# *Athos* I Oil Spill

## Restoration Scaling Paper for Injuries to Non-Tributary Shorelines:

Salt Marsh Restoration at Mad Horse Creek, New Jersey

and

Habitat Creation and Restoration at Lardner's Point, Pennsylvania

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## Introduction

The Trustees determined that approximately 1,730 acres of shoreline habitat (primarily tidal flats) were injured by the *Athos* oil spill, quantified as a spill-related aquatic resource loss of approximately 1,335 discounted service acre years (DSAYs). Table 1 displays the injury by habitat classification. To compensate for this loss, the Trustees propose to restore 37.1 acres of freshwater tidal wetland at Mad Horse Creek in New Jersey and create 0.9 acres of freshwater tidal wetland/wet meadows at Lardner's Point in Pennsylvania. Both project locations are on the Delaware River; Lardner's Point was directly exposed to oil from the Athos spill (see Figure 1). These projects are consistent with existing federal, state, and local restoration goals for the Delaware River and have a high likelihood of success.

## Project Description - Mad Horse Creek

The Mad Horse Creek proposed restoration site is on the former Quashne property located in Lower Alloway Creek Township in Salem County New Jersey, and was acquired by the New Jersey Department of Environmental Protection (NJDEP) in 1997. The 260-acre property contains salt marshes, transitional wetlands (*Phragmites* dominant), agricultural lands and associated buildings, and is now part of the Mad Horse Creek Wildlife Management Area. Past agricultural practices on this property included altering and filling the brackish marsh fringe. These alterations have resulted in a *Phragmites* invasion of the wetland.

The NJDEP's Office of Natural Resource Restoration (ONRR) and the NOAA Restoration Center are now in the design phase of a tidal and freshwater wetland restoration project at the Mad Horse Creek site. The site location near the Delaware Bay, within tidal waters, will allow for the construction of *Spartina alterniflora* habitat at the appropriate elevations. Restoration will be accomplished through the removal of fill material and lowering the marsh elevation so that tidal inundation can occur. A more detailed description of the Mad Horse Creek site is provided in the restoration scaling paper for injuries to birds (Shellenbarger Jones and Donlan 2008).

## Project Description - Lardner's Point

The Lardner's Point proposed restoration site is located in the greater Philadelphia region, within the area oiled by the Athos spill. Just west of the Tacony-Palmyra bridge, the site is situated in the Tacony neighborhood of Philadelphia, bordering the west bank of the Delaware River. Lardner's Point was the former home of a river ferry that provided service between Tacony and Palmyra, prior to the construction of the Tacony-Palmyra bridge in 1929. Following the completion of this bridge, ferry service ceased and the land remained inactive under the ownership of various entities including the current owner, the city of Philadephia. Today the four-acre lot is a barren industrial site, consisting of a deteriorating concrete pad in the north section, with a dilapidated ferry dock and boat ramp on the eastern shoreline. The remainder of the site is vegetated with invasive species.[1]

[1] Invasives to be removed include: Japanese Knotweed (*Polygonum cuspidatium)* Japanese Honeysuckle (*Lonicera japonica)* and Bush Honesuckle (*Lonicera* spp.*),* among others (Biohabitats, 2006).

Conceptual restoration plans for the site (see Figure 2) have been developed jointly by the Delaware River City Corporation, Pennsylvania Environmental Council, and Fairmount Park Association. While the project includes shoreline, upland and recreational components, only the shoreline portion is relevant for Athos-related compensation purposes (to help offset spill-related injuries to shoreline habitat). Shoreline restoration will be accomplished through the demolition of existing structures, import of fill material, and grading of the site to restore tidal inundation; created habitats will include intertidal marsh and wet meadow.

