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# City of Rehoboth Beach

## Report for City of Rehoboth Beach Wastewater Treatment Plant Ocean Outfall Project

### Cost Benefit Analysis

December 2011

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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# 1. Introduction

## 1.1 Background

The City of Rehoboth Beach Wastewater Treatment Plant (RBWWTP) receives wastewater from the City and surrounding areas of Henlopen Acres and Dewey Beach. The RBWWTP treats the waste to a very high level removing not only organics and solids, as is typical of a secondary treatment plant, but also removing nitrogen and phosphorus which can stimulate algae growth in the receiving stream.

The original RBWWTP was completed in November 1987 and was designed to provide a secondary level of treatment. At that time, nutrient removal was not a requirement of the discharge permit. During the next permit review, however, nutrients became an issue and a final cap on nutrients was established based on the 1989 baseline load. The final cap was established as a 30% reduction in nitrogen and a 70% reduction in phosphorus to be monitored on a rolling annual average.

The plant was upgraded in two phases, in 1994 and 1997, to reduce the nitrogen and phosphorus discharge to the required levels. By 1998, the RBWWTP had reduced the amount of nitrogen and phosphorus being discharged by 43% and 82%, respectively, thus exceeding the requirements of the permit. Continued operational improvements have achieved further reductions in the amount of nutrients presently discharged by the plant.

During this period of time, the Delaware Department of Natural Resources & Environmental Control (DNREC) was developing a water quality model of the Inland Bays in response to Federal requirements. The Federal Clean Water Act requires states to identify water bodies that do not meet water quality standards and to impose a “Total Maximum Daily Load” (TMDL) on both the point and non-point sources that discharge to the water body. The TMDL is intended to limit the pollutant discharges so that the water quality will improve. In 1996, portions of both the Indian River and the Rehoboth Bay were listed as water quality impaired and thus required the development of a TMDL.

The TMDL was issued in December 1998 and required that “all point source discharges which are currently discharging into the Indian River, Indian River Bay, Rehoboth Bay, and their tributaries shall be eliminated systematically.” (DNREC, 1998) Thus, the RBWWTP, which discharges into the Lewes-Rehoboth canal, was no longer allowed to discharge and had to find an alternate method to discharge its treated wastewater effluent.

In December 2002, the terms of the consent order, which addressed the TMDL, were finalized between the City of Rehoboth Beach and DNREC,and a revised discharge permit for the RBWWTP was issued in August of 2005. As stated in the plant’s discharge permit, the consent order establishes a firm date of December 31, 2014 for the discharge to be eliminated and the new discharge method to be fully operational (USEPA, 2005).

## 1.2 Environmental Impact Statement

Previous studies were conducted to evaluate various alternatives for the disposal of treated effluent from RBWWTP (Stearns & Wheler, 2005) (Whitman, Requardt & Associates, 2009) (Stearns & Wheler, 2009).

Within these reports, various alternatives were evaluated to identify the most technically feasible, cost effective and environmentally acceptable option. On December 14, 2009, City Commissioners elected to proceed with an ocean outfall as its proposed method of disposal of treated effluent.

Given the controversial nature of an ocean outfall, it was decided in July 2010 that DNREC would take the lead in developing an Environmental Impact Statement (EIS) for RBWWTP effluent disposal. A public scoping meeting was held on September 21, 2010, to obtain community input and ensure that all concerns are identified and addressed in the Draft EIS.

A draft EIS was completed according to DNREC guidelines in late 2011. Following a public hearing and comment period in early 2012, a Final EIS will be prepared and a Record of Decision will be issued.

## 1.3 Purpose of Report

The primary objectives of this report is to investigate the factors not related to environmental quality, which have bearing on the decision regarding how to comply with the consent order. These factors are primarily related to cost. At public meetings, many citizens of Rehoboth Beach expressed concern over potential increases to user rates to finance alternative discharge methods. This is of particular concern to retired residents who are on a fixed income.

The alternatives considered in this cost-benefit analysis include the following, which have also been considered in the EIS.

**Alternative 1: No Action:** Treated effluent continues to be discharged into the Rehoboth Bay.

**Alternative 2: Land Application:** Treated effluent is sprayed on agricultural land to irrigate crops and provide nutrients as required for crop uptake. The effluent, with nutrients not taken up by the crops, percolates through the soil to the groundwater. Several variations of this alternative were evaluated including:

**Alt. 2A:** Treated effluent from Rehoboth Beach is sent to a new facility built for the sole use of the RBWWTP.

**Alt. 2B:** The RBWWTP is shut down and all raw wastewater is sent to the Wolfe Neck Regional Wastewater Facility (WNRWF) with excess flow treated at the Inland Bays Regional Wastewater Facility (IBRWF).

**Alt. 2C:** The RBWWTP is shut down and all raw wastewater is sent to the WNRWF with excess flow treated by a Private Wastewater Provider (PWWP).

**Alt. 2D:** The RBWWTP remains in service and treated effluent is sent to the WNRWF for disposal via spray irrigation, with excess flow sent to the IBRWF.

**Alt. 2E:** The RBWWTP remains in service and treated effluent is sent to the WNRWF for disposal via spray irrigation, with excess flow sent to a PWWP.

**Alternative 3: Ocean Outfall:** Treated effluent is discharged through an outfall and diffuser into the ocean at a depth and distance from the shore that allows adequate mixing with the sea water such that all water quality criteria and public health standards are achieved.

