

**COX HALL CREEK  
WETLAND RESTORATION SCENARIOS  
AND FEASIBILITY STUDY**

**TOWNSHIP OF LOWER  
CAPE MAY COUNTY  
NEW JERSEY**

**VOLUME 3 – PREFERRED CONCEPT**

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**COX HALL CREEK FOCUS GROUP MEETING MINUTES, Dated: December 17, 2003**

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## INTRODUCTION

### Background

Cox Hall Creek, formerly Coxall Creek, is a small watershed (1,940 acres +/-) located in the southwestern portion of Cape May County in the Township of Lower (**FIGURE 1 – All FIGURES are located in VOLUME 2**). Located adjacent to one of the earliest settlements in southern New Jersey, the Creek and its associated wetlands have been bordered by increasing development since colonial times. During early times, it is recognized that the Cox Hall Creek basin was farmed to salt hay, used by livestock for grazing and limited food and fowl production. Its close proximity to intensely developed areas has resulted in closing off tidal flow to this once estuarine basin and the creation of a freshwater complex of wetlands. Fourteen stormwater outfall pipes discharge into the Cox Hall Creek, Mickels Run or their adjacent wetlands. From 1969 to 1990, Cox Hall Creek received treated effluent from the Lower Township Municipal Utilities Authority Sewage Treatment Plant. The lack of adequate grade has resulted in the need for channelization and a pump station to manage stormwater discharged into the system. While an outfall pipe had been installed under the dunes previously, in 1971, the pumping station was installed and all flow from the Creek was mechanically discharged into Delaware Bay through the above-mentioned pipe.

As the uplands surrounding this wetlands area were developed, water management of the site resulted in the establishment of an extensive stand of Phragmites australis, the common reedgrass, which has displaced native species and natural habitats. The channels have been choked with dense vegetation and largely have failed to conduct water efficiently to the discharge channel and pumping station. The extensive stand of common reedgrass in close proximity to residential development constitutes a significant hazard of fire, as the community experienced in 1999.

The Cox Hall Creek, its tributaries and associated wetlands constitute an important ecosystem in the intensely developed southern portion of Cape May County. While the western portion of the watershed exhibits the degradation resulting from human impacts, some of the upstream portions of the watershed contain examples of healthy freshwater ecosystems.

It was recognized by the Technical Advisory Committee (TAC) of the Area 16 Watershed Management Program that the Cox Hall Creek Watershed warranted attention to evaluate if the watershed could be restored to a healthy stream / wetlands complex. In order to assess the

condition of the watershed, identify problems and develop a restoration plan, the Cox Hall Creek Focus Group was established as a sub-group of the TAC. Early efforts of this group focused on examination of the water quality of the Cox Hall Creek basin and its potential impacts on the Delaware Bay. In addition, considerations were given to possible restoration scenarios. The Cape May County Planning Department has served as an advisor and grant administrator to aid the Steering Committee of the Focus Group. Since their formation, the Focus Group, with the aid of the Planning Department, has sought technical assistance and professional aid from governmental agencies and the private sector. They have participated in data collection and evaluation in addition to outreach programs to assess community interests and issues concerning the Cox Hall Creek and possible restoration.

### **Public Participation**

On January 25, 2003, the Cox Hall Creek Focus Group held a public meeting at the Cape May Beach Property Owners Association clubhouse. The presentation portion identified the composition of the Focus Group and its schedule in order that interested citizens and stakeholders could participate. The findings and conclusions of the water quality studies were presented. The wetlands restoration concept was introduced, along with funding considerations and schedules. All participants were encouraged to complete an Information Survey that was designed to solicit input and concerns about various restoration scenarios.

The Presentation, Information Survey and Report of the Public Meeting – Cox Hall Creek Restoration conducted on January 25, 2003 are presented in **VOLUME 1 APPENDICES A, B and C**, respectively. While questions were raised about the process and potential restoration impacts, the overall consensus was to evaluate site conditions and possible wetland restoration scenarios.

Meetings with wetland landowners, public officials, technical advisors and agencies have been held by the Focus Group in the intervening year culminating in the technical review of the “DRAFT Cox Hall Creek Wetland Restoration Scenarios and Feasibility Study (Volumes 1 and 2)” on December 17, 2003. During that meeting, the conditions of the wetlands and surrounding lands were evaluated, along with the alternative wetland restoration scenarios. Critical assessment evaluated the risk and benefits and for scenarios 1, 3 and 4 and the fatal flaws of these scenarios were found. Scenario 2 was not deemed acceptable, though feasible, because

of the significant use of herbicides. Scenarios 5 and 6 were preferred. The minutes of this meeting are presented in **APPENDIX A**.

## Issues and Concerns

Issues and concerns that have been identified are described below:

1. Flooding from the failure of the pumping station to evacuate stormwater and uncontrolled inundation with tidewater from the Delaware Bay can result in the flooding of residences and Township roadways.
2. Pest Species Control constitutes health and safety risks. Common reedgrass (Phragmites australis), has degraded the once natural ecosystem complex by displacing the native wetlands species in the wetlands basin (western and former tidal portion of the wetlands complex) impacting wildlife use of the area and creating a very significant fire hazard. In addition, the extensive area of dense stands of reedgrass choke the streams and ditches thereby inhibiting natural drainage patterns and has created habitats that support mosquito breeding. Some species of mosquitoes may serve as vectors of arthropod-borne diseases, such as West Nile Virus. Mosquito control in this environment is challenging because of the expansive breeding areas without adequate access.
3. Change in habitat could attract Canada geese that could pollute the surface water.
4. Change in water quality from tidal water inundation could result in the loss of potable wells that currently draw water from the surface aquifer, the Holly Beach water-bearing zone.
5. Public Access could result in possible security and liability problems for property owners of and adjacent to the Cox Hall Creek wetlands. In addition to creating parking and traffic problems that could impact the neighborhoods adjacent to the wetlands.
6. Protection of the beach-dune complex is important to protect species relying on these habitats, such as the horseshoe crabs and migrating shorebirds.
7. Cost of construction associated with the wetlands restoration plan is an important consideration in addition to the source(s) of funding.
8. Maintenance of the wetland restoration facilities is important to monitor the restoration plan success and make adjustments in the plan, as necessary.

## WETLAND RESTORATION SCENARIOS

### Goal

The goal of the Cox Hall Creek Focus Group is to restore the quality and enhance the natural functioning of the Cox Hall Creek wetlands. The underlying challenges are to address flooding, stormwater management, fire risk, and mosquito abatement within the overarching responsibilities of protecting and enhancing of the natural and human environments. Surface water quality improvement and groundwater protection are two critical aspects of this wetlands restoration initiative.

In order to develop and evaluate alternative wetland restoration concept plans, existing site conditions had to be characterized and analyzed, in addition to establishing evaluation and design criteria. Abbreviated reviews of these aspects of the study are reviewed below.

### Existing Conditions

#### Wetlands Location and Distribution

The Cox Hall Creek wetlands area of the study is located within a watershed drainage area contains approximately 1,940 acres (3.03 square miles) on the southwest portion of the Cape May peninsula. The Cox Hall Creek wetlands are comprised of Cox Hall Creek basin, which consists of the extensive, flat portion of wetlands, formerly flowed by tidewater from the Delaware Bay. This basin does not currently receive tidal inundation however; the soils in this area reflect their origin and surface composition of muck typically ranging from 45 to 60 inches in depth and upon drying become strongly to ultra acid.

