Wreck Pond
Restoration Measures

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May 2004

Wreck Pond Restoration Executive Summary

Wreck Pond, located in the Boroughs of Sea Girt and Spring Lake in Monmouth County, New Jersey, causes recurring beach closures at nearby ocean recreational areas due to the quality of its discharge. During and after rainfall, the discharge increases the concentration of pathogen indicator species, fecal coliform and enterococci for nearshore ocean waters to substandard levels. Governor James E. McGreevey has directed the New Jersey Department of Environmental Protection (DEP) to reduce or to eliminate beach closures caused by Wreck Pond through restoration initiatives that improve the water quality of the pond.

The DEP is proposing a four-point plan to improve water quality and to reduce the impacts of the pond's discharge on neighboring beach areas, comprised of the following elements:

- Dredging of Wreck Pond and Black Creek to remove sediment;
- Stormwater management measures to stem sediment loading in Wreck Pond;
- Extension of the pond outfall pipe to move the mixing zone further offshore; and
- Wildlife management measures to reduce fecal loadings that affect water quality.

To date, DEP has made progress on each of these elements of its plan:

- We are providing financing for the Monmouth County Planning Board and the state Department of Agriculture to complete a Regional Stormwater Management Plan (RSMP) for the Wreck Pond Watershed;
- We have conducted sediment analysis in the pond in preparation for dredging of the pond;
- We have contracted with the Stevens Institute of Technology to study options for extending the pond's outfall pipe to further dilute discharge; and
- We have financed "Geese Peace's" efforts to reduce waterfowl populations as part of a comprehensive wildlife management strategy that will include habitat alteration through perimeter plantings.

In addition, DEP also considered several other options that we have determined are less feasible and cost-effective. These include:

- Reduction of existing sediments in Wreck Pond and Black Creek through Aeration;
- Disinfection of Wreck Pond discharge; and
- Removal of all dams and flume, and support of channelized flow through the system.

Working in conjunction with local and federal partners – including the EPA, Monmouth County, and the local municipalities of Spring Lake, Spring Lake Heights, Sea Girt and Wall – DEP is committed to finding feasible, publicly-supported options that will improve the overall Wreck Pond system and reduce the number of beach closings.

Problems at Wreck Pond

Wreck Pond is a natural waterbody, approximately 48 acres in size (plus an additional 20 acres in Black Creek and upstream basins) located in the Boroughs of Sea Girt and Spring Lake in Monmouth County, New Jersey. Due to Wreck Pond's location and the intensity of development surround the pond system, this natural waterbody now functions as a large stormwater retention basin for the watershed.

Consequently, over the past several years, the pond has been the source of an increasing proportion of New Jersey's annual total of beach closings. In 2001, 35 ocean beaches were closed due to discharges from Wreck Pond; 16 beaches were closed in 2002; and 58 in 2003. These closings were 87.5 percent of the total ocean beach closings statewide in 2001; 100 percent of the closings in 2002; and 72.5 percent of the total closings statewide in 2003.

Under prevalent meteorological and oceanic conditions, littoral drift at this point along the New Jersey coast is from south to north. For this reason, beaches in Spring Lake immediately north of Sea Girt are the most vulnerable and frequently affected by Wreck Pond discharges. In recent years, maximum fecal coliform concentrations at the Brown Avenue bathing area in Sea Girt have reached 16,900 fecal coliforms per 100 mL and maximum enterococci concentrations have reached 5,100 per 100 mL. Recreational bathing standards are 200 fecal coliforms per 100 mL and 104 enterococci per 100 mL.

Recent water quality monitoring in Wreck Pond, although not concurrent with bathing samples above, has recorded fecal coliform concentrations ranging from 10 to 4,700 per 100 mL and enterococci concentrations ranged from 10 to 3,700 per 100 mL. Given these elevated levels of pathogen indicator species, beginning in 2002 the Monmouth County Health Department (MCHD) implemented a standard operating procedure after any specified rainfall of 0.1 inches in 24 hours, requiring the precautionary closing of the recreational ocean waters at Brown and York Avenues in Spring Lake for 24 hours. Rainfall of 2.8 inches in 24 hours requires a 48-hour closing. These closings are designed to minimize public exposure to waters affected by the discharge.

The beach closings qualify as use impairments, meaning that DEP is required to include these waters on the Environmental Protection Agency (USEPA) 303(d) list of impaired water segments for 2004. 303(d) designation requires the development of total maximum daily loads (TMDLs) for bacteria in the ocean and requires implementation of a water quality restoration plan. Wreck Pond was included on the previous 2002 303(d) list for the reason of nutrients and sedimentation.

