, data collection, mitigation design and construction.

Dana Mock was a member of the Washington Conservation Corps (WCC). She researched study methods and assisted with method development. Dana took the lead in selecting sites and gathering background information. Dana participated in all site visits and assisted with data analysis. She had a background in wetland science, data collection, and mitigation site maintenance.

The author, Patricia Johnson, assumed the role of project lead after Emily Teachout vacated her position. The author took the lead in developing methods. She assisted with site selection and gathering background information. The author contacted landowners or their representatives to obtain access to sites. The author participated in all site visits and took the lead in analyzing data. She had a background in wetland science, plant identification, data collection, and data analysis.

Methods

Site Selection and Background Information

To facilitate objective evaluation of permit compliance for compensatory wetland mitigation projects, the investigators randomly selected potential sites from agency databases. A list of permitted projects from the U.S. Army Corps of Engineer's (Corps) Section 404 database and the Ecology's Section 401 database was compiled (refer to p.2 for a description of wetland regulatory programs). The investigators developed and applied site selection criteria to eliminate projects that were either irrelevant to the study or which would be unproductive to evaluate. The database randomly sorted the remaining projects. The investigators then sequentially selected sites for consideration in the first phase of this study.

The following criteria were applied to the Section 404 and Section 401 databases to search for projects that were relevant for this study (Table 2.1):

1) Permit application date.

   The investigators considered projects with permit applications submitted between 1992 and 1997. Projects with permit applications submitted after 1997 were not included because it was likely that site construction would not have been completed. Prior to 1992 both the Corps' and Ecology's databases were incomplete and inconsistent. Applications submitted before this date were therefore excluded.

2) Permit decision.

   This criterion eliminated projects that the databases described as denied, withdrawn, or expired.

3) Washington State Department of Transportation (WSDOT) projects.

   This criterion eliminated WSDOT projects. WSDOT is a high profile public agency that frequently impacts wetlands through its road building and maintenance activities and, therefore, must perform numerous compensatory wetland mitigation actions. As a result, WSDOT has developed and installed its own monitoring program to study its overall compensatory mitigation success and compliance. Also, WSDOT submits annual monitoring reports to the permitting agencies documenting conditions at its mitigation sites. The purpose of this study was to assess the compliance of other public and private entities.

4) Permit type.

   This criterion eliminated projects authorized under certain types of Nationwide Permits (NWPs) that typically do not require compensatory mitigation. These included NWP 3 (maintenance), NWP 13 (bank stabilization), and NWP 19 (minor dredging). While it is possible that a project authorized through one of these Nationwide Permits might have required compensatory wetland mitigation, the effort required to review each of these permits for mitigation requirements would have been onerous due to the large number of projects and the time required to locate and obtain files.

5) Wetland impact or mitigation.

   This criterion eliminated projects that the database indicated as having no wetland impacts and no compensatory mitigation requirements.

6) Tidal wetlands.

This criterion eliminated projects known to be tidal. Tidally influenced sites function differently than non-tidal sites and a separate approach would have been necessary to evaluate these sites.

7) 401 Thresholds for NWP 26.

This criterion eliminated projects authorized under NWP 26 that had wetland impacts less than one acre prior to February of 1996 and less than 0.33 acre after February of 1996, because these permits typically did not require compensatory mitigation. This criterion did not apply if the database specifically indicated that a project required compensatory mitigation.

Table 2.1 summarizes the criteria used in selecting projects for inclusion in this study.

Table 2.1 Summary of criteria and responses used to eliminate projects that would be irrelevant or unproductive to assess.

Database Field Criteria	**Database Field Entry or Response**
1. Permit application date	"Prior to 1992" "Post 1997"
2. Ecology decision	"Denied," "Expired," or "Withdrawn"
3. Applicant	"WSDOT"
4. Permit Type	"NWP 03" – maintenance "NWP 13" -- bank stabilization "NWP 19" – minor dredging *NWP = nationwide permit
5. Wetland impact or mitigation	"Wetland impact 0" "No wetland impact indicated" "Mitigation not required"
Other Criteria	**Rationale for Eliminating**
6. Tidal wetlands	Lacked a methodology to assess tidal wetlands
7. 401 thresholds on NWP 26	a. Prior to 2/1996 wetland impact < 1 acre did not require mitigation b. After 2/1996 wetland impact < 0.33 acre did not require mitigation

After applying the site selection criteria, the investigators compiled the remaining projects into a single database. This database was stratified into two groups: sites west of the Cascade Range and sites east of the Cascade Range. For each subset, projects were randomly sorted and sequentially numbered.

Starting with the first randomly sorted project, Dana Mock examined each database entry to verify that the project met the study criteria and to obtain sufficient information for locating the project file. Additional projects were then eliminated based on information obtained from file review or telephone conversations with Corps staff, applicants, or consultants. Projects were eliminated for reasons, such as:

- Project revision reduced wetland impacts such that no compensatory mitigation was required.
- Conversion of wetlands to cranberry operations of less than 10 acres required no compensatory mitigation.
- A wetland violation required the removal of fill and no compensatory mitigation.
- The wetland compensation project was pending or currently under construction.
- The project involved pipelines or transmission lines and required "restoration to prior conditions" after the impact.
- The wetland impact never occurred.
- The project had an inaccurate database entry.
- The project was determined to be tidal but did not appear as such in the initial database query.

The investigators relied upon the following background information to assess the sites that were selected:

- Corps Section 404 permits.
- Section 401 Water Quality Certifications.
- Final wetland mitigation plans and site maps.
- Public notices.
- As-builts.
- Monitoring reports.
- Site photos.
- Deed restriction/conservation easement documentation.

- Decision documents.
- Correspondences and memorandums.
- Documents associated with the State Environmental Policy Act (SEPA).
- Agency and public comments.

When available, Dana Mock obtained this information from the Corps' Section 404 files and Ecology's Section 401 files. Ecology's regional wetland staff supplied some additional information from their files.

In several cases vital or pertinent information was lacking from the files. When critical information, such as a mitigation plan, site maps, or design drawings, was missing from the files, the investigators contacted the consultant or the applicant to supply it. Information that was missing from a file was noted as "not found" in the event that it had been submitted by an applicant, but not properly filed.

Site Visits and Compliance Assessment

The investigators did not visit any study sites until the landowners or their representatives granted permission to gain access. To obtain this permission, the author contacted the permit applicant, explained the nature of the study, and requested to gain access to the site on a designated day and time.

In a few instances attempts to gain access were unsuccessful. One applicant denied access, four applicants never responded to the request for permission to gain access to the property, and one applicant granted access after the field portion of this study had been completed. The investigators dropped these sites from the study.

Site visits were conducted in October 1999 for sites east of the Cascades and in October and November 1999 for sites west of the Cascades. This was the end of the growing season, and vegetation was dying back. Therefore, the investigators did not assess any performance standards that were contingent upon growing season conditions.

Upon arriving, the investigators traversed the site to orient themselves and to verify consistency with available project plans or as-built reports and drawings. Grading, vegetation, required habitat features, and signage were checked.

The investigators recorded all plant species that were observed, noted their wetland indicator status[1] (FAC, OBL, etc.), and whether they were native or non-native. Where applicable, it was recorded whether plant species were existing, planted, or dominant across the site or in particular locations. The investigators verified consistency with the planting plans

When available, the investigators field verified a recent monitoring report. They randomly selected and located monitoring points or transects to determine if the reported results were consistent with on-the-ground-conditions. If the investigators determined that data in the monitoring report were inconsistent with conditions on the site then independent sample locations were chosen and the vegetation was characterized.

The investigators established vegetation sample locations by randomly placing two or more points, depending on the size of the site, on the site drawings. Each point on the drawing was located on the ground. Relative areal cover was estimated within a five-foot radius for canopy, shrub/sapling, and herbaceous layers. Cover classes were employed to reduce observer bias and improve consistency. They were as follows:

- >0 to <5%
- >5 to <25%
- >25 to <50%
- >50 to <75%
- >75 to <95%
- >95 to 100%

In addition, the investigators described the water regime (area, extent, and depth of inundation, saturation, or both), and noted the presence of weirs, water control structures, culverts, and flowing water (indicating the direction of flow). The investigators recorded evidence or observations of wildlife, surrounding land uses, and the latitude and longitude of the site (obtained from a handheld GPS unit).

Photos were taken to reflect site conditions. For each photo the general location and direction of the photo were noted. If established photo points or monitoring points existed, the investigators took photos from these locations.

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[1] Wetland indicator status is a system developed by the US Fish and Wildlife Service. It describes the likelihood that a plant will be found growing in a wetland.

The investigators assessed compliance at each site in three parts:

1. Was the compensatory mitigation project installed (i.e., built)?
2. Was the compensatory mitigation project installed according to plan (i.e., complying with as-built specifications, grading plan, planting plan, etc.)?
3. Was the compensatory mitigation project meeting its performance standards?

The investigators determined overall compliance based on the results of the three parts, such that only a project complying with all three parts would be considered in compliance overall.

The first part, "Was the wetland compensation installed?" was assessed based on whether it was evident that the work described in the plan had been carried out. If the investigators observed any evidence that some compensatory wetland mitigation activity had been executed, then the project was considered installed. Compensatory mitigation projects that were not installed were obviously not in compliance with either of the other two questions and, therefore, not in compliance overall.

For compensatory mitigation projects that involved preservation, either as the sole compensation type or in conjunction with another type of compensation, installation was assessed through a site visit to ensure that the preservation area was intact (i.e., there was no obvious development visible). However, two preservation only projects additionally required restoring areas of unauthorized fill. For these projects, implementation was also based on whether the unauthorized fill was removed (e.g. site restored).

To assess the second part, "Was the wetland compensation installed according to plan?" the investigators identified three main elements of a compensatory wetland mitigation plan, including grading, planting, and miscellaneous other requirements (e.g., deed restrictions or conservation easements, signs, and habitat features). Compliance with the approved plan entailed assessing whether each element had been installed as outlined in the plan. If one element of the mitigation plan was evaluated as "no" (not installed to plan) then the overall evaluation of whether the project was installed to plan was "no."

If an as-built document was available, the investigators used it as the basis for assessing sites. Otherwise, on-the-ground-conditions were compared to the most recent version of grading and planting plans/drawings (if available) or to written descriptions in a final mitigation plan.

When applicable, the investigators assessed grading components, such as on-site topography, the presence of soil amendments (if required), presence of water flow, water control structures, and extent of open water or inundation. Planting components included consistency with the planting plan regarding presence of vegetation species, relative numbers, and planting locations.

Components of the miscellaneous other element of a mitigation plan included habitat features (e.g., snags, stumps, brush piles, nest boxes, etc.), and wetland demarcation signs. When required, the investigators assessed this element based on relative numbers and locations consistent with what was called for in the mitigation plan. The other element also included verification of a deed restriction or conservation easement for compensatory mitigation projects involving preservation.

Plan element compliance was categorized as:

1. "Yes," installed to plan.
2. "No," not installed to plan.
3. "CND," could not determine if installed to plan. For example, if extensive flooding occurred after plants had been installed, the investigators could not determine if the site was planted to plan.
4. "NA," not applicable. Not all plan elements were applicable to all mitigation projects. For example, grading was not applicable for many enhancement projects.

The investigators evaluated the third question, "Was the wetland compensation meeting performance standards?" independently of the "installed to plan" question. This meant that a project that was not installed according to plan could still meet its performance standards since performance standards did not often involve measuring or confirming design specifications. For the purposes of this study, the investigators considered performance standards, performance criteria, success criteria, success measures, or measures of success that were identified in a project's approved mitigation plan or were required in the Section 404 permit or WQC.

Performance standards were assessed based on field conditions observed during the site visit. If a monitoring report was available, the investigators compared on-the-ground-conditions to the results of the most recent monitoring event. If one of the assessed performance standards was evaluated as "no", then the overall evaluation of whether the project was meeting performance standards was no.

Some projects did not have performance standards identified in their mitigation plans, nor did they have any applicable Corps or Ecology permit conditions to assess. Furthermore, many projects had performance standards that this study was unable to assess, due to the timeframe of site visits, the study methods used, or both. Performance standards that this study could not assess included:

- Establishment of a specified area of wetland and wetland types (delineations were not conducted);
- Water regime performance standards that required evidence of inundation or saturation during the growing season; and
- Year-based standards that were outside the timeframe of the site visit.

The investigators categorized performance standard attainment as follows:

1. "Yes," meeting performance standard.
2. "No," not meeting performance standard.
3. "CND," could not determine if the performance standard was met. This was used for standards that were not measurable or ambiguous, and also for projects that had no performance standards which this study could assess.
4. "NA," not applicable. This was applied to projects with no performance standards such as preservation-only projects or projects that had only goals.

Results

This study compiled a master database of projects for initial consideration, which was stratified into 831 projects west of the Cascades and 53 projects east of the Cascades. A review of the first 400 randomly numbered projects west of the Cascades resulted in the initial selection of 45 projects. Landowners granted permission to visit 39 of those projects. Of the six projects for which site access was not obtained, one applicant denied access, four did not respond when contacted, and one did not respond prior to the end of the field portion of the study. All 53 projects east of the Cascades were reviewed. Seven projects met all the selection criteria, and permission to visit the property was granted for all seven projects.

When contacting applicants, the author informed them that the study was academic in nature and that no enforcement actions would result from this study's assessment of their compensatory mitigation projects. Therefore, results of this study are reported anonymously. Individual sites are identified by their randomly selected number and by the county in which they are located.

West of the Cascades 38 projects were ultimately assessed. The investigators dropped a project (#219) after it was visited because the wetland impact had not occurred. The wetland mitigation sites visited for this study ranged in age from less than one-year post installation to nearly seven years post installation.

The permits associated with these 45 compensation projects resulted in the loss of 99 acres of wetland. Permitted impacts ranged in size from less than a tenth of an acre to 21 acres. However, the vast majority were less than 2 acres.

The 45 projects cumulatively proposed 479 acres of wetland compensation[2]. Projects ranged from a proposed size of less than a fifth of an acre to 205 acres. However, the vast majority of projects were required to provide less than 5 acres of compensation.

Refer to Figure 1[3] for approximate locations of the 45 compensatory mitigation projects evaluated in the first phase of this study.

Compliance Questions

The investigators assessed 45 compensatory mitigation projects for compliance with each of the following three questions:

1. Was it installed?
2. Was it installed to plan?
3. Was it meeting performance standards?

Projects in compliance with all three questions were in compliance overall. Thirteen projects (29%) were in compliance overall. Four of these projects (9%) involved solely preservation (except for some removal of unauthorized fill, categorized as restoration acreage), while nine (20%) involved some construction or planting.

Thirty one projects (69%) were out of compliance for at least one of the three questions. Projects that were not installed were likewise not installed to plan or meeting

[2] If buffers acreage is included, 578 acres of compensation were proposed.
[3] Figure 1 and all other figures referred to in this Chapter are located in Appendix A. Refer to the Table of Contents for specific page numbers.

performance standards. Some projects met two of the questions, but they were still considered out of compliance since they did not meet all three questions.

One project (2%) was in compliance for the first two questions, but none of the performance standards could be assessed, and therefore overall compliance could not be evaluated.

Refer to Table B.1 in Appendix B for project specific information. For a review of the results of each of the three questions refer to Table 2.2

Table 2.2 Compliance attainment for each of the three compliance questions.

	# of projects	% of projects
Installed	42/45	93%
Not installed	3/45	7%
Installed to plan	23/45	51%
Not installed to plan	19/45	42%
Could not determine	3/45	7%
Meeting all P.S.*	12/37**	32%
Meeting at least one P.S.	6/37**	16%
Meeting no P.S.	19/37**	51%

*P.S.= performance standard
**Only 37 projects had assessable performance standards.

Was It Installed?

The investigators determined that 42 projects (93%), out of the 45 projects assessed, had been installed. All seven projects east of the Cascades were installed. The three projects that were not installed were, therefore, all located west of the Cascades.

The investigators confirmed that each of the three projects was not installed. For example, during a site visit the applicant indicated that the compensation project had not been installed. For a second project, the author and Dana Mock performed a site visit and found a recently installed compensation wetland in the midst of a large abandoned pasture. However, a staff person at the Corps indicated that the project the investigators observed was actually compensation for a different permit. The compensation wetland being considered in this study had therefore not been installed. The investigators confirmed that the third project was not installed during a site visit when they observed no evidence of any of the proposed site work. Follow-up conversations with the applicant confirmed that the compensation project had never been installed.

Was It Installed to Plan?

This study assessed three elements to determine whether a project was installed to plan, including grading, planting, and, miscellaneous other components. Presence of a deed restriction or conservation easement was required in order for preservation projects to be considered installed to plan. When a project was not installed according to plan, discrepancies often occurred in more than one element.

The investigators found that 23 projects (51%) complied with the installation requirements of their mitigation plans. Nineteen projects (42%) were not installed to according to plan. Of these, eight projects had properly installed at least one element of the plan, while eleven did not install any of the applicable elements according to plan (this includes the three projects that were not installed). For three projects (7%) the investigators could not determine whether the project was installed according to plan.

For example, one project involved enhancing a reed canarygrass (*Phalaris arundinacea*) dominated floodplain. The investigators only located a few of the required plantings. However, a conversation with a staff person who replaced the individual who originally developed and installed the mitigation plan revealed that the compensation site experienced extensive flooding which scoured the site. The extent and effects of flooding were documented in monitoring reports for the project. The investigators, therefore, could not determine whether the plantings were originally installed according to plan.

An as-built report was found for 17 projects. The as-built drawing or report reflected the on-the-ground conditions for 15 of these projects, all of which were considered installed to plan. For example, one project which did not complete grading and planting, was determined to have been installed to plan. This was due to correspondence between the applicant and the Corps indicating that during construction a toxic substance was discovered. To reduce exposure and mobilization of the substance, construction ceased. The site was allowed to regenerate naturally. The Corps accepted this notification of circumstances as an as-built. Based on this accepted "as-built", modification from the mitigation plan was also accepted.

The as-built documents for the remaining 2 projects did not reflect the on-the-ground conditions. For example, one project submitted the original plan, except with an as-built stamp, indicating that a portion of the site should have been graded and planted. This area was located, but no grading or planting was observed. This project was therefore not installed to plan. Another project submitted a vague sketch of proposed grading and a list of planted material. The grading was roughly accurate, but much of the listed plant material could not be located during the site visit. This project was not installed to plan (the site was one-year post installation and planted material should have been evident).

The author determined which mitigation plan elements (grading, planting, other) were most often installed incorrectly. This determination was based on the number of projects for which: 1) a plan element was applicable; 2) information was available on a plan element; and 3) it could be determined if the element was installed to plan. Most projects had more than one plan element that was assessed, and several projects had requirements for all three plan elements (Figure 2).

Ninety-one percent of projects had requirements for planting the compensation wetland. Of these projects, over one-third did not install the planting plan as required (Figure 2). Grading was required for 76 percent of projects. The investigators found grading discrepancies in nearly one-third of these projects (Figure 2). Miscellaneous other components were required for 69 percent of the projects, and 19 percent of them were determined to be improperly installed (Figure 2).

Was It Meeting Performance Standards?

The investigators assessed 37 projects to determine if they were meeting their performance standards. Though most projects had more than one performance standard, eight projects were not considered in this evaluation. Six projects did not have any performance standards. Two projects had performance standards, but none of them could be assessed by the methods of this study.

The investigators determined that 12 projects (32%) met all of their assessable performance standards (Figure 3). There were 25 projects (68%) that did not meet all performance standards. Of these, 19 projects did not meet any of their assessable performance standards (this includes the three projects that were not installed). Refer to Table B.1 in Appendix B.

Other Questions

In addition to answering the three primary compliance questions discussed previously, the author and Dana Mock analyzed the data to answer a number of other important questions. For example, what were the most common types of compensation employed, and what was the level of compliance by compensation type? And what types of performance standards were encountered, assessed, and met?

What Types of Compensation Were Encountered?

The types of compensation encountered in this study included wetland creation, restoration, enhancement, and preservation; buffer and upland enhancement; and riparian enhancement. The investigators determined whether projects involved a single type of compensation (e.g., creation) or a mixture of compensation types (i.e., the project performed more than one wetland activity).

The author then assigned projects to a compensation type category. If a project installed one type of compensation along with some buffer work, the project was evaluated as a single activity. However, one project involved solely buffer enhancement, and was therefore assigned to its own category as a single activity. Projects involving preservation as the sole type of compensation for unauthorized fill but which also required removal of some or all of that fill (restoration acreage) were considered as preservation only projects. The author excluded the three projects that were not installed.

Statewide the majority of projects (57%) involved a single type of compensation. However, 43 percent of projects proposed to perform a mixture of compensation types, such as, creation and enhancement. A little more than half of the projects (55%) overall involved some wetland creation (Figure 4). Nearly half of the projects (48%) involved some wetland enhancement. Eleven projects (31%) restored some wetland acreage, and nine projects (21%) preserved some wetland acreage. Over half (57%) of the projects involved a buffer/upland

and/or riparian component. All but one of these projects involved at least one other compensation type.

Acreage by Type of Compensation.

The author and Dana Mock reviewed permits and mitigation plans to determine how much acreage of each type of compensation was required (Figure 6). This analysis did not include the three projects that were not installed.

Preservation and enhancement of existing wetland area provided the greatest compensation acreage (Figure 6). The sum of acreages required for these two types of compensation (459 acres) was 79 percent of the total required acreage of compensation (578 acres). Creation (44 acres) provided about eight percent of the total required compensation acreage, while restoration (30 acres) only provided five percent of the total required acreage of compensation. Buffer/upland/riparian enhancement (41 acres) contributed the remaining seven percent of compensation acreage. For more information see Table B.1 in Appendix B.

This analysis did not involve verifying that the required acreage had been established. Refer to the results in Chapter 3.

What Was the Level of Compliance for Each Compensation Type?

The author analyzed the results of the three compliance questions by the type of wetland compensation. Categories included: creation, restoration, enhancement, preservation, and a mixture of compensation types. The project involving solely buffer enhancement was excluded because it did not implement a wetland compensation type.

All of the wetland restoration projects and wetland preservation projects were installed (Table 2.3). Two projects proposing to create wetland area failed to install the project. One enhancement project and one project performing a mixture of compensation types were not installed.

In terms of installing projects according to plan, only one creation project and one restoration project were installed to plan (Table 2.3). Three of the enhancement projects (38%) were installed according to plan. Most of mixed compensation type projects (74%) were installed to plan. And all of the preservation projects were installed according to plan.

Projects performing a mixture of compensation types met the highest percentage of performance standards, 37 percent. The remaining types of compensation met one-third or less of their standards: Enhancement projects met 13 percent of their performance standards. Preservation projects had no performance standards to assess, and they were therefore not considered in the analysis of performance standard compliance. However, preservation projects were considered in the analysis of compliance overall.

Table 2.3 Number of Projects in Compliance by Type of Compensation*

	# of Projects	Installed	Installed to plan	Meeting Performance Standards	Compliance Overall
Creation	10	9	1	3	1
Restoration	3	3	1	1	1
Enhancement	8	7	3	1	1
Preservation	4	4	4	NA**	4
Mixture of types	19	18	14	7	6

*This table does not include the project that involved solely upland buffer enhancement (n=44).
**NA= Not applicable (preservation projects did not have any performance standards).

What Types of Performance Standards Were Encountered, Assessed, and Met?

Most projects evaluated in this study had more than one performance standard (Table B.1 in Appendix B). The performance standards addressed a variety of factors. In some cases they were specific to a particular year during the monitoring period. For example, one project had performance standards for percent cover of vegetation for years one, three, and five. In other cases, a compensatory project entailed more than one site (i.e., multiple locations combined to fulfill the permit requirements for one project) and had performance standards for each site.

The investigators assigned the performance standards encountered in this study to one of the following categories:

- Vegetation
  - Percent survival
  - Percent cover
  - Percent survival and cover

  - Diversity
  - Invasive species
  - Invasive species and percent cover
- Water regime
- Wildlife
  - Use and diversity
  - Habitat
- Other (wetland area, signs, etc.)

The majority of performance standards fell into the vegetation category (Table 2.4 below and Figure 7 in Appendix A). Over 30 percent of the standards focused on percent cover of vegetation. Only eight percent of performance standards fell into the water regime category. Performance standards in the wildlife category accounted for 16 percent of the standards. Eleven percent of the standards encountered fell into the miscellaneous other category.

The investigators were able to assess only one-third (67) of the total number of performance standards encountered (Table 2.4, Figure 7). Performance standards for vegetation comprised 82 percent (55/67) of the performance standards that were assessed. Only one (2%) water regime standard was assessed. The types of standards that were assessed most frequently were those that addressed invasive or non-native vegetation species (13/20 or 65% of encountered standards were assessed) and survival of vegetation (12/28 or 43%).

The compensation projects met less than half of the assessed performance standards (Table 2.4, Figure 7). However, compensation projects met at least 60 percent of four types of performance standards: survival and percent cover of vegetation, invasive and non-native vegetation species, wildlife habitat, and miscellaneous other standards. The one water regime performance standard that was assessed was also met, thus 100% of the assessed water regime standards were met.

Table 2.4 Types of performance standards encountered, assessed, and met

	Encountered	Assessed	Met	Not Met
Vegetation: survival	28	12	3	9
Vegetation: percent cover	61	24	9	15
Vegetation: survival & cover	16	5	3	2
Vegetation: diversity	6	1	0	1
Vegetation: invasive species	19	13	8	5
Vegetation: cover & invasive species	1	0	0	0
Water regime	16	1	1	0
Wildlife: use & diversity	13	0	0	0
Wildlife: habitat	20	5	3	2
Other	22	6	4	2
TOTAL performance standards	**202**	**67**	**31**	**36**

Discussion

Compliance

Forty-five projects were visited and evaluated in the first phase of this study. The three questions assessed for this study (installed? installed to plan? meeting performance standards?) were aimed at determining whether a wetland compensation project was in compliance with permit requirements and conditions. In regards to the three compliance questions assessed, the investigators generally gave the applicants the benefit of the doubt if there was any uncertainty.

It should be stressed that the first phase of this study did not attempt to assess the ecological functioning or ecological "success" of the projects visited. It is quite possible that projects failing to meet performance standards could still be providing significant ecological functions. Likewise, it is possible that projects meeting all performance standards could be failing to provide significant ecological functions. The second phase of this study will evaluate the level of ecological functioning at the compensation project, how this compares to the wetlands lost, as well as the design, installation, and maintenance factors that contribute to a successful project (refer to Chapter 3).

This study found compensatory mitigation projects to have a 29 percent compliance rate based on the three questions assessed. A King County wetland and stream mitigation study found a 21 percent compliance rate (79% failure) (Mockler et al. 1998). Stellini and Storm (1994) determined that 18 percent of projects were in compliance, while other studies have found permit compliance rates between 0 and 83 percent (Gwin and Kentula 1990, Holland and Bossert 1992, Shaich and Franklin 1995, De Wees 1998, Morgan and Roberts 1999, Michigan Department of Environmental Quality 2000, Brown and Veneman 2001, Balzano et al. 2002, Sudol and Ambrose 2002). Refer to Chapter 1 for more specific information on previous compliance studies.

Problems Encountered

A number of problems emerged while conducting this study, from selecting sites to assessing performance standards. These problems have ramifications for agency staff wishing to follow-up on permitted projects as well as determining a project's level of compliance.

Database problems.

Due to inaccurate or incomplete data entry in the 401 database, it is possible that projects requiring compensatory mitigation were eliminated during the initial site selection process. Reviewing each file to verify database entries, however, would have required too much time to pursue.

A more common database problem encountered as a result of inaccurate or incomplete data entry was the number of projects that should have been eliminated by initial study site selection and were not. For example, the 401 database entry for several NWP 26 projects indicated an acre of wetland impact prior to February of 1996, which should have required compensatory mitigation. The investigators reviewed files for these projects and discovered that compensatory mitigation was not required since the impact was actually 0.9 acre. The time required to review these files could have been used to assess additional compensatory mitigation projects.

A final database problem involved tidal projects, which were originally going to be stratified from freshwater projects and evaluated separately. However, the 401 database was unable to identify or stratify tidal projects. Therefore, tidal projects were dropped from consideration for this study. It was later discovered that two and possibly three of the sites evaluated (#8, #278, and possibly #239) were, at least in part, tidally influenced. Since the site assessment was already complete, these projects were included in the results.

Despite the difficulties with site selection, the author believes that the projects evaluated in this study provide a non-biased representation of compliance in the state.[4] Database errors and omissions appeared as random as the site selection process and, therefore, should not have affected the level of compliance.

Project File Problems.

The investigators, primarily Dana Mock, encountered two main problems when reviewing project files: 1. Incomplete files, particularly the absence of as-built documents and monitoring reports; 2. Multiple versions of mitigation plans.

In general, there was a general lack of consistent information in the files. Few of the Ecology files were complete, and it was unclear whether the missing information had not been submitted to the permitting agencies, or whether the information had been submitted but never made it into the project file. Misplacement or mis-filing appeared to be particularly common for as-builts and monitoring reports, because consultants often send these documents to the regional wetland Ecology staff involved with a given project. Apparently as-builts and monitoring reports often end up in that staff person's office or personal project file rather than in the central 401 file. This is problematic since an individual staff person may file this information and forget about it or it may get misplaced. Regardless, the information may not be available if required by other staff.

Several of the as-built and monitoring reports ultimately obtained were provided by consultants when contacted about this study. For example, a consultant that was contacted to supply a planting plan supplied an as-built planting and grading plan instead. Neither the Ecology file nor the Corps' file contained this as-built.

Receiving such information from the consultants was helpful in facilitating the evaluation of a site. However, not all consultants or applicants were contacted for information due to the tight timeframe under which this study was conducted. As a result of

[4] This does not include WSDOT projects, which were purposefully omitted from this study. Refer to Table 2.1 and the section on Site Selection for Chapter 2.

this inconsistency and a lack of time necessary to pursue every avenue toward obtaining the most complete information possible, it did not seem appropriate to evaluate compliance on whether as-built documents, monitoring reports, and/or deed restrictions or conservation easements were submitted. This information was reported, either as "found" or "not found." Therefore, presence or absence of as-built documents, monitoring reports, or deed restrictions/conservation easements did not influence the attainment of the three main compliance questions. The exception was preservation-only sites which had to have a deed restriction or conservation easement on the parcel in order for the project to be determined "installed to plan."

The second difficulty encountered in finding and reviewing files and background information was the presence of multiple versions of mitigation plans. In a few cases, multiple consultants were involved in planning, designing, implementing, or monitoring a wetland mitigation project. This made it difficult to track down the most accurate and recent plans.

The permits for a few projects required the implementation of a certain version of a mitigation plan, but occasionally, a more recent version of the mitigation plan was present in the file. In these cases project evaluations were based on the most recent mitigation plan.

Obtaining Access.

The investigators, primarily the author, encountered a few problems while attempting to gain access to compensatory mitigation sites. In some instances the applicant listed on the Corps permit no longer owned the project site or the company had changed its name. In these cases, the author made an attempt to locate a new contact name and number. However, there were two cases where several messages were left for individuals believed to be the applicants and the author never received responses.