**Figure 1**

**Approximate Location of Shoreline Restoration Projects and Origin of the Athos Spill.**


## Restoration Objectives

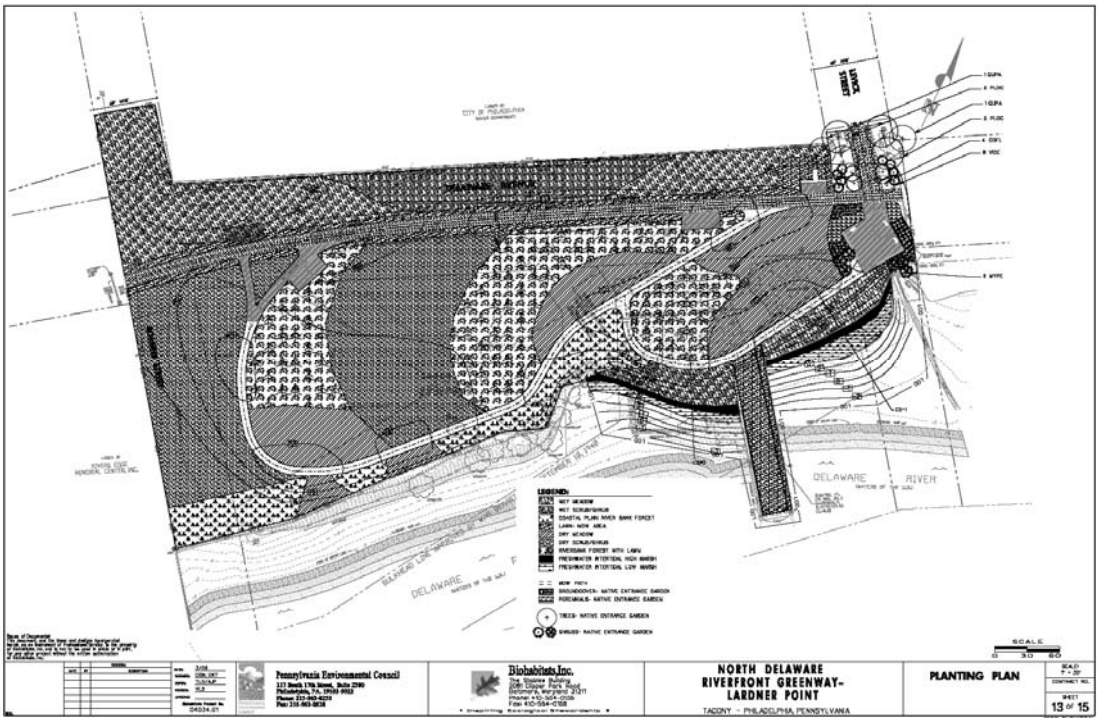
The objective of these restoration projects are to provide 1,335 DSAYs of shoreline habitat, taking into account productivity differences between injured shoreline habitat (predominantly tidal flats but including several shoreline habitat types) and habitat targeted for restoration (marsh habitat).[2] The Trustees propose marsh restoration as compensation for lost shoreline services (non-tributary) for several reasons. Combining the multiple shoreline habitat injuries, many of which are relatively small, into a single type of restoration project provides cost and planning efficiencies. While tidal flat injuries are responsible for the majority of lost

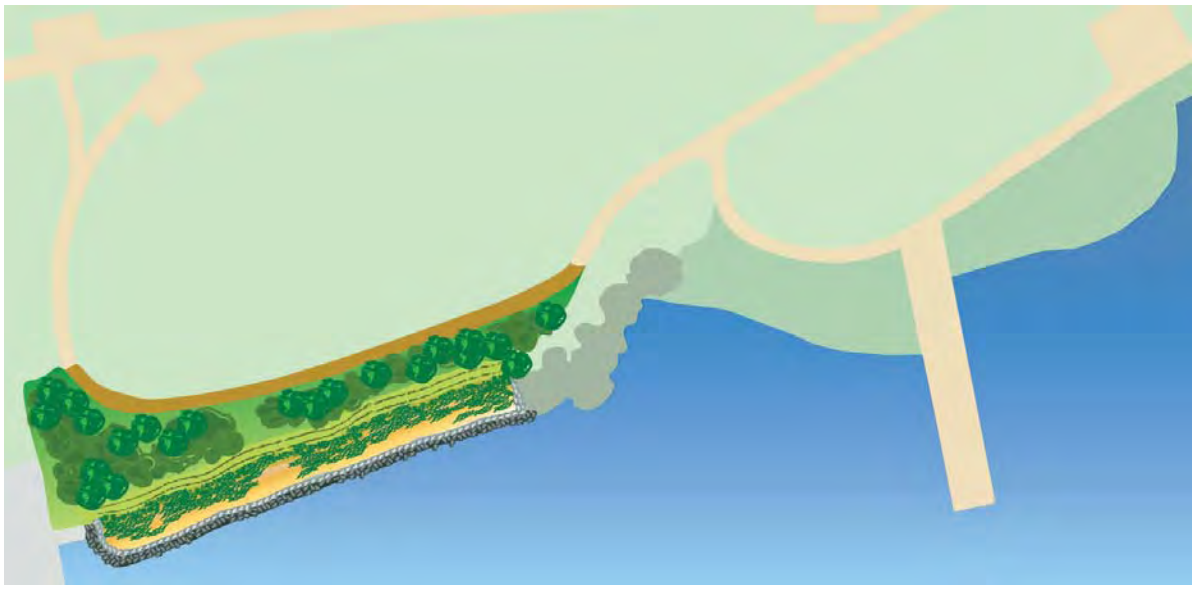
[2] Scaling calculations treat all restoration acreage as marsh due to the relatively small size of relevant Lardner's Point acreage (0.9 acres of marsh/wet meadow restoration) compared to Mad Horse Creek (37.1 acres of marsh restoration).