## 1.4 Previous Studies

**Effluent Disposal Study**

An Effluent Disposal Study was completed in August 2005, which evaluated all of the alternatives listed above except for the no-action option (Stearns & Wheler, 2005). The study recommended that the City pursue an ocean outfall as the preferred solution for effluent disposal. A summary of the primary reasons for selecting this alternative follows:

- Preliminary modeling indicates that, even under the worst-case scenario regarding the performance of the RBWWTP and ocean currents, public health requirements are met at or in close proximity to the diffuser.
- Ocean outfalls have a well-documented history of protecting public health and compliance with environmental regulations.
- An ocean outfall can be considered an “ultimate” solution in the sense that, once it is built and in operation, the discharge is immune from future regulatory issues and environmental concerns related to the TMDL program, which regulates the discharge of nutrients in the watershed.
- Based on an analysis of the present worth costs, the ocean outfall is the most cost-effective alternative.
- The other alternatives evaluated were for various technical, environmental, and financial reasons determined not to be feasible.

**Sussex County Regional Planning Report**

The Sussex County Regional Planning Report, completed in 2009, investigated the additional option of sending either raw wastewater or treated effluent to Sussex County for treatment and disposal via land application at the WNRWF, IBRWF, PWWP, or some combination thereof (Whitman, Requardt & Associates, 2009). The study also considered the possibility of the County partnering with the City of Rehoboth Beach on an ocean outfall alternative. Under this alternative, the County would continue to treat their wastewater via land application but would discharge excess treated effluent through the City’s ocean outfall. In summary, the report evaluated seven (7) different alternatives.

**Alternative Discharge Cost Evaluation**

An Alternative Discharge Cost Evaluation was completed by the city in March 2009 and updated in December 2009 to include the results of the Sussex County Regional Planning Report (Stearns & Wheler, 2009). The purpose of this report was to present a more detailed cost analysis for the alternatives considered and their associated user fees and to revise the cost estimating assumptions so that the cost estimates in the County and City reports were comparable. Rapid Infiltration Bed and Ground Water Injection options were not included in this report as they were deemed infeasible by the 2005 Effluent Disposal Study. The no-action, ocean outfall, and land application options were expanded into more detailed options, which allow coordination and cooperation with Sussex County treatment facilities including WNRWF and IBRWF. Options included in that report included:

- The RBWWTP remains in service and discharges treated effluent via an ocean outfall. The County will continue treating and disposing wastewater via land application at its existing facilities. The WNRWF will remain in service and continue treating and disposing wastewater from its service area. Any excess flow to the WNRWF above the capacity of the facility will be sent to IBRWF for treatment and disposal.
- The RBWWTP remains in service and discharges treated effluent via an ocean outfall. The County continues to treat wastewater via land application at the WNRWF. The WNRWF will expand and upgrade its treatment capacity. Treated wastewater that exceeds the WNRWF disposal capacity will be pumped to the Rehoboth ocean outfall for disposal. After completing the study, this alternative was determined to be unfeasible as the County decided not to pursue the ocean outfall alternative. The primary reason for not pursuing the outfall alternative was based on the significant investment that the County had already made for land application. The Alternative was presented in the Alternative Discharge Cost Evaluation study as a point of comparison only.
- The RBWWTP shuts down and sends all of its raw wastewater to the WNRWF, which will treat as much wastewater as possible under current capacity and send the excess to another facility to be treated. The excess wastewater will be treated by the County owned and operated IBRWF (Alt 3A) or a PWWP (Alt 3B).
- The RBWWTP remains in service and sends its treated effluent to the WNRWF for disposal via spray irrigation. A reduced amount of the WNRWF influent wastewater from its service area will continue to be treated at that facility, with all excess being sent to either to the IBRWF (Alt 4A) or a PWWP (Alt 4B).

According to this evaluation, the most cost effective and feasible option, in terms of the estimated user charges for residents of the City of Rehoboth, is the dedicated ocean outfall by a significant margin. Maintaining the RBWWTP and discharging treated effluent at the WNRWF is the second most cost-effective option. Treating wastewater at the WNRWF and using the IBRWF for excess wastewater is the next most cost effective option; only slightly more expensive than sending treated effluent to the WNRWF.

# 2. Alternatives Evaluated

## 2.1 Alternative 1: No Action

### 2.1.1 Description of Alternative

The City continues to operate the RBWWTP as currently configured, which will result in the continued discharge of treated effluent directly into the Lewes-Rehoboth Canal that empties directly into Rehoboth Bay.

### 2.1.2 Benefits

The RBWWTP currently meets the annual waste load limit of the National Pollutant Discharge Elimination System (NPDES) permit. However, the continued discharge of treated effluent is not in compliance with the consent order imposed by DNREC to enforce the requirements of the TMDL. The TMDL developed by the Watershed Assessment Section, Division of Water Resources, DNREC, identified over enrichment by nitrogen and phosphorus as the cause for the Inland Bays not meeting their established water quality criteria. The symptoms of over enrichment include excessive macroalgae growth, phytoplankton blooms, large diurnal swings in dissolved oxygen, loss of submerged aquatic vegetation, and fish kills (DNREC, 1998). Thus, the Bays are currently listed as water quality impaired and are not recommended for swimming or fishing use. According to the water quality model developed by DNREC, the water quality of the Bays would improve with the removal of other sources of discharge but would be unable to make the maximum recovery required by DNREC unless the point sources are eliminated.

### 2.1.3 Cost

The direct cost of taking no-action would be minimal since no capital investment would be required, and the operating costs would remain constant. However, the consent order finalized in December 2002 and made a part of the NPDES permit established a firm date of December 31, 2014 for discharge to be eliminated from the Lewes-Rehoboth Canal. If no-action is taken, legal action would likely be taken by DNREC against the City of Rehoboth Beach. Thus, this alternative could result in significant legal fees and fines.

## 2.2 Alternative 2: Land Application

### 2.2.1 Description of Alternative

Land application involves the spray of treated wastewater effluent over a vegetated site at agronomic rates appropriate for irrigating the crop. It is considered a form of beneficial reuse since the practice involves the indirect recycle of water. This process accomplishes several objectives including irrigation of the crop, additional wastewater treatment and disposal of the effluent through recycling to the groundwater.