In other cases, permission to gain access to the site was never granted. One applicant denied access. Another two applicants were subsidiaries of larger corporations, and the corporate headquarters needed to grant access to visit the property. In both cases access was not granted prior to completion of the field visits. One has since granted access, while the other never issued a decision.

Projects for which the investigators did not obtain access were not visited. These projects were dropped from consideration for this study. Dropping projects because site access was not granted has the potential to bias the results of this study toward those projects that are in compliance, and therefore, have nothing to hide. The possibility of this study being biased as a result of the sites ultimately evaluated is acknowledged. However, this study was constrained by the legal necessity of obtaining permission to gain access to the compensatory mitigation sites prior to performing all site visits.

Implementation of Plan Elements.

Determining whether a project was "installed to plan?" was generally straightforward. However, assessing water regime was difficult because there was lack of information and site visits did not occur during the growing season. Few plans included any detailed information on the proposed water regime for the compensatory wetland mitigation project. Eight (18%) of the 45 projects evaluated for this study did not identify any hydrologic information. Gwin and Kentula (1990) identified an identical problem in an EPA report examining compensatory wetland mitigation project design and compliance.

When water regime was mentioned in a mitigation plan, it was often a vague description of the existing hydrologic conditions of the site. Since site visits performed for this study occurred at the end of the growing season or during the non-growing season, it was difficult to verify the existence of a wetland water regime, particularly in younger sites. Therefore, hydrologic conditions were not specifically assessed in the first phase of this study.

Planting to plan could not be determined in five (11%) of the 45 projects evaluated. This generally resulted from not being able to locate certain plants from the planting plan on-site. If the project was more than two years old the missing plants could have been planted but died. The dead plants might have been removed or replaced with another species. Such changes were usually not documented in the project file. For example, maintenance staff repeatedly mowed one project (#99): Planted material could not be identified. Another project (#29E) suffered extensive flooding and erosion in the mitigation area. The study could not determine whether material was planted and lost or was never planted.

Documentation of such occurrences in an as-built document, monitoring report, or correspondence would have allowed better evaluation of this element of the plan.

Problems Assessing Performance Standards.

Compliance results for performance standards reflect only those standards that this study was able to assess. Over all, this study was able to assess only one-third (67/202) of the total number of performance standards listed in the mitigation plans and permits (Table 2.4).

A number of factors contributed to the inability of this study to assess all performance standards. Timing of the site visits, timing of the site visit in relation to the age of the compensatory mitigation project, confusing or ambiguous standards, and multiple assessments lumped into one standard were the main reasons for performance standards not being assessed.

1. The site visits occurred during a time of year that prevented assessment of certain performance standards. For example, one out of 15 (7%) hydrologic performance standards were assessed. This was mostly due to the fact that site visits occurred during late fall when the water regime could not be accurately verified. Hydrologic standards would need to be evaluated early in the growing season to verify attainment of wetland hydrology.
2. Several performance standards were age-specific such that a performance standard could not be assessed until the site had reached that particular year post-implementation. For example, many projects had different performance standards for each year's monitoring event. If the site visit occurred in the second year then performance standards for year 3 or year 5 could not be assessed. However, for numerous sites, it was unclear when the project was installed (e.g. the age of the site), since post implementation information was often lacking from project files. Ages of the sites were later determined from conversations with applicants or consultants.
3. The performance standard itself was confusing or difficult to assess during a single site visit. None of the wildlife use/diversity performance standards were assessed. This was due to the fact that these standards generally involved documenting species use of the site over time.

The following is an example of a performance standard that was difficult to assess:

> *After 3 years wildlife habitat support will be measured by documentation of the areal cover of woody vegetation. This measurement will be used as an indicator of an increase in habitat structure and complexity. The initial establishment and survival of either planted or colonizing tree and shrub species should begin to determine the future habitat structure of the wetland and decisions on possible restructuring of the installed plant community, if needed.*

This standard is confusing. The performance standard is trying to determine the level of wildlife habitat support through a measurement of percent areal cover of woody vegetation. If a certain level of habitat support is to be achieved and areal coverage is to be the measurement of this, then why not provide a performance standard to attain a set percent areal cover of woody vegetation? As written, this performance standard could be met by documenting 0% cover of woody vegetation, because the standard does not provide a minimum percentage of areal coverage necessary to meet the objective of wetland wildlife habitat support. Furthermore, a field of Scot's broom (*Cytisus scoparius*), an invasive upland shrub that provides woody coverage, is not precluded from resulting in successful attainment of this performance standard.

Performance Standards Met

Of the types of assessed performance standards that were most often attained, two were relatively easy to attain and did not require any specific site development or wetland conditions. These performance standard types were "wildlife habitat", which generally included placement of woody debris and nest boxes, and "other" standards, which included wetland area and signage. Since wetland area was not assessed for this study, the standards that were assessed in this category primarily involved the placement of signs.

Performance standards directed at the placement of woody debris and wetland signage, though not reflecting ecological site development, do provide an important role to ensure that a compensatory mitigation project is installed in compliance with the authorized mitigation plan. If a performance standard did not require a site to have the number of snags, stumps, and downed logs indicated in a mitigation plan, then this woody debris might not be placed on-site. This project could still be in compliance with permit requirements, but it would not have the necessary habitat features agreed upon in the mitigation proposal.

Wildlife habitat and "other" types of performance standards were always accompanied by additional performance standards, (particularly vegetation) which were directed at ecological development of the site. However, for some projects the wildlife habitat and/or "other" performance standards were the only standards that this study was able to assess. For the purposes of evaluating permit compliance, one standard was considered to be equal to another, regardless of whether it was easy to attain, or whether it focused on site development. Therefore a project meeting its only assessable performance standard for placement of 20 snags and 15 downed logs would be evaluated to be in compliance. Meanwhile another project that met four of its five assessable performance standards, did not meet one to "establish a permanent interpretive sign on [street adjacent to] Mitigation Area C." This project was not in full compliance with permit requirements, because the site assessment team did not locate the sign during the site visit. Therefore, for the first phase of the study, permit compliance does not necessarily indicate ecological success; likewise, non-compliance does not necessarily indicate ecological failure.

Chapter 3 Ecological Success

Introduction

The previous chapter described the first of the two-part study to determine the effectiveness of compensatory wetland mitigation in Washington State. The first phase of the study assessed compliance and found that though most compensation projects had been installed, few were in full compliance. An analysis of performance standards, which was one aspect of compliance, revealed that many performance standards do not provide any information about how the site functions ecologically. Staff at the Department of Ecology, therefore, wondered how compensation sites were functioning ecologically – i.e., how successful were they? And was compensatory wetland mitigation preventing a net loss of wetland acreage and function?

In the spring of 2000 the author and Dana Mock initiated the second phase of the study to determine the effectiveness of freshwater compensatory wetland mitigation in Washington State. As in the first phase, funding for this study was primarily provided by the Environmental Protection Agency.

This chapter describes the goals and objectives of the study and the methods used to evaluate the ecological success of wetland compensation projects. The results and a discussion of this evaluation are also provided.

Goals and Objectives

The goal of the second phase of the study was to determine how successful compensatory wetland mitigation projects in Washington State were ecologically. However, the concept of "ecological success" proved to be difficult to define and measure. It was concluded that no single measure of "ecological success" was feasible, and therefore, overall success was broken out into two factors, each with its own criteria.

The first factor involved whether a compensation project achieved its ecologically relevant measures. Ecologically relevant measures were elements of compliance (permit requirements) that provided information about how the site was progressing or developing ecologically. Three questions were used to address this factor.

1. Did the project establish the required compensation actions and acreage of wetland?
2. Did the project attain its ecologically significant performance standards?
3. Did the project fulfill its goals/objectives?

The second factor focused on whether compensatory wetland mitigation projects provided adequate compensation for their authorized wetland impacts. Three questions addressed this factor.

1. How much of a contribution to wetland functions did the compensation project provide?
2. Did the compensation project provide the same functions as those lost or did it exchange functions?
3. What was the type and scale of the authorized wetland impacts?

Based on the results obtained for each factor, the projects were evaluated to determine how successful they were overall.

In addition, this study investigated whether certain wetland types or functions were being lost as a result of trade-offs. In other words, was the compensation project the same type of wetland as the one that was lost? In particular, is the state of Washington losing certain Cowardin classes and compensating for them with other Cowardin classes (Cowardin et al., 1979)? Or are certain hydrogeomorphic (HGM) subclasses being lost but compensated for with other HGM classes.

Finally, the study investigated the main factors contributing to the success (or lack of success) of compensation projects.

Roles and Responsibilities

The second phase of the study to evaluate the effectiveness of freshwater, compensatory-wetland mitigation in Washington State involved numerous people in different capacities. This section describes how groups, such as an advisory committee, project investigators, site assessment team, and site evaluation team, each contributed to this study.

Project Investigators. The author and another Ecology employee, Dana Mock, began this study in the spring of 2000. Dana Mock and the author were equal partners in coordinating and conducting this study. However, they each assumed specific project responsibilities. The author developed the study methods, participated in all site visits and evaluation. Additionally, she analyzed the data. Dana Mock assisted in developing methods and gathered background information. She participated in all but four site visits, though she was involved with all site evaluations. She assisted with data analysis and provided the final review of all results to assure consistency and accuracy. The author and Dana coordinated site visits with the help of Debi Irwin, an Ecology administrative support person.

Site Assessment Teams. Unlike the first phase of this study in which just the investigators visited and assessed sites, the second phase involved regional wetland staff from Ecology, project consultants, and a couple of members of the advisory committee. Everyone participating in a site visit was collectively termed the site assessment team.

Site assessment teams collected field data for the compensation projects evaluated in this study. An assessment team was composed of up to six members with backgrounds in wetland science, soil science, plant identification, data collection, mitigation design and construction, and wetland policy and regulation. For the majority of sites, the assessment team was composed of three people.

The project investigators coordinated and led each assessment team and assigned team members the responsibility for collecting data to determine wetland area, complete a function assessment data form, and categorize the wetland. In addition team members determined if performance standards were attained. And finally, they made general site observations.

Site Evaluation Teams. The site evaluation teams evaluated the achievement of ecologically relevant measures, compensation for impacts, and the level of overall success for each project based on background information and the data collected by the assessment teams.

An evaluation team included the investigators and all other members of the assessment team for that particular site, as well as Ecology's senior wetland ecologist, senior wetland policy analyst, and wetland mitigation banking specialist. A minimum of five people evaluated each site, and at least four of those people were common to the majority of evaluation teams for consistency.

Limitations of the Study

This study was designed to check the status of compensatory wetland mitigation in the state of Washington by looking at a sample of compensation projects. It was not intended to specifically identify failed projects. Rather, this study provided an opportunity to review past regulatory decisions and understand the rationale behind them.

Furthermore, the results of this study are a snapshot in time. Each project was evaluated based on a one to two-day site visit. The conditions observed at the time of the site visit are reflected in the evaluation of a project's success. It is acknowledged that all of the projects are still developing and site conditions will change for the better or worse. The results of this study, therefore, represent a moment in the life of the projects evaluated.

Methods

This study was implemented in three stages. First, a great deal of office preparation preceded actual field visits and data collection, which came next. Then following the field visits, data collection, and initial data analysis a process was developed to evaluate the data and determine the level of success of each compensation project. This section describes the methods used to complete each of the three stages.

Office Preparation

The office preparation stage included the selection of projects to be evaluated in this study. Once projects were selected, the ability to gain access to the project sites was requested. And finally, background information was gathered and organized to prepare for actual site visits.

Selection of Compensation Projects.

The projects selected for the second phase of this study were a sub-set of the 45 projects assessed in the first phase (described in Chapter 2, refer to Table 2.1 on p.38). The following selection criteria were applied to the original 45 projects to eliminate those that would be unproductive to evaluate in the second phase.

Projects that were less than two years post-installation were eliminated. The second phase of this study focused on determining how successful wetland compensation projects are at performing certain functions, and how well the wetland losses were being compensated for. Compensation projects that were less than two years old were judged to be too immature to evaluate their ecological success or contribution to functions. Wetland compensation projects from the first phase of the study that were not installed also were eliminated.

Projects that consisted solely of preserving existing wetlands were excluded. This study focused on determining how well creation, restoration, and enhancement compensation activities replaced lost wetland functions. Two projects evaluated in this study (#9 & #294) had a preservation component, but the preservation areas were not assessed in this study. However, the preservation areas were considered when evaluating the adequacy of compensation for impacts and overall project success.

One of the projects examined in the previous phase consisted solely of wetland buffer enhancement. This project was eliminated from consideration for this phase of the study because buffers were assessed only as a component of a wetland's ability to perform certain functions.

One of the projects evaluated in the previous phase consisted of excavating additional acreage adjacent to an existing cattail marsh. The created compensation area was indistinguishable from the surrounding existing wetland. As a result, the investigators determined that it would be impossible to evaluate this site.

As in the first phase of this study, wetland compensation projects carried out by the Washington State Department of Transportation (WSDOT) were excluded from this study. WSDOT road building and maintenance activities frequently produce wetland losses that are mitigated for with wetland compensation projects. Therefore, WSDOT has developed and implemented a monitoring program to study and report upon the success and compliance of its wetland compensation projects. This information is provided to the permitting agencies annually. This study was designed to evaluate how wetland compensation projects performed by other public and private entities were functioning.

Obtaining Site Access.

Since all wetland compensation projects selected for evaluation in this study were also part of the first phase of the study, the property owners or managers granted access to all sites without difficulty. Permission to visit all sites was granted based on the fact that this phase of the study, like the previous phase, was academic in nature. Applicants and property owners were informed that no enforcement actions would be triggered as a result of this study's evaluation of their projects. The results of the study are therefore reported anonymously. An individual project is identified by a randomly selected number and by the county in which the project is located.

Background Information

Since a primary focus of this study was determining how well the project compensated for the impacts to wetlands, the following information was necessary:

- Delineation reports and any other information concerning the impacts to wetlands.
- The Corps Section 404 permit and Section 401 Water Quality Certification (WQC).
- Final wetland mitigation plans and project maps.
- Public notices and applicable agency and public comments.
- As-built reports and/or drawings.
- Monitoring reports and site photos.
- Decision documents or notes to the file.
- Correspondences and memorandums.
- Natural Resource Conservation Service soil surveys.
- Aerial photographs.
- National Wetland Inventory maps from U.S. Fish and Wildlife Service,
- Topographic maps.
- Priority habitats and species information from Washington Department of Fish and Wildlife.

Information was obtained from the Corps, applicants, consultants, or Ecology. Aerial photos were obtained from either the Department of Natural Resources or WSDOT.

Field Assessments

After doing all the necessary office preparation, compensation sites were visited and a variety of data were collected. Site assessment teams conducted site visits May through August of 2000. The methods in this section explain how specific site information was collected, such as wetland area, whether performance standard were being met, wetland rating, assessment of functions, and historical/background information on the site provided by the consultant or applicant.

Determination of Wetland Area

The site assessment team determined wetland boundaries using the *Washington State Wetland Identification and Delineation Manual* (Washington State Dept. of Ecology 1997), which is consistent with the Corps 1987 Wetland Delineation Manual. Since site visits were conducted between May and August 2000, the assessment team focused on hydrologic indicators (e.g., water marks, drainage patterns, sediment deposits, etc.) to determine the presence of wetland hydrology. In the absence of hydrologic indicators, vegetation and soil parameters were relied upon more heavily than the hydrology parameter. Thus, the absence of hydrologic indicators did not necessarily result in a determination that the area was non-wetland. Similarly, hydric soil indicators were not relied upon for created wetlands, which may not have had sufficient time to develop such indicators. In general, the assessment team gave the project proponents the benefit of the doubt when determining wetland boundaries.

Once determined, positions along the wetland boundary were collected using a Trimble ProXR Global Positioning System (GPS). Trimble reports that the ProXR equipment has 0.5 meter accuracy (Trimble 1998). GPS data was downloaded into Pathfinder Office 2.51 and differentially corrected using the nearest base station with accessible data[1]. Pathfinder Office 2.51 automatically calculated the area of the wetlands from the position data collected.

Wetland determinations focused on the area where compensation activities took place. If the compensatory wetland site encompassed a large area, but it appeared that compensation activities were conducted only on a portion of this area, then only the "active" compensation area was considered in the wetland determination and subsequent site assessments. For example, a project proposed to remove fill to restore two acres of wetland and plant trees and shrubs to enhance five acres of existing degraded wetland. The assessment team observed that the proposed activities to enhance the 5 acres had not been conducted or had failed. The wetland determination, therefore, focused on the 2 acres of restoration that had been installed.

During the analysis of wetland area data, the author applied a 10 percent margin of error to provide applicants with the benefit of any doubt. This accommodated potential error from the GPS, as well as error associated with determining the limits of the required compensation area (within unmarked property boundaries). The margin of error was applied to each site to determine if an individual site met its acreage requirement. However, total reported wetland area established does not reflect this margin of error, because calculated areas of established acreage are just as likely to be 10 percent larger than the actual acreage as 10 percent smaller than the actual acreage.

For example, a site with a calculated wetland area of 1.82 acres would be given a 10 percent margin of error (1.82 + 0.182 = 2.02), thereby resulting in maximum established wetland acreage of 2 acres. If the wetland acreage requirement for this site were 2 acres, then this study would have determined that the site "met its wetland acreage requirement." However, a wetland area of 1.82 acres would be reported as the established acreage for the site and used in calculations of total compensation acreage.

Attaining Performance Standards

Performance standards for the projects evaluated in the second phase of the study included any performance standards identified in a project's wetland mitigation plan and any Corps permit requirements and WQC conditions. Some performance standards could not be

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[1] In some cases data from the closest base station could not be downloaded properly.

assessed, such as year-based standards that were outside the timeframe of the site visit. Additionally, some water-regime performance standards, which required evidence of inundation or saturation during the early part of the growing season, were not assessed since site visits were conducted primarily in June through August.

Attainment of performance standards was assessed based on field conditions observed during the site visit. If a monitoring report was available, then on-the-ground conditions were compared to the results of the most recent monitoring event.

Wetland Categorization

A wetland category was determined for each site by applying the *Washington State Wetlands Rating System* for either Eastern Washington or Western Washington (Washington State Dept. of Ecology 1991 and 1993).

Function Assessment

During the field visit at each site, the assessment team collected data on wetland functions using *Methods for Assessing Wetland Functions* (Hruby et al. 1999 and 2000). First, the hydrogeomorphic (HGM)[2] subclass was determined for each wetland. Then, the most appropriate data collection form was used (riverine flow-through, riverine impounding, depressional closed, or depressional outflow for lowland western Washington wetlands; and depressional long duration or depressional short duration for wetlands in the Columbia Basin of eastern Washington). Data were collected only within the compensation area, even where the site was a portion of an existing larger wetland.

In some cases an appropriate function assessment method was not available for either the exact HGM subclass of the compensation project or the region of the state where the project was located. In those cases the assessment team chose the most applicable function assessment method and associated data form.

Once the data forms were complete, the investigators entered the information for each site into an Excel spreadsheet specific to each of the HGM subclasses. A numeric score

[2] Hydrogeomorphic (HGM) refers to a categorization of wetlands based upon geomorphic setting, water source and transport, and hydrodynamics. It is designed to group wetlands that function in similar ways. Examples include Riverine, Depressional, Slope, and Lacustrine Fringe.

for each of the functions assessed was automatically calculated. However, numeric scores were only used to stimulate discussion and begin the evaluation process. The completed data forms, which contained pertinent information about each compensation area and its structural characteristics, formed the primary basis for site evaluations.

Two other function assessment methods, Wetland and Buffer Functions Semi-Quantitative Assessment Methodology (SAM) (Cooke 2000) and WSDOT's *Wetland Functions Characterization Tool for Linear Projects* (Null et al. 2000), were performed on each site for comparison and to provide additional information. The author used data collected during the field visits to complete these two methods in the office.

Consultant/Applicant Questionnaire

For each project, at least one questionnaire was sent to the consultant and/or the applicant. The primary purpose of the questionnaire was to find out what type of activities (e.g., excavation, soil ripping, soil amendments, plantings, hydroseeding, irrigation, weed control, etc.) were performed at each of the compensation projects. In addition, the questionnaire asked whether monitoring and/or maintenance had occurred, and if any agencies had followed up on the project.

The information was used to help determine what factors contributed to the success or the lack of success of a project.

Site Evaluation

After completing all fieldwork and data forms, the site evaluation team evaluated each site (some projects had multiple compensation sites). Dana Mock compiled the results of each evaluation on a standardized form (the site evaluation form).

Site evaluations began with a visual orientation to the site. This included using topographic maps and aerial photos to illustrate the landscape position of the compensation site. Then, slides and/or photos taken during field visits were shown to illustrate site conditions (extent of shrubs and percent cover, types of plant species present, extent of inundation, water inlet or outlet, etc.).

Following the visual orientation, the evaluation team reviewed background information describing the wetland that was lost and the goals, objectives, and construction actions of the compensation project.

Site Evaluation Form

The site evaluation form summarized background information, data collected on-site, and the judgments of the evaluation team. The form entailed a series of questions meant to determine the following:

- The potential of the site to perform functions (see definition and example p.72),
- The opportunity of the site to perform functions (see p.72 for definition and example),
- The contribution of the compensation activities to the potential performance of functions on a site (see p.73 for definition and example),
- The degree to which the project achieved ecologically relevant measures, and
- The degree to which the project compensated for the authorized wetland losses.

Answers to the questions on the evaluation form resulted from data collected during the site visits or a consensus judgment by the evaluation team. A model for decision-making (Hruby 1999), which relied on data and the expert knowledge of the evaluation team, was used to arrive at consensus judgments.

Potential and Opportunity

The evaluation team reviewed the numeric scores and data forms obtained from the application of the *Methods for Assessing Wetland Functions* (Hruby et al., 1999 and 2000) to rate the potential and opportunity to perform functions at each site. Numeric scores from the *Methods for Assessing Wetland Functions* were not used for two reasons. Valid quantitative function models did not exist for the HGM subclasses of some sites. Or only the compensation area of a wetland was assessed when sites were part of a larger wetland system. The data obtained from the *Semi-Quantitative Assessment Methodology* (SAM)

(Cooke 2000) and the *Wetland Functions Characterization Tool for Linear Projects* (Null et al. 2000) were used as supplemental information.

A wetland has the **potential** to perform a function if it possesses the physical characteristics indicating the environmental processes necessary to perform the function are present (i.e., the wetland has the capability to perform a function).

For example, the function of removing sediments involves the processes of reducing water velocities and filtering sediments. Determining the actual level of performance of this function is difficult and time consuming to measure (e.g., sediment loads coming into a wetland compared to sediment loads leaving the wetland, or variation in water velocities and rates of filtration). However, determining the **potential to remove sediments** involves readily observable characteristics, such as the presence of a pond, a constricted outlet, or both indicate that water velocities are being reduced. Likewise, the presence of dense, tall, emergent vegetation is a physical characteristic indicating that water filtration may be occurring.

Since numeric scores were not used verbatim, the evaluation team evaluated the potential of each compensation site to perform certain functions using a consensus of its best professional judgment, which was based on all of the available function assessment data. The potential to perform each function was rated as High, Moderately High, Moderate, Moderately Low, Low, Not Applicable (does not perform), or Unable to Assess (the evaluation team lacked sufficient information about a function to assign a rating)

Some functions also were assigned a qualitative rating representing the site's opportunity to perform that function. **Opportunity** refers to whether conditions in the contributing basin (area draining into the wetland) provide the wetland with the possibility to perform a function.

For example, if a wetland has a wide, well-vegetated buffer and the contributing basin is mostly undeveloped (e.g., undisturbed forest), then the wetland would have a **low opportunity** to remove sediments. In that case, there would be a low sediment load coming into the wetland. Regardless of the wetland's physical characteristics, if there are no sediments coming in, then there is no possibility for the wetland to remove sediments.

On the other hand, if the wetland did not have a buffer and the contributing basin was either agricultural or highly urbanized, then the wetland would have a **high opportunity** to remove sediments. In this case, there would be a high sediment load coming into the wetland, and there would be a possibility for the wetland to remove sediments. Opportunity was rated as High, Moderate, or Low.

Refer to Table 3.1 for a list of the functions that were assessed.

Table 3.1 List of Functions Evaluated

Functions Assessed[3]
Removing Sediment
Removing Nutrients
Removing Metals and Toxic Organics
Reducing Peak Flows
Decreasing Downstream Erosion
General Habitat Suitability
*Invertebrate Habitat Suitability
*Amphibian Habitat Suitability
Anadromous Fish Habitat Suitability
*Resident Fish Habitat Suitability
*Habitat Suitability for Wetland Associated Birds
*Habitat Suitability for Wetland Associated Mammals
*Native Plant Richness
*Primary Production and Organic Export

* *The Methods for Assessing Wetland Functions* (Hruby et al. 1999) does not rate the opportunity for these functions; therefore, opportunity for the functions was not rated.

Contribution to Performance of Function. The evaluation team also assigned a qualitative rating to represent how much the compensation activity contributed to the potential of a site to perform functions. **Contribution** refers to how much the compensation activity increased or affected the potential of the site to perform wetland functions. The rating of contribution resulted from a comparison of a site's potential to perform wetland functions prior to any compensation with the site's current potential to perform functions.

[3] The function assessment methods for the Columbia Basin assessed slightly different functions. For example, "removing nutrients" was broken into "removing nitrogen" and "removing phosphorus." Despite this minor variation, the above list of functions was used to evaluate all sites for consistency.

The contribution of a compensation activity to wetland functions was rated as High, Moderate, Minimal, Not At All (no change in function), Negative (level of function was reduced as a result of the compensation action), or Unable to Assess (not enough information to assign a rating).

For the purposes of this study, upland sites that were used for creation and restoration were assumed to have no wetland functions prior to implementing the compensation activities. These projects were therefore rated as "not applicable" for the "before/after" comparisons. (It is acknowledged, however, that upland areas do have the potential to perform some functions that are the same or similar to the wetland functions, but it was not possible to rate these.) For enhancement projects, the evaluation team determined the potential level of function prior to compensation activities based on available background information. Such information included descriptions of the enhancement site prior to compensation. Information on the potential level of functions prior to compensation activities, conversations with the project consultant, and descriptions of the activities that were to be used to "enhance" the site also provided crucial background information.

The contribution of a compensation activity to wetland functions was rated by scoring the increase, or decrease, in the ratings for each individual function. The rating for contribution was based on the increase or decrease in the number of rating levels. If the potential performance went up one level, the contribution was rated as "minimal;" if the rating went up two levels, the contribution was rated as "moderate;" and if the rating of function went up three or more levels, the contribution was rated as "high." Some examples are given in Table 3.2.

Table 3.2. Understanding Contribution.

FUNCTION **Removing Sediment**	**Potential to perform (before)**	**Potential to perform (current)**	**Contribution**
Example 1 – Enhancement	Moderately low	Moderate (rating of function increased 1 level)	**Minimal**
Example 2 – Creation	Not applicable (Does not perform)	Moderate (rating of function increased 3 levels)	**High**
Example 3 – Enhancement	Moderately high	Moderately high (no change in rating of function)	**Not at all**

FUNCTION Removing Sediment	Potential to perform (before)	Potential to perform (current)	Contribution
Example 4 – Creation	Not applicable (Does not perform)	Moderately low (rating of function increased 2 levels)	**Moderate**

Example 1 (Table 3.2) is an enhancement site that performed sediment removal at a moderately low level before compensation. It was judged to have the potential to perform sediment removal at a moderate level after enhancement activities were implemented. This is judged to be a "minimal" contribution (a one-level increase).

Example 2 is a creation site that previously did not perform sediment removal. It was judged to have the potential to perform sediment removal at a moderate level after creation activities were implemented. This is judged to be a high contribution (a three-level increase).

Example 3 is an enhancement site that performed sediment removal at a moderately high level before compensation and after enhancement activities were implemented. Compensation activities, therefore, provided no contribution (not at all) to the performance of functions (no increase).

Example 4 is a creation site that did not perform sediment removal prior to compensation. It was judged to have the potential to perform sediment removal at a moderately low level after creation activities were implemented. This is judged to be a moderate contribution (a two-level increase).

The rating of opportunity was used to modify the initial rating of contribution to derive an overall rating for the contribution a compensation project provided to the performance of wetland functions. If the wetland had a "high" opportunity to perform a wetland function, the initial rating was increased by one level. If the wetland had a "low" opportunity the initial rating was decreased by one level. A moderate opportunity did not change the rating of contribution. The opportunity rating did not change the rating of contribution if it originally was "negative" or "not at all." Some examples are given in Table 3.3.

Table 3.3. Understanding How Opportunity Affects Contribution.

FUNCTION Removing Sediment	**Potential to perform (before)**	**Potential to perform (current)**	**Contribution to potential**	**Opportunity to perform (current)**	**Overall Rating of Contribution**
Example 1 - Enhancement	Moderately low	Moderate	Minimal	*High →*	**Moderate**
Example 2 - Creation	Not applicable	Moderate	High	*Low →*	**Moderate**
Example 3 - Enhancement	Moderately high	Moderately high	Not at all	*High →*	**Not at all**
Example 4 - Creation	Not applicable	Moderately low	Moderate	*Moderate →*	**Moderate**
Example 5 - Enhancement	Low	Moderately low	Minimal	*Low →*	**Not at all**

Example 1 (Table 3.3) is an enhancement site that provided a minimal contribution to the potential for sediment removal. It was judged to have a high opportunity to remove sediment, and therefore, its overall contribution to sediment removal has been boosted to moderate.

Example 2 is a creation site that provided a high contribution to the potential for sediment removal. It was judged to have a low opportunity to remove sediment, and therefore, its overall contribution decreased to moderate.

Example 3 is an enhancement site that did not provide a contribution to the potential for sediment removal. It was judged to have a high opportunity to remove sediment, but the enhancement activities have not provided a contribution to sediment removal, and therefore, its overall contribution remains not at all.

Example 4 is a creation site that provided a moderate contribution to the potential for sediment removal. It was judged to have a moderate opportunity to remove sediment, and therefore, its overall contribution remains moderate.

Example 5 is an enhancement site that performed sediment removal at a low level prior to compensation. After enhancement activities were implemented it was judged to perform sediment removal at a moderately low level. This would be a minimal contribution (a one-level increase). The site was judged to have a low opportunity to remove sediment, and therefore, its overall contribution decreased to not at all.

For a few sites in which the enhancement activities failed, contribution was the only rating given. It did not matter how well the wetland had the potential to perform a function if it had the same potential before the compensation activity was implemented.

Evaluation Questions

The site evaluation form included a series of questions that examined the achievement of ecologically relevant measures, compensation for wetland losses, and ecological appropriateness. The evaluation team answered the questions based on available data and a consensus of their best professional judgment.

Performance Standards

The evaluation team determined to what extent performance standards were attained for all performance standards assessed. However, only the attainment of significant performance standards (e.g., standards that best reflected how the site was progressing ecologically) was considered an ecologically relevant measure. Determining whether a performance standard was significant was based on: 1) the clarity and specificity – was the performance standard measurable and meaningful or was it confusing or vague; 2) feasibility – was the performance standard so specific and/or rigorous that it could never be met, thereby setting sites up for failure (e.g., requiring 100% areal cover of wetland vegetation at a site with large areas of permanent or extended inundation); 3) whether the performance standard related to attaining wetland functions rather than signage or fencing.