DSAYs, the Trustees have been unable to identify viable tidal flat restoration or creation projects of a suitable scale. Appropriate marsh restoration projects will provide many of the same ecological services, are readily available, have a high likelihood of success, and can be scaled to quantified injuries.

**Figure 2**

**Lardner's Point Conceptual Restoration Plan. Proposed shoreline restoration projects are right-hand portion of upper diagram (wet meadows and intertidal marsh sections) and left-hand portion of lower diagram.**



## Scaling Approach

The Trustees quantified a spill-related resource loss of approximately 1,335 DSAYs of shoreline habitat (Shoreline TWG 2006). As shown in Table 1, this consists primarily of injury to tidal flats (1,032 DSAYs). As noted above, direct restoration and/or creation of tidal flats is not feasible. As a result, injury to tidal flats (and other non-marsh shoreline injuries) is scaled to marsh habitat, taking into account differences in the biogenic structure (generally represented as primary productivity) provided by the habitat.[3] The first step in scaling the injury is to therefore estimate all non-tributary shoreline injuries in terms of marsh habitat, as marsh DSAYs.

**Table 1**

**Non-Tributary Shoreline Injury by Habitat Type**

| Habitat Classification | Primary Description | Acres | DSAYs |
|---|---|---|---|
| Marsh | Brackish and freshwater marsh | 117 | 60 |
| Sand/Mud substrates | Mixed sand/gravel beaches, natural banks | 36 | 35 |
| Lower Intertidal Zone | Lower intertidal zone for sand and mud substrates | 83 | 51 |
| Tidal Flats | Mud and sand flats adjacent to beaches, banks, and marshes | 1,298 | 1,032 |
| Seawalls | Exposed man-made structures | 59 | 30 |
| Coarse Substrates | Rip-rap | 137 | 127 |

The tidal flat injuries occur shoreward of the mainstem fringing marshes as well as sand/mud beaches, so replacement with scaling to marsh replacement is appropriate. Created marsh will provide some of the same services as tidal flats, including habitat for benthic infauna and sites for primary and secondary production. Marsh will also provide many additional services, benefiting a wide-range of resources, above and beyond that provided by tidal flat habitat. Based on estimates of structural habitat provision from a range of studies on the east coast, an appropriate habitat equivalency ratio between intertidal flat and marsh is approximately 2.5:1 (Peterson *et al*., in prep).[4,5] Injuries to other mud/sand substrates (shorelines and the lower intertidal zone) are converted using the same ratio, due to similar characteristics and their relatively small contribution to shoreline injuries.

Rip-rap (the primary constituent of the "coarse substrate" injury) and seawalls are a relatively minor component of the total shoreline injury (157 DSAYs). Created marsh habitat will provide erosion protection, refuge for organisms, and a site for primary and secondary production. While rip-rap and seawalls can reasonably be expected to generate substantially less

[3] Structured habitats (e.g. marsh, oyster reef) have significantly higher levels of productivity at multiple trophic levels than do unstructured habitats (e.g. unvegetated tidal flat) (Peterson *et al*., in prep). The methodology compares relative productivity of the habitats and evaluates the contribution of physical structure (e.g. plants, reefs) to productivity.

[4] The ratio of 2.5:1 is based on analysis expected to be submitted for publication in coming months by Dr. Pete Peterson and collaborators. An initial presentation of the work was made at the 2007 conference of the Ecological Society of America and Society for Ecological Restoration International.

[5] The habitat equivalency ratio indicates that 2.5 acres of intertidal flat provides similar service to one acre of marsh. Therefore, to calculate the intertidal injury in terms of marsh DSAYs, the intertidal injury is divided by 2.5.

productivity per unit area than marsh, the Trustees have been unable to identify quantitative data that can be used to develop a "rip-rap and seawall to marsh" equivalency ratio. In the absence of such data, the Trustees adopt a 10:1 equivalency ratio between these habitats, based on qualitative comparisons and professional judgment applied to similar injuries in a past NRDA case (LOSCO *et al.* 2001).

Based on the above assumptions, shoreline injury injuries total 522.9 Marsh DSAYs (Table 2).