The Wreck Pond system clearly is in need of restoration. In addition to the problem of beach closures, there are a number of secondary problems associated with the pond. These include the proliferation of waterfowl, excessive algal growth, and the reduced viability of Wreck Pond as an estuary as the pond moves through stages of succession toward being wetlands. The secondary concerns have been implicated as direct and indirect reasons for the high bacteria concentrations in the Wreck Pond discharge. Further, non-point source pollution must be addressed and curtailed throughout the system.

In May 2002, Governor James E. McGreevey visited Wreck Pond with Congressman Frank Pallone, Jr. and DEP Commissioner Bradley M. Campbell. In addition to his pledge to seek federal funding to address the problems of Wreck Pond, the Governor also charged the DEP with the responsibility of improving Wreck Pond's water quality and reducing the number of subsequent ocean beach closings.

Discussions about the bacteria problems in Wreck Pond are nothing new – state and local governments have known about this problem for at least 15 years. The time for action is now. This report examines several measures the DEP is pursuing to restore the Wreck Pond system.

The Wreck Pond System

A pond restoration plan must take into account the current state of the Wreck Pond system and account for problems exacerbated by years of changes to the system. The natural state of the Wreck Pond estuary has been altered over the years by filling at the eastern shore, bulkheading on the northern and eastern shore, and channelization of the discharge to the ocean through an 84-inch diameter pipe under nearby Brown Avenue beach.

The pipe accommodates tidal flow, although the flow is partially impeded by a flume at the pond end of the pipe. Significant sand movement from the ocean through the pipe creates sandbars in the eastern basin of Wreck Pond and eastern portion of the main basin.

A low dam has interrupted the natural flow dynamics between Wreck Pond and Black Creek, located in the pond's northwest corner. Above the dam, Black Creek has two ponded basins, allowing settling of sediment from upper watershed sources. Similar sedimentation has occurred in the main basin of Wreck Pond, presumably exacerbated by flow restrictions created by both channelization under the beach and by sand bar formation in the eastern part of the main basin.

The result is sediment six feet in depth, on top of hard-packed sand, characterized by an average sand content of 47.4 percent (range of 17.4 to 71.2 percent) and an average silt and clay content of 52.4 percent (range of 32.2 to 82.5 percent) after drying. The sediment moisture content before drying averaged 39.7 percent (range of 27.2 to 47.9 percent).

The fine-grained sediments with high organic and moisture content in Wreck Pond are conducive to bacteria survivability, as indicated by MCHD fecal coliform analyses of the sediments in October 1999. In those tests, concentrations of fecal coliform in the sediments ranged from 300 to 1,600,000 coliforms/100 mL throughout the system. During rainfall, sediments from the pond significantly discolor the discharge to the ocean

and the nearshore ocean waters. The decrease in water quality at neighboring recreational beaches results from a combination of bacteria from these sediments and water column bacteria.

To date, the DEP has not precisely differentiated the bacteria contributions from the Wreck Pond bottom sediments and the water column relative to each other and to the suspended sediment and water column from the upper watershed, which may quickly pass through the pond during rainfall. Rainfall amounts and frequencies will effect the relative bacterial contributions of each. Nevertheless, any restoration plan must address the existing accumulation of bacteria-harboring sediment as well as future sediment loadings.

Another issue for the Wreck Pond system is eutrophication – the increase in nutrients of a lake or pond that allows algae and microorganism populations to grow. Eutrophication is a natural process for lakes in New Jersey, including the coastal lakes in Monmouth County. However, many variables – natural and anthropomorphic – affect the rates of eutrophication and its resultant excessive sedimentation, nutrient loadings, and algal growth. Artificial or altered lakes are considered to be more susceptible to increased rates of eutrophication. The eutrophication of Wreck Pond and Black Creek is facilitated by flow restrictions at their outlets and the increasing stormwater flow to their tributaries as a result of increasing impervious cover in the watershed. Any restoration plan must address the eutrophication process if it is to be successful in the long term.

Local Prerequisites

Prior to DEP's commitment to any final workplan, our municipal partners must make a commitment to address stormwater runoff and the long-term source of the watershed's existing water quality problems. The effort to clean up Wreck Pond and to reduce beach closures is a comprehensive initiative that will only succeed through synergy of action at every level of government. Just as we are working at the federal level with New Jersey's congressional delegation to seek additional federal appropriations to complete the workplan, the DEP is seeking help at the local level from municipal leaders to address stormwater problems in their communities.

The DEP will require the four municipalities in the Wreck Pond Watershed to create a special Stormwater Management District with some of the most stringent stormwater regulations in the state and local ordinances that address the many sources of stormwater runoff. These ordinances must address problems such as burgeoning waterfowl populations in the watershed through bans on wildlife feeding. In addition, initiatives to improve stormwater quality through soil disturbance ordinances and street sweeping ordinances must be implemented.

The municipalities can either develop this district on their own or agree to a DEP-imposed stormwater management district, but either way they must commit to rigorous action to stop new degradations of water quality before the state will commit significant resources to addressing existing problems.