The following is an example of a performance standard that the evaluation team judged to be not significant because it was not measurable or specific:

> *After 3 years, wildlife habitat support will be measured by documentation of the areal cover of woody vegetation. This measurement will be used as an indicator of an increase in habitat structure and complexity. The initial establishment and survival of either planted or colonizing tree and shrub species should begin to determine the future habitat structure of the wetland and decisions on possible restructuring of the installed plant community, if needed.*

The performance standard was not significant because it provided no benchmark for what percentage of area would have to be covered by woody vegetation thus, it was not measurable. In addition the standard does not specify native, wetland, or woody vegetation.

This standard could be met by simply documenting that the site has some areal coverage by any shrub, such as Scotch broom (*Cytisus scoparius*), an invasive upland shrub.

The following is an example of a performance standard that was judged to be significant:

> *The emergent vegetation will cover at least 0.65 acre of the mitigation area, and native emergent species will have at least 80% areal cover in this area*

The performance standard provides a significant measure of how the site is developing. The standard sets a measurable benchmark for native vegetation in a specific Cowardin class.

Goals and Objectives

The evaluation team likewise assessed whether goals and objectives were fulfilled and whether the goals and objectives were appropriate to the project. For example, an enhancement project had an objective to provide aquatic diversity/abundance, but the mitigation plan did not include any aquatic areas and no open water or aquatic bed areas were found on the site. This objective was judged to be inappropriate for this project. However, this same project had another objective to provide sediment/toxicant retention. This objective was judged to be appropriate.

Compensating for the Impact

When assessing how well the project compensated for the impacts to wetlands, the evaluation team considered the rating of potential to perform functions and how much the compensation actions contributed to those functions. First, the evaluation team determined what functions were likely to have been lost, based on wetland impact assessments, delineation reports, and permit records. Then, the evaluation team determined whether the same functions were provided by the compensation project. For example, a wetland impact resulted primarily in a loss of water quality functions; the compensation project provided a moderately high level of water quality functions. The compensation project, therefore, provided the same functions that were lost.

Exchanged/Additional Functions

The evaluation team also determined whether the compensation project provided additional functions or new functions in exchange for the functions lost. If an exchange of functions occurred, the evaluation team determined whether the exchange constituted appropriate compensation for the impacts to wetlands.

The evaluation team used three criteria to judge whether the functions exchanged were appropriate. The first criteria focused on the level of contribution to the function provided by the compensation project. For example, a project exchanging water quality functions for wildlife habitat functions, but providing only a minimal contribution to wildlife habitat may not be an appropriate exchange. Second, whether the exchanged functions were limiting in the basin[4] (e.g., providing water quantity functions in an area that experiences frequent flooding). Third, whether the exchanged functions were provided over a sufficient enough area to compensate for the impact. For example, in the case of the first criteria, a minimal contribution to wildlife habitat may be appropriate if provided over a large area in comparison to the area of wetland that was lost.

For example, a compensation project provided water quantity functions (reduced peak flows and downstream erosion) in a basin that had flooding problems, but wildlife habitat, not water quantity functions, was the primary function lost as a result of the wetland impact. This was an exchange of functions, and it was judged to be appropriate, since the compensation project provided a high contribution to functions that were limiting in that basin. However, the evaluation team judged another project exchanging wildlife habitat functions for lost water quality functions to be inappropriate because the compensation activities provided a minimal contribution to the wildlife habitat functions, and these functions were not provided over a sufficient enough area to compensate for the impact.

Data Analysis

The author relied primarily on descriptive statistics (percentages and raw numbers in tables and figures) to compare data. However, a non-parametric statistical analysis method was also employed to determine when data sets were significantly different. The author used non-parametric analysis due to the small sample size and the lack of a normal distribution. The Mann-Whitney U test, a "distribution-free method" for analyzing variance in samples, was employed to detect significant differences between the results obtained for the different types of compensation (e.g., creation vs. enhancement) and for the effect of follow-up on project success. Application of the Mann-Whitney U test followed methods outlined in Sokal and Rohlf's *Biometry* (1969).

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[4] Area that drains into a particular river, stream, or creek.

Statistical results were reported only when found to be significant at the $p<0.05$ level.

Results/Discussion

The second phase of the study examining the effectiveness of compensatory-wetland mitigation in Washington State set out to evaluate ecological success. However, defining and measuring ecological success proved to be difficult, and the evaluation process was relatively subjective compared to the assessment of permit compliance conducted in the first phase of the study.

To address this subjectivity, the evaluation team employed an approach for decision-making that combined the data collected during field visits with the expert knowledge of the evaluation team. Using this approach, the evaluation team obtained consensus judgments on all factors being evaluated. The consensus judgments were documented and quantified, thereby forming the basis for the following results[5]. The authors of this report have confidence in the results obtained using the approach for decision-making as it "has a history of successful application in complex situations that require the combination of judgment, expertise from many disciplines, and both qualitative and quantitative data" (Hruby 1999).

Discussions about how success should be determined for the projects in this study led to an eventual agreement that no single measure of "ecological success" was feasible. Instead, following a preliminary analysis of the data collected, overall success of a compensation project was broken into two categories.

The first was achievement of ecologically relevant measures. This category is similar to permit compliance except that the evaluation team considered only those requirements that directly related to and provided an indication of the ecological development of the site. In essence, did the compensation project perform as proposed? The evaluation team considered whether the project established the required acreage of compensation, attained significant performance standards, and fulfilled appropriate goals and/or objectives.

The second category focused on whether the project provided adequate compensation for the loss of wetlands. To determine this, the evaluation team considered the level of contribution a project provided to the potential performance of functions, whether the project

[5] Results for the acreage analysis were based on GPS data collected in the field and did not utilize a decision-making approach.

provided the same or exchanged the functions that were lost, and the type and scale of impacts.

In addition, the study evaluated wetland resource trade-offs in terms of Cowardin class and HGM class and the factors that correlate with success, particularly the role of follow-up by regulatory agencies.

Twenty-four projects were evaluated in the study. Eighteen were located west of the crest of the Cascade Mountains, and six were located east of the Cascade crest. The six projects from the east side represent 86 percent of the sub-population of eastern projects that required compensatory-wetland mitigation and met the initial selection criteria. The 18 projects from Western Washington are estimated to represent 16 percent of the sub-population of freshwater west side projects that required compensatory-wetland mitigation and met the initial selection criteria from Table 2.1 (p.38). Refer to Figure 9 in Appendix A[6] for approximate locations of the projects evaluated in this study.

Achievement of Ecologically Relevant Measures

Ecologically relevant measures are those regulatory requirements that relate to achieving the proposed ecological development (target ecosystem) and/or level of function of a wetland compensation project. For example, the requirement to establish a specific acreage of compensation relates to achieving a specific level of wetland function. If a project falls short of establishing the required acreage, then many wetland functions may not be performed at the expected or proposed level. On the other hand, the requirements to submit monitoring reports or construct interpretive signs, though important, do not directly relate to or provide a measure of the ecological development of a site.

Seven projects achieved all measures; 12 projects achieved some measures, and five projects did not achieve any measures (Table 3.4 and Figure 8). This means that only 29 percent of the projects evaluated in this study achieved all of the ecologically relevant measures required by their permits.

[6] All figures in Chapter 3 are located in Appendix A. Refer to the Table of Contents for specific page numbers.

Table 3.4 Achievement of Ecologically Relevant Measures.

	Yes	Somewhat	No	Not applicable
Did the project establish the required acreage of compensation?	14	-	10	-
Did the project attain significant performance standards?	5	4	6	9
Did the project fulfill appropriate goals/objectives?	8	9	4	3
Did the Project Achieve All Ecologically Relevant Measures?	**7***	**12**	**5**	**0**

* The rating for overall achievement of ecologically relevant measures was based on applicable measures only. Projects without significant performance standards or appropriate goals/objectives were not penalized. For example, a project without any significant performance standards could still receive a "yes" rating for overall achievement of measures if it achieved the other two applicable measures (establishing required compensation acreage and fulfilling appropriate G/O).

Establishing the Required Acreage of Compensation.

Perhaps the primary ecologically relevant measure of a compensation project is whether the project established the required amount of acreage of the proposed compensation activity(ies). The agencies that permitted the original wetland impacts decided how much acreage of a given type of compensation would be required to adequately replace the loss of wetland area and functions. Determining the established acreage of compensation was, therefore, a primary focus of this study.

The assessment team determined the wetland boundaries during field visits. If creation/restoration was required then the assessment team focused on determining the wetland acreage of the site. If enhancement was required then the assessment team focused on determining whether the proposed enhancement activities were effectively accomplished, and on confirming that the site was wetland of the required acreage.

Site visits were conducted from May to August 2000. Precipitation for the period from October 1999 to October 2000 was approximately 99 percent of average for the state in general.[7] It was therefore an average year for rainfall, the optimal time to perform wetland delineations.

[7] Data taken from http://www.or.blm.gov/nwcc/nwcc-reports/climateprecip/climateprecip.htm

Table 3.5 Acreage of Wetland Impact Compared to the Acreage Required and Established for Creation/Restoration and Enhancement.

	Impact Acreage	Required Acreage of Wetland Compensation	Established Acreage of Wetland Compensation
Creation/Restoration		42.96	38.21
Enhancement		87.94	71.65
TOTAL	**58.79**	**130.80**	**109.86**

As the results indicate (Table 3.5), the projects evaluated in this study established 84 percent of the total acreage that was required (109.86/130.80=0.84). Individually, 14 projects (58%) established their required acreage (see Figure 8).

However, five of the projects established more wetland area than was required. The site assessment included a determination of the wetland boundary, but it did not include a determination of buffer area. Though several projects required a specific acreage or width of buffer around the site, this was not specifically assessed. Therefore, if the required buffer or a portion of it was wetland and was adjacent to the compensation project, then it was included as wetland area. A separate study to confirm that compensation projects have the width or acreage of buffer required by their permits would be valuable.

Establishment of Required Acreage by Type of Compensation

By comparing the numbers in Table 3.5, it would appear that the acreage of wetland loss was effectively replaced at a ratio of 1.87:1 (109.86/58.79=1.87) even though the required acreage was not established. However, Table 3.5 also indicates that much of the acreage that was established involved enhancing pre-existing wetland areas, which does not result in a net gain in wetland area. Therefore, it is important to examine the established acreage by type of compensation activity.[8]

It can be determined from the data in Table 3.5 that creation and restoration of new wetland area replaced only 65 percent of the total acreage of wetland loss

[8] Two projects (#9 and #294), with a combined total of 21.3 acres of impacts to wetlands, were required to preserve an additional 77.5 acres of existing wetland. The site assessment team did not assess preservation areas. Thus, for the purposes of this study, the acreage of preservation was neither included in the required compensation acreage for the projects nor in the established acreage. However, preservation areas were taken into consideration when the projects were evaluated for compensation of impacts and overall project success.

(38.21/58.79=0.65). Creation and restoration established 89 percent of the acreage required for these activities (38.21/42.96=0.89).

Enhancement activities provided nearly two-thirds (65%) of the total established acreage (71.65/109.86=0.65). However, enhancement of existing wetlands established just 81 percent of the acreage required for that activity (71.65/87.94=0.81). This means that enhancement actions failed on 16.29 acres (87.94-71.65), either because none of the required plantings were established, or wetland acreage was actually lost as a result of the enhancement actions.[9]

Thus, a net loss of 24.18 acres of wetland area resulted.

A project-specific analysis revealed that 14 projects (58%) established the acreage required in the permit, while 10 projects (42%) did not (Table 3.4 and Figure 8). The data was further analyzed by type of compensation (Figure 10).

The 24 compensation projects were assigned to one of four compensation type categories: creation, restoration, enhancement, or mixed. Ten projects involving a mixture of compensation types were assigned to a category based on which activity had the predominant amount of acreage required. If no single compensation type accounted for greater than 75 percent of the required acreage, then the project was placed into the "mixed activity" category. For example, a project that required 1.0 acre of restoration and 5.0 acres of enhancement was assigned to the "enhancement" category, while a project that required 2.0 acres of restoration and 2.0 acres of enhancement was assigned to the "mixed activity" category.

Of the 10 projects that focused on creating new wetlands, seven (70%) established the acreage required (Figure 10), while three (30%) did not. For restoration, one project (50%) established the acreage required, while one (50%) did not. Nine projects focused on enhancing pre-existing wetlands; five (56%) established the acreage required, while four (44%) did not. Three projects involved a mixture of compensation types. Results indicated that one project (33%) established the acreage required, while two (66%) did not.

Several conclusions can be drawn from these results. First, created wetlands did a relatively good job of establishing the required acreage (89% of acreage and 70% of projects). One of the biggest concerns regarding the use of creation is its purported high risk of failure. However, only one of the created wetlands considered in this study failed to create wetland conditions.

Second, restoration was a dominant activity in only two of the 24 projects (8%). Despite the regulatory agencies' stated preference for restoration as the compensation type of choice, this study did not find restoration to be a common form of compensation.[10]

Finally, four enhancement projects (44%) did not establish the required acreage. Since enhancement activities occurred in an existing wetland, the site to be enhanced should have had the same wetland acreage after enhancement activities were performed, but four of the nine enhancement projects did not establish the required acreage. There are two main reasons for this.

The primary reason is that the enhancement actions failed. For example, a wet pasture was to be enhanced by planting shrubs and trees and controlling reed canarygrass (*Phalaris arundinacea*). During the site visit, it was determined that few if any shrubs or trees were present and the area was still dominated by reed canarygrass. The site assessment team concluded that the site did not establish the required acreage of enhanced wetland.

The second reason focuses on enhancement projects involving re-grading, thereby resulting in a loss of wetland acreage. For example, A wet pasture was to be enhanced by significantly re-grading (excavating two large ponds and a channel between them, and re-contouring the remaining soil). During the site visit, which occurred later in the growing season, no evidence of hydrology or hydric soils was observed in the re-contoured mounds. It was concluded that re-grading resulted in an apparent loss of about half of the previously existing wetland area.

Attainment of Performance Standards

Another ecologically relevant measure that was evaluated was whether performance standards were attained. However, many of the performance standards that were assessed did

[9] One enhancement project (#378) appeared to have resulted in a loss of 3.6 acres of previously existing wetland due to re-contouring of the site. This acreage was not included in the "Impact Acreage."

[10] This could be due to the fact that the projects selected for this study were permitted before restoration was as rigorously promoted. Also, restoration activities are generally not suitable for small-scale projects like most of those evaluated.

not reflect how the site was functioning or progressing ecologically. Therefore, the evaluation team determined which of the assessed performance standards were significant for each project. Refer to p. 74 for a description of the criteria used to determine whether a performance standard was significant.

The investigators encountered 114 performance standards (Figure 11). They assessed 62 of them (54%) with the methods and timing of this study. The study, however, focused on attainment of "significant" performance standards, and only 30 (26%) were both assessable and significant (Figure 11). Eighteen performance standards (16%) were assessed, significant, and attained.

Focusing on the significant standards resulted in an increase in the number of projects without applicable performance standards. Figure 12 indicates that three projects (13%) had no assessable performance standards, while nine projects (38%) had no significant performance standards.

Though it was discouraging that nine projects had no significant performance standards and, therefore, no significant benchmarks for the ecological progression of the desired wetland characteristics and functions, it was even more discouraging that most of the projects that had significant performance standards were still lacking many basic standards, such as:

- Wetland area,
- Water regime – permanently ponded, seasonally inundated, seasonally saturated, or a combination of these,
- Area of Cowardin class(es),
- Percent cover (relative or cumulative) of native wetland vegetation species desired,
- Maximum percent cover (relative or cumulative) of invasive vegetation species tolerated.

Since performance standards are the primary benchmark for determining compliance and providing an indicator to success, it is disconcerting that most projects had incomplete and poorly developed standards. This will be discussed further in Chapter 4 – Conclusions and Recommendations.

Fulfilling Goals/Objectives

Goals and objectives are an integral part of a mitigation plan because they provide a description, in general terms, of what the compensation project is trying to achieve. Therefore, fulfilling appropriate goals and objectives was the third ecologically relevant measure that a project needed to achieve as part of the evaluation of success.

A goal is a broad statement of what the compensation project intends to accomplish, while an objective is a specific element or subset of a goal defining specifically what is necessary to fulfill that goal. An objective is typically stated in terms of wetland functions or values. Objectives should lead directly to performance standards, which provide a measurable benchmark to determine if an objective has been accomplished (McCabe and Devroy, 2001; Hruby et al., 1994; Ossinger, 1999).

For example, a project has a goal to create 2.0 acres of emergent and scrub-shrub wetland, which will improve water quality and provide habitat for amphibians. Appropriate objectives for this project would be to create at least 1.5 acres of seasonally inundated wetland. A second objective might be to provide sediment retention and nutrient removal. And a third objective could be to provide breeding habitat for red-legged frogs.

Goals and/or objectives were evaluated for all 24 projects. Goals and objectives were lumped, because several projects had either one or the other but not both. Also, the terms "goal" and "objective" often are used interchangeably. There appears to be some confusion about what, specifically, each term pertains to despite guidance documents that define each term and explain how each should be applied.

The evaluation team determined which goals and/or objectives were appropriate for each project using the same criteria that were applied to performance standards, such as, the clarity of the goal/objective (not confusing or vague) and the feasibility of the goal/objective (for example, proposing to create anadromous fish habitat in an isolated depression is not feasible). Only the fulfillment of appropriate goals/objectives was considered in the overall achievement of ecologically relevant measures.

Twenty-two projects[11] were evaluated to determine if they fulfilled all of their goals/objectives, while only 21 projects were judged to have had appropriate goals/objectives (Figure 13).

[11] Two projects (#334 and 10E) did not have any G/O and, therefore, were not included in this analysis.

In general, projects did a better job of fulfilling appropriate goals and objectives than attaining significant performance standards. This could be due to the fact that performance standards frequently did not represent the goals and objectives of a compensation project. For example, a project could fulfill its goals/objectives to create a scrub/shrub wetland and provide habitat for passerine birds, and either not have significant performance standards or not attain any of them. In addition, there is a wide range of on-the-ground scenarios that could fulfill the same goal or objective. The example of a goal to establish scrub/shrub wetland and provide habitat for passerine birds would be fulfilled by any site that had scrub/shrub vegetation covering greater than 30 percent of the wetland.

Compensating for the Impact

In addition to achieving ecologically relevant measures, the second factor used to determine the overall success of a compensation project was whether the project adequately compensated for the wetland loss. However, this evaluation was more subjective than evaluating the achievement of measures. To minimize subjectivity, the evaluation of whether a compensation project adequately compensated for impacts was based on available data and the consensus judgment of the evaluation team, following a decision-making approach (Hruby, 1999). Four criteria were used to guide the team's judgment:

- How much did the compensation activity contribute to the potential of the site to perform wetland functions? This was the most important criterion considered, and it was based on available data.
- Did the compensation project provide the same functions as the lost wetland and over a sufficient enough area[12] to compensate for the lost functions?
- If the compensation project did not provide the same functions, did the project provide an appropriate exchange of functions (e.g., water quality functions were lost and the compensation project provided wildlife habitat functions)? An exchange was considered appropriate if the functions provided in exchange were implemented over a sufficient enough area, and were limiting in that basin, and/or represented a high contribution to the performance of functions.

[12] A sufficient enough area was a judgment made by the evaluation team, which was made independently of the replacement ratios that were required.

- The type and scale of the authorized wetland impact. For example, a project compensating for impacts to 0.25 acre *Phalaris arundinacea* dominated wetland would not be held to as high a standard as a project compensating for impacts to 5 acres of a forested wetland.

Projects were rated as "Yes," adequately compensating for the impact; "Somewhat," somewhat compensating for the impact; and "No," not adequately compensating for the impact.

In general, the projects evaluated in this study did better achieving ecologically relevant measures than compensating for impacts. **Only 63 percent of projects were even partially compensating for impacts** (Figure 14) **while 79 percent of projects at least partially achieved their measures** (Figure 8). This implies that though projects may be doing a better job of achieving measures, these measures may not indicate whether compensation projects adequately compensate for the wetland impacts.

Contribution of the Compensation Project by Function

Evaluating a site's contribution to the performance of functions was an essential component of determining whether a project adequately compensated for the impact. Evaluating contribution was also crucial to understanding whether enhancement actions provided the necessary gain in wetland functions to make up for the resulting net loss of wetland area. (Contribution to wetland functions was determined for each site. Since some projects had more than one compensation site, for the 24 projects evaluated, there were 31 sites visited and assessed.)

Contribution refers to how much the compensation actions increased or affected the potential of the site to perform wetland functions. The contribution to the performance of functions by a compensation site was determined for three general categories of functions:

- **Water Quality**. The rating for the Water Quality category was an average of the ratings for the potential to remove:
  1. Sediment;
  2. Nutrients; and
  3. Metals and toxic organics.

- **Water Quantity**. The rating for the Water Quantity category was an average of the ratings for the potential to:
    1. Reduce peak flows; and
    2. Decrease downstream erosion.
- **General Habitat**. The rating of General Habitat addressed the suitability of a wetland for all species. The potential to perform this function was based on surrounding land uses, buffer condition, number of habitat niches, and structural complexity and diversity within the wetland.

The individual functions were defined to be consistent with *Methods for Assessing Wetland Functions Volume 1* (Hruby et al. 1999). Groundwater-recharge functions were not considered, because many upland sites perform this function and there is still much that needs to be understood about groundwater interactions in many HGM subclasses.

Determining the contribution of the compensation activity to the performance of functions was particularly important for enhancement projects. Created and restored wetlands either produced wetland conditions and functions where none previously existed or, if the compensation activity did not produce wetland conditions, then the compensation project was judged to have no contribution to functions. However, enhancement projects were wetlands with existing functions prior to compensation actions. Thus, the level of success of an enhancement project depended on determining how much the enhancement actions increased the potential of the site to perform specific functions.

Thirty-one compensation sites (for the 24 projects) were visited and assessed. Contribution and potential to perform wetland functions were assessed for 30 sites. One project/site was established in a coastal dune ecosystem. Little is known about how these systems function in general, and no function assessment methods have been developed for interdunal wetlands. Without information on potential to perform functions, the evaluation team could not determine the level of contribution by this compensation project.

For the 30 sites considered, Figure 15, Figure 16, and Figure 17 illustrate the level of contribution made by each of the four types of compensation for each of the three major function categories: water quality, water quantity, and general habitat.

Contribution to Water Quality Functions

Water quality functions include removal of sediment, nutrient, metals, and toxic organics.

The investigators evaluated a total of 30 sites (Figure 15). Eleven involved predominantly wetland creation. Of these, six sites (55%) had a high contribution toward water quality functions. Two sites (18%) provided a moderate contribution toward water quality functions. One site (9%) did not contribute at all toward water quality functions. And two sites (18%) did not perform water quality functions because of the wetland type (flat) and location in the landscape (top of the watershed).

Only three sites involved predominantly restoring wetlands and all three (100%) had a high contribution toward water quality functions.

There were 12 sites that primarily enhanced pre-existing wetlands. Only one (8%) provided a high contribution toward water quality functions. Four sites (33%) had a moderate contribution toward water quality functions. Another four (33%) had a minimal contribution toward water quality functions, while three sites (25%) did not contribute at all to water quality functions.

Four sites involved a mixture of activities and were not dominated by any one. Of these, half provided a high contribution toward water quality functions, and the other half had a moderate contribution.

According to the Mann-Whitney U test (Sokal and Rohlf 1969), the sites that involved creating wetlands provided a significantly higher contribution to water quality functions than enhancement sites ($p<0.05$).

Contribution to Water Quantity Functions

Water quantity functions include reducing peak flows and decreasing downstream erosion.

The investigators evaluated 30 sites (Figure 16). Of the eleven wetland sites that were predominantly created, four (36%) provided a high contribution to water quantity functions, two (18%) had a moderate contribution, while two (18%) did not contribute at all to water quantity functions. One site (9%) had a negative contribution[13] (i.e., the project increased downstream erosion and peak flows). Two of the sites (18%) were not applicable

[13] The purpose of this project (#41E) was to deepen and widen a creek channel so that more water could move through it more quickly.

to assess water quantity functions due to the presence of a tidal influence and a controlled water source.

Two of the three sites (66%) involving predominantly wetland restoration provided a moderate contribution toward water quantity functions, and the third site (33%) was not applicable to assess water quantity functions due to the presence of a water control structure.

Of the 12 enhanced wetland sites, four (33%) provided a moderate contribution toward water quantity functions. Seven sites (58%) did not contribute at all to water quantity functions. And one site (8%) was not applicable to assess water quantity functions due to our limited knowledge of this function for slope wetlands.

There were four sites that employed a mixture of activities. One (25%) provided a high contribution toward water quantity functions, two (50%) had a moderate contribution, while one site (25%) provided a minimal contribution toward water quantity functions.

Contribution to the General Habitat Function

The investigators evaluated 30 sites (Figure 17). For the eleven sites that predominantly created wetlands, only one (9%) provided a high contribution toward general habitat. Five sites (45%) had a moderate contribution; three sites (27%) had a minimal contribution, while two sites (18%) did not contribute at all to general habitat.

Two of the three restoration sites (67%) had a high contribution toward general habitat, while one site (33%) had a moderate contribution.

Of the 12 sites involving primarily wetland enhancement only one (8%) had a high contribution toward general habitat. Two sites (17%) provided a moderate contribution, six (50%) had a minimal contribution, while three (25%) did not contribute at all to general habitat.

For the four sites performing a mixture of activities, one site (25%) provided a high contribution, one (25%) had a moderate contribution and two (50%) had a minimal contribution toward general habitat.

Contribution by Type of Compensation

Contribution data was also compared within the same compensation type across the three functions. This illustrates more clearly how much a given type of compensation contributes to the major wetland functions assessed. Figure 18 and Figure 19 illustrate contribution levels for creation and enhancement respectively.

Eleven sites involved predominantly creation activities (the interdunal wetland was not included since the evaluation team was unable to assess its potential to perform functions and therefore its contribution). Over half of the created wetland projects (54-73%) provided at least a moderate contribution to each of the three function categories assessed. However, nine to 27 percent of creation sites provided no contribution or a negative contribution to wetland functions.

Over half of the enhanced wetland sites (58-75%) provided no more than a minimal contribution to the wetland functions assessed, and at least 25 percent of projects provided no contribution. Less than half of the enhancement sites (25-42%) provided no more than a moderate contribution to functions, with only one project providing a high contribution (for two of the function categories).

Restoration and mixed activity projects were too few in number to draw any relevant conclusions. However, all restoration and mixed activity areas provided at least a minimal contribution to all wetland function categories.

The results of the analysis of Contribution to Function indicate that the creation areas provided a significantly higher contribution to water quality functions than enhancement projects (Figure 15). Though created wetlands were most effective at providing water quality improvement (Figure18), they also provided a high contribution to water quantity functions (36% of sites) and at least a moderate contribution to wildlife habitat (55% of sites). Since creation areas were not wetlands prior to compensation actions, it is not surprising that these projects could do a relatively good job of contributing to wetland functions.

Results also show that less than 10 percent of the enhancement areas provided a high contribution to the potential performance of functions, while 25 percent of enhancement areas (Figure 19) provided no contribution to any functions. It is particularly noteworthy that enhancement areas generally provided little or no contribution to the General Habitat function (75% were minimal to no contribution).

When the enhancement of existing wetlands was approved as compensation for wetland impacts it was understood that this would result in a net loss of wetland area, but it was believed that enhancement would, instead, result in a net gain of wetland functions, particularly to wildlife habitat. However, as the results indicate (Figure 19), at least half of the enhancement sites provided, at best, a minimal contribution to function performance. The results indicate that, in general, the enhancement projects did not result in a significant net gain of wetland functions.

The highest contribution from all the types of compensation was to water quality functions. Although these functions are often not targeted in the goals or objectives of a compensation project, they are crucial functions to provide since they are generally the most common and important functions lost as a result of impacts to wetlands (based on available delineation reports and function assessment information in mitigation plans). Wildlife functions are generally the most common functions targeted in the goals/objectives of compensation projects. However, the results suggest that compensation sites did not do as well at providing a contribution to wildlife functions (Figure 17).

The relatively low contribution to the general habitat function and the high contribution to water quality functions is greatly influenced by the opportunity that a project has to actually provide the function. As previously mentioned, a project's opportunity to provide a function affected the project's contribution to the function. With this in mind, it appears that, in general, the projects evaluated in this study had a higher opportunity to provide water quality functions than to provide wildlife habitat functions, largely as a result of their location in urban or urbanizing areas.

Similar results were obtained in a recent Massachusetts study. Function assessments results indicated that wetland compensation projects provided a high level of water quality functions, but compensation projects did not do as well at providing wildlife habitat functions (Brown and Veneman 2001).

Provide the Same/Exchange Functions

Another factor used to determine if a project adequately compensated for the authorized impacts to wetlands was whether the compensation project provided the same functions as the lost wetland. For example, if water quality functions were lost as a result of wetland impacts, did the compensation project provide water quality functions over a sufficient enough area to compensate for the loss?

In some cases, the compensation project exchanged wetland functions rather than providing the same functions that were lost. In those cases, the evaluation team determined whether the exchange was appropriate based on: 1) whether the exchanged functions were provided over a sufficient enough area; 2) if the compensation project provided a high contribution to the functions; 3) if the functions provided were limiting in the area; and 4) the landscape position of the site.

Example 1:
Water quality functions were lost. In exchange, the compensation project provided a minimal contribution to wildlife habitat functions. However, the compensation area was surrounded by roads and, thus, provided little opportunity for wildlife to successfully use the site. This was considered an inappropriate exchange of functions.

Example 2:
Water quality functions were lost. In exchange, the compensation project provided a high contribution to water quantity functions in an area that experienced flooding. This was considered an appropriate exchange of functions.

The study evaluated twenty-four projects. Twelve (50%) provided the same functions that were lost, and ten of these also provided functions in addition to those that were lost. For these 12 projects, the evaluation team concluded that eight projects (67%) adequately compensated for their impacts, three (25%) somewhat compensated, and one (8%) did not compensate for its impact.[14]

The evaluation team determined that eight projects (33%) exchanged functions. Of these, one project (13%) was judged to have adequately compensated for its impact, three (37%) somewhat compensated, while four projects (50%) did not adequately compensate for their impacts.

The site evaluation team found that four projects (17%) neither provided lost functions nor exchanged functions and, therefore, did not compensate for impacts.

The results suggest that projects replacing or somewhat replacing the functions lost were better at compensating for impacts than projects exchanging functions. Of the five projects that exchanged functions but did not compensate for the impact, four were enhancement projects that either did not provide a high contribution to the exchanged functions and/or did not provide the functions over a sufficient enough area.

[14] During construction of #278, soils contaminated with toxic organic compounds were exposed and potentially mobilized. As a result of this exposure, the site itself may have degraded water quality. Therefore, it was judged that the project did not adequately compensate for the wetland impacts.