**Table 2**

**Compensatory Restoration Acreage by Habitat Type**

| Habitat Classification | Acres | DSAYs | Marsh DSAYs[a] | Marsh Restoration Acres[b] |
|---|---|---|---|---|
| Marsh | 117 | 60 | 60.0 | 4.4 |
| Sand/Mud substrates | 36 | 35 | 14.0 | 1.0 |
| Lower Intertidal Zone | 83 | 51 | 20.4 | 1.5 |
| Tidal Flats | 1,298 | 1,032 | 412.8 | 30.0 |
| Coarse Substrates | 137 | 127 | 12.7 | 0.9 |
| Seawalls | 59 | 30 | 3.0 | 0.2 |
| **Total** | **1,730** | **1,335** | **522.9** | 38.0 |

a. Marsh DSAYs are calculated by dividing DSAYs by habitat equivalency factor (1 for marsh; 2.5 for sand/mud substrates, intertidal and tidal flats; and 10 for seawalls and coarse substrates) following the methodology developed by Peterson *et al*. (in prep.).
b. Marsh restoration acres are calculated by dividing marsh DSAYs by the average per-acre credit for restored marsh (13.76 DSAYs/acre), reflecting a weighted average of DSAY benefits expected from the Mad Horse Creek and Lardner's Point projects.

The Habitat Equivalency Analysis (HEA) method was used to determine the amount of marsh restoration needed to compensate for the losses resulting from the spill (NOAA 1999). HEA is a resource-to-resource scaling method to determine compensation for lost services based on the quantification of incident-related natural resources injuries. HEA considers several project-specific factors in scaling restoration, including elapsed time from the onset of injury to restoration implementation, relative productivity of restored habitats (that is, the proportional equivalence of ecological services provided by the compensatory restoration project relative to the baseline productivity of the injured habitat), the time required for restored habitats to reach maximum function, and project lifespan.

To determine the appropriate estimates for the HEA input parameters identified above, the Trustees relied on resource agency staff experience with creating wetlands in this region, data from other damage assessment cases, and information in the scientific literature. The Trustees assume that marsh construction for both projects will begin in 2009. Ecological services are expected to develop following a logistic model, reaching maximum service in fifteen years (French McCay and Rowe 2003)[6]. For Mad Horse Creek, a baseline ecological service of 10 percent is used. This reflects the minimal level of service provided by the current area of

[6] Maximum ecological service for restored wetlands is generally considered to be less than 100 percent, due to the difficulties in creating a complex natural system. For example, the Chalk Point NRDA estimated the maximum potential service for restored wetlands to be 80 percent (NOAA *et al.* 2002). The differences in natural versus created marshes are discussed in Strange *et al.* (2002).

*Phragmites*-dominated, disturbed wetlands.[7] At Lardner's Point, a baseline ecological service of zero is used, reflecting the current state of the property, which is abandoned industrial upland, covered in invasive plants such as knotweed, with a steep riverbank. The maximum service level for this project is estimated to be 85 percent, reflecting Trustee experience that restored marshes generally do not quite reach productivity levels associated with natural, fully functional marsh habitat. The project life span is estimated to be 50 years.[8] Based on these inputs and using the three percent annual discount rate typically applied in HEA calculations, each restored acre at Mad Horse Creek provides a credit of 13.72 service acre-years and each acre at Lardner's Point provides 15.56 service acre-years (see Attachments 1 and 2 for calculations). The 0.9 acre site at Lardner's Point provides 13.4 DSAYs; therefore, an area of 37.1 acres at Mad Horse Creek will compensate for the remaining 509.5 marsh DSAYs estimated above (Table 2). For the overall 38 acres of restoration, the average credit is 13.76 DSAYs.

**Probability of Success**

Mad Horse Creek and Lardner's Point restoration projects involve feasible and proven techniques with established methodologies and documented results. Local, state, and federal agencies have successfully implemented similar wetland creation projects in this region of the Delaware River. Thus, the Trustees believe that the projects have a high likelihood of success.

The Mad Horse Creek and Lardner's Point projects are located on land already owned by the government (NJDEP and city of Philadelphia, respectively). While final details of the marsh restoration projects remain to be fully developed, the Trustees will carefully monitor plant handling and installation to ensure that appropriate guidelines are being followed. With respect to revegetation efforts, all plant material will be inspected to ensure that it is healthy and vigorous, and will be protected during mobilization from drying and physical damage. Plants intended for use in these projects will be correctly labeled with scientific name and be native to the area. Furthermore, plants will be provided by certified nurseries that have been inspected by state and/or federal agencies, and seed shall have a designated percentage of Pure Live Seed. Container grown plants will be treated with a slow-release fertilizer at the time of planting. Replanting will occur if a significant number of plants die. For these reasons, the Trustees believe that these projects have a high likelihood of success.

These projects are consistent with existing federal, state, and local restoration goals (as found in DRBC 2005; PDE 2005; Kreeger *et al*. 2006; and Westervelt *et al*. 2006) for the Delaware River and have a high likelihood of success.

[7] Roughly 38 acres of the current Mad Horse Creek site targeted for restoration is a degraded *Phragmites* marsh. The remaining target area is more substantially filled and does not provide significant wetlands services.