The tributary freshwater wetland areas that discharge into the basin are delineated by the various Palustrine wetlands on Berryland and Mullica soils. This soil unit occurs in the freshwater flats, flood plains and depressions landform. The surface layers (0 to 72 inches) of this soil unit are comprised primarily of sand (Berryland) and sandy loam (Mullica), which are very strongly acid or extremely acid throughout the profile.

#### Hydrogeologic Framework

The Cape May peninsula is the southernmost part of the coastal plain of New Jersey. It is underlain by unconsolidated sediments consisting of alternating beds of sand, silt and clay, some of which may be mixtures or pebbly. These sediments extend to the basement complex comprised of the crystalline rocks at a depth of approximately 6,000 feet in the southern part of

the Cape. The study area is underlain by the Kirkwood-Cohansey aquifer system comprised generally of the alluvial deposits and the beach sand and gravel and Cape May Formation. The surface aquifer is the unconfined Holly Beach water-bearing zone. Beneath the Cape May Formation is a confining unit of silt and clay, the estuarine sand aquifer, another confining unit of silty clay and the Cohansey aquifer.

The hydrogeology of Cape May County is described by Lacombe and Carleton (2002) along with the availability of water supplies and salt-water intrusion. This study indicates that the Holly Beach water-bearing zone contains chloride and sodium concentrations in groundwater samples from the Holly Beach water-bearing zone in the western portion of the drainage basin that exceed 250 milligrams per liter and 50 milligrams per liter, respectively. Elevated chloride concentrations impact water quality in terms of objectionable taste and deterioration of domestic and public plumbing. Elevated sodium concentrations, while controversial as pointed out by Lacombe and Carleton, may have health affects on persons on low sodium diets. However, the elevated concentrations of chlorides and sodium indicate that the surface water aquifer, the source of water for some wells in the immediate vicinity, is experiencing salt-water intrusion.

#### Surface Hydrology

The surface waters of the Cox Hall Creek, Mickels Run and their tributaries results from the precipitation intercepted by the drainage basin. Site investigations revealed that the stream flow in upper reaches are impeded by snags and partially blocked culverts. The stream channels within the wetland basin are largely choked with vegetation. In total, the surface water input into this basin is significantly impacted by storm events, existing inefficient surface flow characteristics of the watercourses and the condition of the aged pumping station.

The surface water hydrology associated with the tidally influenced Delaware Bay is based upon the National Ocean Service data from station 8536110, Cape May, Cape May Canal, Delaware Bay. The elevations of tidal datums refer to Water Level 88 NAVD, in feet:

Highest Observed Water Level (9/27/85)	5.79
Mean Higher High Water (MHHW)	2.42
Mean High Water (MHW)	1.99
North American Vertical Datum – 1988 (NAVD)	0.00
Mean Tide Level (MTL)	-0.43
Mean Sea Level (MSL)	-0.45

Mean Low Water (MLW)	-2.86
Mean Lower Low Water (MLLW)	-3.02
Lowest Water Level Observed (1/28/71)	-6.04

The surface hydrology of the Delaware Bay and its shoreline in the vicinity of the Cox Hall Creek is impacted by numerous factors. While the climate of the Delaware Bay is moderated by its proximity to the Atlantic Ocean, severe weather conditions may be experienced as a result of coastal storms, including hurricanes. Large amounts of ice form in the Delaware Bay during severe winters damaging shore protection and outfall structures. The southwest wind direction prevails in the area; however, gale force winds, come most often from the northwest and winds of more than 60 miles per hour originate from seven of the eight principal compass directions. The strongest winds tend to be most frequently from the northwest during the winter. These winds traveling over more than 20 miles of unfettered Bay surface generate waves, which are less than 2 feet nearly 80 percent of the time, but exceeding 6 feet only 2 percent of the time. Additionally large waves may be infrequently generated through the mouth of the Bay.

Tides in the study area are of the semi-diurnal type, i.e., two high waters and two low waters occur in a period of 24 hours and 50 minutes. The mean tide range is 4.85 feet at the entrance to the Cape May Canal in close proximity to the Cox Hall Creek Outfall. While not considered strong near shore during normal tide flows, currents in the lower Bay may be significantly affected by winds and waves to impact the shoreline sediments. The net potential longshore sediment transport in the vicinity of the Villas is 57,000 cubic yards per year in a net southerly direction. The sea level rise is an average rate of 0.0102 feet per year or a 0.51-foot rise in sea level rise over a fifty-year project life. However, a National Research Council study on sea level rise indicates that a 1.4-foot rise could occur over a 50-year project life based upon certain criteria.

Storms and storm surge produce damaging effects. While hurricanes can severely impact structures and shoreline erosion in a short period of time, northeasters occur more frequently and can cause equal or greater damage because of their longer duration. The Delaware Bay shores retreated up to 75 feet in the March 1962 northeaster. Between 1923 and 1994 16 storms reported moderate damage levels, 13 sever damage levels and 5 extremely severe damage levels. The highest still water level at Lewes Delaware occurs at an elevation of +7.1 feet NAVD during the March 3-6, 1962 northeaster. The peak surge levels, simulated from

historic hurricanes and northeasters, produce the following stage frequency flood elevations at the Villas site:

5-year event	+4.0 feet NAVD
10-year event	+4.9 feet NAVD
20-year event	+5.7 feet NAVD
50-year event	+6.9 feet NAVD
100-year event	+7.5 feet NAVD
200-year event	+8.3 feet NAVD
500-year event	+9.3 feet NAVD

The topography of the Project Area was prepared by Hatch Mott MacDonald ranges from –3.0 to +10.0 feet plus (NAVD 1988) in one-foot contours.

#### Cultural Features

The cultural features of the lands adjacent to the Cox Hall Creek wetlands considered include the Cox Hall Creek outfall pipe into the Delaware Bay, its associated pump station, stream channels and associated culverts, community roads and stormwater outfalls, in addition, to house and property improvements, based upon the aerial photographs taken 3-4-03, and Tax Map data.

Data indicate that the Cox Hall Creek wetlands complex is bordered largely by residential development. On the north central boundary, the Ponderlodge Golf Course has been constructed and an active farming operation occurs on the eastern boundary. While the majority of the roadways and residences occur at an elevation above +5.0 feet, a significant number of homes and portions of 11 roads occur at an elevation between +4.0 and +5.0 feet. Six homes and portions of four roads occur between elevations of +3.0 to +4.0 feet. As such, the water elevation within the Cox Hall Creek wetlands basin of +3.0 feet is the maximum elevation that will not result in flooding roads and homes.

Evaluation of the topography of the area clearly indicates that the wetlands basin is flat. Except for the channels of the lower Cox Hall Creek, the majority of the basin has elevations ranging from +1.0 to +3.0 feet extending from Clubhouse Drive 4,200 feet northeast up the Cox Hall Creek and 3,500 feet east up Mickels Run. More importantly from a stormwater management perspective, the elevation of the basin between Clubhouse Drive and the major stormwater

outfalls at the southern end of the wetlands range from +1.0 to +2.0 feet over a 3,300-foot distance. As such, the grade for surface water flow within the wetlands basin is very flat. Therefore, the community drainage features are challenged by flat grade and vegetation choked watercourses. Finally, the freeboard or ability of the wetlands to store stormwater is restricted by the existence of residences and roadways occurring between elevations +3.0 to +4.0 feet NAVD.

The Cox Hall Creek wetlands complex of comprised of all or portions of 22 lots. Fourteen lots are owned privately; 2 lots are owned by the Cape May County Mosquito Commission, 3 lots by Lower Township; 1 lot by the Lower Township Municipal Utilities Authority, and 2 lots by the New Jersey Conservation Foundation.