Type and Scale of Impacts

A final factor that was considered when evaluating whether a project provided adequate compensation was the type and scale of the authorized impacts to wetlands. This information provided a basis for comparing the impacts to the functions potentially being provided by the compensation project. For example, a project resulting in the loss of several acres of higher-quality wetlands would be held to a higher standard of compensation than a project resulting in a quarter-acre impact to a wetland ditch dominated by non-native vegetation. This idea of type and scale of impact is involved in the replacement ratios that are used for projects during the initial permitting. Higher-quality wetlands require a larger area of wetland compensation, more successful/better functioning wetland compensation or both.

Three examples are provided to help illustrate this concept. The first project resulted in a 0.07-acre impact to a portion of a high quality forested headwater wetland. Though this was a very small impact, it bisected the existing forested wetland, thereby diminishing the overall functioning of the whole system due to habitat fragmentation. The functions and overall quality of the compensation would, therefore, need to be of a higher quality to adequately compensate for this type of impact. In this case, the 0.13-acre created wetland did not provide the functions that were lost but exchanged functions. The evaluation team judged that this exchange only somewhat compensated for the impact.

Another project of comparable size resulted in a 0.14-acre impact to a tidally influenced wetland ditch of low to moderate quality. Although the compensation involved creating a swale adjacent to a highway, the functions and overall quality of the created wetland were, on average, moderate. The compensation project provided the same functions that were lost as well as providing additional functions, and thus, the evaluation team judged that the project adequately compensated for the impact.

A third project resulted in 17.4 acres of impact to low-quality wetlands. The 55.33-acre compensation project primarily enhanced an extremely degraded wetland system (the compensation also included some restoration and creation). The compensation project provided the same functions that were lost as well as additional functions. The evaluation team judged that this project adequately compensated for the wetland loss.

Data on the type and scale of the impacts to wetlands came from background information in the project file or was provided by the project consultant. Detailed information, however, was often lacking.

Success

The main purpose of this study was to determine the overall success of a representative sample of compensation projects. Achievement of ecologically relevant measures and adequate compensation for wetland losses were considered the main indicators of a successful compensatory-wetland mitigation project.

As described in the methods, a rating was used to evaluate how well the compensation project achieved ecologically relevant measures. Achievement was rated as:

- Yes (achieving all measures) ,
- No (achieving no measures), or
- Somewhat (achieving some measures).

The degree of compensation for wetland losses for each project was rated as:

- Yes, adequately compensating for the loss of wetlands,
- No, not adequately compensating, or
- Somewhat compensating.

The evaluation team broke the results of the combination of the two ratings into four categories of success:

- **Fully Successful** projects received a "Yes" for both achieving all measures and adequately compensating for the impact,
- **Moderately Successful** projects received one "Yes" rating and one "Somewhat" rating,
- **Not Successful** projects received a "No" for both achieving measures and compensating for the impact,
- **Minimally Successful** projects involved all other combinations of "Yes," "Somewhat," and "No."

The overall result of the combination of the two ratings is represented in Table 3.6.

Table 3.6 Number of Projects Attaining the Factors Indicating Success

	Yes	Somewhat	No
Achieving Measures*	7	12	5
Compensating for the Impact*	9	6	9
Doing Both = Level of Success*	3 **Fully Successful**	16 **Moderately or Minimally Successful**	5 **Not Successful**

* n=24

The evaluation team determined that of the 24 projects evaluated three (13%) were fully successful, eight (33%) were moderately successful, another eight (33%) were minimally successful, and five (21%) were not successful (Figure 20).

Thirteen percent of compensation projects were judged to be fully successful, while more than half of the projects evaluated (54%) were minimally successful or not successful. This is consistent with results from other studies, which have found success rates from 12 to 50 percent, though a variety of criteria were used to define success (Holland and Bossert, 1994; Michigan Dept. of Environmental Quality, 2000; Morgan and Roberts, 1999; Redmond, 1992). However, interpreting the results another way suggests that the majority of projects (66%) are mediocre (moderately or minimally successful).

It is interesting to note that all of the projects that were judged to be not successful were also not built to plan according to the first phase of this study, described in Chapter 2.

Level of Success by Type of Compensation

Since there are three primary types of compensation currently in common use (creation, restoration, and enhancement) it is important to examine the level of success of each type (Figure 21).

The results show that, of the three fully successful projects, two (67%) were predominantly created wetlands, while one (33%) was a restored wetland. None of the enhancement projects were fully successful. Of the five projects that were not successful, four (80%) were enhanced wetlands, while one (20%) was a creation project.

The level of success of enhanced wetlands was significantly lower than the level of success of created wetlands ($p<0.05$) (Mann-Whitney U test – Sokal and Rohlf 1969).

Restoration and Mixed-Activity

The sample size of restoration and mixed-activity projects was too small to draw any relevant conclusion about the overall success of those activities. However, neither category had projects judged "not successful" (Figure 21). In regard to the mixed activity projects, all were a combination of creation/restoration and enhancement. Based on the level of success of enhancement projects, it could be speculated that the mixed projects did as well as they did (all were moderately successful) because enhancement comprised only about half of the wetland area.

Creation

The results of this study indicate that created wetlands are more successful than previous studies have shown. For example, 87 percent of the acreage required to be created was established, 60 percent of the creation projects were at least moderately successful, and only one project (10%) was not successful (Figure 21).

Enhancement

The results indicate that eight out of nine (89%) enhancement projects were minimally or not successful, and no enhancement projects were fully successful. From these results, it is apparent that enhancement projects are not as successful as the other types of compensation evaluated. In fact, enhancement projects were significantly less successful than creation projects (see Figure 21).

It is acknowledged that enhancement activities result in a net loss of wetland acreage, since no new wetland area is established to compensate for the wetland area lost as a result of the authorized impact. The rationale for allowing the losses of area has been that compensation would instead significantly enhance the performance of wetland functions in an existing wetland with degraded wetland functions.

The primary emphasis of enhancement projects has been targeted at improving wildlife habitat by:

- Adding structural diversity (e.g., planting shrubs and trees in a pasture),

- Adding vegetative diversity (e.g., planting numerous species of shrubs and trees),
- Adding open water (e.g., excavating permanent ponds for waterfowl habitat).

There are two main reasons for the low level of success among enhancement projects. First, the enhancement project did not achieve the proposed vegetative structure and/or diversity (e.g., failed to achieve ecologically relevant measures). For example, a project proposed to enhance a degraded pasture by adding vegetative structure and diversity. Numerous trees and shrubs in a variety of species were planted, but after three years (at the time of the site visit), virtually none of these plants had survived and no natural colonization was observed. The site was essentially the same as it was prior to enhancement. This project failed to establish the required acreage of enhancement, and it did not compensate for the impact. Thus, it was judged to be not successful.

Second, the enhancement project achieved the proposed structure and/or diversity, but despite this, it did not adequately compensate for the wetlands lost (i.e., it provided a low level of contribution to the performance of wetland functions and/or it did not provide functions over a sufficient enough area). For example, a project implemented what was required (planting and establishing trees and shrubs), and the project was achieving its ecologically relevant measures. However, the results of the function assessment and site evaluation indicated that this project was not adequately compensating what was lost. The moderate to minimal contribution to functions did not provide enough of a gain in functions over the acreage required to compensate for the original wetland impact. This suggests that what was originally required as compensation was not sufficient. Thus, the project was judged to be minimally successful.

The results indicate that enhancement activities generally do not provide a high contribution to the improvement of wetland functions. This is not to say that enhancement sites are not potentially performing important wetland functions, but many of those functions already had the potential to be performed prior to the compensation project's implementation. In order to compensate for the wetland acreage lost, the enhancement activity should provide a moderate to high gain in function potential above what the enhancement site previously had the potential to perform, or provide a minimal contribution over a much larger enhancement area.

Wetland Resource Tradeoffs

One of the components of the overall success of a compensation project was whether it adequately compensated for what was lost. This was evaluated in terms of a compensation project's contribution to functions, as well as the type and scale of wetland functions provided. However, compensating for impacts traditionally has been evaluated in terms of whether the compensation was the same wetland type (e.g., same Cowardin class, same HGM subclass).

This was not one of the considerations in evaluating the overall success of a compensation project in this study. However, whether the project provided the same wetland type as the wetland lost was analyzed to understand what, if any, tradeoffs may be occurring as a result of mitigation policies.

<u>Cowardin Class</u>

Cowardin class refers to the dominant vegetation type of the wetland (e.g., emergent, scrub-shrub, forested, aquatic bed, or open water). Scrub-shrub and forested classes must have greater than 30 percent cover by shrub or forest species (Cowardin et al. 1979).

One question that this study set out to answer concerned whether Washington state is losing certain Cowardin classes as a result of authorized impacts to wetlands, and disproportionately replacing that loss with other Cowardin classes. To examine this, background information was compiled to ascertain the acreage of impacts to each Cowardin class. For the compensation sites, the site assessment team collected Cowardin class information during the site visits.

Acreage of Cowardin classes provided as a result of compensation activities were categorized as a gain in acreage, a loss of acreage, or no change in acreage: For projects that <u>created</u> and/or <u>restored</u> new wetland area, the acreage of each Cowardin class found on-site was considered a **GAIN** of new acreage for the respective Cowardin class.

However, since enhancement projects occur in existing wetlands, some Cowardin class was present on the site prior to the commencement of any compensation activity. This often resulted in an exchange of Cowardin classes. For projects that <u>enhanced</u> wetlands, if one Cowardin class, such as emergent, was converted to another Cowardin class, such as scrub/shrub, then this was considered a **LOSS** in emergent acreage and a **GAIN** in scrub/shrub acreage. For projects that enhanced wetlands, if the site was emergent before the mitigation activity and it remained emergent after the mitigation activity was completed then **NO CHANGE** in Cowardin class occurred. For example, if a wetland enhancement project was meant to establish shrub cover on 3-acres of degraded pasture, but shrubs were found to cover only 1-acre, then this would be a **GAIN** of 1-acre for scrub/shrub, a **LOSS** of 1-acre of emergent, and **NO CHANGE** in 2-acres of emergent.

Table 3.7 summarizes the observed trade-offs in Cowardin class for 23 of the 24 compensation projects evaluated in this study[15].

Table 3.7 Acreage of Cowardin Classes Lost vs. Cowardin Classes Gained

	OW/AB	**FO/SS**	FO/SS No change	**EM**	EM No change
Wetland Impact Acreage	-0.66	-7.29		-49.35	
Wetland Compensation Acreage	16.86	19.57	*1.87*	23.62	*54.50*
Wetland Compensation Acreage Converted				-26.07	
Net GAIN in Cowardin Class	**+16.20**	**+12.28**			
Net LOSS in Cowardin Class				**-51.80**	
Net LOSS of Wetland Overall					**-23.32**

OW/AB=open water/ aquatic bed, FO=forested, SS=scrub/shrub, EM=emergent.

For the twenty-three projects considered[14], the total acreage of compensation was 116.42 (areas of "gain" + areas of "no change")

- Established acreage of compensation for the 23 projects = 107.83 acres
- 2 enhancement projects (#334 & #29E) were judged "not successful" because all the enhancement activities failed. The wetland acreage for these two projects was not included in the total established acreage of compensation, but was included in the Cowardin class analysis as "no change" area (0.10 SS no change and 8.49 EM no change).
- Thus 107.83 + 0.10 + 8.49 = 116.42

[15] One project (#89) was excluded, because it did not have specific background information on either the impact or the mitigation site prior to enhancement and creation activities.

Net Gain is the amount of new area in a Cowardin class minus the area of that Cowardin class lost to permitted wetland impacts.

- 16.86 acres of new OW/AB minus 0.66 acres of impacts to OW/AB, resulted in a NET GAIN of 16.20 acres of OW/AB (Table 3.8).
- 19.57 acres of new FO/SS minus 7.29 acres of impacts to FO/SS, resulting in a NET GAIN of 12.28 acres of FO/SS.
- 23.62 acres of new EM minus 49.35 acres of impacts to EM and 26.07 acres of EM converted to other Cowardin classes as a result of compensation activities, resulting in a NET LOSS of 51.80 acres of EM (23.62 – 49.35 = -25.73 – 26.07 = -51.80).

Another way to look at the numbers is to add up all of the gains (16.86 + 19.57 + 23.62 = 60.05) minus the losses from Cowardin class conversions (60.05 – 26.07 = 33.98) and compare this number to the area of authorized impacts to wetlands of all Cowardin classes.

- 33.98 acres of gained wetland area compared to 57.30 acres of impacts to wetlands (0.66 + 7.29 + 49.35).
- For the 23 projects considered in this analysis, new wetland area replaced only 60 percent of the wetlands lost. There was, therefore, a NET LOSS of 23.32 acres of wetland[16].

Forested and scrub/shrub acreages were combined for a couple of reasons. Background information about the Cowardin class of the wetland losses was vague for several projects. Forested and scrub/shrub often were described as one category and it was impossible to determine the exact amount of acreage for each. For the established acreage of compensation, forested and scrub/shrub areas were combined, because much of the area evaluated as scrub/shrub was vegetated with young tree species and will become forested in the next few years. Of the nearly 20 acres of compensation area categorized as FO/SS, it is estimated that about 66 percent will eventually be forested. In addition, all of this area was either completely or predominantly composed of native shrub or tree species.

[16] If project #89 (see footnote 13) is added into this computation, the result is: GAINED wetland area (0.63 acre + 33.98 = 34.61) compared to LOST wetland area (1.49 acres + 57.30 = 58.79) results in (58.79 – 34.61) **A NET LOSS of 24.18 acres of wetland**

The investigators examined the net loss of emergent area to determine the condition (i.e., whether it was predominantly native or non-native vegetation according to percent cover) of the wetlands that were lost and gained. Delineation reports and mitigation plans were used to estimate how much of the emergent wetlands were non-native before either impacts or compensation occurred (Table 3.8). This included information on the condition of impact sites as well as the condition of existing wetlands proposed for enhancement. The investigators collected information during the site assessments to determine how much of the emergent areas were non-native after compensation was completed (Table 3.9).

Table 3.8 Condition of Emergent Wetlands Prior to Impacts or Compensation Actions.

	TOTAL Acreage	% Non-native*	% Native*
Impact	49.35	~90%	~10%
Converted[17]	26.07	~90%	~10%
Unchanged[18]	54.50	~100%	~0%

* Percent area of native and non-native are approximations. Specific acreage data was not collected.

Table 3.8 indicates that of the 49.35 acres of impacts to emergent wetlands, nearly 90 percent of the vegetation was dominated by non-native pasture. Before compensation actions occurred, 90 percent of the 26.07 acres of emergent wetland converted to other Cowardin classes was dominated by non-native pasture grasses. In addition, prior to compensation nearly 100 percent of the "unchanged" emergent areas were dominated by non-native vegetation. The data in Table 3.8 suggest that the emergent wetlands lost to impacts and proposed for enhancement were predominantly non-native.

[17] Converted = areas where mitigation actions resulted in a change of Cowardin class; emergent areas were changed to scrub/shrub, forested, aquatic bed, or open water. Table 3.8 provides information on the condition of these areas prior to compensation.

[18] Unchanged = areas where mitigation actions failed or did not result in a change of Cowardin class; emergent areas remained emergent. Table 3.8 provides information on the condition of these areas prior to compensation, while Table 3.9 provides information on the condition of these areas after compensation actions were completed.

Table 3.9 Condition of Emergent Wetlands After Compensation Actions.

	TOTAL Acreage	% Non-native*	% Native*
Unchanged[19]	54.50	~70%	~30%
Created/Restored	23.62	~70%	~30%

* Percent area of native and non-native are approximations. Specific acreage data was not collected.

Table 3.9 indicates that after compensation actions occurred, the resulting emergent wetlands provided a higher percentage of native vegetation. The "unchanged" emergent areas previously had nearly 100 percent coverage by non-native vegetation, but after compensation 30 percent of these areas were dominated by native species. Of the 23.62 acres of emergent area gained as a result of creation or restoration, 70 percent was dominated by non-native species, while 30 percent was dominated by native vegetation.[20]

The Cowardin class results reveal that not only was there a net loss of emergent wetlands (51.80 acres), but there was also a significant net loss of wetland area; 24.18 acres of net wetland area has been lost as a result of the 24 permitted projects evaluated in this study.

The net loss of emergent wetlands (51.8 acres) is due to wetland impacts as well as to compensation projects converting existing emergent wetlands to forested/scrub-shrub (FO/SS) or open water/aquatic bed (OW/AB) wetlands. Although it seems like a startling loss, the vast majority of this emergent area was degraded pasture, dominated by non-native species (at least 90%). Likewise, 70 percent of the created emergent acreage was predominantly non-native. However, this was the result of one large non-native-dominated project that accounted for 65 percent of the new emergent acreage. The remainder of the projects created new emergent areas that were predominantly native, plant communities. It should be noted that a few enhancement projects (4) transformed some areas of non-native vegetation into predominantly native, emergent communities (EM no change or Unchanged).

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[19] Unchanged = areas where mitigation actions failed or did not result in a change of Cowardin class; emergent areas remained emergent. Table 3.8 provides information on the condition of these areas prior to compensation, while Table 3.9 provides information on the condition of these areas after compensation actions were completed.

[20] 12 projects were dominated by native, emergent vegetation. However, one compensation project, which accounted for 15.34 acres (65% of the emergent acreage listed above), was dominated by non-native species.

The results indicate that there has been a net gain of 12.3 acres of FO/SS wetlands (Table 3.7). Though some of this area was created or restored (~4 acres), the gain in FO/SS acreage is primarily due to the conversion of emergent wetlands. Since many of the areas probably were historically FO/SS wetlands prior to conversion for agricultural uses, the wetland compensation projects may be contributing to regional efforts to re-establish historic vegetation communities.

The net gain in OW/AB wetland areas (16.2 acres) was also primarily a result of converted emergent areas. Though generally considered aesthetically pleasing, many of the OW/AB wetland areas (44%) often result in compensation projects that are an atypical HGM class (discussed in next section), such as excavated ponds with steep banks, or ponds excavated in a landscape setting where they would not naturally occur.

Replacement of Hydrogeomorphic (HGM) Subclass

Hydrogeomorphic class refers to the position of a wetland in the larger landscape (such as a depression in the land, a break in a slope, or adjacent to a river or stream) the wetland's water source, and the flow and fluctuation of the water once in the wetland. The HGM class influences how well a wetland performs certain functions. For example, a slope wetland (i.e. a wetland positioned at the break of a slope) can slow water flowing down a slope, but it cannot detain flows, whereas a depressional wetland can. The various HGM classes and subclasses have unique criteria that allow them to perform functions at varying levels. When one type of HGM subclass is lost and "replaced" with a different HGM subclass, the result is often a trade in wetland functions (Bedford 1996, Gwin et al. 1999).

More commonly, created and enhanced compensation wetlands result in HGM subclasses that are atypical. An atypical subclass was defined as one that would not normally or naturally occur in that area or landscape position (Gwin et al. 1999). It included depressional out-flow wetlands with an exaggerated morphology (e.g., banks too steep); depressions excavated in a slope wetland; and projects using a water-control structure (e.g., constructed weir or artificially controlled water inputs).

The assessment team collected data to determine whether the wetland compensation project was of the same HGM subclass as the wetland lost, and whether the wetland compensation project was of an atypical HGM subclass.

Of the twenty-four compensation projects evaluated, 13 (54%) were of the same HGM subclass as the wetlands lost. Four projects (17%) were partially the same. This occurred when there were impacts to wetlands of more than one HGM subclass, but the compensation project had only one HGM subclass; or when the compensation project consisted of multiple sites with more than one HGM subclass and not all of them were the same as the HGM subclass lost. Seven projects (29%) were not of the same HGM subclass as the wetlands lost. For example, one project replaced a slope wetland with a depressional out-flow wetland.

The 23 projects establishing wetland conditions were evaluated to determine whether the compensation was of an atypical HGM subclass. The investigators determined that 15 projects (65%) were typical or natural HGM subclasses, while six projects (26%) were atypical HGM subclasses. Two projects (8%) were somewhat atypical, meaning that one site was typical or natural, but another portion of the project was atypical.

More than half of the wetland compensation projects evaluated in this study (54%) were the same HGM subclass as the wetlands lost, and 65percent of projects were considered typical subclasses. Of the 30 sites evaluated (for 23 projects), 10 (30%) were atypical, and all but one were less than five years old. This may indicate that in urban and urbanizing areas, on-site space for compensation is limited, and therefore, more recent projects are utilizing atypical designs to maximize replacement ratios and "fit" compensation projects onto a site.

Factors that Correlate with Success

One goal of this study was to identify some of the main factors that influence the level of success of compensation projects. The factors identified as potentially correlating with success were documented in three analyses:

- The evaluation team determined the primary reasons for a project's level of success during the site evaluation. This determination was based on aerial and site photos, data collected during field visits, and consultant questionnaire responses. The primary factors for all projects were combined and totaled, such that the top 10 factors most frequently cited as potentially influencing a project's success and failure were compiled into Tables 3.10 and 3.11.

- Responses on the consultant questionnaires were analyzed to determine whether follow-up by regulatory agencies might be correlated with a project's level of success.
- The level of success of the projects evaluated in this second phase was compared with the same projects' level of compliance in the first phase of the study to determine if there was a correlation between compliance and success.

Top Ten Factors

Originally, results from the Consultant Questionnaires were going to be analyzed to find correlations between the actions taken on successful compensation projects and the actions taken (or not taken) on compensation projects that were not successful. Questionnaires were completed for 19 of the 24 (79%) projects evaluated in the study.

When the authors began reviewing the responses to the questionnaires, it became clear that the design of the questionnaire was inappropriate for statistical analysis. The responses varied from one-word answers to several paragraphs of useful anecdotal information. In addition, some questionnaires did not appear to be fully completed. Statistical analyses were, therefore, limited to questions pertaining to agency follow-up.

The evaluation team used the valuable information provided by the consultants, both in the questionnaires and during on-site conversations, to determine the primary factors that appeared to contribute to the success (Table 3.10), lack of success (3.11), and overall outcome of a project.

Table 3.10 Top Ten Factors that Contributed to the Success of Projects
Adequate source of hydrology present
Same consultant involved from the very beginning of the project (from delineation of impacts to monitoring and maintenance)
Good site selection
Oversight and follow-up by regulatory agencies
Mitigation designer on-site during construction
Good mitigation design
Natural revegetation (native seed source present) or native hydroseed mix used
Maintenance conducted on site
Irrigation was used for at least one growing season
Hydrologic monitoring was conducted prior to mitigation plan implementation

Table 3.11 Top Ten Factors that Contributed to the Lack of Success of Projects
No irrigation of planted material
Poor site location
Lack of maintenance (e.g., invasive species control) or a poor job of maintaining planted material (mowed over)
Poor design
Poor planning and a lack of prior hydrologic monitoring
Lack of follow-up by applicant and regulatory agencies
Compacted soil or lack of soil amendments creating a poor substrate for plant growth
A buffer that was too small or unvegetated
Lack of consistency between project goals and mitigation plan (e.g., not enough planted material to provide the required shrub cover)
Lack of experience by heavy equipment operators and/or planting crew

Agency Follow-up

Nearly all studies of wetland compensation have recommended that regulatory agencies improve follow-up activities on compensation projects, assuming that this would improve the success of wetland compensation. The author attempted to determine if follow-up activities by regulatory agencies influenced (were a factor in) the success of a project.

The consultant questionnaire included the following question:

"Have any agencies followed-up on the project?" And if so, what type of follow-up activity(ies) occurred (Table 3.12)?

- "Sent a letter?"
- "Made a phone call?"
- "Performed a site visit?"

Any phone calls, letters, and/or site visits associated with this study were not considered regulatory follow-up.

Consultant questionnaires were filled out and returned for 19 projects. These questionnaires were analyzed to determine how many projects received some type of follow-up by a regulatory agency (Table 3.13). Responses were categorized as:

- "Yes," there was some follow-up by a regulatory agency,
- "No," there was no follow-up by a regulatory agency;
- "Don't Know," the respondent did not know if a regulatory agency followed up on the project, or
- "No Response" (i.e., the question was not answered).

Whether follow-up occurred was then compared with the level of success of projects (Figure 22).

Table 3.12 What Kind of Follow-up Was Conducted?

	Fully Successful	Moderately Successful	Minimally Successful	Not Successful
Projects with Follow-up	1	5	2	1
Letter	1	5	0	1
Phone Call	1	3	1	1
Site Visit	1	3	1	1

Table 3.13 Have Any Agencies Followed-up On the Project?

	Fully Successful	Moderately Successful	Minimally Successful	Not Successful	TOTAL
YES	1	5	2	1	9
NO	0	0	3	3	6
Don't Know	0	1	1	0	2
No Response	0	1	1	0	2
TOTAL	1	7	7	4	19

Data analysis of the results in Table 3.13 revealed that projects receiving agency follow-up were significantly more successful than projects lacking follow-up ($p<0.05$) (Mann-Whitney U test – Sokal and Rohlf 1969). This implies that follow-up by regulatory agencies results in a more successful compensation project. Table 3.12 indicates that the fully successful project received all three follow-up actions. In addition, many of the moderately successful projects received more than one follow-up action (e.g., a letter, a phone call, a site visit), and at least half of them received all three follow-up actions. However, the project that was not successful also received all three follow-up actions (Table 3.12)

The results appear to support recommendations made in compensatory mitigation studies over the years that assume follow-up activities improve the success of compensatory mitigation. However, there are a few caveats.

The primary caveat is that the question, "Have any agencies followed-up on the project?" is poorly worded and should have clearly stated that site visits, phone calls, etc. relating to this study or the first phase of the study did not count as agency follow-up. In some cases, respondents identified that a site visit was performed because of this study and those responses are considered a "no" in the results. In other cases, however, the respondent indicated that "Ecology" performed a site visit. Those answers were considered a "yes" in the results unless it was determined that no staff at Ecology, aside from this study, had performed a site visit.

Other problems encountered in analyzing results from the questionnaires included:

- Incomplete questionnaires – several of the respondents did not complete all of the questions.
- Inconsistent answers
  - A consultant and an applicant both responded to the questionnaire for the same project, and their answers to the same question were different.
  - Some consultants verbally answered questions while assisting with the site visit and then answered the questions differently on the written questionnaire.
- Lack of (institutional) memory
  - Some individuals could not remember exactly what had occurred with a particular project, especially after four or more years.
  - Staff with knowledge about a particular project no longer worked for the consulting firm.

Though the results suggest that follow-up by a regulatory agency is a factor associated with success and a lack of follow-up is a factor associated with a lack of success, it should be noted that this analysis was based on data provided by applicants and consultants based primarily on their recollections. The veracity of the data therefore has its limitations.

Success vs. Compliance

The results of the first phase - Compliance study were compared with the results of the second phase - Success study to determine whether a project's level of compliance correlated with that project's level of success.

As described in chapter 2, compliance for the first phase of this study was based on meeting three conditions:

1. Implementing the compensation project;
2. Implementing the project according to the pre-approved plan; and
3. Attaining the project specific performance standards.

Since all the projects evaluated in the second phase were implemented, the first condition was disregarded. Thus, for this analysis, the level of compliance was based on meeting the second and third conditions.

- Projects that met both of the other two conditions were considered to be "in compliance."
- Projects that met one but not both of the other two conditions were considered to be "somewhat" in compliance.
- Projects that met neither of the other two conditions were considered to be "not in compliance."

The criteria involved in evaluating a project's level of success were described earlier in this chapter.

Twenty-four projects from the first phase of this study were compared with the same projects evaluated in the second phase of the study

Table 3.14 Comparison of Success (Second Phase) and Compliance (First Phase)

Level of Success	Level of Compliance		
	In Compliance	Somewhat	Not In Compliance
Fully Successful	0	1	2
Moderately Successful	2	5	1
Minimally Successful	4	2	2
Not Successful	0	0	5

The results (Table 3.14 and Figure 23) appear to suggest that there is a negative relationship between compliance and the ecological success of a project, since none of the "fully successful" projects were "in compliance" in the first phase of the study. And of the three projects that were evaluated to be "fully successful, two (67%) were "not in compliance." Also, four of the projects (67%) that were "in compliance" were evaluated to be "minimally successful" in the second phase of the study.

However, all of the projects (100%) that were evaluated as "not successful" also were "not in compliance." This suggests that a compensation project that is not ecologically successful will likewise not be in compliance.

The lack of consistency between success and compliance could be due to the fact that one of the criteria for compliance in the first phase and success in the second phase was attaining performance standards. The methods and timeframe of the first phase of the study did not allow for assessing ecologically significant performance standards, such as water regime or wetland area, while other performance standards, such as for signage and fencing, were assessed in the first phase. Therefore, attaining performance standards in the first phase was not necessarily representative of how a site was functioning ecologically.

In contrast, the timing and methods of the Phase 2 study focused on assessing wetland area, hydrologic criteria, and percent cover and acreages of different Cowardin classes.

As previously mentioned, overall attainment of performance standards in the second phase of the study was limited to those standards that provided a significant measure of how a project was functioning or developing ecologically.

Understanding the limitations of the comparison between "success" and "compliance," this analysis suggests that being "in compliance" is not a primary factor that correlates with success. The results suggest that if a project is "in compliance," it is not completely unsuccessful ecologically. However, since all of the projects that were evaluated as "not successful" were also "not in compliance," a lack of compliance may be a factor correlated with a lack of success.

What does all of this data indicate about the status of freshwater compensatory wetland mitigation in Washington State? How does Washington compare with other states? And what can be done to improve compensatory wetland mitigation? These topics will be addressed in the following chapter.

Chapter 4 Conclusions and Recommendations

Conclusions

Chapters 2 and 3 described the results of studies conducted in Washington State to determine the effectiveness of compensatory wetland mitigation. How do these results compare to what other studies in Washington and other states have found? And what do these results indicate about the status of freshwater compensatory wetland mitigation? This chapter focuses on addressing these questions and providing recommendations for improving compensatory mitigation.

When compared with the results of other studies it appears that compensation projects in Washington State perform similarly. In some areas Washington is doing better; in others Washington is not doing as well. In terms of success this study found a lower percentage of compensation projects to be fully successful than other studies generally found -- 13% of projects compared with an average of 28% of projects for other studies (Storm and Stellini 1994, Allen and Feddema 1996, Michigan Department of Environmental Quality 2000, Sudol and Ambrose 2002). Though the methods used to evaluate success differed from one study to the next, all considered similar factors. However, the Washington study was unique because it considered the degree to which the compensation project made up for what was lost.

In terms of compliance, this study found that 29% of projects in Washington complied with all their regulatory requirements. This is somewhat higher than what other studies in Washington have found (18-21%) (Storm and Stellini 1994, Mockler et al. 1998). Studies from other states generally found a higher percentage of projects to be in compliance (36-83%) (Holland and Bossert 1994, Shaich and Franklin 1995, DeWeese 1998, Brown and Veneman 2001, Balzano et al. 2002, Sudol and Ambrose 2002).

Compliance, as defined in the first part of the study, did not appear to correlate with project success, as defined in the second part. A comparison indicated that 67 percent of the fully successful projects were not in compliance in the first part of the study. However, a *lack of success* does appear to be associated with a *lack of compliance*, since all of the projects that were not successful were also not in compliance.