[8] The project lifespan is estimated based on the historic rate of sea level rise near the proposed site. The rate for the Delaware River at Philadelphia is 3 mm/yr based on tidal gauges. A similar rationale was used for a fifty-year marsh lifespan in the marsh restoration following the Chalk Point spill (NOAA *et al*. 2002), where historic rates of sea level rise in the mid-Chesapeake near the Patuxent River are also 3 mm/yr.

### Performance Measures and Monitoring

Project performance at Mad Horse Creek and Lardner's Point will be assessed by comparing quantitative monitoring results to predetermined performance standards. These standards will be based on guidelines established by NJDEP for assessing wetland mitigation projects (Attachment 3). Restored habitats will be monitored twice a year, in early spring and fall, for five full growing seasons. Monitoring assessments will include documentation of hydrologic regime, soil characteristics, plant species present, and confirmation of planned site grading and elevation. At the end of the monitoring period, a survival rate of 85 percent of planted vegetation (and/or similar native vegetation) should be documented; less than 10 percent of plant species should be characterized as non-native, invasive, or noxious. At the conclusion of monitoring, the created wetland areas should be delineated using federal standards and the final acreage corroborated with compensatory requirements.

The monitoring program for these two projects will use the standards described above to determine whether the project goals and objectives have been achieved, and whether corrective actions are required to meet the goals and objectives. In the event that performance standards are not achieved or monitoring suggests unsatisfactory progress toward meeting established performance standards, corrective actions will be implemented. Possible corrective actions include regrading the area to proper elevations and replanting appropriate vegetation. Any necessary corrective actions would be funded by the contingency component of the project costs.

### Approximate Project Costs

Table 3 provides a summary of expected costs for restoring 37.1 acres of marsh habitat at Mad Horse Creek and 0.9 acres at Lardner's Point as compensation for injuries to non-tributary shorelines. Estimated costs of $150,000 per acre for Mad Horse Creek reflect site characteristics and Trustee experience with similar restoration projects in NJ. The current estimate is based on similar projects conducted in the New Jersey/New York area, particularly the Woodbridge Creek marsh restoration project. The Woodbridge restoration consisted of 23.6 acres of wetland restored by the Army Corps of Engineers as mitigation for harbor dredging; an additional 8.7 acres at the site was restored for compensation following the 1990 Exxon Bayway spill. Overall, the project scope is similar to the proposed marsh restoration at Mad Horse Creek. The Woodbridge Creek site was dominated by *Phragmites*, requiring dredging and regrading to restore tidal flow and recreate the native salt marsh. The project included extensive planting of marsh plants and native vegetation. Final implementation costs at the Woodbridge Creek site are roughly $200,000 per acre, with a total project implementation cost of roughly $6.4 million (2006 costs). The final cost includes budget overruns, reportedly due to contractor issues and interpretation of project specifications. These problems are not anticipated for the Mad Horse Creek project; additionally, the larger project size is expected to afford some economies of scale. Therefore, the Trustees use a preliminary cost estimate of $150,000 per acre for implementation. The Trustees will update this estimate as warranted to reflect additional cost information generated by the on-going detailed project design efforts.

Estimated costs for the Lardner's Point project were obtained from site-specific planning work performed by Biohabitats, Inc. Monitoring costs for both projects reflect NJ monitoring experience for similar restoration projects, consistent with monitoring requirements identified in

the Performance Measures and Monitoring section. A 25 percent contingency is included to cover the risk that (1) the costs of the project will turn out to be higher than expected, and/or (2) the project will not result in the expected magnitude of benefits and need augmentation. As shown, estimated project costs total $7,735,117 for the Mad Horse Creek Project and $499,250 for the Lardner's Point project.

**Table 3**

**Summary of project costs: Mad Horse Creek and Lardner's Point**

| Cost Element | Per Acre | Acres | Total |
|---|---|---|---|
| **Mad Horse Creek** | | | |
| Design | | | $76,886 |
| Implementation[a] | $150,000 | 37.1 | $5,565,000 |
| Monitoring[b] | | | $197,611 |
| Technical Oversight[b] | | | $504,371 |
| Contingency (25%) | | | $1,391,250 |
| **Total** | | | $7,735,117 |
| | | | |
| **Lardner's Point** | | | |
| Implementation[c] | | | $365,315 |
| Monitoring | $5,000 | 0.9 | $4,500 |
| Technical Oversight | | | $29,585 |
| Contingency (25%) | | | $99,850 |
| **Total** | | | $499,250 |

a. Costs include fill removal and redistribution, grading, mobilization, and planting.

b. Cost estimates for monitoring and technical oversight were developed through discussion with Trustees and New Jersey personnel. These reflect primarily contracting costs for construction oversight and monitoring, due to the large scale of the Mad Horse Creek project.

c. Costs include planting ($65,408), mobilization ($45,000), fill for intertidal/subtidal grading ($31,175), and earthwork/concrete rubble removal ($160,885).