### Ecology

The ecology of the Cox Hall Creek wetlands complex has been characterized as three components the Cox Hall Creek basin constitutes the portion of the wetlands complex that was under tidal influences until the Creek outfall into the Delaware Bay was piped and a tide gate installed. A pumping station was installed that discharged the fresh waters from these meadowlands into the Bay. As such, the basin was converted from a tidal marsh to a freshwater marsh dominated by common reedgrass. The tidal streams that were formerly flowed by mean high water are now choked with the reedgrass.

While the dense stands of common reedgrass create limited habitat diversity over the extensive area; some species of birds and muskrats have been observed in the basin.

The freshwater stream corridors consists of the stream channels and a ponded area of the Cox Hall Creek, the stream channel of Mickels Run and the adjacent scrub/shrub, deciduous wooded and herbaceous wetlands. The freshwater stream courses serve as habitat for fish and wildlife species adapted to use of these features, including frogs and toads, snakes and turtles, birds and mammals.

The freshwater wetlands extend beyond the stream corridors. They are largely comprised of deciduous wooded, coniferous wooded, mixed forested, deciduous scrub/shrub, mixed scrub/shrub and disturbed wetland biotic communities.

The diversity of species and community structures, in addition to the ecotone effect, provide suitable habitat to a diversity of wildlife species. These habitats support significant populations of resident and migrating species of birds, in addition to a diversity of mammals, reptiles and amphibians.

While not included in the Cox Hall Creek wetlands complex, the beach and dune ecosystems contain important habitats that are utilized intensely by the public and wildlife. The dunes are used by resident and migratory birds, in addition to cottontail rabbits and meadow voles. The beach adjacent to the outfall is used by migratory shorebirds, gulls and some passerines during the horseshoe crab breeding periods, primarily in May and June. However, a diversity of birds utilize the beach throughout the year, including overwintering shorebirds and gulls.

The principal wildlife phenomena that are noteworthy for the subject area are include spring shorebird migration, fall migrations of raptors and neotropical songbirds, spring migrations of neotropical songbirds, breeding, roosting and foraging by summer residents birds and a diversity of habitats within the wetlands complex for indigenous non-avian species of fish and wildlife.

Based upon site inventory, the Natural Heritage Database and the Landscape Project threatened and endangered species of plants and animals occur within the vicinity of the study area; such species include swamp pink, crane fly orchid, barred owl, black-crowned night-heron, Cooper's hawk, Cope's gray treefrog, eastern tiger salamander, migratory raptor concentrations, migratory shorebird concentrations, red knot, red-shouldered hawk, and suitable vernal pool wildlife habitat.

The Natural Heritage Priority sites that occur on or in close proximity to the project site:

- Cape May Corridor Macrosite (the eastern portion of the wetlands complex)
- Cold Spring Woods Site (the upstream portions of Cox Hall Creek and Mickels Run) and
- Delaware Bay Macrosite (the Delaware Bay shoreline comprised of sandy beach and nearshore water habitats).

Pest populations of primary focus of this wetland restoration project include common reedgrass and mosquitoes.

Common reedgrass (*P. australis*) has become established in the basin area as a result of the disturbance of the tidal wetlands by manipulating water quality and hydrologic regimes. Once established in the basin area, the reedgrass spread rapidly in available habitat through vegetative reproduction by rhizomes and wind-dispersed seeds. While common reedgrass is beneficial in terms of trapping sediment, concentration of pollutants and providing limited wildlife habitat, it negatively impacts the wetlands. Negative impacts include: altering the marsh topography by accretion, choking channels, retains nutrients longer than native vegetation, alters the light and temperature regimes of the marsh, forms a monoculture, changes the marsh structure and alters the animal communities – both fish and wildlife.

The single-most negative aspect of the reedgrass is its propensity to create wildfires. Once the aerial portion of the plant dies in the fall, it dries and continues to stand. The standing crop constitutes a massive source of flammable material that is very difficult to manage once the fire has begun. Fire control is almost impossible because of the rapid spread of the fire, especially during windy conditions, and because of the inaccessibility of the wetlands to fight the fire. In order to protect the residents who live adjacent to the wetlands basin and to protect the wooded wetlands to the east, control of the reedgrass is an important benefit of the wetland restoration.

Mosquitoes are an integral part of most wetland ecosystems. Review of the Cape Map County Mosquito Control Commission survey records from 2001 to 2003, indicates that a variety of species of mosquitoes are produced in the Cox Hall Creek wetland complex including species associations arthropod borne pathogens amplification / transmission.

The control of mosquitoes is an important consideration in the wetlands restoration concept development. By modifying the wetland habitats in the restoration process and enhancing biological control methods, a significant level of mosquito control may be affected without the use of insecticides.

In summary, the current physical, chemical and biological characteristics of the Cox Hall Creek wetlands complex are a result of natural forces and human impacts. While the basin portion of the wetlands and the stream corridor have been significantly altered from their natural conditions, this wetland complex none the less, continues to serve many of the important functions of wetlands. They include trapping of sediments, erosion control, water quality improvement through treating stormwater, floodwater storage, surface water aquifer recharge,

habitat for threatened and endangered species of plants and animals, fish and wildlife and net primary productivity discharged into the Delaware Estuary food web. In addition, this wetland area is inextricably connected to the residents of the area for recreation and their quality of life. While the wetland functions and values are beneficial to the natural and human environments, the wetland degradation has resulted in threats to residents by fire and flooding. Additional threats include the annoyance and potential arthropod-borne disease transmission from the hematophagous arthropods (mosquitoes, biting flies, ticks) bred in the wetlands.

Restoration of the Cox Hall Creek wetlands complex can result in improvement of many of the functions and values, while abating to a large extent flooding, fire and pest production.

### **Design Criteria**

The design criteria for the wetland restoration project were developed based upon the issues, interests and concerns articulated by the public, in addition to the professional evaluation of existing project site conditions.

These design criteria reflect the overarching public and professional concerns for the protection and improvement of the quality of life for the community residents, in addition to protection and enhancement of the natural ecosystems associated with the Cox Hall Creek wetlands complex.

1. If dredging is required, dredged materials resulting from water body construction will require disposal in a manner that is appropriate, i.e., will not result in the distribution of important stand of plants and wildlife or their habitats. Acidification of the dredged materials is a concern within the context of the beneficial reuse of these materials.
2. Surface waters, resulting from tidal inundation, precipitation and stormwater, must be treated in a manner to improve water quality and to ensure their conveyance through watercourses and water control structures that meet the goals of the restoration project.
3. The Holly Beach water-bearing zone (surface water aquifer) is currently the source of water for some shallow wells in the adjacent community. The use of shallow wells in this aquifer and salt-water intrusion are a consideration. If intrusion results from the actions of the wetland restoration, resources will be