Only with comprehensive efforts throughout the watershed will we be able to address the source of the long-term problems that have plagued water quality in Wreck Pond. The DEP is prepared to spearhead several initiatives to address the immediate and medium-term problems in the pond; but only through local efforts to address non-point source pollution will we effectively address Wreck Pond's problems.

DEP's Water Quality Restoration Plan

The goal of DEP's restoration plan for Wreck Pond and Black Creek is to improve the bacterial quality of the discharge from Wreck Pond to the ocean recreational waters and to improve water quality throughout the Wreck Pond system.

In developing our initiatives, we began from the premise that any plan must consider the tidal excursions into Wreck Pond as well as the periodic movements of the anadramous herring to and from the ocean for spawning. Our plan also had to consider the presence of threatened and endangered bird species, such as the least tern and the piping plover, both during any temporary construction and over the long term.

The plan had to be aesthetically and practically acceptable to the residents in the watershed and to the recreational beach users. The plan could not increase the potential for flooding around Wreck Pond and Black Creek or in the upper watershed. The public hazard created by the flume and ocean discharge pipe as currently constructed could not be increased. The plan and its various component projects had to be feasible and had to require low maintenance.

Any successful restoration of Wreck Pond will depend on the reduction of the existing bacteria and of nutrient and sediment loading to limit the rate of the redevelopment of the existing problems. Addressing closings of neighboring beaches also will require more successful dilution of the pond's discharge. To that end, the DEP has begun work on four separate initiatives:

- Regional Stormwater Management Plan (RSMP)
- Reduction of Existing Sediments in Wreck Pond and Black Creek through Dredging
- Extension of Wreck Pond Discharge Pipe
- Goose and Swan Population Reduction and Habitat Alteration through Perimeter Plantings

Measure A. Regional Stormwater Management Plan (RSMP)

DEP Position: Mandatory

Pro: The plan will help to characterize the watershed's water quality problems and the point and nonpoint sources of loadings to the pond. It will also help to focus local resources and to address the long-term issues affecting the pond.

Con: None

Anticipated cost: $350,000

Estimated Timetable: Two years

Preliminary Steps: The DEP has secured the $350,000 in funding for use by the Monmouth County Planning Board and the state Department of Agriculture to complete the RSMP. Funding was released within the last few weeks and both agencies are preparing to begin their work. Depending on the availability of additional monies, the DEP may be able to fund recommended projects that result from the RSMP on an ongoing basis, rather than waiting two years for the RSMP to be completed.

Description: The RSMP provides for a knowledgeable, systematic approach to the expenditure of funds on stormwater management projects. It will develop runoff controls for existing and future development throughout the entire watershed that make technical and policy sense for the detailed features and circumstances found within a particular drainage. The RSMP process will:

- *Update the 1996 Wreck Pond Brook and Old Mill Pond Watershed Management Study. Rework groundwater recharge, surface water runoff, and zoning maps/data to ARC 8.3 level;*

- *Prepare a build-out model based on municipal zoning. The model will incorporate GIS techniques with respect to impervious surface projections and relationships to stormwater and groundwater management. The model will be rooted in standard data management and spreadsheet formats;*

- *Inventory existing stormwater management features;*

- *Prepare a hydrologic model and analysis. The model should organize hydrologic data and features to demonstrate how the system functions. Analysis will include demonstrations of hydrologic and water quality change as land use/land cover changes and as stormwater management features are installed, altered or eliminated;*

- *Identify current regulations and how they are utilized with respect to flooding, injured parties with respect to stormwater discharges and the TMDL procedure. Identify any stream segments included in the 2004 Integrated List (Sub list 5) that may be influenced by stormwater discharge;*

- *Identify and rank current and potential water quality concerns. Identify any TMDL targets that have been adopted. Identify and rank any surface water and groundwater quantity issues;* and

- *Identify stormwater-related impacts associated with current and future land use. Suggest standards consistent with New Jersey's Design and Performance Standards for Stormwater Management Measures that need to be met to eliminate, to reduce or to minimize impacts.*

Following the assessment, in defining potential solutions, the contractor will:

- *Develop, in consultation with the RSMP Committee, a management rationale that will be used in the selection of stormwater management measures in the Wreck Pond Brook RSMP area. Include feasibility and cost/benefit analyses, expected pollution load reductions and effective time of service for each stormwater management measure in the rationale;*

- *Identify the stormwater management measures that need to be installed to meet the standards set out in the previous section;*

- *Identify, from the above list, stormwater management measures that can best be incorporated into the Basic State Requirements (SBRs) of municipal stormwater management programs as added and optional measure;*

- *Prepare guidelines for existing and future land uses. Include standards and achievement targets for stormwater quality, quantity and groundwater recharge volume;*

- *Identify corrective and preventive maintenance requirements for each management measure. Suggest long-term maintenance schedules and entities that might be responsible for maintenance.*