### Environmental and Socio-Economics Impacts

Marshes are widely recognized as providing numerous ecological functions, including habitat for juvenile fish and shellfish, exporting detritus (energy source for the aquatic food web) into the estuary, and increasing water quality by filtering sediments and other pollutants from the water column. Marshes also provide many additional benefits such as storm surge protection, habitat for birds and mammals, and enhanced recreational use of the area by increasing the numbers of important aquatic species.

Habitat restoration at Mad Horse Creek and Lardner's Point is not expected to have any significant adverse environmental impacts. Any impacts to existing habitats from project

construction are expected to be temporary. Because lands intended for restoration already are government-owned, the Trustees do not expect the projects to have any significant adverse economic impacts.

**Evaluation**

The identified projects are consistent with the Trustees' evaluation criteria, and restore the same or similar types of injury (i.e., wetland/intertidal habitat loss) in the same geographic area of the spill. Both projects provide many of the same ecological services, are readily available, have a high likelihood of success, and can be scaled to quantified injuries. Marsh restoration and enhancement is also consistent with state, federal, and local restoration goals established for the Delaware River.

Overall, these projects are a cost-effective method to address injuries to multiple habitat types along the Delaware River. Accounting for productivity differences between injured shoreline habitat, many of which are relatively small, into a single type of restoration project, provides cost and planning efficiencies. The estimated cost per acre for Mad Horse Creek is $150,000, which is below per acre costs for nearby wetlands restoration projects (e.g. Woodbridge Creek, as discussed above). Although the Lardner's Point per acre cost is approximately $400,000 per acre, the small size of the project (0.9 acres) and its location near the spill origin make it reasonable to include. The Lardner's Point shoreline restoration project will provide multiple benefits in the urban part of the river that was heavily impacted by the spill. These benefits include providing public access to a large population density to an ecologically restored area in the vicinity of the impacted area, habitat restoration for estuarine fish, avian, and mammalian species, contributing to proposed networks of habitat restoration projects to provide connectivity between the upper and lower estuary, and localized water quality, sediment attenuation, and nutrient recycling benefits. Although the project has somewhat high dollars per acre cost, the benefits of the project are high due to the location and baseline conditions.

The Trustees do not expect any adverse impacts. Other than risk to workers, there is no significant risk to human health and safety.

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**Attachment 1**

**HEA Inputs and Results for Salt Marsh Restoration at Mad Horse Creek**

**Inputs:**

| | |
|---|---|
| Project Implementation | 2009 |
| Maximum Ecological Service | 85 percent |
| Baseline Ecological Service | 10 percent |
| Years to maximum service | 15 |
| Curve for Service Gain | Logistic |
| Project life span | 50 |
| Discount Rate[1] | 3 percent |

**Results:**

1 acre restored marsh provides 13.72 DSAYs of ecological service.

**Annual Calculations:**

| Year | Ecological Service Improvement (per acre) | Discounted Ecological Service (per acre) | Year | Ecological Service Improvement (per acre) | Discounted Ecological Service (per acre) |
|---|---|---|---|---|---|
| 2009 | 1% | 0.01 | 2034 | 74% | 0.32 |
| 2010 | 2% | 0.02 | 2035 | 74% | 0.31 |
| 2011 | 4% | 0.04 | 2036 | 74% | 0.30 |
| 2012 | 8% | 0.07 | 2037 | 74% | 0.30 |
| 2013 | 13% | 0.11 | 2038 | 74% | 0.29 |
| 2014 | 21% | 0.17 | 2039 | 74% | 0.28 |
| 2015 | 32% | 0.24 | 2040 | 74% | 0.27 |
| 2016 | 43% | 0.32 | 2041 | 74% | 0.26 |
| 2017 | 54% | 0.39 | 2042 | 74% | 0.26 |
| 2018 | 62% | 0.43 | 2043 | 74% | 0.25 |
| 2019 | 67% | 0.46 | 2044 | 74% | 0.24 |
| 2020 | 71% | 0.47 | 2045 | 74% | 0.23 |
| 2021 | 73% | 0.47 | 2046 | 74% | 0.23 |
| 2022 | 74% | 0.46 | 2047 | 74% | 0.22 |
| 2023 | 74% | 0.45 | 2048 | 74% | 0.21 |
| 2024 | 74% | 0.43 | 2049 | 74% | 0.21 |
| 2025 | 74% | 0.42 | 2050 | 74% | 0.20 |
| 2026 | 74% | 0.41 | 2051 | 74% | 0.20 |
| 2027 | 74% | 0.40 | 2052 | 74% | 0.19 |
| 2028 | 74% | 0.39 | 2053 | 74% | 0.18 |
| 2029 | 74% | 0.37 | 2054 | 74% | 0.18 |
| 2030 | 74% | 0.36 | 2055 | 74% | 0.17 |
| 2031 | 74% | 0.35 | 2056 | 74% | 0.17 |
| 2032 | 74% | 0.34 | 2057 | 74% | 0.16 |
| 2033 | 74% | 0.33 | 2058 | 74% | 0.16 |
| | | | | **Sum (2009-2058):** | **13.72** |