- obtained to replace wells subject to contamination with appropriate alternative potable water resources.
4. Controlled Tidal Inundation from the Delaware Bay can be employed to control the common reedgrass, restore vegetation-choked channels, and improve the function and value of the basin component of the wetlands. Uncontrolled tidewater inundation can result in the flooding of residences, roads and important freshwater wetlands habitats. The maximum tidewater inundation elevations should be +2.5 feet NAVD and under no circumstances exceed +2.75 feet NAVD.
  5. The input of surface water that results in a water elevation above +3.0 feet NAVD will result in community flooding. Therefore, a surface water management strategy requires that the comprehensive analysis be conducted during the design phase to ensure that watercourses, culverts and the pumping station are designed to safeguard the adjacent community in addition to the self-regulating tide gate and tidal inundation regimes.
  6. Currently Stormwater Management entails the discharge of the communities' stormwater through 14 outfalls into the project wetland. Facilities and practices must be incorporated to efficiently discharge stormwater into Delaware Bay with minimal adverse impact to the wetland ecosystems while safeguarding the community from flooding.
  7. The Surface Water salinity of the basin area wetlands may be increased to that of the Delaware Bay, if acceptable to the public and reviewing professionals. It is recognized that increased salinity could impact shallow wells and possibly localized salt-water intrusion. Safe potable water resources must be ensured for the impacted residents of intrusion occurs. Further, the inundation of tides may not result in the loss of important freshwater wetland / stream habitats or promote the drainage of the adjacent freshwater wetlands during the ebbing tidal cycle.
  8. Water quality improvement systems should be incorporated to pretreat stormwater prior to its discharge into the wetlands.
  9. Efficient and cost effective ecosystem enhancement strategies must be employed to restore this wetlands complex, while protecting the important and viable freshwater tributaries to the basin area. The self-regulating tide gate design and operation must promote controlled tidal inundation without community

and critical freshwater wetlands flooding. Band ditches with adequate flow capacity convey stormwater from the outfalls, while promoting mosquito control. Adjustable water control structures and weirs will be employed to manage water elevations in the ditches and streams, as required, between +0.5 feet to +4.0 feet NAVD. Fish ladders will be installed if they are necessary to permit fish to swim upstream of the water control structures.

Wetlands restoration ecological design criteria require protection at the Cox Hall Creek and Mickels Run freshwater wetlands in addition to threatened and endangered species habitats.

10. Control of mosquito breeding must emphasize biological control measures includes band ditches, water control structures and weirs to promote fish and predatory insect access to breeding areas.
11. Control of common reedgrass is accomplished by tidal inundation with Delaware Bay water to establish salinity above 15 ppt, at least for the period of major control efforts, and water elevation and regime management to prevent the germination of the wind-blown seeds.
12. Surface Water Management is critical to mosquito and invasive plant abatement. The elevation of the basin wetlands cannot be accurately assessed until the reedgrass has been controlled and its associated biomass has been discharged into the system. However, watercourses and control structures must be designed to be adjustable to fine-tune the water elevations to prevent flooding, to protect the fish and wildlife, to restore the wetlands and to aid in the control of the reedgrass and mosquitoes.
13. The wetlands ownership of the project site is by several private citizens, public agencies and an environmental organization. The project will be benefited by a single governmental entity empowered to coordinate the design and to implement this wetlands restoration. A single decision entity will facilitate design actions. Public input during the selection, design, implementation and monitoring phases is essential to ensure community support.
14. Fire control design criteria will not be required if the reedgrass stands are eliminated through water management.
15. No design criteria have been incorporated specifically for recreation enhancement because the public did not wish to attract large numbers of non-

residents to the neighborhood that would create security, traffic, public safety and wildlife disturbance issues. During the final design stage, wetland / wildlife observation facilities, will be evaluated at selected street ends to provide visual access to the wetlands, if desirable.

The design criteria presented above have been based on the assumptions that the human environment (residents, utilities and roadways) must be preserved in their current conditions (except for Clubhouse Drive) and that a wetlands restoration is intended to enhance the functioning and values of the wetlands. Inherent in the later assumption is the recognition that portions of the existing wetlands may be changed in character, i.e., converted from freshwater wetlands to tidal wetlands and flowing open water channels.

## **FEASIBILITY ANALYSIS**

Analysis of the alternative wetland restoration scenarios has been made on the basis of evaluation and design criteria previously discussed in Volume 1

### Scenario 1. No Action Alternative

This scenario will result in the surface water flooding will continue to impact the community and is expected to become more severe in the future. Stormwater quantity and quality will continue to be a community problem. Further, the no action will result in the perpetuation of the reedgrass problem and the associated fire, flood and pest (mosquito) problems. Continued pesticide applications will be required to control mosquitoes. This scenario does not resolve any of the issues and problems articulated by the public agencies that are required to manage this area. While there is limited immediate cost to this management strategy, long-term costs and efforts will be required to control flooding, mosquitoes and fires and control stormwater. The immediate cost that must be anticipated is the rehabilitation of the pumping station and the restoration of channels through Cox Hall Creek basin area to major stormwater outfalls.

### Scenario 2. Manage and Enhance the Cox Hall Creek Wetlands as a Freshwater Ecosystem Complex

This restoration concept entails controlling the reedgrass with herbicide treatments, channel restoration and stream clearing, in addition to water quality and regulating water levels discharged into the wetland basin. Water level management is required to preclude reestablishment of the reedgrass.

Restoring a freshwater wetlands ecosystem in the basin is desirable from a possible aquifer recharge and a shallow well use perspective. While this restoration strategy may achieve the desired outcome, use of herbicides for an extended period of time (including spot treatments) and the criticality of water level management will be the primary challenges of this scenario. Additional detailed water budget analysis is required to determine if there are adequate water resources discharged into this wetlands to maintain a surface water regime that will sustain a freshwater wetlands, while precluding the reestablishment of the reedgrass. Mosquito control will continue to require significant control efforts, especially in cattails because it is a dominant plant in the basin area.

### Scenario 3. Creation of a Freshwater Lake in the Cox Hall Creek Basin

The freshwater lake concept entails a major dredging project with the challenge of finding a beneficial reuse of the dredged material or an affordable method of transport and disposal.

While the freshwater lake concept has many attributes, the probable fatal flaws are associated with multiple regulatory agency permitting the loss of 86+ acres to wetlands to an open water lake, the extensive dredging and dredged material dewatering and transportation and the ultimate disposal of 735,680 CY of the dredged material. The acidification if the dredged material is a significant issue having limited solutions.

### Scenario 4. Return Natural Tidal Flow to the Wetlands by Breaching the Dunes

The uncontrolled inundation of the basin by Bay water has several inherent challenges; the inlet (tidal channel) must be designed and maintained to avoid blockage by sand. Further, an engineered earthen berm is required to protect the adjacent community from coastal flooding. However, the berms would have to be constructed on wetlands. Permitting these structures would be most unlikely. At least 11 stormwater inlets would require valves to preclude the back flow of stormwater into the community.

While this concept has many attributes, not the least of which is the restoration of a healthy tidal marsh with all natural functions and values; the invitation of the full forces of coastal storms into the community poses significant risks. This concept cannot adequately address the management of stormwater and upstream flooding. In addition, resulting expanded mosquito breeding may preclude meeting public health goals of the restoration. The salt-water intrusion may impact shallow wells and destroy adjacent forests resulting in an aesthetic, environmental

and safety controversy, similar to the Green Creek restoration experience. The non-renewable resource commitment to create the berm, the construction traffic and equipment will not only impact the community, but also result in wildlife disturbance and wetland destruction.

Scenario 5. Return Limited Tidewater Flow into the Wetlands and Scenario 6. Freshwater and Tidewater Ecosystem Complex

Both concepts entail the return of tidal flow to the basin area in a controlled manner; however, scenario 5 entails controlling tidal inundation by restricting the total volume of inflow from the Delaware Bay. Scenario 6 entails a safe guard for the upstream flora and fauna of the Cox Hall Creek and Mickels Run wetlands by installation of dams (berms) and water control structures to maintain the upstream hydrology during droughty periods and the ebbing phase of the tidal cycle. The surface hydrology will be changed in the basin to tidal inundation twice daily; however, the inflow will be regulated to maintain a healthy tidal wetlands, but also preclude coastal flooding through the use of a self-regulating tide gate set at between +2.0 and +2.5 feet NAVD. The mean high water and mean higher high water at the Bay discharge / inlet is +1.99 and +2.42 feet NAVD, respectively. The advantage of Scenario 6 is the ability of the berms (dam) in the Cox Hall Creek and Mickels Run and the water control structures to maintain the upstream surface hydrology. Band ditch configuration promotes tidal circulation and tidewater inundation of the basin marsh.