The additional treatment provided by the land application system is limited, but in the case of the Rehoboth Beach wastewater treatment plant, the effluent is already treated to a very high level. Typically, conventional secondary effluent would be acceptable for land application at restricted public access sites. This would require an effluent BOD and TSS of 30 mg/L. The RBWWTP currently produces an effluent with less than 15 mg/L BOD and TSS.

The land application system design for the sole use by RBWWTP (Alternative 2A) will include a spray irrigation system, onsite storage (lagoon), a pump station and an effluent flow conveyance system. In addition, an effluent pump station would be required at the RBWWTP to provide the hydraulic head necessary to pump effluent to the land application site.

One option is to shut down the RBWWTP and send all of the raw wastewater to the WNRWF with excess flow to be treated by the IBRWF (Alternative 2B) or a PWWP (Alternative 2C). Alternatively, the RBWWTP would remain in service and treated Rehoboth Beach wastewater would be land applied at the WNRWF, which is owned and operated by Sussex County. The amount of influent wastewater the WNRWF is able to receive from its current service area would be reduced, requiring excess flows to be diverted from the WNRWF to the IBRWF (Alternative 2D) or a PWWP (Alternative 2E) for treatment and disposal..

### 2.2.2 Benefits

Land application is well proven and established, and has been practiced successfully in Delaware for over 25 years with no adverse effect on the fields, crops or groundwater. In addition, land application recharges groundwater and preserves the agricultural use of land.

The primary health related concern is in regards to the potential for either direct or indirect contact with pathogenic organisms contained in the effluent wastewater. This could potentially occur either by direct contact with effluent that has collected in ponds on the site in runoff from the site, or from contact with aerosols. This risk is essentially nonexistent since the effluent is disinfected prior to application on the field. Epidemiological studies have demonstrated that aerosols pose no increased health concern to the public. There are several regulatory requirements regarding site buffers and level of disinfection that are intended to protect the public from these potential health risks.

Design standards for land application systems prohibit the application of treated effluent at rates that will exceed the hydraulic capacity of the soils. Thus, runoff from the site should not be a concern. However, buffers are also required which provide an extra measure of protection to streams passing through the site.

The treated effluent will percolate through the soil and into the shallow aquifer. As it passes through the soil and the roots of the crops, additional treatment of the effluent is achieved. The nitrate concentration in the percolate must not exceed the state drinking water standard of 10 mg/L. The RBWWTP operates a biological nutrient removal process in which ammonia is oxidized to nitrates and some of the resulting nitrates are removed as nitrogen gas through the process of denitrification. The effluent of the RBWWTP is typically 6 mg/L Total Nitrogen of which approximately 4 to 5 mg/L is in the form of nitrate. However, from an agronomic point of view, the discharge of nitrified wastewater, in which most of the ammonia has been oxidized to nitrate, is not preferred. The maximum uptake of nitrogen by plant growth is when the nitrogen is

in the form of ammonia or organic nitrogen. Nitrate is soluble, not retained by soil particles and tends to move with the groundwater.

Also, land application is essentially not a farming operation. The treated effluent must be discharged throughout the year despite the fact that farming is a seasonal operation. Thus, during the winter there would be little or no additional uptake of nitrogen by crops.

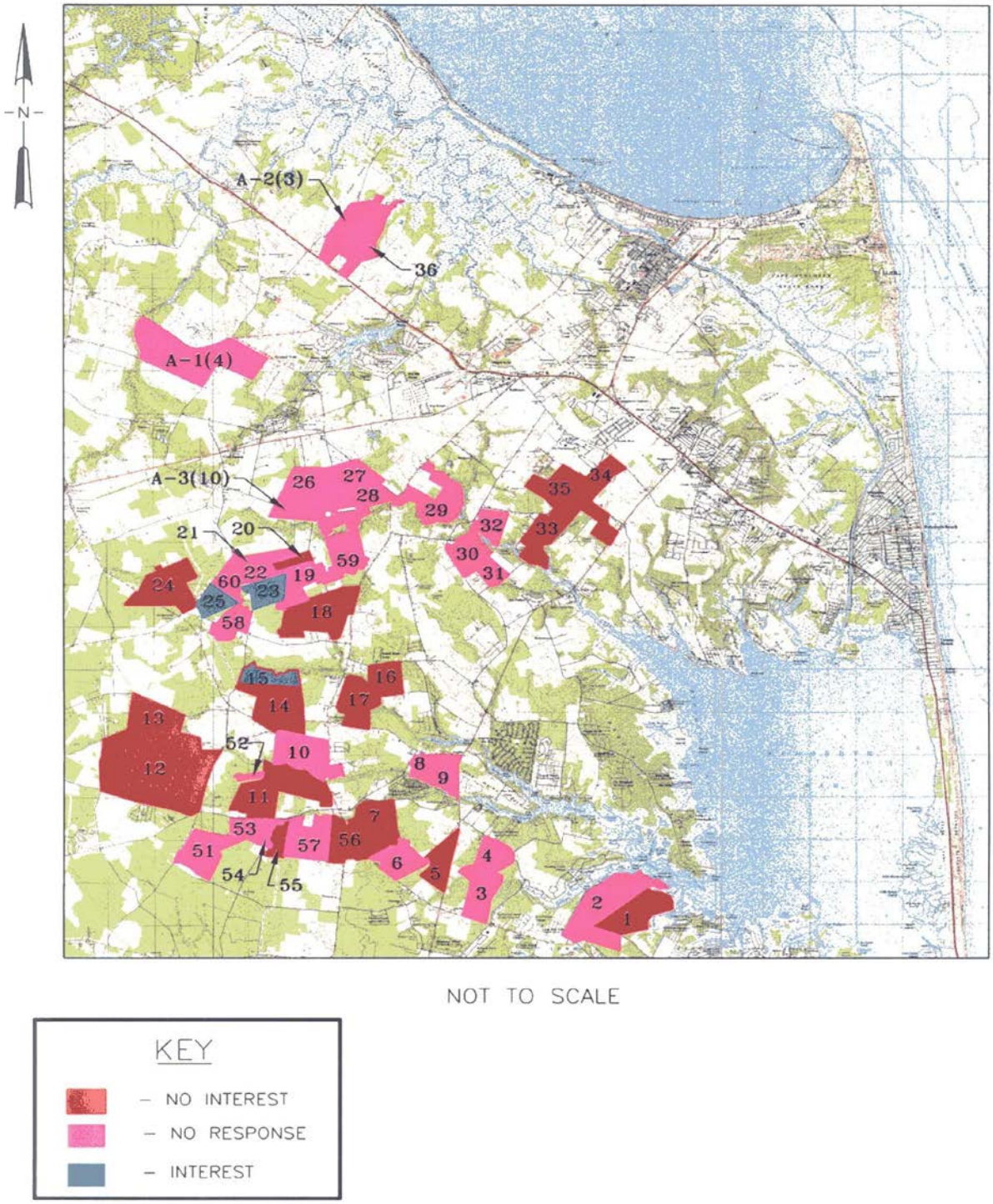
Another concern in regards to the soils is the addition of salts that can accumulate over time. High concentrations of salts can cause injury to the crops. Also, high concentrations of sodium relative to calcium and magnesium can reduce the permeability of the soil by the dispersion of clay materials.