- Implementation of the RSMP during and after the two-year development process will require the RSMP to:

- *Provide for the selection of a lead planning agency;*

- *Suggest entities that could be expected to monitor and report to the Lead Planning Agency and the RSMP Committee on success levels with respect to the operation of the management measures installed in the RSMP area. The monitoring program would also be expected to include an achievement estimate with respect to the overall project objectives;*

- *Provide an implementation timetable;*

- *Provide an implementation operating (short term) and capital improvement (long term) budget;*

- *Identify potential funding sources;* and

- *Provide for an ongoing achievement record with a view to updating the RSMP every five years.*

Measure B. Reduction of Existing Sediments in Wreck Pond and Black Creek through Dredging

DEP Position: Mandatory, but in need of public input. Of the disposal options, the DEP would prefer to incorporate the dried dredge materials into the existing dune system, if possible, to minimize local truck traffic.

Pro: The removal of sediment will improve flow, reduce the bacteria reservoir, reduce nutrients available for algal growth, delay eutrophication, provide for long term aesthetics and water quality improvement

Con: The community may be disrupted during the dredging process, depending on the disposal option chosen, by up to 35,000 disposal truck trips as well as by decreased aesthetics in the area including odors. Furthermore, a temporary downgrading of ocean discharge quality should be expected while, beach closings would probably be required during the recreational season. Trucking activity may require street repaving.

Anticipated Cost: Between $13,000,000 and $15,000,000 in Wreck Pond (Item Quantity Unit Cost Total Material Excavation – 500,000 cubic yards (cy) x $10.00/cy = $5,000,000; Transportation & Disposal – 500,000 cy x $15.00/cy = $7,500,000; Coffer Dams – 5,000 lf x $700.00/lf = $350,000; Temporary haul roads – 10,000 cy x $10.00/cy = $350,000; **Total – $13,200,000**)

Estimated Timetable: At least three years

Preliminary Steps: In the fall of 2002, as a first step in our response to Governor McGreevey's call to action, DEP sponsored dredging in the eastern basin to relieve temporarily flow restrictions caused by existing sandbars. Nevertheless, the sandbars began to reform only a month later. The DEP is still committed to continuing minor dredging of sandbars in the eastern basin of the pond to help maintain existing flows through the outfall pipe.

The DEP recently completed a characterization of the sediment in the Wreck Pond system. The results suggest that the sediment may be cleaner than first anticipated. In one area of the pond, sediment samples slightly exceeded the Residential Direct Contact Soil Cleanup Criteria (RDCSCC). All sediment samples exceeded groundwater quality standards for certain inorganic parameters.

PCBs and pesticides were either not detected or detected at ranges far below RDCSCC and groundwater standard limits. These results suggest that there will be greater options and flexibility for the disposal of any dredge materials.

Description: Dredging Wreck Pond is potentially highly effective in the short and medium term at improving the water quality of flows from the pond into the ocean. The process does raise several concerns that need to be considered by local residents prior to any final decision to dredge the pond.

The DEP is concerned that the existing water depth of Wreck Pond may be too shallow, inhibiting the use of conventional dredge equipment. Also, the development adjacent to the pond precludes hydraulic dredging because there is no place to dry the material. Therefore, the lake will have to be sectioned off with coffer dams, dewatered, dried, and then excavated to a depth of six feet, as determined by hydraulic surveys of the pond using an electronic survey fathometer. The pond would be segmented into cells utilizing steel sheet pile coffer dams along the chosen segment lines. This segmentation would allow the isolated section to be dewatered and partially dried.

Depending on the disposal option, once this is accomplished, a track-mounted excavator would be employed to excavate mechanically the partially dried material and deposit it in awaiting transport trucks. Once the trucks were filled to capacity (15 cubic yards by conventional dump truck, 22 cubic yards by dump trailer) the material would be hauled away to a legal, upland location. This operation would continue until the entire cell was excavated. The steel sheet piles would be moved to other segments of the pond and the process repeated until the entire pond was excavated to the required depth.

Such an operation raises two significant concerns. The first concern is the disposal of the dredged sediments. The dredged sediments from Wreck Pond will have to be dried, after which time DEP has examined several options for disposal. These include:

- Trucking to James Landfill in Brick Township
- Trucking to Ocean County Landfill for use as daily cover
- Creating an island within Wreck Pond
- Incorporating the dredge into the neighboring dune system
- Offshore placement of the dredge material, which is largely sand
- Selling the dredge to a local company

Originally, DEP was only evaluating the James Landfill in Brick Township as a possible placement site for the material, pending analytical results of the sediment. However, our initial analysis of the sediment suggests that these other placement options may be viable, since the dredge material is cleaner than at one time believed. The James Landfill is about 18 acres in size and due to settling it seems possible that the entire estimated 500,000 cubic yards of dredge materials could be placed there as grading material. Other landfill options, such as the Ocean County landfill may now be an upland option for dredge placement.