On a bright note, this study found that nearly all of the projects in Washington were installed (93%). Only Portland, Oregon (99%) and Orange County, California (96%) found a higher percentage (Shaich and Franklin 1995, Sudol and Ambrose 2002). Other studies ranged from 80% to less than 40% of projects installed (Kunz et al. 1988, Erwin 1991, Storm and Stellini 1994, Mockler et al. 1998, Morgan and Roberts 1999, Michigan Department of Environmental Quality 2000, Brown and Veneman 2001, Robb 2002).

This study also found that a higher percentage of compensation projects met their required acreage of wetland (58%). Results from studies in other states ranged from 7 to 53% of projects (McKinstry and Anderson 1994, Shaich and Franklin 1995, Wilson and Mitsch 1996, Michigan Department of Environmental Quality 2000, Brown and Veneman 2001, Balzano et al. 2002, Sudol and Ambrose 2002, Morgan and Roberts 2003). Likewise, results indicate that Washington established a higher percentage of the total required acreage of wetland (84%), while other states ranged from 44 to 74% (Gwin and Kentula 1990, Erwin 1991, Allen and Feddema 1996, Wilson and Mitsch 1996, Balzano et al. 2002, Robb 2002, Morgan and Roberts 2003).

In terms of performance standards and goals/objectives this study found 35% of projects met their performance standards (21% met ecologically significant performance standards) and 38% met their goals and objectives. This is higher than some studies (Erwin 1991, Mockler et al. 1998) but lower than other studies (Cole and Shafer 2002).

However, more important than the percentage of projects meeting their standards is the percentage of projects without ecologically significant performance standards or goals/objectives. This study found that 38% of projects lacked ecologically significant performance standards. Likewise, many of the standards reviewed for this study were not measurable or contained confusing or ambiguous language and, therefore, could not be used to evaluate the success or compliance of projects; also, some standards were too general or easy-to-attain and, therefore, were not indicative of the ecological development at a site. Two other studies noted that performance standards were so poorly written they hindered compliance evaluations and prevented agencies from requiring corrective measures or carrying out enforcement actions (Sheldon and Dole 1992, Michigan Department of Environmental Quality 2000).

Approved mitigation projects can also lack performance standards for important wetland functions or conditions. This study reviewed 179 performance standards from 36 projects and observed that 8% of the performance standards related to hydrological conditions, while most projects lacked basic standards for wetland area, water regime, area of Cowardin classes, percent cover of native wetland vegetation, and maximum percent cover of invasive vegetation. Other studies found from 0 to 22% of projects had quantitative standards for hydrologic parameters (Breaux and Serefiddin 1999, Michigan Department of Environmental Quality 2000).

The findings of this thesis strongly suggest that follow-up by regulatory agencies results in more-successful compensation projects. This study and others indicated that more successful projects received follow-up, while less successful projects generally did not receive follow-up from regulatory agencies (Balzano et al. 2002, Robb 2002).

However, based on the results reported in this thesis, the author concludes that overall, compensatory wetland mitigation in Washington State is not effective. It is not effective at complying with permit requirements or preventing a net loss of wetland acreage and functions. In fact, for the 24 projects evaluated, this study found a loss of 24 acres of wetland. This was due to the use of enhancement and unsuccessful compensation activities. Furthermore, the author concludes that a loss of functions occurred, as demonstrated by the analyses of contribution to functions and exchange of wetland types – Cowardin class and water regime (hydrogeomorphic class).

The primary conclusion of this thesis with regard to a compensation project's contribution to functions is that enhancement of existing wetlands did not appreciably improve the ability of those wetlands to perform functions. The extensive use of wetland enhancement (65% of the established compensation acreage) resulted in a net loss of water quality functions since the majority of enhanced wetlands evaluated in this study provided minimal or no contribution to the performance of water quality functions. Thus the water quality functions lost as a result of the authorized impact were not replaced. Furthermore, the results of this thesis indicate that at most sites (75%) wetland enhancement resulted in, at best, minimal gains in wildlife functions, despite that fact that the primary focus of wetland enhancement has been improving wildlife habitat by adding structural diversity (e.g., planting trees and shrubs, installing snags and woody debris). Unfortunately, the author found no other studies that evaluated the effectiveness of wetland enhancement projects.

In contrast, the study found that creation and restoration, in addition to replacing wetland acreage, did a relatively good job of replicating water quality functions. Other studies indicated that water quality functions, such as retention of sediments, phosphorus, and nitrogen can be successfully performed by created and restored wetlands (Mitsch 1992, Mitsch et al. 1995, Niswander and Mitsch 1995, Moore et al. 1999, Romero et al. 1999, White et al. 2000).

In terms of wildlife habitat this study found that created and restored wetland compensation projects generally provided a high to moderate contribution to the performance of functions. This does not, however, mean that the created and restored wetlands replaced or replicated the wildlife habitat that was lost. Other studies have found that created and restored wetlands typically have lower diversity, density, or abundance of wildlife than reference wetlands (Delphey and Dinsmore 1993, Brown et al. 1997, Brown and Smith 1998, Bursey 1998, Dobkin et al. 1998, McIntosh et al. 1999, Fairchild et al. 2000, Dodson and Lillie 2001, Lehtinen and Galatowitsch 2001, Penchmann et al. 2001). The biggest reasons for the differences appear to be that created and restored wetlands have less developed vegetation communities (Bilanger and Couture 1988, Hemesath and Dinsmore 1993, Chovanec 1994, VanRees-Siewert and Dinsmore 1996, Brown et al. 1997, Chovanec and Raab 1997, McIntosh et al. 1999, Fairchild et al. 2000). And this is primarily influenced by the age of the wetland, such that older sites have more mature vegetation communities (VanRees-Siewert and Dinsmore 1996, Brown et al. 1997, Fairchild et al. 2000, Dodson and Lillie 2001). The author therefore concludes that creation and restoration are resulting in a temporal loss of wildlife functions.

The duration of the loss probably varies with the type of wildlife. One study concluded that it would require at least six years to form a zooplankton community of similar richness to a reference wetland (Dodson and Lillie 2001). Wildlife functions that are dependent upon the formation or accumulation of organic matter will be lost for an indeterminate amount of time since studies have indicated that created and restored wetlands (up to eleven years post construction) fail to accumulate organic matter (Bishel-Machung et al. 1996, Shaffer and Ernst 1999). For specific habitats such as bogs or mature forested wetlands there is currently no evidence that creation or restoration can replace the lost functions, primarily because such a long time is necessary and no project has been monitored or studied for that long (Natural Research Council 2001). Though an upland site, a reforested gravel pit differed from forested reference sites even after 107 years (Larson 1996). A lack of organic matter in the soil appears to have limited regeneration, particularly for coniferous species (Larson 1996).

In addition to the temporal loss of function, this study and many others observed that compensatory mitigation has resulted in an exchange of Cowardin classes and their accompanying functions. The consequence is a net loss of some Cowardin classes and a gain in open water and aquatic bed (Kentula et al. 1992, Shaich and Franklin 1995, Bishel-Machung et al. 1996, Magee et al. 1999, Cole and Brooks 2000, Michigan Department of Environmental Quality 2000, Balzano et al. 2002, Cole and Shafer 2002, Robb 2002).

The gain in open water/aquatic bed is typically accompanied by a change in the hydrogeomorphic (HGM) class of the wetland. Wetlands created using berms to retain water or deep excavation with steep sides result in HGM classes that are atypical since they do not naturally occur in the landscape (Gwin et al. 1999). This means that permitted wetland losses are being replaced by wetlands with an atypical hydrologic regime (Shaffer et al. 1999, Cole and Brooks 2000). This is particularly problematic for the multitude of wetland organisms that depend upon specific water regimes, such as many native amphibians or the federally threatened Howellia aquatilis (water howellia), which requires water to suspend its flaccid stems yet similarly relies on late summer/fall draw-downs to allow its seeds to germinate in the presence of oxygen (Washington Natural Heritage Program 2000). Therefore, "Unless wetlands are restored or created in a manner that reproduces the hydrogeomorphic characteristics of naturally occurring wetlands in a region, management activities are unlikely to maintain or replace hydrologic and other valued functions of wetlands" (Schaffer et al. 1999).

So, what does it all mean? Follow-up by regulatory agencies, when conducted, appears to improve the permit compliance of compensatory wetland mitigation and some aspects of ecological success, such as establishment of required wetland acreage. But despite follow-up, wetland functions are being lost, at least in the short term (temporal loss). Data regarding the duration of the temporal loss of functions is lacking, primarily because compensation sites are not monitored or studied long enough or with enough scientific rigor to determine at what point created, restored, and enhanced wetlands begin to provide specific functions, particularly wildlife habitat.

So, what can be done to stop the loss of wetland area, functions, or both?

Recommendations

Avoidance

Since no study has shown compensatory wetland mitigation to be 100% effective, many in the environmental community advocate the complete avoidance of wetland impacts. They claim this is the only way to ensure that no further loss of wetland area and functions occurs. However, avoidance of all wetland impacts, within the current social, economic, and political paradigm would be unfeasible for at least a couple of reasons. First, situations frequently emerge where avoidance is not possible for logistic or economic reasons. For example, maintenance of federal, state, or local roads (e.g., re-paving, road widening, adding shoulders or bike lanes) often results in wetland impacts since numerous wetlands exist in the right-of-way. Even bridges over wetland areas and streams require placement of fill for bridge support footings.

Furthermore, some wetland areas cannot be avoided because to do so would deprive landowners of all reasonable economic use of their land, thereby resulting in regulatory takings. For example, a family owns a 2-acre plot of land situated between a state highway and the Pacific coast. The parcel is long and linear. A wetland exists adjacent and parallel to the road, which provides the only access to the property (except perhaps by boat or surfboard). The family would like to construct a driveway, 1000 feet long to get to an upland area where they plan to construct their home. But the driveway would cross the wetland, resulting in over 0.2 acre of wetland fill.

Should the family be denied the ability to build and live in a home because it would result in the loss of wetland acreage and function? And if the answer is yes, how long would such a policy be tolerated by property rights activists before wetland regulations and protections were completely eliminated?

Second, current regulations allow state and federal agencies to have jurisdiction over only direct impacts to wetlands. Even if all direct impacts to wetlands could be avoided, the surrounding upland areas would undoubtedly be developed, thereby degrading wetland functions over time (increased impervious surface results in habitat fragmentation and increased storm-water and run-off thereby altering hydrologic regimes and adding excess nutrients and pollutants, all of which stresses native plant communities while favoring non-native and aggressive vegetation such as *Phalaris arundinaceae* and *Typha spp*.).

Since avoidance of all wetland impacts is not practicable under the current system of regulation, some wetland loss will occur. Thus, measures must be taken to improve compensatory wetland mitigation in order to prevent further losses of wetland acreage and functions.

So, what can be done to improve compensatory wetland mitigation?

Recommendations fall into two basic categories: improving the effectiveness of individual compensation projects; and improving the regulatory approach to wetland compensation.

Improving Compensatory Wetland Mitigation Projects

Recommendations meant to improve the effectiveness of individual compensation projects fall into three main categories:

- Recommendations for regulators of compensatory mitigation, such as conducting or improving compliance tracking and enforcement and improving or updating guidance on mitigation plans and monitoring reports.
- Recommendations for selecting and designing better compensation sites, such as conducting baseline monitoring and hydrologic analysis.
- Recommendations for implementing compensatory mitigation, such as having a wetland biologist on-site to oversee construction activities and performing monitoring and maintenance of sites.

<u>Agencies with regulatory authority over wetlands could do a lot to improve the effectiveness of compensatory mitigation</u> without substantially altering regulations or the current paradigm of regulation. Primarily, local, state, and federal agencies should coordinate their efforts to conduct regular compliance visits to every compensation project that they approve, since regulatory follow-up was strongly associated with more successful projects. At a minimum, there should be a visit within the first year or two post-installation and another visit just prior to or during the final year of monitoring. The first visit would ensure the site was constructed correctly and allow emerging problems to be identified before they affect compliance and success.

Involving the applicants, consultants, or both in these visits would enhance a cooperative working relationship, improve the detection of problems, and facilitate the identification of solutions that are ecologically as well as economically viable. When applicants are unresponsive or unwilling to perform the measures necessary to correct problems affecting the ecological success of a project, regulators should implement enforcement actions to bring projects into compliance. A number of other studies recommended follow-up and enforcement as a means to improve compensatory wetland mitigation (Erwin 1991, Storm and Stellini 1994, Shaich and Franklin 1995, Allen and Feddema 1996, Race and Fonseca 1996, Morgan and Roberts 1999, Michigan Department of Environmental Quality 2000, National Research Council 2001, Robb 2002).

How do regulatory employees remember or identify which projects to follow-up on, particularly since it may be five to ten years since a permit was issued? Any meaningful follow-up and compliance-tracking program must be supported by functional and complete data management systems, such as databases and filing systems (Erwin 1991, Holland and Kentula 1992, Storm and Stellini 1994, Shaich and Franklin 1995, Allen and Feddema 1996, Morgan and Roberts 1999, Michigan Department of Environmental Quality 2000, National Research Council 2001, Balzano et al. 2002). In addition, allocating staff specifically for follow-up and compliance of permits and compensation projects will ensure that the job gets accomplished, rather than requiring that permit staff perform another task (Erwin 1991, Shaich and Franklin 1995, Morgan and Roberts 1999). Finally, conducting regular reviews (every five to 10 years) of a wetland regulatory program will help to identify when improvements have been made (Holland and Kentula 1992, Shaich and Franklin 1995, Balzano et al. 2002).

Since recent studies are making the same recommendations about follow-up as studies from about a decade ago, the author concludes that they are not being implemented, or if implemented they are not being maintained. Enforcement can be politically unpopular, and in times of budget shortfalls follow-up activities are typically viewed as a lower priority than reviewing and issuing more permits.

In the past decade much has been learned about compensatory wetland mitigation, particularly in terms of how compensation actions have affected the types of wetlands on the landscape (e.g., open water and atypical hydrologic regimes). New guidance for every step of the mitigation process, from avoidance and minimization to submitting a monitoring report for a compensation wetland, would help regulatory staff with permit review and decision-making as well as informing consultants about what constitutes adequate compensation, thereby improving mitigation packages and conceptual plans.

Guidance documents would provide the most benefit if they were jointly developed by local, state, and federal agencies with regulatory authority over wetlands. This would provide more consistency and predictability for applicants.

New guidance should discuss what constitutes adequate compensation, such as requirements for replacing functions as well as area (Wilson and Mitsch 1996, National Research Council 2001) and adjusting replacement ratios to reflect the current estimates of risk of failure and temporal losses of function (Allen and Feddema 1996, Balzano et al. 2002, Robb 2002). In addition, guidance should describe (include a matrix) the gain in functions expected from various activities. For example, this study has indicated that enhancement of vegetative structure provides minimal gains in habitat, at least in the short term (first 10 years), and no gains in water quality and quantity functions. Therefore, enhancement of this type should require compensation to occur over larger areas than has previously been required. On the other hand, enhancement activities that restore hydrologic processes, such as plugging ditches or reconnecting a water channel to its floodplain, provide significant and more immediate gains in water quality and quantity functions. These activities should receive a replacement ratio similar to what is required for wetland restoration.

Furthermore, guidance documents should address permit requirements or conditions that would improve compliance and success, such as requiring financial assurances or performance bonding and protecting all compensatory mitigation sites in perpetuity with a legal mechanism, such as a deed restriction or conservation easement. In addition, guidance needs to clarify the critical connection between a project's goals, objectives, and performance standards.

Performance standards are another permit requirement in need of major improvements. Ideally performance standards are intended to serve as "measurable benchmarks used to evaluate the development of ecological characteristics associated with specific wetland functions" (Azous et al. 1998). Performance standards allow regulators to determine if a compensatory mitigation project has fulfilled its goals, and also provide a mechanism for regulators to implement enforcement actions against unsuccessful projects (Streever 1999).

Compensatory wetland mitigation projects exhibit considerable variability with different types of wetland compensation (creation, restoration, etc.). The variability makes it difficult to develop and require universal performance standards, yet in the absence of some kind of uniformity, performance standards that are approved can lack meaning. Guidance documents should therefore explain how to tailor performance standards to each specific project while targeting the basic parameters of wetland development, such as wetland area, area of Cowardin class(es), percent cover (relative or cumulative) of native wetland vegetation species desired, and maximum percent cover (relative or cumulative) of invasive vegetation species that will be tolerated.

Breaux and Serefiddin (1999) argue, "In seasonal wetlands, hydrology clearly ought to be the reigning criterion given that the successive presence and absence of water is the defining characteristic of a seasonal wetland." However, the authors go on to admit, "there is no agreement as to what the specific hydrological criterion should be." Though there is no universally accepted hydrologic standard, the goals and objectives should identify the expected or targeted water regime (e.g., permanently ponded, seasonally inundated, seasonally saturated). Performance standards should therefore be developed to ascertain in a measurable way whether the site exhibits the targeted hydrologic regime.

Compensatory mitigation would also be improved with <u>better site selection and design</u>. Using a watershed approach would improve site selection (Shaich and Franklin 1995, Allen and Feddema 1996, Morgan and Roberts 1999, Kentula 2000, National Research Council 2001), but this will be discussed later in this chapter.

Two factors have been identified that should improve both site selection and design. First, wetland restoration areas should given priority. Since these areas were wetlands previously they are more likely to support wetland hydrology without producing atypical HGM classes (Morgan and Roberts 1999, Michigan Department of Environmental Quality 2000, National Research Council 2001).

Second, baseline monitoring of the wetland to be lost should be performed to identify the wetland types and functions that will be lost. That way, applicants and consultants can look for potential compensation sites that will be capable of providing those wetland types and functions (Kunz et al. 1988, Erwin 1991, Sheldon and Dole 1992, Storm and Stellini 1994, National Research Council 2001). Additionally, baseline monitoring of the areas proposed for compensation should be performed to document the existing conditions and level of function (particularly for enhancement). This should include conducting a hydrologic analysis to identify where the water will come from, how it will get to the site, and what the extent and duration of inundation or saturation will be (Kunz et al. 1988, Erwin 1991, Sheldon and Dole 1992, Mockler et al. 1998, Kentula 2000, Balzano et al. 2002).

Several other factors have been identified that relate specifically to site design. Primarily, the design should result in a self-sustaining compensation site and incorporate or simulate natural processes whenever possible (Zedler and Callaway 2000, National Research Council 2001). The grades of slopes should match those of adjacent reference wetlands, the more gentle the better (Gwin and Kentula 1990). Topography of sites should be variable and incorporate some native upland habitats, thus providing microhabitats and niches (Erwin 1991, Barry et al. 1996, National Research Council 2001). Soils should be deconsolidated to reduce compaction and amended to increase soil organic matter (Gwin and Kentula 1990, Mockler et al. 1998, Whittecar and Daniels 1999, Kentula 2000).

Moreover, various aspects of the implementation of compensation projects would result in improvements in compliance and success. For example, compensatory wetland mitigation projects would be greatly improved if they were implemented as designed (Balzano et al. 2002). Having a wetland biologist on-site during construction may help ensure that sites are constructed as designed or that changes, when necessary and ecologically beneficial, are documented (Erwin 1991, Sheldon and Dole 1992, Balzano et al. 2002).

A number of recommendations have been identified that relate to monitoring of the compensation wetland. For example, monitoring should document conditions on the site before commencing any work (i.e., baseline), during construction, as-built (i.e., immediately after all work has been completed), and at several pre-determined post construction time points (Kunz et al. 1988, Gwin and Kentula 1990, Erwin 1991, Castelle et al. 1992, Holland and Kentula 1992, Sheldon and Dole 1992, Holland and Bossert 1994, Storm and Stellini 1994, Shaich and Franklin 1995, Michigan Department of Environmental Quality 2000, Balzano et al. 2002). One study suggested that hydrology should be monitored during the first growing season to characterize a site's hydroperiod. Vegetation planting should then be planned and implemented based on this information (Hunt et al. 1999).

Specific parameters and duration of monitoring will depend upon the type of wetland being proposed and its likelihood of success, though studies suggested three to 15 years of monitoring (Erwin 1991, Mitsch and Wilson 1996, Breaux and Serefiddin 1999, Morgan and Roberts 1999, Michigan Department of Environmental Quality 2000). However, all compensation wetlands should be monitored for wetland size and hydroperiod at a minimum (Erwin 1991, Morgan and Roberts 1999, Zedler and Callaway 2000).

A few studies suggested that compensation sites should receive some long-term monitoring after regulatory requirements have been met (Erwin 1991, National Research Council 2001). This would allow scientists to study how the site matures over time, providing more information about how long it takes before a wetland is capable of performing various functions. In addition monitoring data on compensation wetlands could be used as models for other sites. Older compensation wetlands could serve as reference sites for younger sites, both in terms of functions and performance standards (Kentula 1995).

Finally, maintenance (e.g., irrigation, weed control, replacing dead plants) must occur on compensation projects if they are to be compliant and successful (Kunz et al. 1988, Castelle et al. 1992, Sheldon and Dole 1992, Holland and Bossert 1994, Balzano et al. 2002). Maintenance inspections provide early detection of problems. Contingency measures should be identified during project planning so that when problems arise the appropriate corrective measures can rapidly be implemented. Adaptive management should be employed to deal with unforeseen problems or changes in site conditions that are better addressed through changes in the goals, objectives, and performance standards rather than requiring that the site be completely reconstructed.

As with the recommendations for improved regulatory follow-up, most of the recommendations identified thus far in this thesis have been made before in scientific journal articles or government documents over the past decade. In fact a previous study of mitigation in Washington State made the same recommendations as this thesis (Storm and Stellini 1994).

Why then has compensatory mitigation remained so ineffective and riddled with problems? There are three probable explanations. One, recommendations are not being implemented. Two, they may have been initially implemented but were not carried through. Three, they were implemented, but the recommendations did not improve the effectiveness of compensatory mitigation.

Regardless of the exact reason, more holistic changes and improvements need to be made if wetland resources are to be protected.

Improving Regulatory Approaches

Even if the previously described recommendations result in improvements, the current site specific approach to regulating wetland impacts and compensation fails to consider the loss of wetland functions on a larger landscape scale. For example, filling a one-acre shrubby wetland to build a parking lot could be effectively compensated. However, if that wetland provided the connection between two other existing green spaces, thereby providing a corridor for wildlife movement, compensating for the loss of that function is more difficult and may not even be considered in the analysis of wetland functions.

Addressing these landscape scale impacts would primarily be accomplished by using a watershed approach. In the context of compensatory mitigation, a watershed approach means:

> *to recognize that management of wetland types, functions, and locations requires structured consideration of watershed needs and how wetland types and location serve these needs. A watershed approach means that mitigation decisions are made with a regional perspective, involve multiple agencies, citizens, scientists, and nonprofit organizations, and draw upon multiple funding sources (e.g., permittee-responsible, mitigation banks, and in-lieu fees). A watershed approach means that permitting decisions are integrated with other regulatory programs (e.g., storm water management or habitat conservation) and nonregulatory programs (e.g., conservation easement programs)* (National Research Council 2001).

Bedford (1996) explained the need for a watershed/landscape approach as follows:

> *From a policy perspective, the central issue in wetland mitigation is not the effects on a single site but the cumulative effect of numerous mitigation decisions on landscapes. Mitigation must be recognized as a policy that has the potential to re-configure the kinds and spatial distribution of wetland ecosystems over large geographic areas. ... 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).*

A report by the National Research Council (2001) describes three types of watershed planning approaches.

- **Management-oriented** wetland planning, which would replace case-by-case permitting. Decisions about permitting, mitigation sequencing, and the acreage, type, and location of compensation would be made in advance using a watershed approach. This type of watershed plan would require regulatory and non-regulatory programs to be coordinated.

- **Protection-oriented** wetland planning, which is focused on avoiding wetland loss and alteration by identifying wetlands and their ecological value. This type of watershed plan would be used during the mitigation sequencing process.
- **Compensation** wetland planning, which "identifies watershed needs for types, functions, and general locations of wetlands in the landscape in order to establish restoration priorities for both regulatory and nonregulatory programs. ...This type of planning might link projects undertaken through both regulatory and nonregulatory programs to secure some desired mosaic of wetlands in the landscape."

Hashisaki (1996) discusses the utility of a landscape-level analysis to examine conditions not just at an impact, compensation, or reference site, but also in the surrounding landscape. A landscape-level analysis "considers the effect of historic, current, and proposed land management practices on the individual functional indicators. . . . In addition to identifying constraints on land management practices, it can be useful in identifying critical preservation and restoration opportunities. Understanding the control that human activities exert on the disturbance regimes of an ecosystem allows projections about expected future conditions."

Bedford (1996) recommends developing wetland profiles/templates based on the diversity of wetland types that exist in a region as a result of the unique interaction of hydrogeology and climate. By understanding the current and historic wetland types and their relative abundances in a region, decisions regarding compensatory mitigation can be made to help maintain the diversity and hydrologic equivalence.

In some cases, using a watershed approach may result in a watershed plan that identifies all the wetlands in an area and assesses the functions that they perform. Hruby and Scuderi (1995) used this approach for a watershed near Seattle, Washington, that was experiencing development pressure. The goal of the plan was "to ensure that the performance of wetland functions and their societal values continue to be equal to or greater than those currently existing..." (Hruby and Scuderi 1995). Wetland areas targeted for restoration or enhancement were assessed to quantify how much wetland function could be gained. The proposed/potential gain in function through restoration/enhancement could then be used to determine how much wetland function could be lost to development activities in the watershed.

A report by the National Research Council (2001) proposed that once a watershed plan has been developed for an area, such that the functions at wetlands proposed for loss or alteration are understood and the functional needs of the watershed are understood, then "Functional tradeoffs might be considered in the context of the needs of the watershed." This means that functions which are abundant or a low priority in a watershed could be lost and replaced by other functions that are limited or a higher priority in the watershed.

Race and Fonseca (1996) point out that on a national level, a landscape approach to land use and compensation would require the cooperation/participation of thousands or millions of private landowners:

> *Taking a large-scale, ecosystem approach to wetlands management is a significant change in natural resource management policies, one representing a major paradigm shift that will require radical revision in values, management practices, and institutional structures in order to succeed (Cortner and Moote 1994). ...Thus, integrating ecologically relevant concepts such as landscape-scale decision criteria need more than good science; it will also require conscious redesign of the entire permitting infrastructure to avoid legal challenges.*

Additional changes in the current regulatory approach that could result in improvements in the effectiveness of compensatory mitigation involve using market-based mitigation, such as mitigation banking and in-lieu fee programs, or programmatic mitigation approaches, such as designated mitigation areas. These modes are believed by some to provide part of a solution and have offered new hope for successful compensation wetlands.

Currently, even when wetlands have been avoided or established as compensation they often "have diminished ecological functions from polluted runoff, from changes in hydrologic regimes, and from the fragmentation of the landscape which isolates the wetlands from the surrounding uplands, water, and biological resources of the watershed" (Shabman et al. 1993).

In addition, some federal, state, and local permits for wetland loss do not require compensatory mitigation because the individual impact is so small that compensation is considered impractical, despite the fact that cumulative losses are occurring (Shabman et al.1993). Finally, even when compensatory mitigation is required there is no guarantee that it will be implemented or successful.

Shabman et al. (1993) outlined a market solution to improve compensatory wetland mitigation. Market-based mitigation approaches start with an entrepreneurial restoration firm seeking to make a profit from selling a product—a wetland ecosystem, such as a wetland mitigation bank. If the product is not of a particular quality then it will not sell. For example, if the wetland bank is not in compliance, not meeting its performance standards, or not providing the proposed functions then the regulatory agencies will not accept credits from the bank as compensation for wetland losses. The permit applicant, therefore, will not purchase the "product" of the wetland bank. This is the incentive for the restoration firm to establish a functioning wetland ecosystem.

In addition, a restoration firm can take the time to find a suitable location for the wetland ecosystem that will minimize problems with fragmentation and isolation. Wetland banks can also secure large sites for restoration that would not be feasible on a small project scale.

Once the wetland ecosystem is established, credits or tradable portions of the wetland ecosystem can be made available for purchase to compensate for wetland losses, even wetland losses that were previously too small to require compensation. The availability of bank credits for compensation can also provide efficient permitting since the applicant would not have to worry about getting a mitigation plan approved, and regulators could more readily assess the effectiveness of the compensation.

Like mitigation banking, in-lieu fee programs provide an additional compensatory mitigation option. They allow permit applicants to compensate for wetland losses by paying a fee to a third party such as a government agency or conservation organization (U.S. General Accounting Office 2001, Environmental Law Institute 2002). The fees are meant to be used to restore, create, enhance, or preserve wetlands (U.S. General Accounting Office 2001).

Generally, in-lieu fee contributions are collected in advance of wetland losses. These funds are accumulated until they are sufficient to design and implement the wetland compensation project (Environmental Law Institute 2002).

Designated mitigation areas are useful if individual applicants want to do their own compensation projects, or if no banks or in-lieu fee programs are available in the area, the state or local jurisdiction may request that applicants perform their compensation on an area that has been prioritized for restoration but for which no funds are available to implement restoration actions.

The Author's Plan

New approaches and improvements to wetland compensation will succumb to the same problems plaguing existing projects unless all projects receive regulatory follow-up to monitor compliance and effectiveness. Therefore, a staff person should be hired[1] to do follow-up, compliance tracking, and enforcement on compensatory mitigation projects. The person who performs these job duties would need to be an experienced wetland scientist with knowledge of the wetland regulatory framework in Washington State, in other words, a mid-level environmental specialist position.

Since this staff position would be responsible for following-up on compensatory projects associated with wetland impacts, applicants utilizing the services of this individual should contribute the funding for the position.[2] In other words, an impact fee should be required.

How much would this fee be? Well, it would have to be enough to pay for the staff position. The average salary and benefits (including administrative overhead) for a mid-level environmental specialist add up to about $80,000/year. The estimate for this plan requires only one position, yet there would be numerous applicants who require the services. The cost per applicant would therefore be a fraction of this. Unfortunately, the exact cost per applicant is difficult to determine primarily due to the data management problems discussed in Chapter 2.

Based on available data it is possible to calculate a rough estimate. In the year 2001 Ecology issued 50 Section 401 Water Quality Certifications (refer to Chapter 1 p.3 for a discussion of the 401 process) and also started regulating impacts to isolated wetlands that were no longer part of the 401 process (refer to p.3). Approximately 50 permits divided into $80,000 yields a cost of $1600 per permit ($80,000/~50 permits). However, a wetland impact fee should be assigned based on the size of the wetland impact, since a larger impact

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[1] The staff person should be an Ecology employee since Ecology is the state agency with regulatory oversight of wetland impacts.

[2] Currently, state funds (i.e., money from state taxpayers) are used to pay for staff to review permit applications for wetland impacts, thereby maintaining the public's stake in protection of wetland resources.

will typically require a larger compensation project, which will require more time to evaluate and follow-up on.

Likewise, specific information on the acreage of wetland impacts permitted in Washington over the course of a year is not readily available. Therefore, to generate an estimate an impact fee of $1600 will assume a wetland impact of one-acre. For example, the fee for an impact to half an acre would be $800, while the fee for an impact to five acres would be $8000. The fee would be collected when the permit is issued and based on the final acreage of authorized wetland loss, thus providing an incentive for applicants to avoid or minimize impacts so that they can eliminate or reduce their fees.