### 2.2.3 Cost

#### 2.2.3.1 Alternative 2A: Dedicated Spray Irrigation Facility

The site selected for the preliminary layout of the spray irrigation system was based on the single property owner that indicated tentative interest in selling his property to the City. However the size of this property is inadequate for a spray irrigation system and adjacent lands are not available to the City for purchase. An extensive land search used the services of a professional realtor over a period of several years, but was not successful in identifying even a single landowner willing to sell their property to the City for the purpose of spraying treated effluent. Letters were sent to all the property owners within a reasonable distance of the RBWWTP (approximately 15 miles) soliciting interest. This effort was followed up by phone contact and an additional letter. A map showing the properties contacted and the results is presented in Figure 2-1. A search for leasable land was also conducted and was also not successful.

**Figure 2-1 Sussex County Land Availability (Stearns & Wheler, 2005)**



For a dedicated effluent spraying operation to be feasible, it is necessary to acquire adjacent properties. If the spray fields are too spread out geographically, the piping to distribute the effluent and the management of the operation becomes impractical and excessively expensive. However, for the purpose of developing cost estimates for this alternative, it was assumed that the City could acquire these lands for constructing an effluent spray irrigation system.

An engineering estimate of probable construction cost for spray irrigation is presented in Table 1.

**Table 1 Estimate of Probable Construction Cost for the Rehoboth Beach**

| Description | Cost |
|---|---|
| RBWWTP Effluent Pump Station | $1,000,000 |
| Force Main to Lagoon (Holding Pond) | $15,500,000 |
| Spray Irrigation System | $16,400,000 |
| Land Purchase Price(1) | $18,500,000 |
| Construction Cost (Year 2005 Dollars)(2) | $51,400,000 |
| Engineering, Construction Inspection, Administration, Legal and Financial Expenses @ 30% | $9,900,000 |
| Total Project Cost (Year 2005 Dollars) | $61,300,000 |
| Total Project Cost (Year 2009 Dollars) (3) | $69,000,000 |

Notes:

1. Land price estimate based on 740 acres @ $25,000 per acre.
2. Cost includes 30 % contingency.
3. At 3.0% inflation rate.

#### 2.2.3.2 Alternative 2B: Sending Raw Wastewater to WNRWF with Excess Flow Sent to the IBRWF

Table 2 summarizes the capital costs for Alternatives 2B. This alternative will require the construction of a new Rehoboth Beach raw wastewater pump station (RBWWPS), a force main to convey the flows from the RBWWPS to the WNRWF, upgraded headworks facilities at the WNRWF, a new Wolfe Neck transfer pump station (WNTPS), and a new force main to the IBRWF. Expanded treatment and disposal facilities will have to be constructed at the IBRWF to handle additional flow.

**Table 2 Alternative 2B Capital Cost Summary**

| Description | Total Estimated Capital Cost[1] (Year 2009 Dollars) | Estimated Cost for RB Service Area [2] (Year 2009 Dollars) |
|---|---|---|
| RBSTP Pumping Station | $3,000,000 | $3,000,000 |
| 30" PVC Force Main to WNRWF | $3,120,000 | $3,120,000 |
| WNRWF Headworks Upgrades | $1,530,000 | $550,000 |
| WNRWF to IBRWF Transfer Pumping Station | $2,490,000 | $1,350,000 |
| 24" PVC Force Main to IBRWF | $13,030,000 | $7,070,000 |
| IBRWF Phase 2 Upgrades | $20,600,000 | $20,600,000 |
| IBRWF Phase 3 Upgrades | $12,700,000 | $6,770,000 |
| IBRWF Phase 4 Upgrades | $18,850,000 | $0 |
| Land/Easements | $11,250,000 | $11,250,000 |
| 10% Contingency | $7,530,000 | $4,250,000 |
| Engineering/Administration | $18,230,000 | $10,280,000 |
| Total Project Cost | $112,320,000 | $68,250,000 |

Notes:

1. Total Estimated Capital Cost includes total construction cost, including cost Sussex County is responsible for.
2. Cost for RB Service Area includes cost for Sussex County residents in Dewey Beach, Henlopen Acres, and North Shores.