The concern about these placement options is public reaction to truck traffic from the project. The DEP has estimated that over 35,000 truckloads would be required to complete the project. The duration of the trucking operation is anticipated to be at least two years. This time does not include the construction of the coffer dams or the sediment drying times, which are dependent on the weather.

The DEP therefore is recommending other placement options that would limit the amount of off-site truck traffic. Our primary option would be to incorporate the dredge into the neighboring dune systems, but other options include the creation of an artificial island in

the pond. Depending on the final quality of the sediment, these options could beneficially use the dredge materials in the area immediately adjacent to the pond and reduce truck traffic. Another option may include offshore placement of the dredge material, which could be removed from the Wreck Pond site via barges rather than trucks.

The DEP is also investigating possible commercial interest in use of the dredge materials to see if costs for the dredging could be minimized.

Other Dredging Alternatives: In addition to these options for large-scale dredging with coffer dams, another dredging option may be to buy a dredge for Monmouth County. This could be considered as an alternative, if necessary, to large operation dredging. However, the process would put tremendous burdens on the smaller-scale dredge, leading to concerns about an extended timeframe for completion of the dredging and the potential for delays due to mechanical failure.

We estimate the cost of purchasing a dredge for the county to be $500,000, with similar disposal costs as the dredging options above. The purchase would, in part, provide for continuous small scale dredging in Wreck Pond and other coastal lakes. Small scale dredging also may be less disruptive to the community. On the other hand, this pond and others may be too shallow and in too developed an area for this type of operation, which would require continuous state and county management of dredging and disposal logistics. Operation staging areas in the area of each lake may have to be semi-permanent to allow for access and preparation of sediments for disposal.

DEP and Monmouth County have previously discussed a cooperative agreement that would result in a dredging plan for the county's lakes based upon the purchase and county use of a small dredge. This alternative requires significantly more discussion before DEP could commit to its implementation. Furthermore, as stated above, this option would likely involve continuous operations and some semi-permanent structures, which would disrupt the use and enjoyment of the pond by local residents.

Therefore, any dredging process, while potentially beneficial, will require significant local input to ensure public support and to educate the public about the issues of truck traffic, dredge spoils and other construction concerns.

Measure C. Extension of Wreck Pond Discharge Pipe

DEP Position: Mandatory

Pro: Extension will decrease public exposure to discharge, the quality of which will always present an increased risk to recreational bathers.

Con: This does not address water quality in Wreck Pond or the watershed. Discharge plume may, depending on ocean and wind conditions, impinge on the shoreline even with a pipe extension of a feasible length.

Anticipated Cost: Approximately $5,200,000

Estimated Timetable: Difficult to establish; we estimate that an outfall extension would require several years to complete.

Preliminary Steps: The DEP has contracted with the Stevens Institute of Technology to examine the potential benefits of extending the pond's outfall pipe past the groins in the area so that the discharge would be further dispersed by offshore flows. This month, Stevens is placing monitors along the pipe to measure coastal currents and the discharge. Based on their analysis, we will be able to better evaluate the costs and design options for an outfall extension.

Description: Currently, the Wreck Pond discharge pipe ends at the high water line of the Brown Avenue recreational bathing area. Compounding the problem of the discharge quality, there are two groins located just north and south of the pipe, which interfere with the dispersion and dilution of the discharge. By discharging water from the Wreck Pond system so close to shore, this setup significantly contributes to the number of beach closings in the immediate area.

A review of aerial photography indicates that the existing Wreck Pond pipe should require approximately a 250-foot extension to allow the pipe to extend twenty feet further seaward than the existing stone groins. This extension would assist in moving the discharge further seaward into deeper water and into the longshore drift. However, this would not necessarily guarantee that the discharge plume impingement onto the beach would be eliminated.

To calculate an approximate cost to construct this 250-foot extension, DEP used past estimates that the U.S. Army Corp of Engineers (USACOE) had generated for similar projects. These prices were increased by 10 percent to bring them up to current pricing. DEP estimates the cost per linear foot of pipe extension to be $20,856, which would include pile bent supports, bracing, pipe and all labor. Thus, the estimated total cost for the 250-foot extension of the existing 84-inch diameter steel pipe would be $5,214,000.

DEP further compared this estimate against actual bid prices received by the USACOE in 1998 from a contractor who extended Wreck Pond outfall for 34 feet as part of the Spring

Lake beachfill project. The cost at that time for this 34-foot extension was $632,124.35. Based on these actual figures, both adjusted to the length of this project and with 10 percent added for inflation, the cost would be approximately $5,112, 000, which is consistent with the estimated cost.