1. Values are discounted to 2006, the year for which injury DSAYs are calculated.

**Attachment 2**

**HEA Inputs and Results for Marsh Restoration at Lardner's Point**

**Inputs:**

| | |
|---|---|
| Project Implementation | 2009 |
| Maximum Ecological Service | 85 percent |
| Baseline Ecological Service | 0 percent |
| Years to maximum service | 15 |
| Curve for Service Gain | Logistic |
| Project life span | 50 |
| Discount Rate[1] | 3 percent |

**Results:**

1 acre restored marsh provides 15.56 DSAYs of ecological service.

**Annual Calculations:**

| Year | Ecological Service Improvement (per acre) | Discounted Ecological Service (per acre) | Year | Ecological Service Improvement (per acre) | Discounted Ecological Service (per acre) |
|---|---|---|---|---|---|
| 2009 | 2% | 0.01 | 2034 | 84% | 0.37 |
| 2010 | 3% | 0.03 | 2035 | 84% | 0.36 |
| 2011 | 5% | 0.04 | 2036 | 84% | 0.35 |
| 2012 | 9% | 0.07 | 2037 | 84% | 0.34 |
| 2013 | 15% | 0.12 | 2038 | 84% | 0.33 |
| 2014 | 24% | 0.19 | 2039 | 84% | 0.32 |
| 2015 | 36% | 0.28 | 2040 | 84% | 0.31 |
| 2016 | 49% | 0.36 | 2041 | 84% | 0.30 |
| 2017 | 61% | 0.44 | 2042 | 84% | 0.29 |
| 2018 | 70% | 0.49 | 2043 | 84% | 0.28 |
| 2019 | 76% | 0.52 | 2044 | 84% | 0.27 |
| 2020 | 80% | 0.53 | 2045 | 84% | 0.27 |
| 2021 | 82% | 0.53 | 2046 | 84% | 0.26 |
| 2022 | 83% | 0.52 | 2047 | 84% | 0.25 |
| 2023 | 84% | 0.51 | 2048 | 84% | 0.24 |
| 2024 | 84% | 0.49 | 2049 | 84% | 0.24 |
| 2025 | 84% | 0.48 | 2050 | 84% | 0.23 |
| 2026 | 84% | 0.47 | 2051 | 84% | 0.22 |
| 2027 | 84% | 0.45 | 2052 | 84% | 0.22 |
| 2028 | 84% | 0.44 | 2053 | 84% | 0.21 |
| 2029 | 84% | 0.43 | 2054 | 84% | 0.20 |
| 2030 | 84% | 0.41 | 2055 | 84% | 0.20 |
| 2031 | 84% | 0.40 | 2056 | 84% | 0.19 |
| 2032 | 84% | 0.39 | 2057 | 84% | 0.19 |
| 2033 | 84% | 0.38 | 2058 | 84% | 0.18 |
| | | | | **Sum (2009-2058):** | **15.56** |

1. Values are discounted to 2006, the year for which injury DSAYs are calculated.

# Attachment 3

## NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

## MITIGATION PROJECT MONITORING REPORTS FOR TIDAL WETLAND

## CHECKLIST FOR COMPLETENESS

**(8/00)**

All mitigation sites must be monitored starting the first full growing season after the construction/planting of the mitigation project is completed. The mitigation project must be monitored for three **full** growing seasons. Below are the submission requirements for a complete monitoring report. Please read each section and check each area after you have fully completed the information for each applicable requirement.

**Section A: All monitoring reports must include five copies of the following information**

- ☐ 1. A USGS quad map, and a county road map showing the location of the mitigation site, including the lot and block of the mitigation site. Furthermore provide a copy of an aerial photograph of the mitigation site. This information must clearly indicate the point(s) of access to the mitigation site.
- ☐ 2. A copy of the permit that required the mitigation.
- ☐ 3. A brief description of the mitigation project.
- ☐ 4. Photographs of the mitigation site with a location map indicating where they were taken on the site.
- ☐ 5. An assessment of the planted vegetation as well as the species that are naturally colonizing the site. This assessment shall include the location and percent coverage of each species.
- ☐ 6. Documentation demonstrating that the hydrologic regime specified in the mitigation proposal, which proves the mitigation site is a wetland, is present. The documentation shall include, as appropriate, monitoring well data, stream gauge data, photographs and/or field observation notes collected throughout the monitoring period.
- ☐ 7. Data sheets from sampling points, which describe the vegetation present, the percent coverage of the vegetation, soil borings and location of the water table.
- ☐ 8. Documentation, based on field data, that the goals of the wetland mitigation project (including the transition area) as stated in the approved wetland mitigation proposal will be satisfied.
- ☐ 9. A narrative evaluating the success/failure of the site.
- ☐ 10. If problems with the site are identified, identify actions that should be taken which will permanently rectify the situation.