#### 2.2.3.3 Alternative 2C: Sending Raw Wastewater to WNRWF with Excess Flow Sent to a PWWP

Table 2.2.3.3-1 summarizes the capital costs for Alternatives 2C. This alternative will require the construction of a new Rehoboth Beach raw wastewater pump station (RBWWPS), a force main to convey the flows from the RBWWPS to the WNRWF, upgraded headworks facilities at the WNRWF, a new Wolfe Neck transfer pump station (WNTPS), and a new force main to the PWWP. Expanded treatment and disposal facilities will have to be constructed at the PWWP facility to handle additional flow. The cost of partnering with a PWWP was estimated based on an approach, suggested by Artesian Resources, to pump excess wastewater to the Artesian Northern Sussex Regional Water Recharge Facility (ANSWRF).

**Table 3 Alternative 2C Capital Cost Summary**

| Description | Total Estimated Capital Cost[1] (Year 2009 Dollars) | Estimated Cost for RB Service Area[2] (Year 2009 Dollars) |
|---|---|---|
| RBSTP Pumping Station | $3,000,000 | $3,000,000 |
| 30" PVC Force Main to WNRWF | $3,120,000 | $3,120,000 |
| WNRWF Headworks Upgrades | $1,530,000 | $550,000 |
| WNRWF to ANSWERF Transfer Pumping Station | $2,490,000 | $1,350,000 |
| IBRWF Phase 2 Upgrades | $10,910,000 | $0 |
| 24" PVC Force Main to ANSRWF | $15,700,000 | $8,530,000 |
| ANSWRF Treatment Capacity | $48,410,000 | $26,310,000 |
| Land/Easements | $500,000 | $270,000 |
| Contingency | $3,720,000 | $1,680,000 |
| Engineering & Administration | $10,630,000 | $4,800,000 |
| Total Project Cost | $100,010,000 | $49,600,000 |

Notes:

1. Total Estimated Capital Cost includes total construction cost, including cost Sussex County is responsible for.
2. Cost for RB Service Area includes cost for Sussex County residents in Dewey Beach, Henlopen Acres, and North Shores.

#### 2.2.3.4 Alternative 2D: Sending Treated Effluent to WNRWF with Excess Flow Sent to the IBRWF

Table 4 summarizes the capital costs for Alternatives 2D. This alternative will require the construction of a new Rehoboth Beach pump station (RBPS), a force main to convey the flows from the RBPS to the WNRWF, a new Wolfe Neck transfer pump station (WNTPS), and a new force main to the IBRWF. Expanded treatment and disposal facilities will have to be constructed at the IBRWF.

**Table 4 Alternative 2D Capital Cost Summary**

| Description | Total Estimated Capital Cost[1] (Year 2009 Dollars) | Estimated Cost for RB Service Area[2] (Year 2009 Dollars) |
|---|---|---|
| RBSTP Pumping Station | $900,000 | $900,000 |
| 30" PVC Force Main to WNRWF | $3,500,000 | $3,500,000 |
| RBWWTP Improvements | $2,930,000 | $2,930,000 |
| WNRWF Headworks Upgrades | $1,300,000 | $0 |
| WNRWF to IBRWF Transfer Pumping Station | $2,270,000 | $950,000 |
| 24" PVC Force Main to IBRWF | $13,030,000 | $5,430,000 |
| IBRWF Phase 2 Upgrades | $20,600,000 | $18,190,000 |
| IBRWF Phase 3 Upgrades | $12,700,000 | $0 |
| IBRWF Phase 4 Upgrades | $10,660,000 | $0 |
| Land/Easements | $11,250,000 | $11,250,000 |
| Contingency | $6,930,000 | $3,340,000 |
| Engineering/Administration | $16,460,000 | $7,750,000 |
| Total Project Cost | $102,500,000 | $54,200,000 |

Notes:

1. Total Estimated Capital Cost includes total construction cost, including cost Sussex County is responsible for.
2. Cost for RB Service Area includes cost for Sussex County residents in Dewey Beach, Henlopen Acres, and North Shores.

#### 2.2.3.5 Alternative 2E: Cost of Sending Treated Effluent to WNRWF with Excess Flow Sent to a PWWP

Table 5 summarize the capital costs for Alternatives 2E. This alternative will require the construction of a new Rehoboth Beach pump station (RBPS), a force main to convey the flows from the RBPS to the WNRWF, a new Wolfe Neck transfer pump station (WNTPS), and a new force main to a PWWP. Expanded treatment and disposal facilities will have to be constructed at a PWWP facility. The cost of partnering with a private WW provider was estimated based on an approach, suggested by Artesian Resources, to pump excess wastewater to the Artesian Northern Sussex Regional Water Recharge Facility (ANSWRF).

**Table 5 Alternative 2E Capital Cost Summary**

| Description | Total Estimated Capital Cost[1] (Year 2009 Dollars) | Estimated Cost for RB Service Area[2] (Year 2009 Dollars) |
|---|---|---|
| RBSTP Pumping Station | $900,000 | $900,000 |
| 30" PVC Force Main to WNRWF | $3,500,000 | $3,500,000 |
| RBWWTP Improvements | $2,930,000 | $2,930,000 |
| WNRWF Headworks Upgrades | $1,300,000 | $0 |
| WNRWF to ANSWERF Transfer Pumping Station | $2,270,000 | $950,000 |
| IBRWF Phase 2 Upgrades | $10,910,000 | $0 |
| 24" PVC Force Main to ANSRWF | $15,700,000 | $6,550,000 |
| ANSWRF Treatment Capacity | $38,580,000 | $16,090,000 |
| Land/Easements | $500,000 | $210,000 |
| Contingency | $3,950,000 | $1,650,000 |
| Engineering & Administration | $10,470,000 | $4,140,000 |
| Total Project Cost | $91,000,000 | $36,900,000 |

Notes:

1. Total Estimated Capital Cost includes total construction cost, including cost Sussex County is responsible for.
2. Cost for RB Service Area includes cost for Sussex County residents in Dewey Beach, Henlopen Acres, and North Shore.