Impact fees would, of course, need to be collected from applicants for approximately a year prior to hiring a staff person in order for sufficient funds to accrue to pay the salary. During that time data on the acreage of wetland impacts occurring over a year will be collected to calculate a more exact cost of impact fees.

An alternative to charging applicants an impact would be to obtain state funding for the position. Currently state funding pays for employees to review permit applications. Why shouldn't the state also pay for someone to follow-up on the requirements of the permits that are issued? This alternative does not seem feasible since voter approved initiatives have reduced the state's tax base. State funding of one position will undoubtedly result in cutting funding for another position. In addition, funding for compliance with and enforcement of environmental laws has not been a high priority for state government (Chasan 2000).

Initially applicants will undoubtedly complain that impact fees are an unfair burden that previous applicants did not have to bear. Applicants probably had the same grievance when compensatory mitigation was first required. Just as information then indicated that impacts to wetland functions needed to be avoided or compensated for, so today information indicates that effective compensation requires regulatory follow-up.

The follow-up and compliance position would initially follow-up on permits that required individual compensation projects. However, interest and proposals for mitigation banking are increasing in Washington State. In a few years more banks will be available as an option to fill applicants' needs for wetland compensation. Certainly banks will not be able to compensate all wetland impacts, but over time the number of individual compensatory projects will diminish as wetland compensation is consolidated in banks. One bank could compensate for potentially hundreds of small wetland impacts.

Fewer consolidated compensation areas will require less time to follow-up on than numerous individual projects. Therefore the follow-up and compliance staff person will begin to have time to focus on additional duties that will improve both compensatory wetland mitigation as well as wetland resources in the state.

For example, to protect wetland resources, existing habitats and hydrologic processes must be preserved. In addition, degraded areas with the greatest potential must be targeted for restoration. Conversely, areas that are severely degraded and surrounded by development may offer little hope for restoration of hydrologic processes or significant wildlife habitat. Severely degraded areas may therefore need to be sacrificed in order to secure the protection and restoration of the areas with potential. In other words, a landscape-based approach to wetland management and compensation should be fostered. Fostered is the key word because these efforts are already underway both on the local (basin or sub-basin) and state (WRIA) level.

State wetland regulatory staff positions currently provide technical assistance to local jurisdictions (e.g., training, information sharing, providing feedback and comments on specific projects and critical area ordinances, etc.) as part of their assigned duties. The new follow-up staff position could also provide technical assistance to local governments, particularly to help them with their landscape level assessments. Landscape level assessments will provide spatial information to help regulators make more informed decisions about wetland impacts and compensation, and where to site non-regulatory restoration projects. Additionally, landscape level assessments will improve comprehensive planning and zoning, thereby allowing local governments to direct development activities away from priority wetland areas. When a comprehensive plan targets development for an area containing severely degraded wetlands, impacts, and therefore compensation, could be planned for, thus providing opportunities for advance wetland compensation.

As more landscape-level assessments are completed by jurisdictions across the state, the staff position should coordinate with them to incorporate their information into a state-wide wetland program. This program would include wetland mitigation banks, in-lieu fee program(s), and designated mitigation areas (described on pages 129-130).

Restoration of areas identified as priorities in a landscape level assessment should result in significant improvement to hydrologic and wildlife functions over time. Review and approval of wetland mitigation banks should also be more timely and efficient when banks are proposed for areas prioritized in landscape level assessments. Likewise, the presence of banks, in-lieu fee areas, and designated mitigation areas in a basin or jurisdiction should reduce permit approval times since most wetland compensation could be sent to the larger established areas rather than reviewing and approving individual mitigation plans.

Establishing an in-lieu fee program will require some initial time and planning to figure out who will receive the funds, who will conduct the restoration/enhancement actions, and who will manage the site over the long-term. Once these issues are decided, in-lieu fee programs could be used to fill in the gaps. For example, fees from an in lieu program could purchase and enhance a riparian corridor to connect two banks or existing wildlife areas. Fees could also be used to buy land or obtain a conservation easement, thereby providing an effective buffer around an existing wetland. Fees could additionally be used to develop an overall restoration plan for a county's designated mitigation area. Individual applicants wishing to use the mitigation area to compensate for their wetland impacts would then be responsible for implementing a portion of the existing restoration plan.

If developed properly, banks, in-lieu fee, and designated mitigation areas should compliment one another, thereby resulting in significant improvement of wetland functions on a landscape level (e.g., hydrologic processes, wildlife habitat). In addition, the existence of various compensation options should enable regulators at every level (local, state, and federal) to require compensation for small wetland impacts that are currently below most regulatory thresholds. For example, some Corps nationwide permits merely require that applicants notify the Corps about wetland impacts, but compensation is typically not necessary. Furthermore, the state of Washington typically approves wetland impacts of less than 0.1 acre without stipulating any compensation requirements (the rationale being that staff time is better spent reviewing the impacts and compensation for larger projects). These cumulative losses of wetland acreage and function should be addressed, and programmatic mitigation approaches will provide an efficient means to do so.

Obviously, the staff position identified to perform follow-up and compliance tracking, funded by impact fees, may not be able to perform all duties described as part of this plan. The author believes that it will take many years to realize all aspects of this plan. As one aspect gets implemented efficiencies should occur. For example, if a position is created to perform follow-up and compliance tracking, it should free up a bit of time for permit reviewers who previously had to perform this task, albeit in a limited capacity. At Ecology permit reviewers also provide technical assistance to local jurisdictions. Permit reviewers could therefore spend more time providing technical assistance to local jurisdictions as they conduct their landscape-level assessments.

Furthermore, completion of landscape-level assessments and their incorporation into comprehensive plans and zoning should make permit review more efficient, thereby freeing up more time for both local government and Ecology personnel. This "extra" time could then be used to help get the wetland program started.

This thesis provides a general description of a plan to improve compensatory wetland mitigation and the status of wetland resources in the state. However, there are a few considerations and a few cautions that need to be addressed. First, this plan must consider stormwater and find ways to integrate stormwater management with wetland compensation. Since the programmatic mitigation approaches previously outlined would result in off-site and possibly out-of-basin compensation, how would on-site water quality and quantity issues be dealt with?

New developments should require stormwater treatment for their impervious footprint, while compensation for any wetland impacts needs to be in addition to the requirements for stormwater treatment. For example, a warehouse facility would need to install a stormwater treatment system to detain the surface water run-off produced by the facility's impervious surfaces. The stormwater treatment system should be designed to provide initial water quality treatment, such as retaining sediments and pollutants adhered to the sediments. If construction of the warehouse facility also resulted in permitted wetland losses, then wetland compensation would be required in addition to and separate from stormwater treatment.

However, compensatory wetlands could receive hydrologic inputs from a stormwater treatment system. Treated stormwater can provide a supplementary source of water for a compensatory wetland, and the wetland can provide tertiary treatment resulting in greater water quality improvements. Likewise, the same compensatory wetland, with the proper design, can also provide a refuge for common urban wildlife (song sparrows, marsh wrens, rabbits, raccoons, mallards, dragon flies) as well as reducing storm flows and providing some infiltration.

There are concerns about allowing impacts to wetlands to be compensated off-site. Some wetland functions that were lost may be needed on-site to prevent flooding, water quality degradation, or loss of salmonid habitat. On suggestion would be to splitup the replacement of functions, such that some functions would be replaced on-site, while other functions would be compensated off-site, perhaps at a mitigation bank. Along these lines, biologically engineered stormwater treatment could, if designed properly, compensate for lost wetland functions as well as run-off needs. However, off-site compensation of functions may result in a relocation of wetland functions, particularly wildlife habitat, from urban to rural areas.

This leads to a second consideration, the importance of preserving existing functional wetlands. Preservation should be a part of every compensation package since existing wetlands and wetland-upland mosaics are already functional habitats, and by permanently protecting these areas temporal loss of wildlife habitat can be minimized.

Rather than requiring an individual project with a small impact to preserve a small area, preservation should be administered through programmatic mitigation approaches, such as banks that have preserved large areas of high quality wetlands or mosaic habitats. Alternatively, an in-lieu program could be used to preserve upland/riparian corridors that connect existing wetland and wildlife habitats.

Regarding cautions, it is not clear who would require impact fees. Should all agencies (federal, state, and local) require a fee for the impacts authorized through the permits they issue? Collection of fees may be politically unpopular and could be viewed as an economic hardship, particularly if all agencies had a fee. It would therefore be difficult to initiate. The author suggests that Ecology should collect the impact fee since Ecology can regulate impacts to all wetlands that are waters of the state. However, Ecology currently lacks legislative authority to collect such a fee for wetland impacts.

A second caution, the author provided a rough estimate for the cost of an impact fee that is based on amount of wetland area that will be lost. If the amount of wetland losses is dramatically reduced, how will this affect the follow-up and compliance position? Would impact fees have to increase to cover the cost of this position?

A possible solution would be to initiate an experimental study the first year of the new follow-up position. All of the permits issued for projects requiring compensatory mitigation during that first year would be randomly assigned to one of two groups: Follow-up; or No follow-up. The study would last through the duration of the projects' monitoring periods. At the end of each project's monitoring period it would be evaluated to determine if it was in compliance with its permit requirements, and if it effectively compensated for lost wetland functions (i.e. was successful). The specific parameters of the study will need to be identified, but essentially the projects assigned to the follow-up group would receive site visits and other regulatory input during the monitoring period, while projects in the no follow-up group would not receive any regulatory consideration for the duration of their monitoring periods.

The purpose of this study would be to test the hypothesis that regulatory follow-up significantly improves project compliance/success. If this hypothesis is supported, the state would be remiss in not financially supporting a follow-up position, should the number of permits and impact fees decline.

A final caution, it is not known how much programmatic mitigation approaches would cost applicants. Mitigation banks, if operated by private entrepreneurs, are a for profit venture. It is, therefore, up to the banker to determine how much to charge applicants for compensation acreage/credits. In the case of in-lieu fees, it is also not known how much to charge applicants so that compensation for wetland impacts could be accomplished. Without knowing how much these fees and programs would cost applicants, it is possible that it would be cost prohibitive. If costs were too high, applicants would continue to do their own "postage stamp" compensation projects. If costs were too low, applicants would buy into it, but the funds received would not be sufficient to conduct the required restoration work.

Despite these cautions, the author believes this plan will result in improvements to compensatory wetland mitigation, net gains in wetland functions, and improvements in the status of wetland resources in the state.

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Appendix A – Figures

Figure 1. Relative Locations of Wetland Compensatory Mitigation Sites

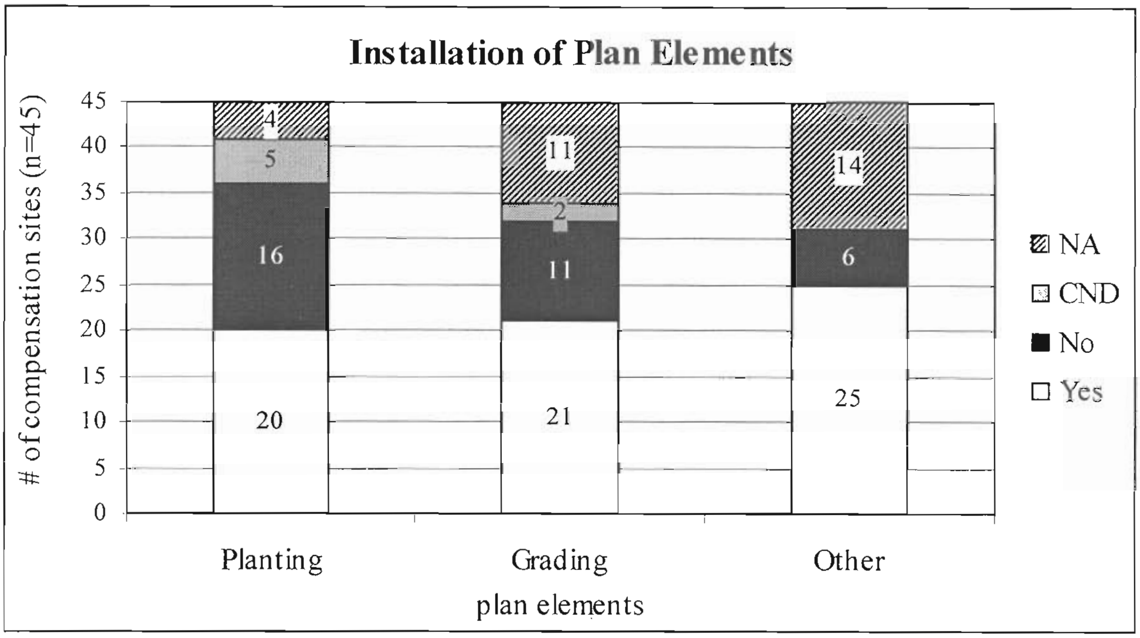

Figure 2 Depicts the elements of mitigation plans that were evaluated to determine whether a project was installed according to plan. Forty-five projects were considered. Yes indicates those elements that were installed to plan. No= elements not installed to plan. CND= could not determine if the element was installed to plan. NA= not applicable, an element that was not part of a particular project's plan.

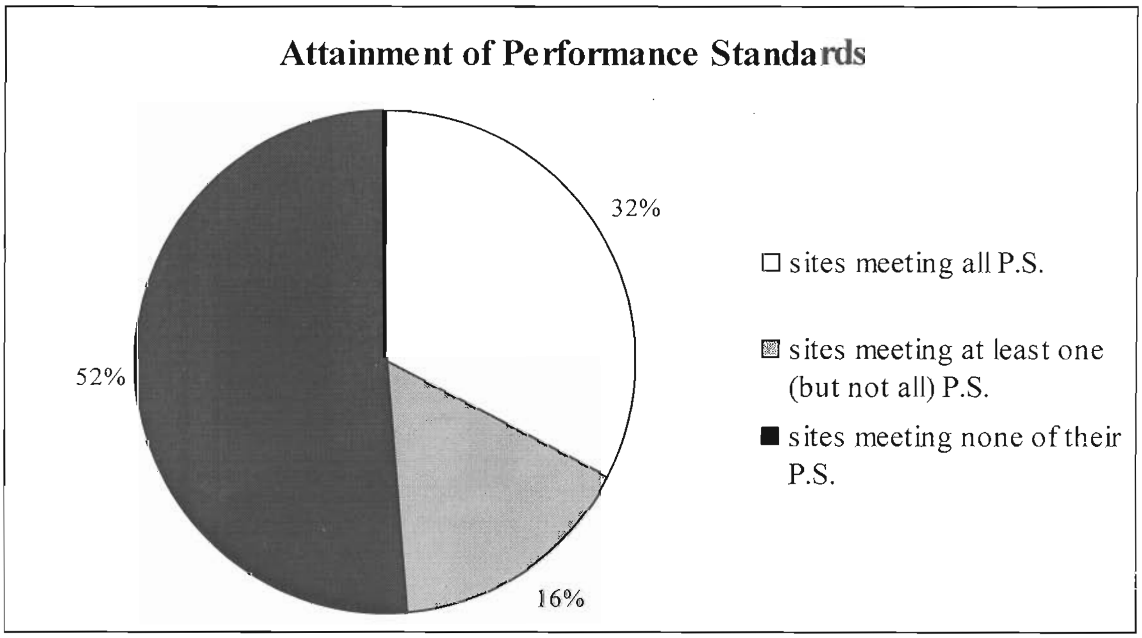

Figure 3 This evaluation considered 37 projects with assessable performance standards (P.S.). It excludes 6 projects that did not have performance standards and 2 projects that did not have any performance standards assessable by the methods of this study.

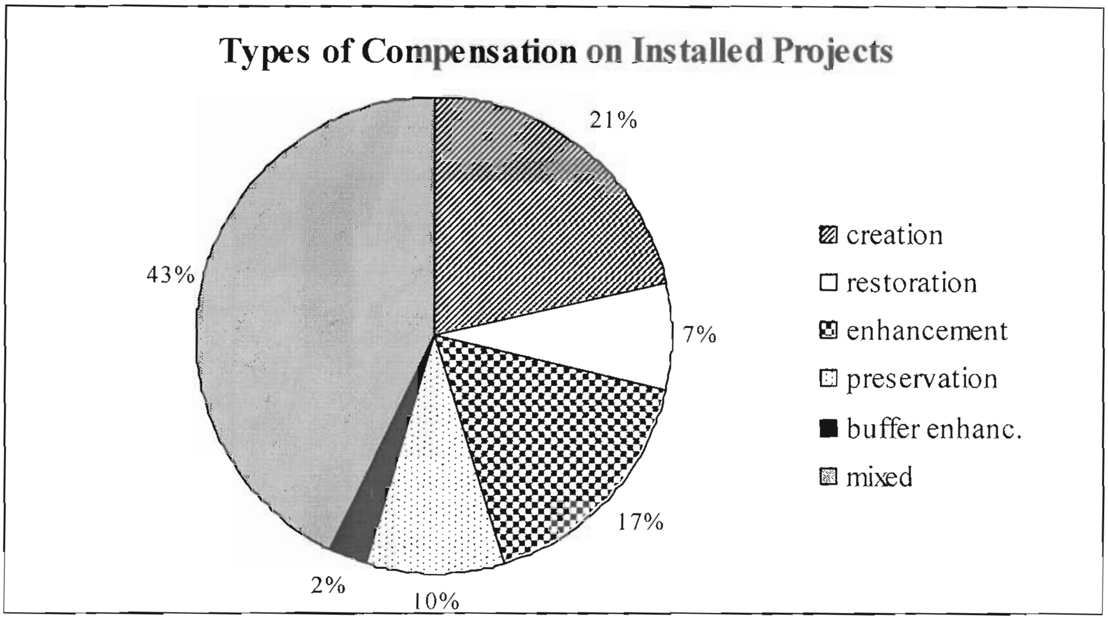

Figure 4 This pie chart shows the percentage of projects that implemented each type of compensation as a single activity and the percentage of projects that implemented a combination (mixture) of compensatory types. Forty-two projects were considered (excludes the 3 projects that were not installed).

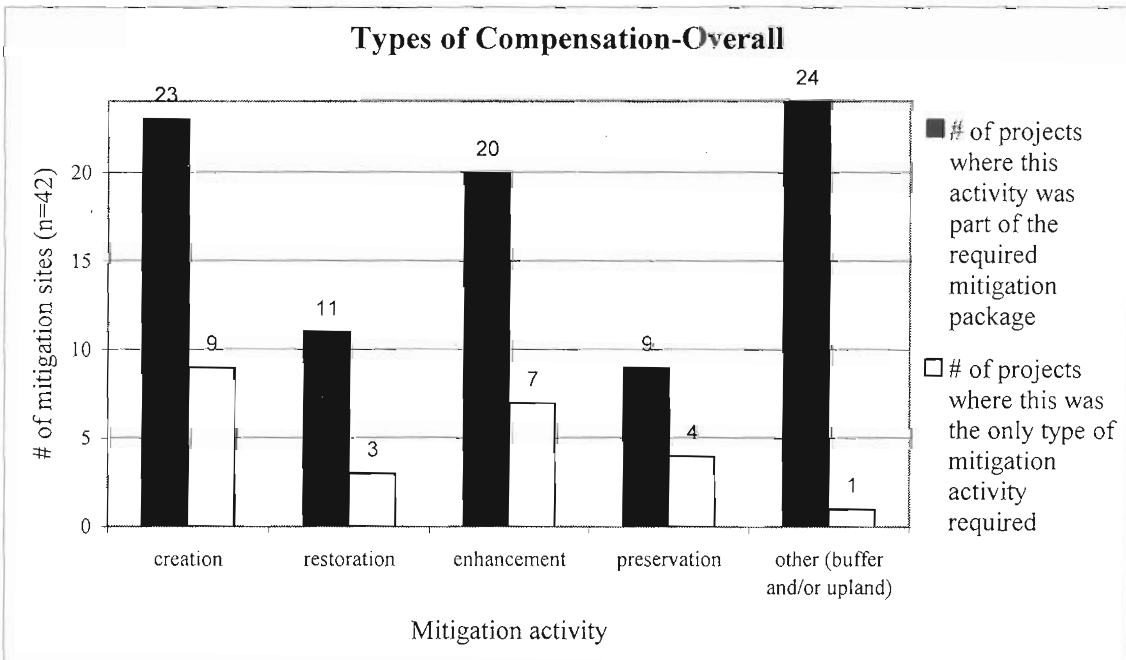

Figure 5 Number of sites implementing each type of compensatory activity. Black bars indicate the total number of sites that implemented each type of compensation, while the white bars indicate the number of sites implementing that type of compensation as a single activity.

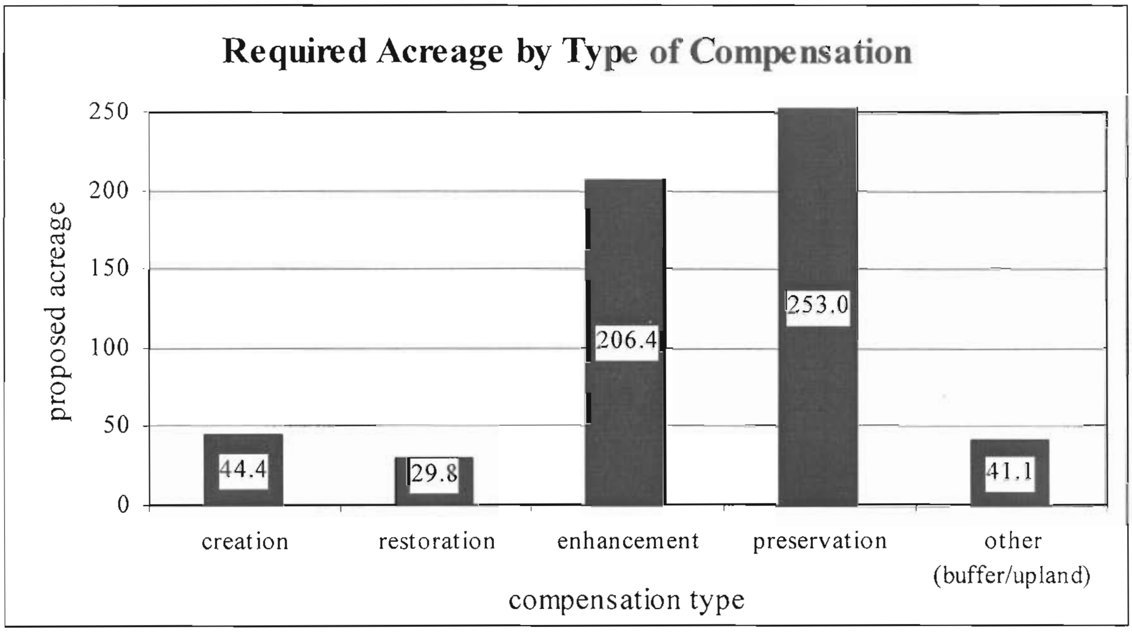

Figure 6 Numbers within the bars indicate the required acreage of compensation for each activity. Forty-one projects were considered. This excludes the 3 projects not installed and the buffer-only enhancement project, which specified no acreage.

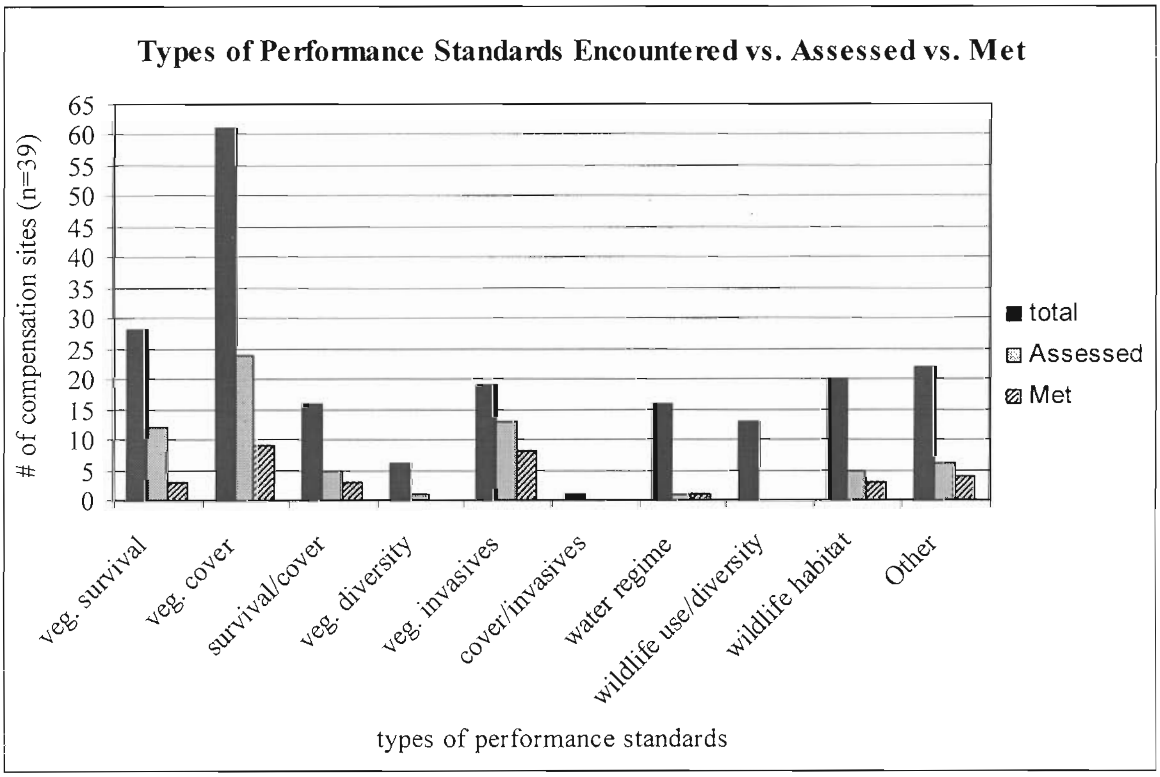

Figure 7 Depicts the variation for 10 performance standard categories between the total number of performance standards encountered, the number that were assessed, and the number that were met. Thirty-nine projects were considered for this evaluation, and there were 202 performance standards considered. This excludes 4 preservation-only projects and 2 projects with no performance standards.

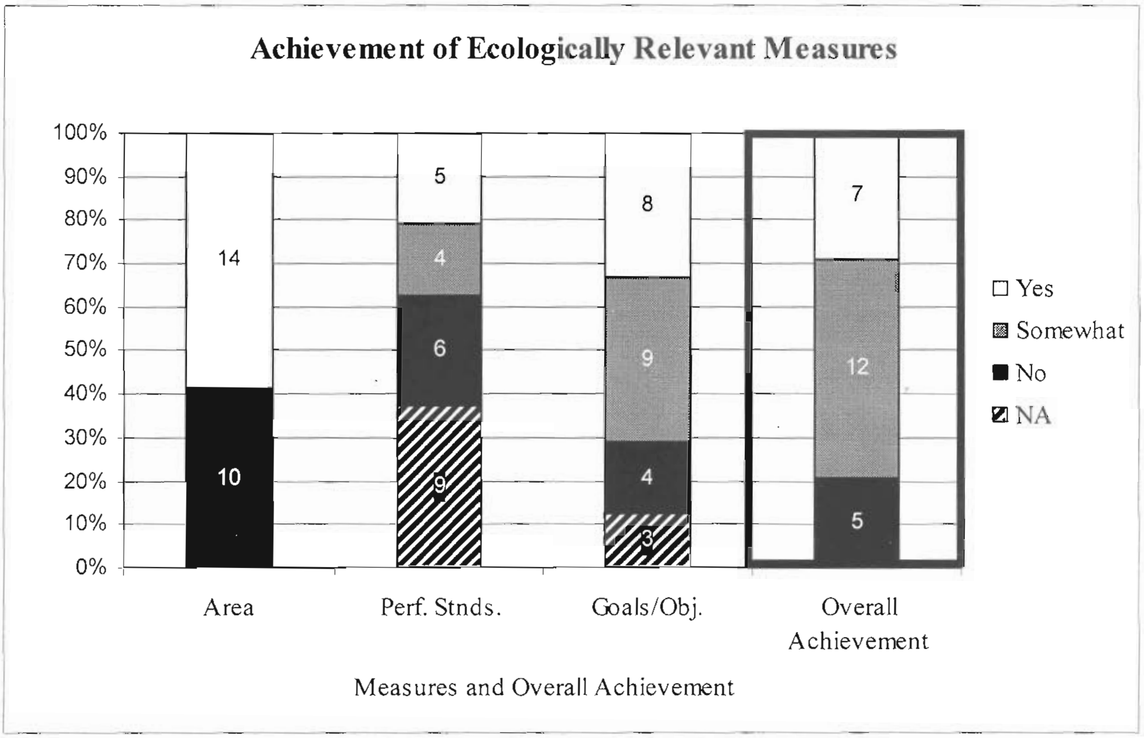

Figure 8. Percentage of projects achieving each measure: 1) establishing required acreage of mitigation; 2) attaining significant PS; 3) fulfilling appropriate G/O; and 4) overall achievement of measures. This analysis included all 24 projects.