The surface aquifer may be impacted; additional professional guidance and assessment is required to evaluate the extent to which this aquifer is impacted. This wetland restoration treatment will require acceptable alternative means of supply potable water as a part of the project. Tidewater will be introduced into the basin. In Scenario 5, the upper reaches of the basin will experience brackish to freshwater conditions. In Scenario 6, the wetlands upstream of the dams will continue to be fresh and the area downstream of the dam will be tidal, similar to the freshwater / tidal interface at the Beaver Swamp Wildlife Management Area.

Flooding is controlled through the use of self-regulating tide gates to prevent excessive back flow of Bay water during storm conditions into the basin. During severe storm events the gate could be closed after low tide (in both Scenarios) to create adequate freeboard (capacity) in the meadow to store precipitation and stormwater discharged from the community. The water control structures and weirs require special design considerations to allow adequate upstream discharge and intra-basin tidal circulation.

The stormwater management plan entails maintaining adequate inflow capacity of the basin to protect the community from flooding. Further, the stormwater discharges will be diluted by tidewater and discharged through an improved watercourse network. Therefore, water quality will be improved. Detailed hydrologic evaluation of flexible water control structures are required to ensure the concept is refined and the operation fine-tuned to manage the stormwater and surface hydrology to the benefit of the community and the wetland complex. These scenarios provide maximum opportunity for managing stormwater for water quality improvement and stormwater storage in the basin.

The salinity of the surface waters will be increased to less than that of the Bay waters, but not less than 15 ppt, thereby controlling the reedgrass and maintaining a healthy tidal wetland. The surface water aquifer and shallow wells may be impacted by the introduction of tidewater into the basin; however, the routing of the stormwater and upstream discharges and the placement of the dams (Scenario 6) could direct freshwater into strategic recharge areas. Additionally, during the winter through early spring (outside of the period of biological activity) the strategy of freshening the basin wetlands should be evaluated. During this season, water tables are high and stream flow is typically at its peak. In addition, stormwater runoff is increased by greater soil saturation.

Both concepts restore the basin wetlands to an estuarine wetland ecosystem. Scenario 5 provides for a gradual, or brackish, transition between the Bay waters and the upstream freshwater ecosystem; however, it does not provide for the protection of the upstream hydrology. Scenario 6 provides a more abrupt transition between the estuarine and freshwater ecosystem but also safeguards the upstream hydrology by regulating the freshwater discharges into the estuarine wetlands.

Both concepts will increase the diversity of habitats for fish and wildlife in the basin area while protecting the upstream freshwater wetlands. The reestablishment of the tidal wetlands will promote the use of that ecosystem by such listed species as American bittern, northern harrier, short-eared owl, black skimmer, least terns, sedge wren, night-herons, red knot and likely several additional species of concern.

Mosquitoes will be controlled through changing the water quality conditions, controlling water level fluctuation and providing access to mosquito breeding areas for predacious fish and

aquatic insects via band ditches and currently weed-choked watercourses and ditches that will be reopened by tidal inundation.

The reedgrass will be controlled by the inundation of tidewater as long as the salinity exceeds 15 ppt. Both concepts will control the greater portion of the reedgrass stand. While both concepts may require limited spot treatments with herbicides, Scenario 5 will require greater management in the brackish water transition area. It is anticipated that tidal inundation will result in the reestablishment of the watercourses choked by vegetation in the basin area.

The surface water management and water level is regulated through channels, band ditches, water control structures, weirs and the pumping station operational plan. The water management facility will provide for fine-tuning water levels on a daily, seasonal, and storm basis. The pumping station, self-regulating tide gate, water control structures and weirs require design flexibility to adjust water control elevations. Each structure will require analysis to establish the operational range of elevations from minimum to maximum water management levels.

These concepts will not impact ownership; however, common ownership or decision-making authority, with appropriate public input, will facilitate the implementation of this project.

Both scenarios will result in the restoration of tidal wetlands to eliminate the reedgrass biotic community and its associated flood, fire and pest problems. The Scenario 6 concept promotes maximum diversity, while protecting the upstream wetlands. Stormwater management is achieved through channel restoration and band ditch construction. While both scenarios create the best solutions for community benefits, water quality enhancement, a restoration strategy to maximize wetland functions and values, and stormwater management; the issue of salt-water intrusion and impact on shallow wells must be evaluated. In this regard, additional analysis is required and a component of the plan must include providing potable water to those whose wells are impacted.

## **RECOMMENDED WETLANDS RESTORATION CONCEPT**

Analysis of the six design scenarios indicates that Scenarios 1, 3 and 4 have significant fatal flaws. Scenario 1 (No Action) does not meet any of the public goals of improving water quality, restoring the wetlands habitats and controlling flooding, fire and pests. Scenario 3 (Lake) will

result in a major dredging and dredge material management / disposal challenge. Further, the conversion of wetlands to an open water ecosystem will require a comprehensive alternative analysis by regulatory agencies. Scenario 4 (Uncontrolled Tidal Inundation) will create a level of risk that may not be acceptable regarding the storm protection, salt-water intrusion and wetlands destruction for the construction of the flood protection berm.

While Scenarios 2 (Freshwater Ecosystem), 5 (Limited Tidewater Flow) and 6 (Freshwater / Tidewater Ecosystem) appear to be technically feasible restoration concepts for the Cox Hall Creek wetlands; however, review and constructive critical analysis of these scenarios by the Cox Hall Creek Steering Committee, landowners and technical advisors provide additional input focused on Scenario 6. Scenario 6, illustrated in **FIGURE 1**, has been selected as the Preferred Restoration Concept based upon the analysis presented in Volume 1 and the input received during the December 17, 2003 meeting (Meeting minutes are attached in **APPENDIX A**).

### **PREFERRED WETLANDS RESTORATION CONCEPT**

Evaluation of the site conditions, design criteria and public / agency input has led to the selection of the preferred wetland restoration strategy.

This concept employs the strategy of wetlands restoration by re-establishing tidal inundation and a salt marsh ecosystem to the extent of influence of the tidewater. The concept entails the installation of self-regulating tide gates into a reconstructed culvert system through the beach and dune complex which reconnects the wetlands basin to the Delaware Bay. The self-regulating tide gate and culvert system will require a design that permits sufficient tidal water ingress to the site to promote the control of the reedgrass and its replacement with a salt marsh ecosystem, while permitting tidal water and stormwater evacuation from the site during periods of heavy precipitation. Adjustment of the volume of Bay water permitted to enter the Cox Hall Creek wetlands will establish the extent of tidal inundation and influence without degradation or conversion of the well-established freshwater ecosystems of Mickels Run and Cox Hall Creek, and without permitting flooding of residences or roads during storm events. The channel between the pumping station and Clubhouse Drive will be reconstructed along with the culverts under Clubhouse Drive to ensure that adequate volumes of water from the Bay enter the basin on flood tides. The pumping station will require redesign and replacement, in order to provide adequate pumping capacity to evacuate stormwater discharged into the basin during storm events when normal outflow is prevented by high water elevation in the Bay.