## 2.3 Alternative 3: Ocean Outfall

### 2.3.1 Description of Alternative

This method of effluent disposal is based on the discharge of the highly treated effluent wastewater into the ocean at a distance offshore and at a depth where the potential public health and environmental impacts are minimized or proven to be negligible. The system would be designed such that the initial dilution and dispersion of the treated effluent will achieve compliance with all water quality regulations and public health standards. Ocean outfalls have been used for many years, both locally and around the world, as a means to dispose of treated wastewater with an excellent record of protecting environmental resources and protecting public health. Public health is protected in several ways, including:

- Advanced Treatment: A very high level of treatment is provided prior to discharge. It is anticipated that the same level of treatment provided by the South Coastal Regional Wastewater Facility, which discharges treated effluent through an ocean outfall off South Bethany in Delaware, will be required for the RBWWTP. The anticipated discharge permit, summarized in Table 6, would require effluent filtration be provided to remove additional organics and nutrients and, as is the case with the existing system, a very high level of disinfection would be required.
- Initial Dilution: The effluent is discharged through specially designed diffusers that promote the mixing and dilution of the treated effluent with the seawater. A very significant degree of dilution is achieved.
- Farfield Dilution: After the initial mixing of the effluent plume with the seawater, the plume continues to mix and dissipate as it travels. The location of the diffuser is such that, even under the worst case operating conditions, the plume is so dilute that public health requirements are met and exceeded before the plume has any possibility of reaching the beach. In fact, in most cases, public health requirements are met at the initial zone of dilution.

**Table 6 Anticipated NPDES Permit Limits for Ocean Discharge**

| Parameter | Permit Requirement | Unit | Basis |
|---|---|---|---|
| $BOD_5$ | 15 | mg/L | Daily Average |
| TSS | 15 | mg/L | Daily Average |
| pH | 6.0 – 9.0 | | |

Several alternative locations for the ocean outfall were considered in previous studies. The locations were based on some earlier work that will be referred to as the LaCato Project (George, Miles & Buhr, 1977). This project was comprised of a series of studies and reports that were completed in the 1970s in an effort to evaluate alternatives for the treatment and disposal of wastewater from a new proposed service area; the John M. LeCato Sanitary and Water District.

The results of dilution studies performed for the LaCato Project suggested that an ocean outfall located 6,000 feet offshore from the City would provide adequate dilution. In order to determine if greater distance from shore provided any discernible benefits, locations 9,000 feet and 12,000 feet offshore were also considered by the City in the “2005 Effluent Disposal Study”. A regional alternative located about four (4) miles north of the other three (3) potential locations was evaluated in the 2005 report as well, but this location is no longer practical as the City and County have rejected regional solutions to effluent disposal.. The locations of the alternative ocean outfall sites are shown in Figure 2-2 and are described in Table 7.

**Figure 2-2 Outfall Locations Considered in Lawler, Matusky & Skelly Engineers Model**

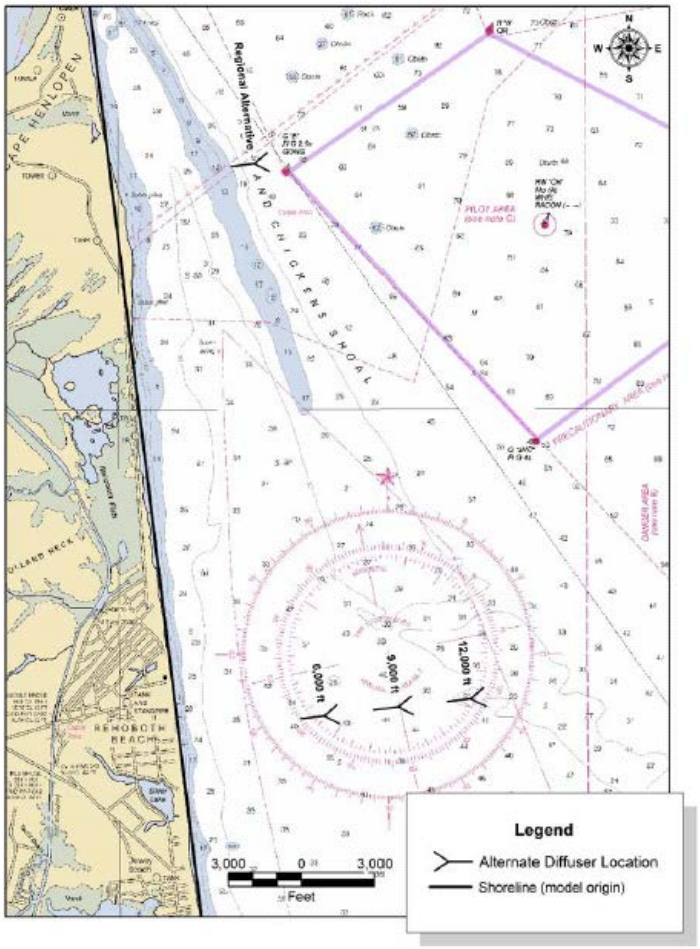



**Table 7 Approximate Outfall Locations Considered in Lawler, Matusky & Skelly Engineers Model (Stearns & Wheler, 2005)**

| Location | Coordinates |
|---|---|
| Rehoboth Beach – 6,000 ft offshore | 75° 3.3' W 38° 42.9' N |
| Rehoboth Beach – 9,000 ft offshore | 75° 2.6' W 38° 43.0' N |
| Rehoboth Beach – 12,000 ft offshore | 75° 2.0' W 38° 43.1' N |