Measure D. Wildlife Management/Waterfowl Population Reduction

DEP Position: Mandatory

Pro: Margin plantings provide a passive means to bird control that will provide a more natural, aesthetic landscape than exists today. In addition, a method proposed by the group Geese Peace may help humanely control bird populations and limit their contributions of indicator bacteria and pathogens.

Con: The public perception and reality of obstructed views and access to Wreck Pond and Black Creek. For waterfowl population control, the relative contributions of indicator bacteria by birds to stormwater loadings may be small; potential public misperception of process may invoke protest.

Anticipated Cost: Margin plantings – $250,000; Geese Peace – under $10,000

Estimated Timetable: Ongoing for Geese Peace, with margin plantings completed within two years.

Preliminary Steps: The DEP has appropriated monies in 2003 and in 2004 for work with a local organization, "Geese Peace," to promote humane ways of reducing local waterfowl populations. These efforts include harassment of geese and swans by trained dogs and egg addling.

Bradley Beach, Avon, Belmar, Spring Lake and Spring Lake Heights have entered into an Interlocal Service Agreement with Geese Peace to start the geese harassment program. They will start in Bradley Beach in May 2004, with the intention to move the geese progressively south. Local citizens have been trained in egg addling and have been doing that throughout the spring. Belmar addled 80 eggs in a two-week period.

We plan to continue these efforts while supplementing them with extensive habitat alterations.

Description: Geese and swans nesting on the Wreck Pond System have posed an increasing liability to the water quality. Their fecal matter is being carried in runoff and contributing to non-point source pollution.

Neither the Geese Peace contract nor an U.S. Department of Agriculture contract involved the local population of swans. However, the swans may be contributing bacteria loads in Wreck Pond and Black Creek equal to the geese and contributing significantly higher loads to upstream Lake Como, where their numbers are significantly higher.

While short-term measures like Geese Peace remain important, a long-term management plan for geese and swan populations needs to be resolved. For such a plan, Wreck Pond and Black Creek should be principal target areas, although Lake Como to the north may need simultaneous attention if the activity is to be effective given bird movement from one area to the other. Therefore, this activity should be supplemented by habitat alteration.

Wreck Pond is typical of many of New Jersey's stressed water bodies. In a eutrophic system, such as Wreck Pond, excess nutrients enter the pond from the watershed from fertilized lawns within the watershed and from waterfowl droppings and other inputs. In a natural pond, abundant emergent vegetation lines the shore, capturing nutrients for their own use and causing sediment to deposit before it reaches open water.

Thus, the second means for further controlling local waterfowl – while also beautifying the area – is to establish plantings around the perimeter of the pond using an integrated management approach. Perimeter plantings, in combination with a “no mow” policy in areas that currently are lawn-like and attract geese, would be designed to eliminate the preferred goose habitat of low grass surrounding water and would capture runoff of excess nutrients.

The plantings would provide a landscape that is aesthetically acceptable to area residents, while not negatively affecting their views of Wreck Pond and Black Creek. This option would include an integrated system of plantings, visually unobtrusive fencing, erosion control and potentially a drip irrigation system to serve as goose landing deterrents.

Emergent plantings of native wetland plants could be installed on all of the shorelines. These plantings would capture excess nutrients from Wreck Pond and convert them to plant biomass; and filter sediment from runoff before it can reach the pond.

Many emergent wetland plants, such as blue flag iris (*Iris versicolor*), swamp rose-mallow (*Hibiscus moscheutos*), pickerelweed (*Pontedaria cordata*), and buttonbush (*Cephalanthus occidentalis*), have brightly colored or sweet-smelling flowers. In recent years, grasses and grasslike plants (*Juncus and Scirpus*) have become desirable in the

ornamental plant industry for their graceful foliage and flower heads, a complement to many flowering plants. Sedges and rushes, such as softstem bulrush (*Scirpus validus*), and soft rush (*Juncus effusus*) are integral parts of any native wetland planting.

Emergent plants will also contribute to environmental education because 1) they are highly visible; 2) they will increase the numbers and visibility of dragonflies, butterflies, amphibians; and 3) they demonstrate the interrelationships among plants and wildlife and the connection between the terrestrial and water environments.

Emergent plants should be installed in zones: wetland shrubs farthest from the water, blue flag and several sedge and rush species at the water/land interface, and plants requiring constant flooding – such as pickerelweed and arrow arum (Peltandra virginica) – further into the water. Pickerelweed and arrow arum should be planted, according to water depth, so that foliage and flower shoots project above the water. This zone should extend about three to four feet into the water. Sedges, rushes, blue flag iris, swamp milkweed and joe-pye weed should be planted in a zone extending from the shallow water immediately adjacent to the water's edge up to a two foot distance from the water, adjusted to soil moisture. Finally, a border of two staggered rows of wetland shrubs should be planted in a zone extending from three to nine feet from the water's edge. These shrubs will limit trampling and prevent accidental mowing of the more sensitive herbaceous vegetation, create wildlife habitat, and help intercept leaf litter and sediments carried by runoff.