Band Ditches connecting the main Cox Hall Creek channels and ditches in the basin area will be constructed to expedite the replacement of the common reedgrass with tidal marsh flora and fauna and promote mosquito control by native fish. Weirs will be installed at the intersections with the Cox Hall Creek channels to prevent the discharge of all waters from the band ditches at low tide. Weir discharge elevations can be set to promote a circulation of tidewater in the ditches. The destruction of the common reedgrass will result in the natural reestablishment of most of the existing channels and ditches, if adequate tidal ebb and flow is provided. Those watercourses, that are not reestablished be self-cleaning, will require channel maintenance. Monitoring is required to ensure that the objectives of the restoration are met through tide gate and weir water elevation adjustments and in addition to the control of the reedgrass.

Scenario 6 is designed to restore basin wetlands to an estuarine ecosystem supporting salt marsh flora and fauna through tidal inundation from the Bay via the use of self-regulating tide gates as described in Scenario 5. However, the freshwater ecosystems would be preserved in their current condition by isolating them from tidal inundation through the use of low elevation berms and water control structures. The water control structures will be designed and adjusted to an elevation that permits natural flow of the Cox Hall Creek and Mickels Run while discharging stormwater to prevent upstream flooding. Concurrently, the level controls of the water control structures can be adjusted to ensure the protection of the upstream freshwater ecosystems, their inhabitants and endangered and threatened species from back flooding by brackish waters. Fish ladders will be installed in the berms to permit anadromous and catadromous fish species to migrate upstream for spawning, if such structures are considered beneficial.

The wetlands restoration concepts will require full engineering design; site specific evaluation for placement of band ditches, berms, dams and water control structures; construction and operation monitoring, and water level monitoring and adjustment in order to achieve the wetland restoration success.

In summary, Scenario 6 addresses the control of stormwater and associated flooding, mosquito control and fire abatement through the control of the reedgrass stand in the basin area. Most importantly, however, this concept restores the natural estuarine ecosystems to the basin area without extensive applications of herbicides to control the reedgrass. Safeguards are

incorporated in this concept to improve stormwater quality, to protect against flooding and to ensure potable water is available to those whose surface aquifer wells are impacted.

Prior to finalizing the design, a detailed surface hydrology analysis will be required to establish specific design standards for channels, culverts, berms, water control structures (including the weirs), stormwater quality improvement facilities and the pumping station. Concurrently, an inventory of land use/ environmental regulatory approvals for construction will be required and preapplication conferences held to aid in the refinement of the project to meet engineering and environmental standards mandated by federal, state, regional and local regulation.

The preliminary construction cost estimate for the Preferred Wetlands Restoration Concept is presented in **TABLE 1**. Prudent assumptions were considered in the cost estimate preparation. This estimate will require revisions as additional information (e.g., surface hydrology and nearshore bathymetry) is obtained during the next design development phase.

The public is invited to review and comment on the preferred alternative at the March 27, 2004 meeting. In addition, the public is invited to continue to participate through the Cox Hall Creek Steering Committee and additional public meetings during the design development and land use / environmental agency permitting process. Comments may be submitted in writing to the:

Cox Hall Creek Focus Group  
C/o The Cape May County Planning Department  
4 Moore Road  
Cape May Court House, NJ 08210

**Table 1**

**Cox Hall Creek  
 Wetland Restoration**

**Construction Cost Estimate Summary  
 For Preferred Alternative**

**March, 2004**

<b>Description</b>	<b>Estimated Construction Cost</b>
1) 400LF Intake/Outlet Culvert*	\$1,600,000
2) Pump Station/Self Regulating Tide Gate Structure	\$1,000,000
3) Outlet Pond Dredging/Stabilization (Does Not Include Landfill Disposal)	\$115,000
4) Clubhouse Road Culvert Installation	\$300,000
5) Water Quality Basin	\$279,000
6) Band Ditching/Overflow weirs	\$290,000
7) Berm/Water Control Structures/Fish Ladder	\$300,000
<b>Subtotal</b>	<b>\$3,884,000</b>
<b>Contingency 10%</b>	<b>\$388,000</b>
<b>Total</b>	<b>\$4,272,000</b>

(Does not include design, permitting, land acquisition, legal or administrative costs)

\* Outfall to be confirmed, bathymetry required, length may be extended as required by regulatory agencies.

**APPENDIX A.  
COX HALL CREEK FOCUS GROUP  
MEETING MINUTES**

**Dated: December 17, 2003**

**COX HALL CREEK FOCUS GROUP MEETING**  
Wednesday, December 17, 2003  
Intermediate Meeting Room, Crest Haven Complex

Attendance:

Joe Lomax, Lomax/Morey Consulting	Peter Kocsik, Hatch, Mott McDonald
Eric Schrading, USFWS	Pierre Lacombe, USGS
Nick Cassetta, Cape Atlantic SCD	Betsy Clark, NRCS
Jim Wick, NRCS	Phil Broder, Wetlands Institute
Keith Seager, LT Environmental Comm.	Ed Sokorai, CMC Mosquito Comm.
Steve Hampton, Deputy County Admin., GAC	Ron Way, TAC
Jim Smith, CMC Planning Brd, GAC	Matt Diem
George Marinakis, CMCMUA, Chair, TAC	Mary Ellen Spruell, CHC Focus Grp.
Ward Burnside, TAC, CHC Focus Grp	Jim Welch, TAC, CHC Focus Grp.
Lee Spruell, Chair, CHC Focus Grp.	Bill Thomas, CHC Focus Grp.
Claire Nagel, Sec'y, CHC Focus Grp.	
Kent Schellenger, CMC Ass't County Engineer, TAC	
John Kraueter, Professor, Rutgers University, TAC	
Brian O'Connor, CMC Planning Department, TAC-CHC Focus Group	

**Call To Order**

Chairman Lee Spruell called the meeting to order at 10:05 a.m. Brian O'Connor introduced Joe Lomax and Peter Kocsik.

**Project Reports**

Joe Lomax and Peter Kocsik reviewed their report *COX HALL CREEK, WETLAND RESTORATION SCENARIOS, AND FEASIBILITY STUDY, Volumes 1 and 2*, detailing the Topography of the Project, The Planning Process, Existing Site Conditions, Design Criteria, Proposed Wetlands Restoration Scenarios and Assessment of Each Scenario.

The six-wetland restoration scenarios include:

**Scenario 1. No Action Alternative**

This scenario entails not initiating any wetlands restoration efforts.

**Scenario 2. Manage and Enhance the Cox Hall Creek Wetlands as a Freshwater Ecosystem Complex**

The design concept for this scenario includes: (a) Creation of water quality basins at the major stormwater outfalls into the Cox Hall Creek wetlands. This basin constitutes a retrofitted pretreatment of the stormwater prior to its discharge into the wetlands. They must be designed to accommodate the appropriate design flows and routine maintenance. (b) The channels, natural and manmade, must be restored in order to promote efficient surface water runoff to the pumping station, while at the same time providing for fish and wildlife habitats and mosquito control. Because the basin wetlands have subsided, weirs will be installed to main channels in order to prevent drainage of the upper streams and wetland areas that currently support a rich, native, flora and fauna. (c) It is recommended that a band ditch be constructed around the edge of selected wetland areas to serve as a collection system of stormwater from the upland discharge points. Concurrently, this ditch system will provide access to the wetlands

fringe for native fish that feed on mosquito larvae. Band Ditches would not be constructed in any areas that currently support threatened or endangered species. Check weirs will be constructed in the ditches to prevent the draining of the fringe wetlands. (d) The invasive plant control would be effected through the application of an approved herbicide. The selection of herbicide, rate and application timing would be consistent with U.S. Environmental Protection Agency and N.J. Department of Environmental Protection regulations, product labeling and best management practices. The application of the herbicide will be monitored for safety and effectiveness. Supplementary spot treatments will be continued until the common reedgrass is brought under control. (e) The pump station will require upgrading or replacement and the channel between Clubhouse Drive and the pumping station will require replacement and bank stabilization.