**Section B: In addition to the information required in Section A above, all successful first full growing season monitoring reports must include the following information. If any one or more of the below listed parameters are not met then this full growing season monitoring period must be repeated until satisfied.**

- 1. Documentation that demonstrates through soil borings that the appropriate soil was used on the site as indicated in the mitigation approval.

- 2. As built plans, which demonstrate that the site was graded and planted in accordance with the approved mitigation plans. Any deviations from the approved mitigation plans must be highlighted and explained to the Program for review and approval.

- 3. Documentation that the hydrologic regime specified in the approved mitigation proposal, which proves the mitigation site is a wetland, appears to be present. Any deviations from the approved proposal must be highlighted and explained to the Program for review and approval.

- 4. Documentation that demonstrates that there is at least 30% areal coverage of the planted vegetation or target hydrophytes which are species native to the area and similar to ones identified on the mitigation planting plan.

- 5. Documentation that demonstrates less than 10 percent of the site is occupied by invasive or noxious species such as but not limited to *Phalaris arundinacea* (Reed canary grass), *Phragmities australis* (Common reed grass), *Pueraria montana* (Kudzu), *Typha latifloia* (Broad-leaved cattail), *Typha angustifolia* (Narrowed leaved cattail), *Lythrum salicaria* (Purple loosestrife), *Ailanthus altissima* (Tree-of-heaven), *Berberis thunbergi* (Japanese barberry), *Berberis vulgaris* (Common barberry), *Elaeagnus angustifloia* (Russian olive), *Elaeagnus umbellata* (Autumn olive), *Ligustrum obtusifolium* (Japanese privet), *Ligustrum vulgare* (Common privet) and *Rosa multiforia* (Multiflora rose).

**Section C: In addition to the information required in Section A above, all successful second full growing season monitoring reports must include the following information. If any one or more of the below listed parameters are not met then this full growing season monitoring period must be repeated until satisfied.**

- 1. Documentation that the hydrologic regime specified in the approved mitigation proposal, which proves the mitigation site is a wetland continues to appear to be present.

- 2. Documentation that demonstrates that there is at least 60% areal coverage of the planted vegetation or target hydrophytes which are species native to the area and similar to ones identified on the mitigation planting plan.

- 3. Documentation that demonstrates less than 10 percent of the site is occupied by invasive or noxious species such as but not limited to *Phalaris arundinacea* (Reed canary grass), *Phragmities australis* (Common reed grass), *Pueraria montana* (Kudzu), *Typha latifloia* (Broad-leaved cattail), *Typha angustifolia* (Narrowed leaved cattail), *Lythrum salicaria* (Purple loosestrife), *Ailanthus altissima* (Tree-of-heaven), *Berberis thunbergi* (Japanese barberry), *Berberis vulgaris* (Common barberry), *Elaeagnus angustifloia* (Russian olive), *Elaeagnus umbellata* (Autumn olive), *Ligustrum obtusifolium* (Japanese privet), *Ligustrum vulgare* (Common privet) and *Rosa multiforia* (Multiflora rose).

**Section D: In addition to the information required in Section A above, all successful third and final full growing season monitoring reports must include the following information. If any one or more of the**

**below listed parameters are not met then this full growing season monitoring period must be repeated until satisfied.**

- 1. Documentation which demonstrates that the goals of the wetland mitigation project (including the required transition area) as stated in the approved wetlands mitigation proposal and the permit, has been satisfied. This documentation must include information concerning invasive/noxious plant species and the percent coverage of these species on the site.

- 2. Documentation which demonstrates that the proposed hydrologic regime as specified in the mitigation proposal, which proves the mitigation site is a wetland has been satisfied. The documentation shall include when appropriate monitoring well data, stream gauge data, photographs and field observation notes collected throughout the monitoring period.

- 3. Documentation that demonstrates that there is at least 85% areal coverage of the planted vegetation or target hydrophytes which are species native to the area and similar to ones identified on the mitigation planting plan.

- 4. A field wetland delineation of the wetlands mitigation project based on techniques specified in the Federal Manual for Identifying and Delineation Jurisdictional Wetlands (1989).

- 5. A plan showing the flagged wetland delineation referenced above for review and approval by the Program. The wetland line must include global positioning system data points.