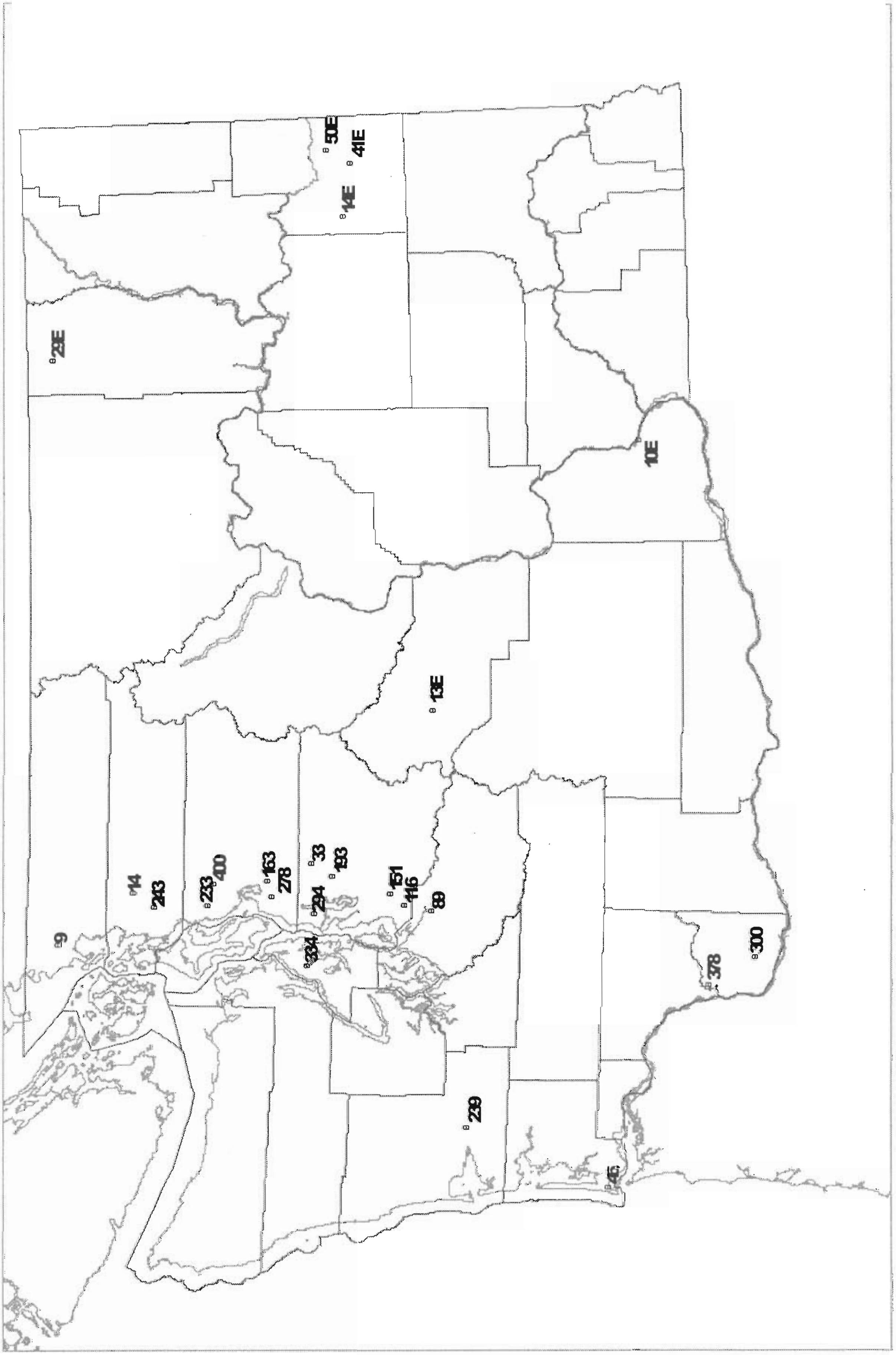

Figure 9. Approximate locations of the 24 projects evaluated in the Phase 2 study.

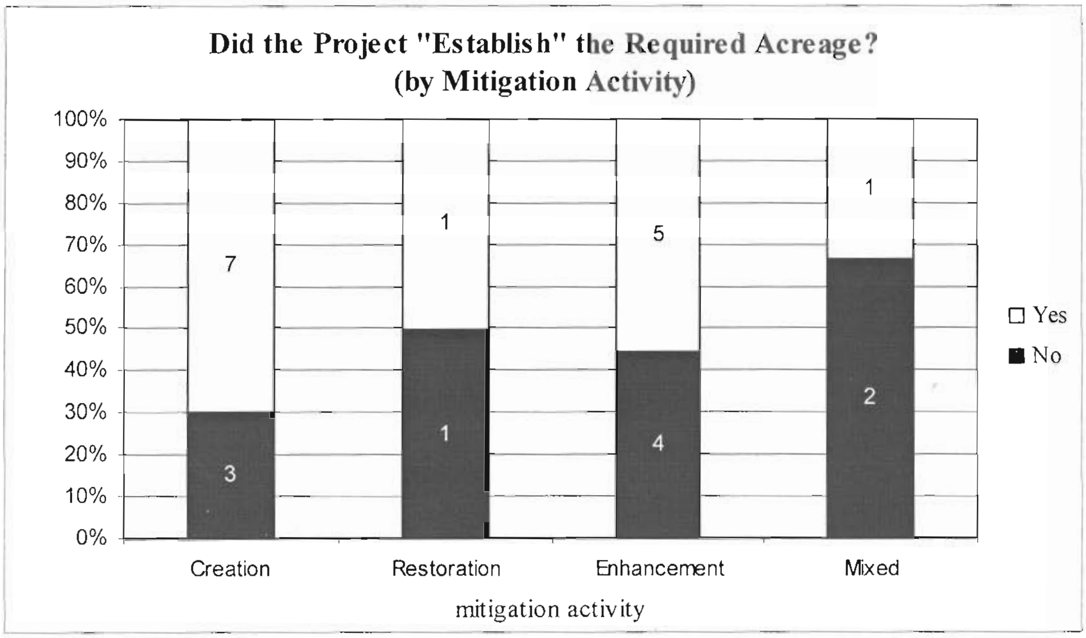

Figure 10 Relative percentage of projects in each category of mitigation activity (type of compensation) that either did or did not establish the required acreage of mitigation (n=24).

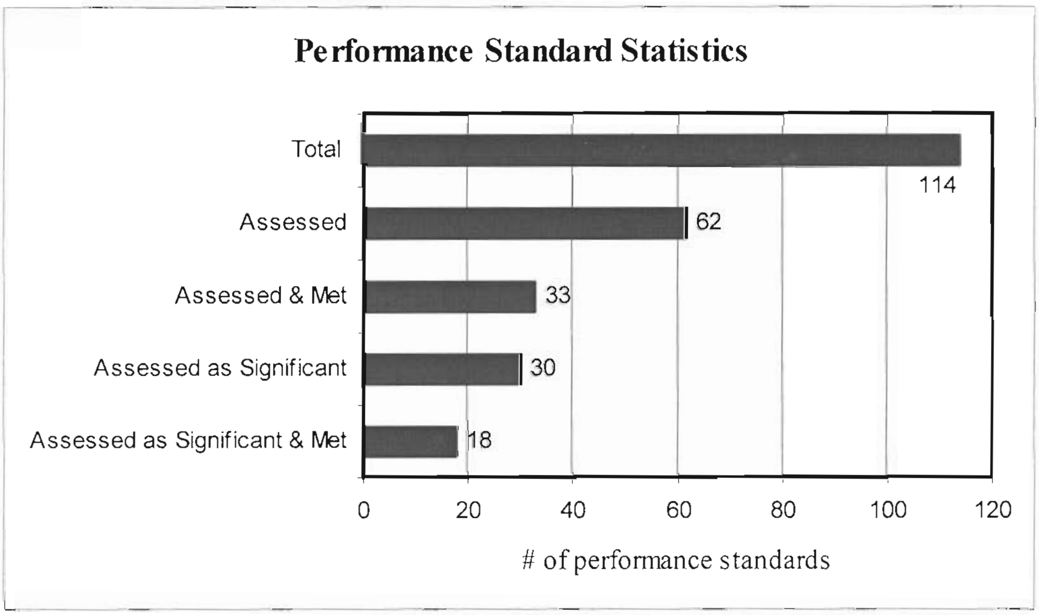

Figure 11 Comparison of the total number of performance standards encountered, the total number assessed, the total number attained of those assessed, then the number of performance standards that were considered significant of the total number that were assessed, and the number of significant assessed performance standards that were met.

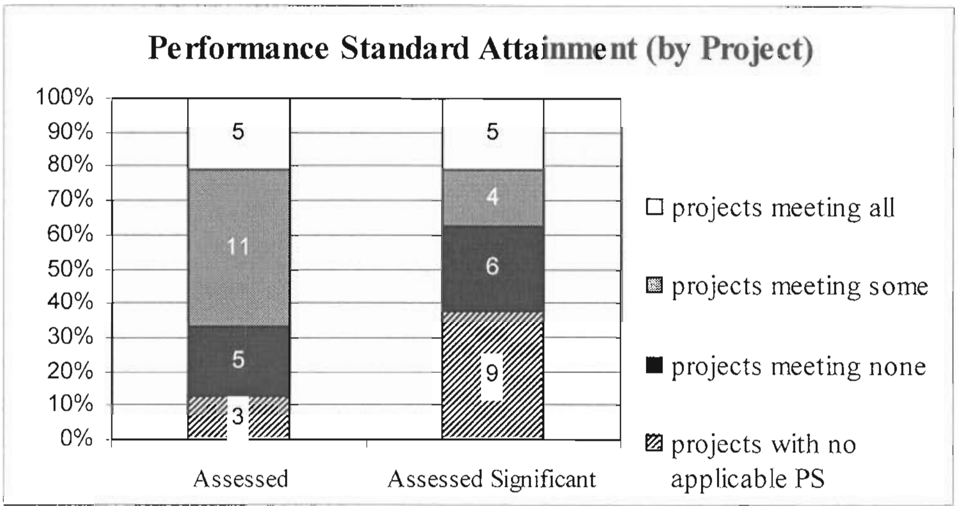

Figure 12 Performance standard (PS) attainment by relative percentage of projects for two categories: all assessed PS, and assessed PS that were determined to be significant (n=24 projects).

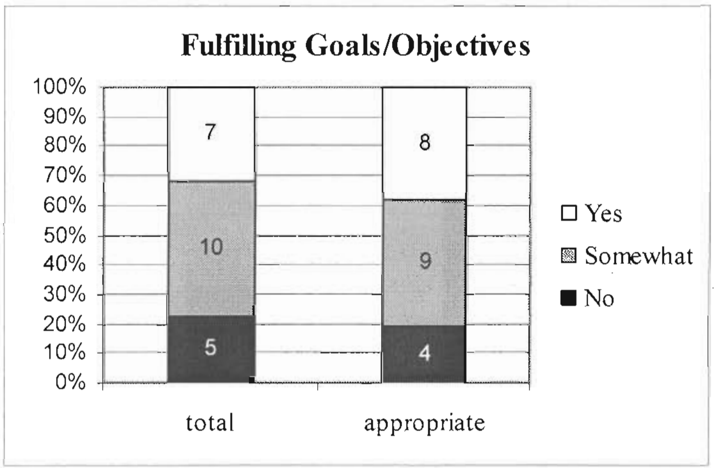

Figure 13 Comparison of the relative percent of projects fulfilling all goals and objectives versus the percent of projects fulfilling those goals and objectives judged to be appropriate. Yes = fulfilling all goals/objectives; Somewhat = fulfilling some but not all; and No = not fulfilling any.

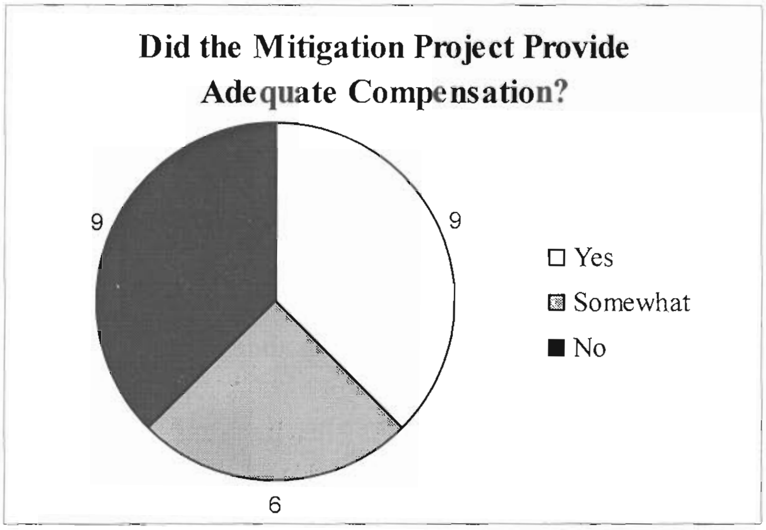

Figure 14 Distribution of the 24 projects into one of the three categories of compensation for the impact (n=24 projects).

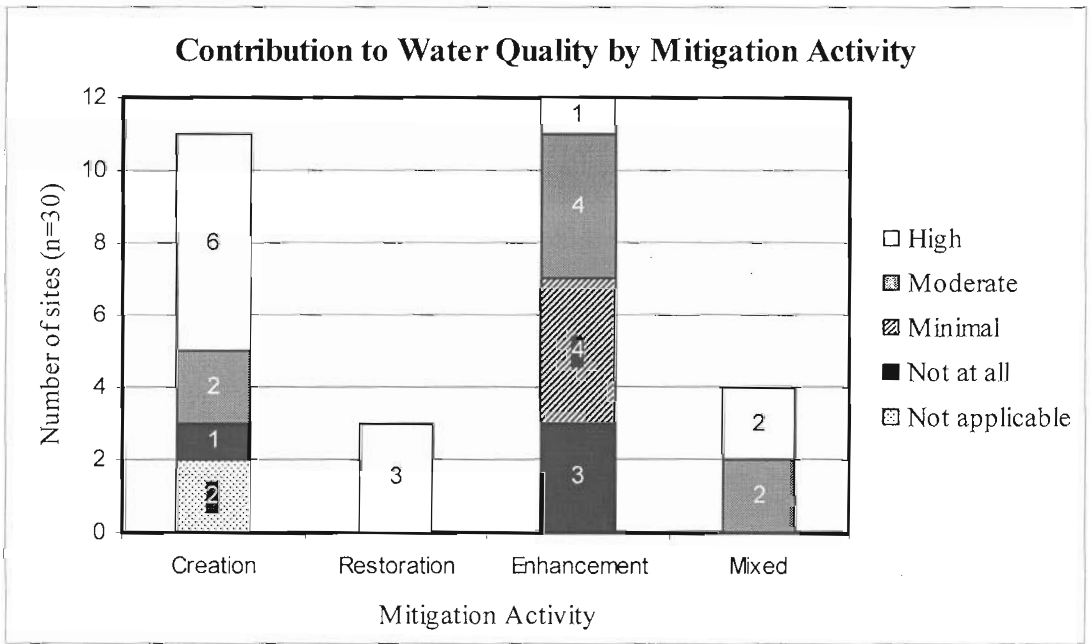

Figure 15 Comparison of the level of contribution to water quality functions for each mitigation activity.

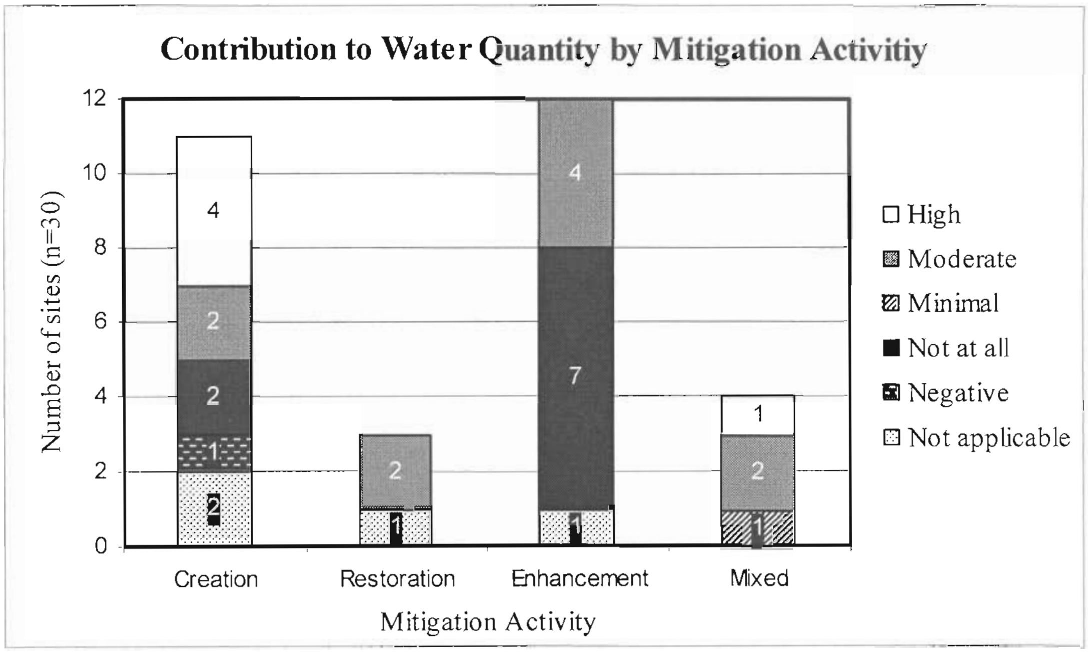

Figure 16 Comparison of the level of contribution to water quantity functions for each mitigation activity.

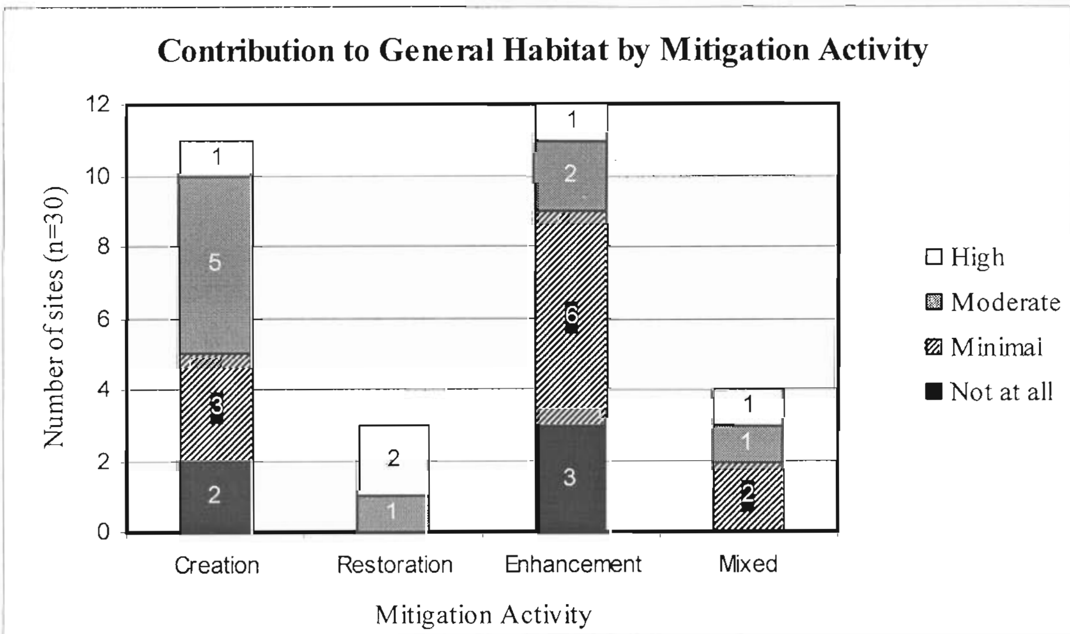

Figure 17 Comparison of the level of contribution to the general habitat function for each mitigation activity.

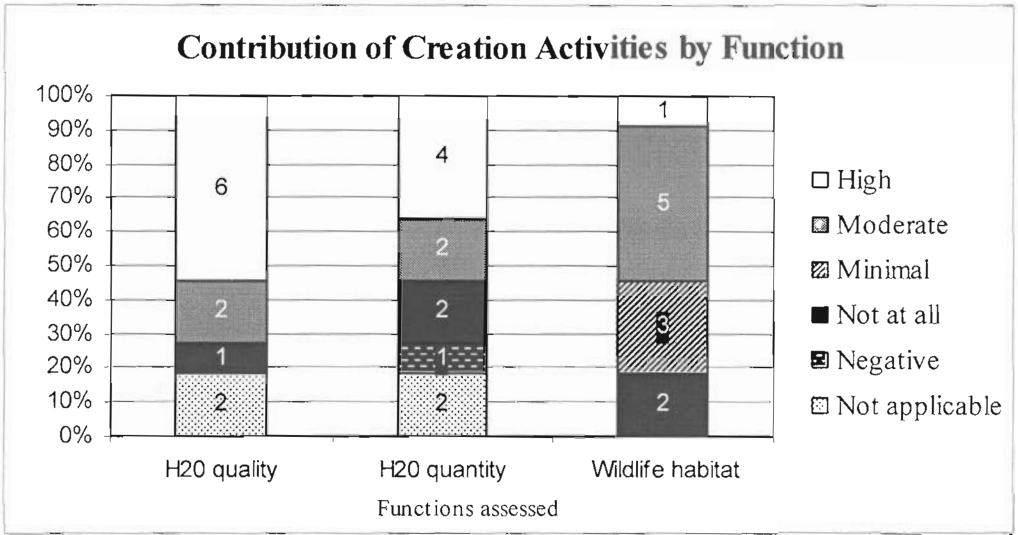

Figure 18 Comparison of the level of contribution to each of the three functions by percentage of sites that performed predominantly creation activities (n=11sites).

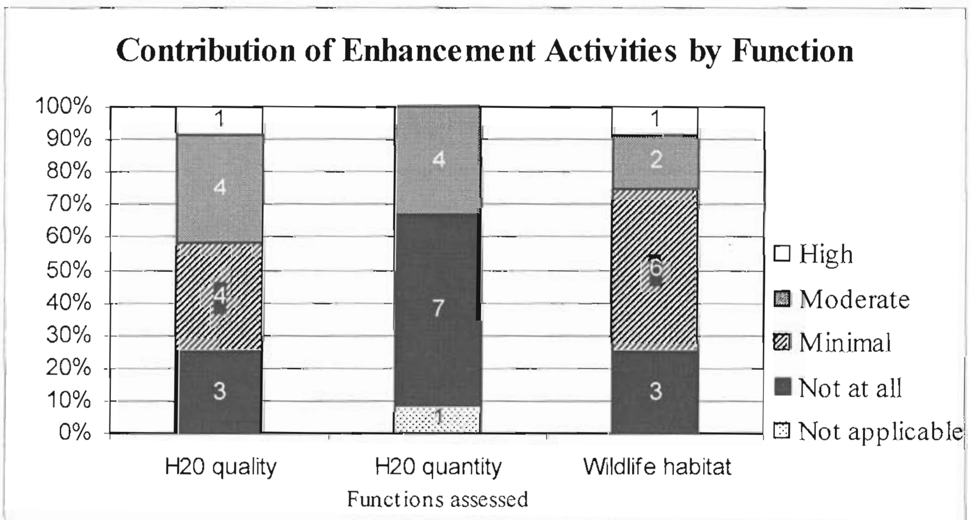

Figure 19 Comparison of the level of contribution to each of the wetland functions by percentage of sites that performed predominantly enhancement activities (n=12 sites).

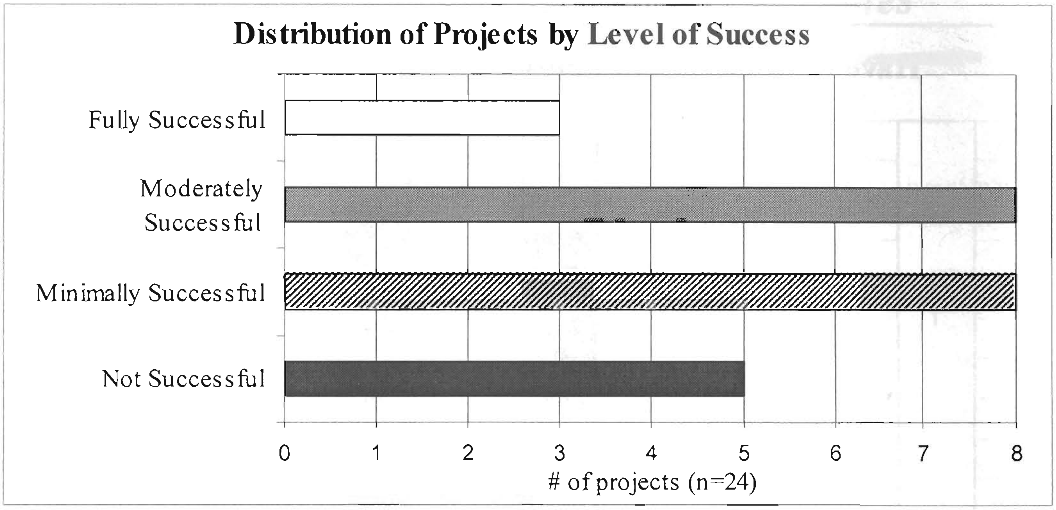

Figure 20 Distribution of 24 projects into four levels of success, based on whether the project compensated for the impacts to wetlands and whether the project achieved its ecologically relevant measures.

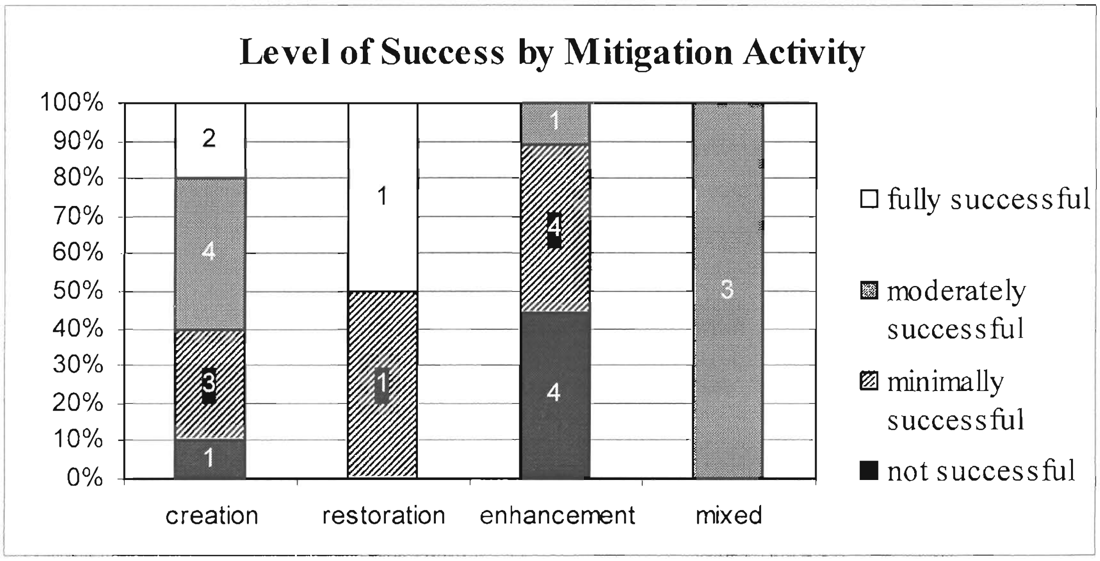

Figure 21 Comparison of level of success for each of the mitigation activities evaluated. Projects were assigned to a mitigation activity based on the predominate activity performed (>75% of the required mitigation acreage). n=24 projects.

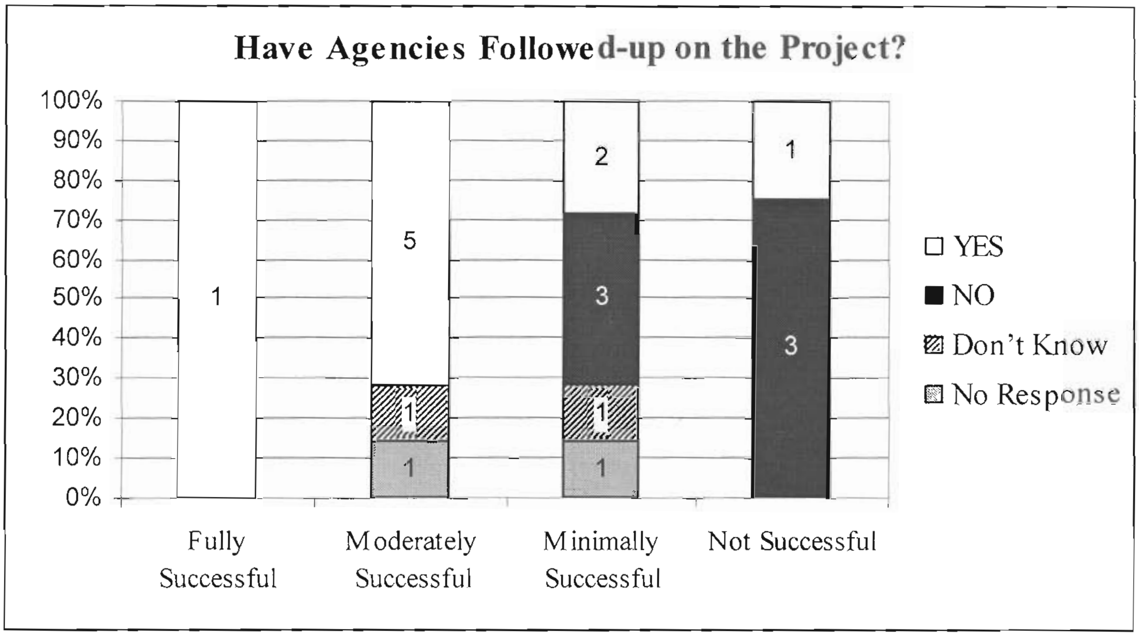

Figure 22 Comparison of agency follow-up with project level of success (n=19). Yes= follow-up occurred. No= there was no follow-up. Don't know=whoever responded to the questionnaire did not know if follow-up occurred. No response=there was no response to this question.

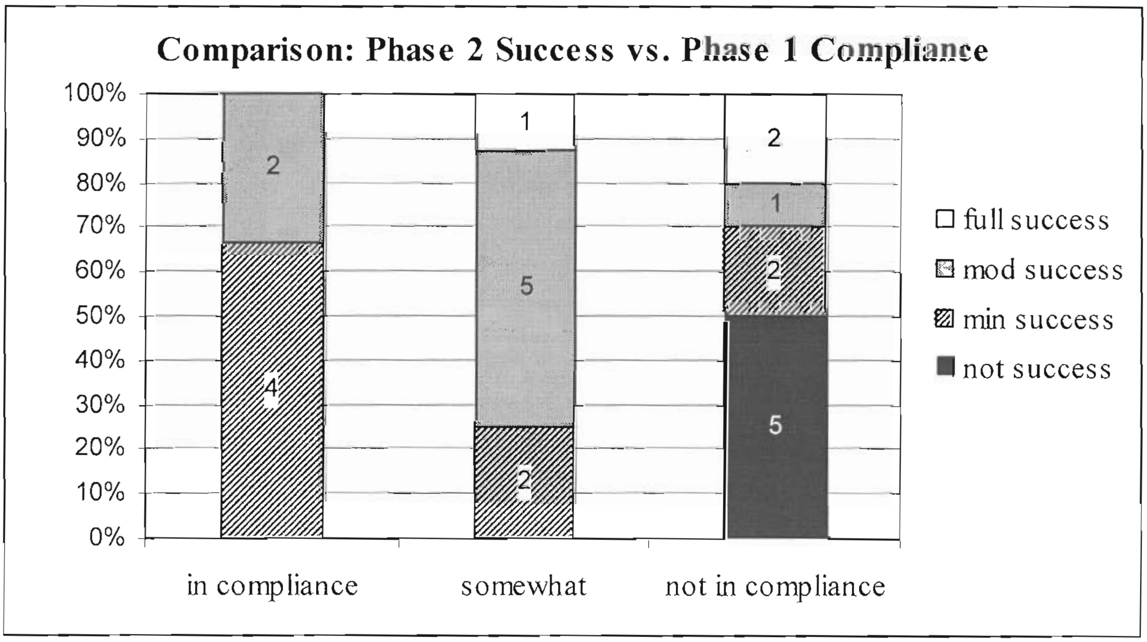

Figure 23 Comparison of level of success (Phase 2 results) with level of compliance (Phase 1 results) (n=24).