Extensive current and dilution modeling was performed for the 2005 Effluent Disposal Study by Lawler, Matusky & Skelly Engineers. The results of the model are summarized in Table 8 (Stearns & Wheler, 2005). The results indicate that the 100:1 dilution is achieved in less than 500 feet and in slightly more than five minutes. The time and distance to the 100:1 dilution was essentially the same at all locations and thus there

would no benefit gained by the additional construction cost and operating cost imposed by extending the outfall. While the extended outfall provides a greater distance between the shore and the diffuser for far-field dilution to continue, the distance is not required in light of the very effective mixing achieved at the 6,000 foot location. Also, extending the outfall further would, at some point, require construction in the Hen and Chicken Shoals, which would potentially have an adverse environmental impact.

**Table 8 Rehoboth Beach - Distance and Time to Achieve 100:1 Dilution (Stearns & Wheler, 2005)**

| Scenario | Downcurrent distance to 100:1 dilution (feet) | Time to 100:1 dilution (minutes) |
|---|---|---|
| 6,000 ft offshore | 415 | 5.4 |
| 9,000 ft offshore | 432 | 5.4 |
| 12,000 ft offshore | 420 | 5.3 |

### 2.3.2 Benefits

An ocean outfall will discharge treated effluent directly into the ocean, thus eliminating any potential for nutrients within the wastewater to enter the inland bays. This ensures that the City will conform with the consent decree and that all possible action is taken by RBWWTP to improve the water quality of the inland bays.

Effluent disposal through an ocean outfall would not be dependent on any land-based facilities or installations outside of the existing RBWWTP site. This will minimize the risk of operations becoming limited or prohibited in the future due to changes to regulations or land use.

The most critical issue regarding water quality is to maintain compliance with the water quality criteria that is designated by EPA and DNREC to protect aquatic and human health. The standards are specified in the State of Delaware Surface Water Quality Standards as amended July 11, 2004 (DNREC, 2004). Delaware's 2002 305(b) report indicates that all assessed coastal waters fully support both swimming and aquatic life (DNREC, 2002).

The Surface Water Quality Standards also impose limits for pollutants that have been identified as potential carcinogens. Rehoboth Beach effluent was collected on three separate days during Summer 2010 and tested for priority pollutants. No metals were found in concentrations exceeding the specified limit. The RBWWTP is currently in compliance with all the criteria at its existing discharge location.

The effluent from the RBWWTP will be a highly treated effluent with advanced treatment processes in place to remove nutrients and additional solids and to provide a very high degree of disinfection. The discharge permit that is anticipated will apply even higher standards and require a greater degree of solids removal from the effluent than is required for conventional secondary treatment. This is based on the discharge permit currently applied to the South Coastal WWTP which discharges treated effluent through an ocean outfall located in the vicinity of Bethany Beach. In order to more reliably achieve compliance with this standard, the City plans on replacing of the microscreen system at the RBWWTP with new effluent filters. The existing microscreens are an older technology that is difficult to maintain. New filter systems are

available that provide better performance and are more reliable. The RBWWTP currently utilizes a chlorine disinfection system to comply with a very stringent bacterial standard that is based on the protection of swimmers for primary contact recreation and for shellfish resources. The current discharge permit standard for the plant is 10 colonies per 100 ml enterococcus and the treatment plant routinely produces an effluent with either no enterococcus or levels of 1 to 2 colonies per 100 ml. Thus, even without the dilution provided by the diffuser, the effluent complies with the applicable bacterial standard for primary contact recreational marine waters.

However, the assessment of potential impacts should reasonably consider a worst-case scenario. As described previously, the ambient conditions considered by the dilution model already has a worst case scenario built into its assumptions since the current vectors used are the vectors which have the greatest onshore component during the summer season. The worst case scenario that could possibly be experienced at the RBWWTP would be a failure of both the normal power and the emergency backup power. If this were to happen, the efficiency of the biological treatment processes would be greatly reduced since blowers providing air to the process would not be operable. The treatment plant would essentially function as a primary plant in which the aeration basins and clarifiers become settling basins. In this case, the effluent characteristics that would be expected are equivalent to primary effluent. It should be noted however, that this worst case scenario is impossible because, in the event of a power failure, the influent pumps pumping raw wastewater to the treatment plant and the effluent pumps required to discharge the effluent through the ocean outfall would not be operable and thus there would be no effluent. The disinfection system is provided with backup systems for reliability but even if they were inoperable, a manual system for metering chlorine into the effluent could be utilized. Thus, under the worst case scenario, backup treatment systems and initial and farfield mixing of the effluent would protect public health.

The water quality standards to protect aquatic life focus on the prevention of acute and chronic toxicity. Concentration limits are placed on a number of metals, organic compounds and inorganic compounds. The compounds are not suspected to be present in the RBWWTP effluent. The wastewater treated at the plant is almost entirely domestic with some light commercial wastes such as from restaurants. One exception is chlorine which is used for disinfection. However, a dechlorination system is in-place at the treatment plant that effectively removes all of the chlorine prior to discharge. The scan of priority pollutants in the RBWWTP effluent that was completed as part of the NPDES permit renewal confirm that there are no hazardous chemicals in the effluent.

The NPDES permit for the RBWWTP requires the plant to conduct a chronic biomonitoring test on their effluent annually. The test procedures are outlined in the “Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms” (USEPA, 2002b). The treatment plant has never failed a toxicity test and there is no reason to suspect that they would be at risk to fail a biomonitoring test.