Plantings should also be used to replace lawn/grass that is readily colonized by Canada Geese. Limiting colonization could be accomplished by planting a mix of open dry coastal plants, including Beach plum (*Prunus maritina*) and bayberry (*Myrica pennsylvania*), interspersed with warm season bunchgrasses (*Andropogon virginicus, Schizacaryium scoparius*). Such a system of plantings would be optimal in reducing browse for geese, especially as geese do not like their underbellies rubbed by these plants.

Recommended Species:

Botanical Name	Common Name
Shrubs/Upland	
Cephalanthus occidentalis	Button Bush
Hamamelis virginiana	Silky Dogwood
Ilex Glabra- no cultivars	Inkberry (6 male, 50 female)
Ilex verticillata	Winterberry (2 male, 12 female)
Rosa palustris	Swamp Rose
Salix discolor	Pussy Willow
Viburnum dentatum	Arrow wood
Viburnum trilobum	Highbush Cranberry
Clethra alnifolia	Summersweet

Lake Edge/Wetland Herbaceous

Clatha palustris	Marsh Marigold
Hibiscus moscheutos	Marsh Mallow
Iris pseudoacorus	Yellow Flag Iris
Iris versicolor	Blue Flag
Pontederia cordata	Pickerel Weed
Sagittaria latifolia	Duck Potato
Typha angustifolia	Narrow Leaf Cat-tail
Saururus cernuus	Lizard Tail

Species to Replace Lawn and Discourage Geese

Schizacaryium scoparius	Little Bluestream
Andropogan virginicus	Big Bluestream
Panicum virgatum	Switchgrass
Myrica pennsylvania	Bayberry

In building a system of plantings, it will be important to consider the existing conditions, including soil types and salinity. Native beach grasses are of relatively short stature and grow slowly. In most contexts they represent an ephemeral, early state of succession. Low nutrient sand placed to a depth of approximately one meter would limit competition by invasives (*Phragmites, etc*). Where higher salinities exist on the pond, *Spartina alterniflora* and *S. cynoseroides* borders may be appropriate.

Other Alternatives Considered

In addition to the primary, recommended initiatives, which we believe are mandatory needs if the water quality of Wreck Pond is truly to be improved, the DEP also examined a number of other potential restoration options. Based on our analysis, we do not recommend these initiatives at this time.

Measure E. Reduction of Existing Sediments in Wreck Pond and Black Creek by Aeration

DEP Position: Not Recommended

Pro: Aeration technology could complement dredging by delaying need for future dredging.

Con: Expensive for unproven technology; depending on actual method deployed, the process would require limited dredging or hole digging for installation; process has high maintenance costs.

Anticipated Cost: $1,000,000+ ($400,000 for Black Creek alone in addition to ongoing maintenance costs and monitoring).

Estimated Timetable: Aeration would have to continue on an ongoing basis, with continual maintenance required.

Description: One method that has been posited for improving Wreck Pond's water quality is an aeration system. Based on our research about the water quality issues in the pond and aeration systems, DEP does not recommend aeration as an option for restoration.

DEP has evaluated both conventional and new and unproven technologies designed to reduce organic sediments, bacteria, or both in a natural environment. The success of these systems in achieving sediment reduction is not predictable and we expect them to be highly variable in natural settings. The reduction of organic sediments through aeration has been successful in wastewater treatment systems where variables can be controlled and the start point is one of significantly poorer water quality.

The approach will probably be inadequate in addressing the bacteria problem, as claims of potential success are based on an incomplete understanding of the processes that control bacteria survival. Oxygen is the least factor in determining the survival rate of coliform bacteria, since fecal coliforms are facultative bacteria (can grow with or without oxygen). In fact, oxygen concentration is not included in the list of factors in the bacteria decay rate equation. The factors that influence the survival of pathogenic organisms within the waterbody are the physical conditions of the water, sunlight, temperature, salinity, predation, nutrient deficiencies, toxic substances, settling, resuspension of particles with sorbed organisms, and aftergrowth. Typically, pathogens require much

lower amounts of light energy, lower salinity, elevated levels of nutrients and organic matter, and lower temperature than a normal, healthy ecosystem to survive.

DEP has investigated three sample aeration systems, all of which rely upon creating an inversion process to bring more oxygen to the bottom of the lake. All of the systems would require some dredging or digging a hole in the lake bottom to install. One system uses a laminar flow principle to carry oxygenated surface water to the bottom of a water body. Another system installs a solar-powered circulator to draw bottom water up and spread it across the surface of the lake.

One system proposes installing 30 aerators in Black Creek, which would be connected to a common header and blower located in the borough's maintenance yard. Black Creek would have to be dredged to a depth five feet before this system could be installed. This particular project would be for Black Creek only and cost at least $429,000. This cost does not include pre-project dredging, the costs to run the blower system or biweekly monitoring to be performed by DEP. Furthermore, this system has not been installed in any other natural setting so we don't know if it will really work.