Appendix B – Raw Data Tables

Table B.1 Phase I Raw Results

site #	County	impact size (acres)	mitigation size (acres)	creation acreage	restor. acreage	enhanc. acreage	preserv. acreage	buffer/ upland acreage	age of mit	built?	built to plan?
8	Grays Harbor	4.92	205.05	0.32	8.22	84.47	112.04	0	<1	Y	N
9	Whatcom	21.1	96.1	16.1	0	5	75	riparian	5 & 4	Y	Y
11	Pacific	1.57	11.36	0	0.37	0	10.99	0	NA	Y	Y
14	Skagit	1.76	4.21	0	0	2.21	0	2	2+	Y	Y
17	Pacific	1.43	10	0	0	0	8.3	1.7	NA	Y	Y
33	King	0.07	0.14	0.14	0	0	0	0	2+	Y	N
46	Pacific	0.24	0.3	0.3	0	0	0	0	6	Y	N
55	Snohomish	0.94	7.54	0.12	0	3.09	0	4.33	<1	Y	Y
62	Mason	0.31	0.62	0.18	0.44	0	0	0	1+	Y	N
89	Pierce	2.2	3.6	0.98	0	0.96	0	1.66	4+	Y	Y
99	Clark	1.84	0	0	0	0	0	yes	2+	Y	CND
116	King	17.4	56.5	1.5	9.2	45.8	0	0	2+	Y	Y
125	Pacific	0.47	3.65	0	0.15	0	3.5	0	NA	Y	Y
151	King	0.98	1.6	0	1.4	0.2	0	0	<7	Y	Y
163	Snohomish	1.84	7	0	1.97	3.78	0	1.25	2+	Y	Y
180	Snohomish	2.53	3.22	2.63	0.19	0	0	0.4	<1	Y	N
193	King	1.59	5.82	1.75	0	1.57	0	2.5	2+	Y	Y
204	Cowlitz	2.68	4.28	0	4.28	0	0	yes	<1	Y	Y
218	Lewis	1.17	1.75	0.55	0	1.2	0	riparian	NA	N	N
232	Snohomish	0.79	0.79	0.79	0	0	0	yes	<1	Y	N
233	Snohomish	0.41	0.82	0	0.82	0	0	0	<3	Y	N
239	Grays Harbor	0.14	0.21	0.09	0	0.12	0	0	5+	Y	CND
243	Skagit	1.99	4	0	0	4	0	0	3	Y	Y
278	Snohomish	0.06	0.28	0.28	0	0	0	yes	3+	Y	Y
289	Whatcom	1.83	10	6	0	0	0	4	1+	Y	N
290	Pacific	0.7	0.7	0	0	0	0.7	0	NA	Y	Y
294	King	0.22	2.71	0.21	0	0	2.5	0	4+	Y	Y
299	Clark	0.83	0.56	0	0	0.56	0	0	NA	N	N
300	Clark	1.31	3.54	0	0	3.49	0	0.05	5+	Y	Y
305	Clark	2.15	10.9	0	0	10.9	0	0	1+	Y	N
325	King	0.86	1.32	0.88	0	0.44	0	0	<1	Y	Y
334	Kitsap	0.67	2.86	0	0	0.9	0	1.96	3	Y	N
336	King	2.83	6.83	0	2.06	4.01	0	0.76	1+	Y	Y
357	Clark	6.55	34.9	3.5	0	9.02	19	3.38	<1	Y	Y
378	Clark	1.6	6.86	0	0	6.86	0	yes	1+	Y	N
389	Clark	1.97	43.82	0	0	8	21	14.82	1+	Y	Y
398	Wahkiakum	2.7	2.7	2.7	0	0	0	yes	NA	N	N
400	Snohomish	1.54	4.62	2.03	0	0.32	0	2.27	2 & 1	Y	Y
7E*	Franklin	0.27	0.54	0.54	0	0	0	yes	5+	Y	N
10E	Benton	0.13	0.137	0	0.137	0	0	0	<3	Y	N
13E	Kittitas	0.9	2.47	1.92	0.55	0	0	yes	2+	Y	Y
14E	Spokane	0.141	0.144	0.144	0	0	0	yes	4+	Y	N
29E	Ferry	0.935	9.5	0	0	9.5	0	riparian	6+	Y	CND
41E	Spokane	1.87	3.53	3.53	0	0	0	0	2+	Y	N
50E	Spokane	0.09	0.46	0.46	0	0	0	yes	4+	Y	N
Total		**98.53**	**577.94**	**47.64**	**29.79**	**206.4**	**253.03**	**41.08**		**42**	**23**

Table B.1 Phase I Raw Results

Site #	total # of Perform. standards	# of P.S. assessed	# of P.S. met of those assessed	P.S. met?	as-built required?	as-built found?	monitoring required?	monitoring found?	deed restriction required?	deed restriction found?
8	5	1	1	Y	Y	N	Y	N	Y	Y
9	11	5	4	N	Y	Y	Y	Y	Y	Y
11	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y
14	9	3	3	Y	Y	Y	Y	Y	Y	N
17	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y
33	3	1	1	Y	N	NA	N	NA	N	NA
46	0	0	0	NA	Y	N	Y	N	Y	N
55	3	1	1	Y	N	NA	N	NA	N	NA
62	1	1	0	N	Y	N	Y	N	N	NA
89	4	3	1	N	N	NA	N	Y (NA)	N	NA
99	1	1	0	N	Y	N	Y	N	Y	N
116	26	4	0	N	Y	Y	Y	Y	Y	Y
125	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y
151	4	3	2	N	Y	Y	Y	Y	N	N
163	9	1	0	N	Y	Y	Y	N	Y	Y
180	3	0	0	CND	Y	N	Y	N	Y	N
193	6	5	4	N	Y	Y	Y	N	Y	N
204	6	1	1	Y	Y	Y	Y	N	Y	N
218	15	NA	0	N	Y (NA)	NA	Y (NA)	NA	Y(NA)	NA
232	4	3	0	N	N	Y (NA)	N	NA	N	NA
233	10	2	0	N	N	NA	N	NA	N	NA
239	1	1	0	N	Y	N	Y	N	N	NA
243	2	0	0	CND	Y	Y	Y	Y	Y	N
278	4	2	2	Y	Y	Y	N	NA	Y	N
289	14	1	1	Y	Y	Y	Y	N	Y	Y
290	NA	NA	NA	NA	NA	NA	NA	NA	Y	Y
294	3	1	1	Y	Y	N	Y	Y	Y	Y
299	1	NA	0	N	Y	NA	Y	NA	Y	NA
300	2	2	1	N	N	NA	Y	Y	N	NA
305	3	2	0	N	Y	N	Y	N	Y	N
325	3	1	1	Y	CND	Y	CND	N	CND	N
334	2	2	0	N	CND	N	CND	N	CND	N
336	9	1	0	N	Y	Y	Y	N	Y	N
357	4	2	0	N	Y	Y	Y	Y	Y	Y
378	2	2	0	N	Y	N	Y	Y	Y	N
389	4	3	3	Y	Y	Y	Y	Y	Y	Y
398	7	NA	0	N	Y	NA	Y	NA	N	NA
400	3	2	2	Y	Y	Y	Y	Y	Y	N
7E*	1	1	0	N	N	NA	Y	N	N	NA
10E	1	1	0	N	Y	N	Y	N	Y	N
13E	6	1	1	Y	Y	Y	Y	Y	Y	N
14E	0	0	0	NA	N	NA	N	NA	Y	N
29E	1	1	0	N	Y	N	Y	Y	Y	N
41E	3	2	1	N	Y	N	Y	Y	N	NA
50E	6	4	0	N	Y	N	Y	N	Y	N
Total	**202**	**67**	**31**	**12**	**31**	**17**	**32**	**15**	**31**	**12**

*E = projects from east of the crest of the Cascade Mountains.

N= No; Y= Yes; NA= Not applicable; CND= Could not determine

Table B.2. Implementation of Plan Elements

Site #	Planting	Grading	Other	Implemented to Plan?
8	No	No	Yes	No
9	Yes	Yes	Yes	Yes
11	NA	NA	Yes	Yes
14	Yes	NA	Yes	Yes
17	NA	NA	Yes	Yes
33	No	No	NA	No
46	No	Yes	No	No
55	Yes	Yes	Yes	Yes
62	No	No	NA	No
89	Yes	Yes	Yes	Yes
99	CND	NA	NA	CND
116	Yes	Yes	Yes	Yes
125	NA	NA	Yes	Yes
151	Yes	Yes	Yes	Yes
163	Yes	Yes	Yes	Yes
180	No	No	NA	No
193	Yes	Yes	Yes	Yes
204	Yes	Yes	Yes	Yes
218	No	No	No	No
232	No	No	Yes	No
233	No	CND	NA	No
239	CND	Yes	NA	CND
243	Yes	NA	NA	Yes
278	Yes	Yes	Yes	Yes
289	No	Yes	Yes	No
290	NA	NA	Yes	Yes
294	Yes	Yes	Yes	Yes
299	No	No	No	No
300	Yes	NA	Yes	Yes
305	CND	Yes	No	No
325	Yes	Yes	Yes	Yes
334	No	NA	NA	No
336	Yes	Yes	Yes	Yes
357	Yes	Yes	Yes	Yes
378	Yes	No	No	No
389	Yes	NA	Yes	Yes
398	No	No	NA	No
400	Yes	Yes	NA	Yes
Totals				
Yes	19	18	23	22
No	12	9	5	14
CND	3	1	0	2
NA	4	10	10	0

Table B.2 ***continued***

Site #	Planting	Grading	Other	Implemented to Plan?
7E	No	CND	No	No
10E	No	Yes	NA	No
13E	Yes	Yes	Yes	Yes
14E	No	Yes	Yes	No
29E	CND	NA	NA	CND
41E	CND	No	NA	No
50E	No	No	NA	No
Totals				
Yes	1	3	2	1
No	4	2	1	5
CND	2	1	0	1
NA	0	1	4	0

Overall				
Totals	Planting	Grading	Other	Implemented to Plan?
Yes	20	21	25	23
No	16	11	6	19
CND	5	2	0	3
NA	4	11	14	0

CND = Could not determine
NA = Not applicable

Table B.3. Phase 2 Raw Results

Project #	County	wetland impact (acres)	required wetland mitigation (acres)	required creation acreage	required restoration acreage	required enhancement acreage	other required mitigation acreage
9*	Whatcom	21.1	21.1	16.1	0	5	75 (preservation)
14	Skagit	1.76	2.21	0	0	2.21	2 (buffer/upland)
33	King	0.07	0.14	0.14	0	0	0
46	Pacific	0.24	0.3	0.3	0	0	0
89	Pierce	1.49	2.52	1.12	0	1.4	2.26(upl) 1.89(wl)
116	King	17.4	56.5	1.5	9.2	45.8	0
151	King	1.2	1.6	0	1.4	0.2	0
163	Snohomish	1.84	5.75	0	1.97	3.78	1.25(buffer)
193	King	1.59	3.32	1.75	0	1.57	2.5 (buffer)
233*	Snohomish	0.41	0.82	0	0.27	0.65	buffer
239	Grays Harbor	0.14	0.21	0.09	0	0.12	0
243	Skagit	1.99	6	0	0	6	0
278	Snohomish	0.06	0.28	0	0.28	0	buffer
294	King	0.22	0.21	0.21	0	0	2.5 (preservation)
300	Clark	1.31	3.49	0	0	3.49	0.05 (upland)
334	Kitsap	0.67	0.9	0	0	0.9	1.96 (upland)
378	Clark	1.6	6.86	0	0	6.86	buffer
400	Snohomish	1.54	2.35	2.03	0	0.32	2.27 (buffer)
10E	Benton	0.13	0.137	0	0	0.137	0
13E	Kittitas	0.99	2.47	1.92	0.55	0	buffer
14E	Spokane	0.141	0.144	0.144	0	0	buffer
29E	Ferry	0.935	9.5	0	0	9.5	riparian
41E	Spokane	1.87	3.53	3.53	0	0	0
50E	Spokane	0.09	0.46	0.46	0	0	rest. of temp. imp
Statewide Total		**58.79**	**130.80**	**29.29**	**13.67**	**87.94**	**89.09**

*9-of the 16.1 acres of creation, 12.7 acres were to become an area that was previously wetland, but this area was re-graded and was considered part of the 21.1 acres of impact. Of the 15.35 acres of established creation acreage, 12.24 acres were generated from this "impact" area.
*233-The mitigation was called restoration in the permits and the mitigation ratios were determined based on this. In our evaluations we determined (based on definitions, pg 9) that only 0.27 acres of the mitigation was actually restoration, while the rest (0.65 acres) was enhancement.

Table B.3. Phase 2 Raw Results continued...

Project #	established wetland mitigation acreage	established creation acreage	established restoration acreage	established enhancement acreage	year implemented (age when evaluated)	Ecology wetland rating category (points)
9	19.69	15.34	0	4.35	1994 (6)	3(15),3(13),3(18)
14	3.11	0	0	3.11	1997 (3)	2 (23)
33	0.13	0.13	0	0	1997 (3)	3 (14)
46	0.3	0.3	0	0	1993 (6+)	3 (11)
89	2.03	0.63	0	1.4	1995 (5)	3 (19), 3 (8)
116	55.33	0.33	9.2	45.8	1996 (4)	2 (40), 2 (32)
151	1.58	0	1.38	0.2	1992 (7+)	2 (27)
163	2.56	0	1.97	0.59	1997 (3)	2 (29)
193	4.31	1.75	0	2.56	1997 (3)	2 (24), 2 (27)
233	0.55	0	0	0.55	1996 (3+)	3 (14)
239	0.26	0.14	0	0.12	1994 (6)	3 (7)
243	5.85	0	0	5.85	1996 (3+)	2 (23)
278*	0.23	0	0.23	0	1996 (3+)	3 (10)
294	0.16	0.16	0	0	1995 (5)	3 (5)
300	3.34	0	0	3.34	1994 (6)	2 (23)
334*	0	0	0	0	1996 (3+)	3 (15)
378	3.26	0	0	3.26	1998 (2)	3 (21)
400	3.14	2.82	0	0.32	1997&8(3&2)	2 (23), 3 (9)
10E	0.124	0	0	0.124	1996 (3+)	3 (12)
13E	1.4	1.4	0	0	1997 (3)	2 (34)
14E	0.217	0.144	0	0.073	1995 (5)	3 (14)
29E*	0	0	0	0	1993 (7)	3 (20)
41E	2.29	2.29	0	0	1997 (2+)	NA
50E*	0	0	0	0	1995 (5)	NA
Total	**109.86**	**25.43**	**12.78**	**71.65**		

*278-This project was described in the permit to be creation and enhancement. Information from the consultant and the mitigation plan indicated that fill was removed from a historic wetland area. We therefore classified the project as restoration (based on definitions, pg. 9).
*334-This project was an enhancement project. None of the wetland enhancement plantings survived, therefore, the mitigation activities resulted in the establishment of 0 acres of enhancement.
*29E- This project was an enhancement project. None of the wetland enhancement plantings survived, therefore, the mitigation activities resulted in the establishment of 0 acres of enhancement.
*50E – This project was a creation project. The area where the mitigation activities took place was determined to not be wetland; therefore, the mitigation activities resulted in the establishment of 0 acres of creation.

Table B.4. Achievement of Ecologically Relevant Measures

Project #	Did the project establish the acreage for the required mitigation activity(ies)? (within 10%)	Did the project attain the "significant" or appropriate performance standards?	Did the project fulfill the appropriate goals/ objectives?	**Did the project achieve the ecologically relevant measures?**
9	Y	N	S	S
14	Y	S	S	S
33	Y	Y	NA	Y
46	Y	NA	Y	Y
89	N	Y	Y	S
116	Y	Y	S	S
151	Y	NA	Y	Y
163	N	S	S	S
193	Y	S	S	S
233	N	NA	N	N
239	Y	NA	Y	Y
243	Y	Y	Y	Y
278	N	NA	S	S
294	*Y	NA	S	S
300	Y	N	Y	S
334	N	NA	NA	N
378	N	N	N	N
400	Y	S	Y	S
10E	Y	NA	NA	Y
13E	N	Y	S	S
14E	Y	NA	Y	Y
29E	N	N	N	N
41E	N	N	S	S
50E	N	N	N	N

Y = Yes, N = No, S = Somewhat, NA = Not Applicable

*294- Though this project was not within the 10% margin of error we gave the project the benefit of the doubt due to the fact that there was a thick canopy which did not allow for the collection of very many GPS points. Based on the SAT's knowledge of the site it was determined that the GPS positions did not adequately represent the size of the site.

Table B.5. Factors Used in Determining Adequate Compensation for the Impacts

Site #	H20 quality Function potential/ contribution (L, ML, M, MH, H)/ (Hi, Mod, Min, NAA, Neg)	H2O quantity Function potential/ contribution (L, ML, M, MH, H)/ (Hi, Mod, Min, NAA, Neg)	Wildlife habitat Function potential/ contribution (L, ML, M, MH, H)/ (Hi, Mod, Min, NAA, Neg)	Did the mitigation project provide the same functions as those lost? (Y,N,S)	Did the mitigation project exchange functions? (Y,N,S)	**Did the mitigation project adequately compensate for the impacts? (Y,N,S)**
9A	NA	ML/ Mod	ML/ Mod	N	Y	S
9B	NA	L/ NAA	L/ Min			
9C	MH/ Mod	MH/ NAA	ML/ Min			
14	M/ Min	ML/ NAA	M/ Mod	N	Y	S
33	M/ Hi	ML/Mod	ML/ Mod	N	Y	S
46	unable to assess	unable to assess	unable to assess	S	Y	S
89-1	M/ Hi	M/ Hi	M/ Min	Y	Y	Y
89-2	MH/ Hi	H/ Mod	L/ Min			
116E	MH/ Hi	MH/ Mod	MH/ Hi	Y	Y	Y
116W	MH/ Mod	M/ Mod	MH/ Mod			
151	MH/ Hi	M/ Mod	M/ Hi	Y	Y	Y
163r	H/ Hi	NA	M/ Hi	Y	Y	Y
163e	/NAA	/NAA	/NAA			
193s	M/ Mod	ML/ Mod	MH/ Mod	Y	Y	Y
193G	M/ Mod	L/ Min	MH/ Hi			
233	M/ Mod	M/ NAA	ML/ Min	N	N	N
239	H/ Hi	NA	ML/ Min	Y	Y	Y
243	M/ Mod	ML/ Mod	ML/ Min	N	Y	N
*278	M/ Hi	M/ Mod	ML/ Mod	Y	Y	*N
294	MH/ Hi	H/ Hi	M/ Mod	S	Y	Y
300	MH/ Min	NA	ML/ Min	N	Y	N
334	/ NAA	/ NAA	/ NAA	N	N	N
378	MH/ Min	ML/ Mod	M/ Min	N	Y	N
400A	M/ Hi	M/ Hi	M/ Mod	Y	Y	Y
400B	M/ Hi	M/ Hi	L/ Min			
10E	MH/ Min	ML/ NAA	M/ Min	N	Y	N
13E	MH(sed)/ Hi	NA	MH/ Hi	Y	N	S
14E	M/ Mod	M/ Hi	ML/ Mod	N	Y	Y
29E	H(sed)/ NAA	M/ NAA	ML/ NAA	N	N	N
41E	MH(sed)/ Mod	M/ Neg	M/ NAA	S	N	S
50E	/NAA	/NAA	/NAA	N	N	N

L = Low, ML = Moderately Low, M = Moderate, MH = Moderately High, H = High
Hi = High, Mod = Moderate, Min = Minimal, NAA = Not at all, Neg = Negative
NA = Not applicable
Y = Yes, N = No, S = Somewhat

*278. This site was contaminated with a toxic organic substance that was mobilized during mitigation construction. This and other factors, including the site's location in the watershed resulted in the conclusion that the site did not replace the lost wetlands, which primarily provided wildlife habitat.

Table B.6. Level of Success

Project #	Mitigation activity (activity that comprised >75% of the project)	Did the mitigation project achieve the ecologically relevant measures? (Y,N,S)	Did the mitigation project adequately compensate for the impacts? (Y,N,S)	**Level Of Success**
151	Restoration	Y	Y	Full Success
239	*Creation	Y	Y	Full Success
14E	Creation	Y	Y	Full Success
400	Creation	S	Y	Mod Success
89	Mixed	S	Y	Mod Success
294	Creation	S	Y	Mod Success
116	Enhancement	S	Y	Mod Success
163	Mixed	S	Y	Mod Success
193	Mixed	S	Y	Mod Success
33	Creation	Y	S	Mod Success
46	Creation	Y	S	Mod Success
9	Creation	S	S	Min Success
14	Enhancement	S	S	Min Success
13E	Creation	S	S	Min Success
41E	Creation	S	S	Min Success
243	Enhancement	Y	N	Min Success
10E	Enhancement	Y	N	Min Success
300	Enhancement	S	N	Min Success
278	Restoration	S	N	Min Success
233	Enhancement	N	N	Not Success
29E	Enhancement	N	N	Not Success
334	Enhancement	N	N	Not Success
378	Enhancement	N	N	Not Success
50E	Creation	N	N	Not Success

Y = Yes, N = No, S = Somewhat

*239-Though this project was a mixture of creation and enhancement, the site assessment and evaluation focused on the creation area, and therefore, the project was considered creation in the Phase 2 results.

Table B.7. Hydrogeomorphic Subclass and Cowardin Classification

Site #	HGM subclass of mitigation site	mitigation same HGM subclass as the impacts? (Y, N,S)	atypical HGM subclass? (Y, N)	Cowardin Classes present at mitigation site	mitigation same Cowardin class(es) as the impacts? (Y,N,S)
9A	flat	Y	N	EM	N
9B	flat	Y	N	EM	N
9C	depres out	N	Y	EM, SS	N
14	slope/DO	Y	Y	EM, SS	S
33	depres out	Y	N	EM	N
46	dunal	Y	N	EM, SS	N
89-1	depres out	Y	N	EM, SS	Y
89-2	depres close	Y	N	EM, SS	Y
116E	depres out	Y	Y	EM, OW, AB, SS	N
116W	DO/RI	N	N	EM, SS, OW, AB	N
151	depres out	S	N	EM, SS/FO	S
163r	depres out	Y	N	EM, AB	Y
163e	depres out	~	N	EM	~
193s	depr in slop	N	Y	AB, EM, SS	N
193G	depr in slop	N	Y	SS, EM, OW	N
233	river flow-thr	Y	N	SS	N
239	tidal	Y	N	EM, SS	S
243	DO w/weir	Y	Y	EM, SS	S
278	DO/RI	Y	N	EM, OW	N
294	depres close	N	N	FO, EM, SS	N
300	slope	Y	N	EM, SS	S
334	DO/DC	N	N	EM, SS	N
378	depres out	N	Y	EM, AB, OW	S
400A	depres out	N	Y	EM, SS, AB	S
400B	depres out	N	Y	EM	Y
10E	depres LD	N	N	EM	Y
13E	riverine Imp	Y	Y	AB, EM, OW	Y
14E	depres LD	N	N	EM	Y
29E	riverine flow	S	N	EM, OW	N
41E	riverine flow	Y	N	EM	N
50E	not wetland	N	NA	not wetland	N

Y = Yes, N = No, S = Somewhat
OW = Open Water, AB = Aquatic Bed, EM = Emergent, SS = Scrub-Shrub, and FO = Forested

Table B.8. Cowardin Class Acreages (Impacts)

Impacts				
Site #	County	Forest (FO) / Scrub-Shrub (SS)	Emergent (EM)	Open Water (OW)/ Aquatic Bed (AB)
9A	Whatcom	3.60	17.50	0
9B	Whatcom	[redacted]		
9C	Whatcom			
14	Skagit	0	1.76	0
33	King	0.07	0	0
46	Pacific	0.14	0.10	0
89*	Pierce			
116E	King	0.30	17.10	0
116W	King	[redacted]		
151	King	0.08	1.12	0
163	Snohomish	0	1.78	0.06
193s	King	0	1.59	0
193G	King	[redacted]		
233	Snohomish	0.41	0	0
239	Grays Harbor	0	0.14	0
243	Skagit	0	1.99	0
278	Snohomish	0.06	0	0
294	King	0	0.22	0
300	Clark	0	1.31	0
334	Kitsap	0.33	0.34	0
378	Clark	0	1.60	0
400A	Snohomish	0	1.54	0
400B	Snohomish	[redacted]		
10E	Benton	0	0.13	0
13E	Kittitas	0.09	0.30	0.60
14E	Spokane	0	0.141	0
29E	Ferry	0.875	0.06	0
41E	Spokane	1.24	0.63	0
50E	Spokane	0.088	0	0
Totals		**7.28**	**49.35**	**0.66**

*#89- was not considered for this analysis, because information on Cowardin classes lost, enhanced, and mitigated was incomplete.

Table B.8. Cowardin Class Acreages (Mitigation)

MITIGATION						
Site #	FO/SS gain	FO/SS *no change	EM gain	EM loss due to conversion	EM *no change	OW / AB gain
9A	0	0	3.11	0	0	0
9B	0	0	12.23	0	0	0
9C	2.61	0	0	-2.61	1.74	0
14	0.40	0	0	-0.40	2.71	0
33	0	0	0.13	0	0	0
46	0.03	0	0.27	0	0	0
89	Could not determine					
116E	3.29	0	0	-7.85	14.35	12.25
116W	6.77	1.10	0	-5.70	16.80	0.77
151	1.11	0	0.47	-0.2	0	0
163	0	0	1.53	0	0.59	0.44
193s	0.17	0	0.25	0	0	0.30
193G	2.56	0	0.08	-1.97	0.59	0.36
233	0	0.55	0	0	0	0
239	0.03	0.12	0.11	0	0	0
243	1.70	0	0	-1.70	4.15	0
278	0	0	0.19	0	0	0.04
294	0.11	0	0.05	0	0	0
300	0.43	0	0	-0.43	2.91	0
334	0	0.10	0	0	0.48	0
**378	0	0	0	**-5.07	1.79	1.47
400A	0.36	0	0.63	-0.14	0.18	0.35
400B	0	0	1.62	0	0	0
10E	0	0	0	0	0.124	0
13E	0	0	0.52	0	0	0.88
14E	0	0	0.144	0	0.073	0
***29E	0	0	0	0	***8.01	0
41E	0	0	2.29	0	0	0
50E	Not applicable - No wetland area established					
Total	**19.57**	**1.87**	**23.62**	**-26.07**	**54.50**	**16.86**

*"No change" = areas where mitigation actions failed or did not result in a change of Cowardin class (i.e., shrubs provided <30% cover).
**#378 resulted in wetland loss due to re-grading; the loss was "EM loss due to conversion" (to upland); it was not included as impacts (Table 1).
***#29E had OW (stream channel), but this was not a change from the pre-mitigation condition of the site. Therefore, the OW acreage was included in "EM no change." OW was included in Table 6.

Table B.9. Performance Standard Attainment

Project #	Built to plan? (from Phase 1- updated)	Total # of performance standards	% attainment of assessed performance standards (#met / #assessed) **Phase 1**	% attainment of assessed performance standards (#met / #assessed) **Phase 2**	% attainment of assessed "significant" performance standards **Phase 2**
9	Y	11	80% (4/5)	50% (2/4)	0% (0/1)
14	Y	9	100% (3/3)	50% (2/4)	50% (2/4)
33	N	3	100% (1/1)	50% (1/2)	100% (1/1)
46	N	0	NA	NA	NA
89	Y	4	33% (1/3)	100% (3/3)	100% (2/2)
116	Y	25*	0% (0/4)	50% (5/10)	100% (5/5)
151	Y	4	67% (2/3)	67% (2/3)	NA
163	Y	9	0% (0/1)	60% (3/5)	50% (2/4)
193	Y	3*	80% (4/5)*	67% (2/3)	67% (2/3)
233	N	10	0% (0/2)	67% (2/3)	NA
239	CND	1	0% (0/1)	NA	NA
243	Y	2	CND (0/0)	100% (1/1)	100% (1/1)
278	Y	4	100% (2/2)	100% (2/2)	NA
294	Y	3	100% (1/1)	100% (2/2)	NA
300	Y	2	50% (1/2)	0% (0/1)	0% (0/1)
334	N	2	0% (0/2)	0% (0/2)	NA
378	N	2	0% (0/2)	0% (0/2)	0% (0/1)
400	Y	3	100% (2/2)	50% (1/2)	50% (1/2)
10E	N	1	0% (0/1)	100% (1/1)	NA
13E	Y	6	100% (1/1)	67% (2/3)	100% (2/2)
14E	N	0	NA	NA	NA
29E	CND	1	0% (0/1)	0% (0/1)	0% (0/1)
41E	N	3	50% (1/2)	67% (2/3)	0% (0/1)
50E	N	6	0% (0/4)	0% (0/5)	0% (0/1)
Totals		**114**	**48% (23/48)**	**53% (33/62)**	**60% (18/30)**

Y = Yes, N = No, CND = Could Not Determine
NA = Not Applicable (for example, #46 did not have any performance standards, #239 did not have any that we could assess and #29E did not have any significant ones that we could assess)

*116 – In Phase 1, there were 26 P.S. evaluated for this site. Since the Phase 1 site visit, one of the approved P.S. was eliminated from monitoring as approved by the appropriate agencies, therefore only 25 P.S. were included in the Phase 2 study.
*193- Based on new background information collected for Phase 2, it was determined that this site had three performance standards, according to the most recent approved monitoring plan.

Table B.10. Phase 2 Success vs. Phase 1 Compliance

Project #	County	Level Of Success Phase 2	Level Of Compliance Phase 1
151	King	Full Success	S
239	Grays Harbor	Full Success	N
14E	Spokane	Full Success	N
400	Snohomish	Mod Success	Y
89	Pierce	Mod Success	S
294	King	Mod Success	Y
116	King	Mod Success	S
163	Snohomish	Mod Success	S
193	King	Mod Success	S
33	King	Mod Success	S
46	Pacific	Mod Success	N
14	Skagit	Min Success	Y
13E	Kittitas	Min Success	Y
41E	Spokane	Min Success	N
243	Skagit	Min Success	Y
10E	Benton	Min Success	N
300	Clark	Min Success	S
9	Whatcom	Min Success	S
278	Snohomish	Min Success	Y
233	Snohomish	Not Success	N
29E	Ferry	Not Success	N
334	Kitsap	Not Success	N
378	Clark	Not Success	N
50E	Spokane	Not Success	N

Y = Yes, N = No, S = Somewhat

Table B.11. Level of Success vs. Follow-up

Project #*	County	Level Of Success Phase 2	Follow-up Performed?**	Type Of Follow-up
151	King	Full Success	Y	L, C, V
400	Snohomish	Mod Success	Y	L
89	Pierce	Mod Success	Y	L, C, V
294	King	Mod Success	Y	L
116	King	Mod Success	Y	L, C, V
163	Snohomish	Mod Success	Y	L, C, V
33	King	Mod Success	U	
46	Pacific	Mod Success	NR	
14	Skagit	Min Success	Y	C
13E	Kittitas	Min Success	N	
41E	Spokane	Min Success	NR	
243	Skagit	Min Success	N	
300	Clark	Min Success	N	
9	Whatcom	Min Success	Y	V
278	Snohomish	Min Success	U	
233	Snohomish	Not Success	N	
334	Kitsap	Not Success	Y	L, C, V
378	Clark	Not Success	N	
50E	Spokane	Not Success	N	

Y = Yes, N = No, U = Unknown, NR = No response
L = Letter, C = Phone call, V = Site visit

*n=19 projects
**information based on responses to a questionnaire that was sent to all applicants or their consultants, but only 19 were returned