### Scenario 3. Creation of a Freshwater Lake in the Cox Hall Creek Basin

The development of a freshwater lake within the wetlands entails: (a) The dredging of the lake to a depth of at least four feet in the periphery of the basin and increasing the depth to eight feet in the middle in order to permit the aquatic animals, most notably fish, to survive winter conditions. The lake will cover approximately 86.81 acres and contain 5.5 million gallon of water. It will require the removal of approximately 735,680 cubic yards (CY) of dredged material. Approximately 543,720 CY of dredged material will be primarily muck and approximately 191,960 CY will be sand dredged from the deeper depths. A dredge material disposal site including containment areas and dredge water return facilities will have to be developed, in addition to dredged material management and disposal plans. The beneficial reuse or even disposal of the dredged muck material is a significant challenge because these materials are expected to become strongly acid to ultra acid with drying. (b) The banks of the freshwater lake will be graded for safety purposes as follows:

- \* Slope from top of bank to safety shelf – 1:5 slope
- \* Safety shelf at a depth of 2 feet and a width of 8 feet – slope level
- \* Slope from safety shelf to the pond depth of 4 feet – 1:3 slope
- \* Slope from pond area at a depth of 4 feet to 8 feet – 1:1 slope

(c) A portion of the dredged material may be used to construct a series of small islands to serve for waterfowl and colonial waterbird breeding / roosting sites. While the island construction could utilize a portion of the dredge material, the islands would require vegetation management initially to preclude or control the establishment of common reedgrass. Additionally, the waterfowl could require management activities to prevent damage to the adjacent golf course and could degrade surface water quality, if they become too abundant. (d) The pump station will require upgrading or replacement and the channel between Clubhouse Drive and the pumping station to be dredged and stabilized.

### Scenario 4. Return Natural Tidal Flow to the Wetlands by Breaching the Dunes

The concept of returning natural or unimpeded tidal inundation to the Cox Hall Creek wetlands will result in changing the wetland basin into a coastal estuary dominated by salt marsh vegetation and the upstream wetlands into a brackish marsh to the head of tidal influence. This concept entails: (a) construction of a berm of adequate height and mass to prevent coastal storm driven floodwaters from inundating home sites and roadways adjacent to the wetlands within the flood prone areas. (b) Existing stormwater outlets would require one-way (tide excluder) valves or gates to preclude back flooding into the communities during coastal storm events or possibly even spring high tide and may require individual pump / lift stations to address local flooding from

stormwater runoff or additional new storm systems. (c) Berms and water control structures will be required especially in Mickels Run and Cox Hall Creek stream corridors to prevent tidal inundation from adversely impacting the well-established freshwater wetlands ecosystems and associated fauna and flora, including known sites that support threatened and endangered species. (d) Once the flooding safeguards are constructed, the beach and dune complex would be removed and stabilized in a manner that ensured continued daily tidal ebb and flood. (e) This inlet construction will require the removal of the pumping station, the restoration and stabilization of the Cox Hall Creek channel from the Delaware Bay to an area upstream of Clubhouse Drive. This stabilization may require jetties into the Bay and gabions to stabilize the channel banks. Clubhouse Drive and its Cox Hall Creek culvert will require evaluation and possible replacement by a higher elevation road and larger culvert. In addition safety structures (grating) will be required to prevent the unwary from being carried by the tide into the culvert.

#### Scenario 5. Return Limited Tidewater Flow into the Wetlands

This concept employs the strategy of wetlands restoration by re-establishing tidal inundation and a salt marsh ecosystem to the extent of influence of the tidewater. The concept entails: (a) The installation of self-regulating tide gates into a reconstructed culvert system through the beach and dune complex will reconnect the wetlands basin to the Delaware Bay. The self-regulating tide gate and culvert system will require a design that permits sufficient tidal water ingress to the site to promote the control of the reedgrass and its replacement with a salt marsh ecosystem. Further, the system must be designed to permit tidal water and stormwater evacuation from the site during periods of heavy precipitation. In addition, the self-regulating water control structures must be designed to permit adjustment of the volume of Bay water permitted to enter the Cox Hall Creek wetlands and thereby the extent of tidal inundation and influence. The extent of tidal influence must be controlled by the project design to not result in the degradation or conversion of the well-established freshwater ecosystems of Mickels Run and Cox Hall Creek nor permit flooding of residences or roads during storm events. (b) The channel between the pumping station and Clubhouse Drive will be replaced in order to ensure that adequate volumes of water from the Bay enter accessible areas of the basin on flood tides. (c) The pumping station will require redesign and replacement, in order to provide adequate pumping capacity to evacuate stormwater discharged into the basin during storm events when normal outflow is prevented by high water elevation in the Bay. (d) A band ditch, connecting to the main Cox Hall Creek channels and ditches in the basin area, will be constructed to expedite the replacement of the common reedgrass with tidal marsh flora and fauna and promote mosquito control by native fish (Lomax, 1970). Weirs will be installed at the intersections with the Cox Hall Creek channels to prevent the discharge of all waters from the band ditches at low tide. Weir discharge elevations can be set to promote a circulation of tidewater in the ditches. It is anticipated that the destruction of the common reedgrass will result in the natural reestablishment of most of the existing channels and ditches, if adequate tidal ebb and flow is provided. Those watercourses, that are not reestablished be self-cleaning, will require channel maintenance. (e) This concept requires continued monitoring to ensure that the objectives of the restoration are met through tide gate and weir water elevation adjustments and control at a portion of the reedgrass with herbicides, if necessary.

#### Scenario 6. Freshwater and Tidewater Ecosystem Complex

This concept is the same as Scenario 5 except the freshwater wetlands of Cox Hall Creek and Mickels Run will be isolated by the construction of low elevation dams

and water control structures. The water control structures will be designed to set at an elevation to permit the natural flow of the streams and discharge stormwater to prevent upstream flooding. Concurrently, the level controls of the water control structures can be adjusted to ensure the protection of the upstream freshwater ecosystems, their inhabitants and endangered and threatened species from back flooding by brackish waters. Fish ladders will be installed in the berms to permit anadromous and catadromous fish species to migrate upstream for spawning.

Pierre Lacombe reported his findings regarding the hydrology of the CHC project area. He researched 35 well records, which included well drillers' data, from DEP records. To determine the extent, if any, of salt water intrusion, he suggested that these wells be tested for salinity and selected other chemical components. Kent Schellenger asked if he would recommend new wells to access the Holly Beach Aquifer. Pierre responded that there is such a risk of contamination of the service aquifer that deeper wells using the estuarine sands would be safer.

### **Question and Answer Period**

Following a break for lunch, Lee Spruell reconvened the meeting and invited participants to ask questions and make comments.

#### Scenario 1. No Action Alternative

Joe Lomax pointed out that although Scenario 1 (no action alternative) appears to be without cost; the risks of fire, flooding and mosquito-borne disease and their potential costs would not be addressed by this alternative.

#### Scenario 2. Manage and Enhance the Cox Hall Creek Wetlands as a Freshwater Ecosystem Complex

In response to a question regarding Scenario 2 (freshwater marsh), Joe responded that herbicides would be used to kill the reedgrass (*Phragmites australis*), primary channels would be dredged to same or deeper depth as band ditches, weirs installed at key locations and some storm water inlets would require pre-treatment. The extensive reedgrass stand will require a major treatment with herbicides the first year and would require follow-up treatments periodically for up to ten years or possibly longer for maintenance purposes.