The main problem with any aeration system is that it is ineffective for shallow lakes. The EPA has determined that effectiveness of hypolimnetic aeration or oxygenation works best for deeper waters (over 12 - 15 meters) and that use in shallow lakes should be viewed with caution (USEPA, 1988.) A March 2003 article on pond aeration published in Recreation Management states that "scientists have determined that the peak efficiency depth is 15 feet, and studies indicate that for every three-foot decrease in depth, the system's relative efficiencies drop about 50 percent." Using this metric, the effectiveness of any system used in Wreck Pond, with an average depth of less than two feet, would be reduced by about 97 percent.

Measure F. Disinfection of Wreck Pond Discharge

DEP Position: Not recommended

Pro: Disinfection would decrease public health risk from recreational bathing near discharge.

Con: The placement of the treatment facility near the beach may not be acceptable to the public. Disinfection would reduce indicator bacteria, but at a different rate than potential pathogens. Risk would not be eliminated.

Anticipated Cost: Not estimated at this time.

Estimated Timetable: Disinfection would have to continue on an ongoing basis, with continual maintenance required.

Description: One possible option for reducing the number of beach closings would be to treat the discharge from the Wreck Pond system to reduce the number of bacteria that

entered the ocean. This method, aside from being technologically difficult would also be very costly.

Disinfection of the Wreck Pond discharge would require a treatment system to remove the sediments, which would otherwise interfere with the effectiveness of any disinfection method. Then a treatment and disinfection system, preferably based on ultraviolet radiation, could be engineered for the water. However, the system would have to accommodate the tidal flow and fish movement into the lake and the range of flows from the lake caused by rainfall intensities and duration.

Given the tremendous technical and financial obstacles relative to the benefits, the DEP does not consider this option to be feasible. Furthermore, this option would allocate too great a proportion of resources toward the problem of beach closings rather than toward improving the water quality of the overall Wreck Pond system.

Measure G. Removal of All Dams and the Flume, and Support of Channelized Flow through the System

DEP Position: Not recommended at this time.

Pro: This would alleviate some of the sediment, nutrient, and bacteria accumulation that the impoundments facilitate. Stream flow would be restored to a more natural state.

Con: The affect on the quality of the ocean discharge from Wreck Pond cannot be determined. The pond environments that residents prefer would be eliminated.

Anticipated Cost: Not estimated at this time.

Estimated Timetable: At least two to three years.

Description: One potential option to improve the water quality and flow throughout the Wreck Pond system would be to eliminate all upstream dams and return the system to more natural stream flow rather than the current pond environment. The removal of the upstream dams and the flume will have varying effects over time on downstream sediment deposition and the quality of the ocean discharge, neither of which have been determined at this time. An anticipated initial transport of materials downstream subsequent to the dam removal should stabilize over time. However, the rate of movement of new sediments from the upper watershed could increase sedimentation in Wreck Pond if upstream sediment controls have not implemented. This option must be considered in concert with other options after the RSMP has been completed.

A radical approach to the dam removal option would allow all except a channel through Wreck Pond to ultimately fill in and move to wetlands. Wetland formation could be assisted with plantings and the channel development could be assisted with dredging. The result could be a more aesthetic, naturally functioning tidal system. The effect on the

quality of the ocean of this activity is not known; however, wetlands, through the animal populations they support, often increase bacteria populations.

Another partial option would be the removal of the flume at the end of the eastern basin of Wreck Pond to facilitate tidal movement. The effect of this option on the formation of sandbars in that basin has not been determined, however. The unimpeded flow may provide sufficient bottom scouring to reduce the sandbars or may allow for the movement of more sand to the basin from the ocean.

If this option or any part of it is pursued, significant local input will be required to ensure that residents are supportive of any radical changes to the landscape and to educate the public about the changes in the succession of ecosystems that will take place.

Conclusion

Our Wreck Pond watershed restoration plan will be influenced by the findings of the RSMP, helping further refine our initiatives to mitigate sedimentation and stormwater flow. In the interim, the DEP is laying the groundwork for dredging of Wreck Pond to "jump start" the process of improving the quality of the ocean discharge and for extending the outfall pipe to increase dispersal and dilution of the discharge. Comprehensive wildlife management strategies are already underway and should continue to be coordinated with local ordinances in a new, special Stormwater Management District. Variations on the initiatives as described can be considered.

No initiative alone will resolve the Wreck Pond watershed issues. However, working in close partnership with local governments and through strong solicitation of public input and support, we can improve the Wreck Pond watershed and reduce the number of beach closings in this area. Working to meet Governor McGreevey's charge, we will find a way to restore Wreck Pond to the proper condition it deserves.