In response to a question from Pierre, Joe responded that the channels would have to be dredged from time to time. Mary Ellen asked about the safety of the herbicide and whether or not it would get into the wells. Joe responded that treatment would be made consistent with product labeling; therefore, the herbicide would not be expected to contaminate the wells. Betsy Clark pointed out that the reedgrass would need to be treated a minimum of three years, with a full application in year one and follow up in years two and three. A monitoring plan would need to be in place. Eric said that the Mullica and Salem projects have been successful. They aim for two applications of herbicides followed with long-term changes, e.g., tidal water or water control (temporary flooding).

If the topography remains the same, it would require re-treatment with herbicides every three to five years. Fishing Creek is a good example.

Ed pointed out that simply dredging the main channels would not be sufficient.

In response to a question regarding the effect of herbicide on trees, Eric said that timing of the treatments is important. It is best to treat when the trees go into dormancy. He said they had sprayed in mid-September and the perimeter trees were OK, but those in the center of the reedgrass were adversely affected.

Kent asked about using fresh water controls of the reedgrass during drought periods. Betsy pointed out that there is not much room for using fresh water controls because of low elevations of adjoining development. Joe said that six-inch depth of water is not enough to kill the reedgrass or preclude its reestablishment.

In response to a question regarding pre-treatment of storm water, Pete said there could be a vortex-type floatable / sediment trap in or downstream of the catch basins before the water is discharged into the wetlands. These would need periodic maintenance. Ward said he thinks the catch basins are currently being maintained, but Brian said he had never seen them being cleaned out.

John pointed out that all the scenarios would require some maintenance. He said that the water must be kept moving or there would be a terrible mess. Joe responded that everyone knows there will be costs to maintain any of the scenarios, but we are not at a point yet of estimating these costs. He said we must first determine which scenario best meets the needs.

Pierre asked for a review of what would happen to the pumping station. Pete responded that it would require reconstruction and a greater capacity than it currently has.

Would the culvert under Club House be sufficient to handle the increased flow if the channels are opened up? Joe said that hydrology studies would be needed to determine the channel size and culvert needed.

It was pointed out that it would be a major regulatory hurdle to create a cleared buffer to protect homes from fire. Eric said that there might still be reedgrass along the periphery, but not in sufficient quantities to be a significant fire hazard. He said he does not think Scenario 2 is feasible. Betsy agreed. Mary Ellen expressed concern about herbicides eventually affecting wells. There was no support in the group for Scenario 2.

### Scenario 3. Creation of a Freshwater Lake in the Cox Hall Creek Basin

Discussion about Scenario 3 (lake) included concern for expense, the massive dredging and the disposal of more than 700,000 CY of very acidic dredged material. John suggested that possibly the spoil from dredging the lake could be put into a barge and dispersed into the ocean. Ocean dumping regulations might be a problem, but it would be much better than drying it and the resultant acidity. Kent suggested that perhaps there could be islands created in the lake. Mary Ellen pointed out that at the January public meeting, people made it clear they did not want a recreational facility that would draw more people to the area. Eric said the lake would be a regulatory nightmare; the state would require mitigation at 2:1, therefore it is not an ecologically sound alternative. John pointed out the regulatory objections to the lake scenario are too great and it would also need to be flushed. Sloshing could also be a problem.

### Scenario 4. Return Natural Tidal Flow to the Wetlands by Breaching the Dunes

Considering 4 (open to salt water). Concerns about severe coastal storm conditions were raised. Pete said storm water would be trapped behind berms and then would have to be pumped over them. The consensus was that the costs to build the berms would be prohibitive and very difficult from a regulatory perspective because they would have to be constructed in wetlands. These berms would significantly impact the aesthetics of the wetland. Inviting uncontrolled tidal inundation into the community was not considered acceptable.

### Scenario 5. Return Limited Tidewater Flow into the Wetlands

Scenario 5 would employ self-regulation tide gates permitting controlled volume and duration of flooding of meadows. The pumping station would continue to be needed for storm events. John pointed out that things that don't require maintenance never work. He said the danger is that monitor might slack off. Betsy said that it would take time to get tidal flow data. Joe said that there would need to be provisions for inspecting the pump house.

Brian said that WMA 16 is obtaining a \$10,000 grant. He asked if Pierre could conduct a study concerning the potential for salt-water intrusion for that cost. Pierre responded that he would get back to him.

John asked why the ditches were necessary. Joe responded that there are 14 storm water discharges into the meadow. When we have a storm, water will have alternate watercourses, whether during a storm or drought, to access the discharge point. In addition, the edge of the mainland is most vulnerable to mosquito infestation. These band ditches allow predatory fish access to mosquito breeding areas. The Mosquito Commission has a rotary ditcher that could excavate the ditches in two passes and disperse the excavated material.

Joe pointed out also that we would not need to dredge the Creek channels because the ebb and flow of tide would rejuvenate these channels.

John raised a concern that storm water being pumped out into the Bay might increase pollution there. Joe responded that the reedgrass are now trapping some pollutants. However, there will be tidal flow twice a day that would flush the meadows. We need to make sure pollutants don't stay in the marsh. John said they would probably close the area to shellfish. Joe responded that pre-treatment of the outfalls would minimize the discharge of pollutants into the system. In addition, he also indicated that Mickels Run and the upper reaches of Cox Hall Creek would be cleared of snags.

There was general agreement that scenarios 5 and 6 came closest to meeting most of the participants' goals.

Eric said that fish ladders might not be necessary. He said to consider that some band ditches may serve as reservoirs to protect fish populations. In addition, the outfall and sizing of water control structures can limit tidal flow. Eric also indicated that Scenarios 5 and 6 may bring a lot of partners to the project. Both Scenarios will require an analysis of water inflow. In Scenario 5, main channels may fall bare as the tide runs out. Water control structures will protect fresh water resources in the upper reaches of the tributary streams. Ed said he concurs with Eric's assessment.

#### Scenario 6. Freshwater and Tidewater Ecosystem Complex

Scenario 6 is similar to Scenario 5; however, water control structures and berms would limit salt-water intrusion and drainage of the freshwater wetlands upstream of the basin. Thus it protects the upstream fresh water areas.

Betsy suggested that a box culvert under the dunes might be a solution for fish migrating from the Bay.

Joe said water control structures are very basic. He suggested looking at Timber-Beaver Wildlife Management Area as an example of the low elevation berm and water control structure approach.

John agrees that we should keep Scenario 6 for regulatory purposes for the protection of endangered species identified in the Cox Hall Creek.

A concern was expressed for whether Club House Drive would have to be raised. Pete said it probably would not need to be raised, but that we would need to replace the culvert with more than a single culvert to ensure adequate tidal circulation.

It was agreed that wells would need to be tested before the project proceeds. The timetable for public water service into the area should be explored. Perhaps this area can be targeted for earlier access to public water.

Concerning the possible salt-water impact on shallow wells, it was also commented that Rural Development, USDA might be a source of funding also.

Ed suggested that we consider under Scenario 6 using tidal inundation to kill the reedgrass for five to six years and then revert to a fresh water marsh. John pointed out that the death of the reedgrass might lead to a mud flat and then eventually lower the elevations and make the water deep enough to kill the reedgrass.

The group reached consensus that Scenarios 5 and 6 are the preferred with a preference for 5 unless the surface hydrology study indicates that the low level berms and water control structures are required to protect the freshwater habitats upstream of the basin.

**Adjournment**

The meeting was adjourned at 2:30 p.m.