### 2.3.3 Cost

The RBWWTP already provides a high level of treatment, which include advanced treatment for nutrient removal that complies with the anticipated discharge permit. However, in order to improve the reliability of the existing RBWWTP, improvements to the plant are planned. These improvements include new motor

controls, emergency power generation, and more efficient effluent filters, followed by an effluent pumping system. The effluent pump station will provide the hydraulic head required to pump the flow through the ocean outfall pipe and diffuser. The effluent filters and effluent pump station can be located just south of the Microscreen Building.

A summary of the engineering estimates from three construction firms for the probable construction cost consisting of the ocean outfall (only from the dune parking lot to the outfall location) is presented in Table 9. The average from the different firms was used to estimate the total construction cost of the Ocean Outfall Alternative, which is presented in Table 10.

**Table 9 Summary of Estimated Capital Costs – Ocean Outfall (Year 2009 Dollars)**

| Cost Component | Stearns & Wheler | Weeks Marine | WorleyParsons |
|---|---|---|---|
| Subtotal | $19,900,000 | $11,700,000 | $12,720,000 |
| Contingency (15%) | $ 2,990,000 | $ 1,760,000 | $ 1,910,000 |
| Total | $22,900,000 | $13,500,000 | $14,600,000 |
| Average | | | $ 17,000,000 |

**Table 10 Estimate of Probable Construction Cost for the RBWWTP Ocean Outfall Alternative**

| Component | Estimated Cost (Year 2009 Dollars) |
|---|---|
| RBWWTP Pumping Station | $990,000[1] |
| Rehoboth Treatment Upgrades | $3,330,000[1] |
| Rehoboth FM to Ocean Outfall | $2,820,000[1] |
| Rehoboth Ocean Outfall | $17,000,000[1,2] |
| Subtotal | $24,200,000 |
| Engineering & Administration | $5,320,000 |
| Permitting (5%) Ocean Outfall Only | $850,000 |
| Total Project Cost | $30,370,000 |

Notes:

1. Costs include contingencies.
2. Cost based on average of estimates from previous studies.

# 3. Comparison of Alternatives

In this section, the relative merits of each alternate method of effluent disposal for the City of Rehoboth are presented in order to identify the most technically feasible, environmentally acceptable and cost-efficient alternative. The technical issues, environmental impacts and costs associated with each alternative were provided in Section 2 of this report. Table 11 presents a summary of this discussion and the resulting conclusions regarding the suitability of each alternative.

Table 12 compares the alternatives on the basis of other more subjective issues. The subjective analysis indicates a generally favorable rating for the ocean outfall alternative compared to the other alternatives. During the completion of the various studies since 1998 when the City was notified that an alternative discharge would be required, there has been an extensive effort to provide information to the public regarding the various alternatives. The outreach has been in the form of workshops, newspaper articles, presentations to various organizations and public hearings. These efforts have allowed an informal consensus to be reached by the City and the citizens with the result that the ocean outfall is the preferred alternative.

According to DNREC guidelines, the maximum “reasonable” user charge for wastewater is 1.5% of the median household income, which equates to $989 for the City of Rehoboth Beach (Stearns & Wheler 2009). The typical current annual user charge was calculated to be $326 for a residential customer within the City of Rehoboth Beach limits (Stearns & Wheler 2009), based on the estimated daily water usage and the actual rate structure.

Table 13 provides a summary of the estimated annual user rates for the residents of the City of Rehoboth Beach for the alternatives. Under the no action alternative, annual user charges for wastewater are expected to remain at current levels ($326 per resident). However, this alternative is infeasible as it would result in a violation of the consent order.

It is estimated that the land application alterative would increase the typical annual user charge by a factor of 3.85 (285 %) to approximately $1,255 per year, which is well above the maximum “reasonable” charge of $989 for the City of Rehoboth Beach (Stearns & Wheler 2009). User rates this high are expected to place an economic burden on residents of Rehoboth Beach, especially retired residents living on a fixed income.

The ocean outfall alterative would increase it user charges by a factor of 1.95 (95 %) to approximately $635 per year. Although user charges would be higher than they are currently, charges would remain below the “reasonable” charge of $989 for the City of Rehoboth Beach (Stearns & Wheler 2009).

Thus, the most technically feasible, cost effect, and environmentally friendly option for the City of Rehoboth is an ocean outfall.

**Table 11 Benefit Analysis**

| Alternative | | Advantages | Disadvantages |
|---|---|---|---|
| 1. | No Action | No capital investment required<br>Operating costs remain constant | Water quality of Rehoboth Bay would continue to deteriorate<br>Breaks consent order, resulting in significant legal fees and fines |
| | | **Conclusion:** Does not meet TMDL established by DNREC and would result in legal action being taken against the city. | |
| 2. | Land Application | Well established and accepted practice in Delaware<br>Recharges groundwater<br>Preserves agricultural use of land | High cost of property<br>Significant effluent wastewater storage volume required<br>Use of existing WNRWF spray irrigation facilities would require coordination with Sussex County including capital improvements to County WWTPs<br>Potential to continue discharge of nitrogen into Inland Bay via groundwater<br>City essentially operating two treatment facilities<br>If contract with private utility, increased risk associated with City not being in charge of their own destiny<br>If lease land or contract with private utility, risk of increased cost or need to abandon operation due to changing land use patterns or regulatory requirements |
| | | **Conclusion:** Land not available. Alternative possible only if cooperation with County at significantly higher cost. City and County rejected regional solution. | |
| 3. | Ocean Outfall | Minimal operational requirements<br>Minimal maintenance requirements<br>No potential nutrient transport into Bay | Public acceptance by certain groups may be difficult<br>Permitting issues<br>No groundwater recharge |
| | | **Conclusion:** Most practical solution considering the availability of land,and the protection of groundwater and water quality of the Inland Bays. Also, this alternative has the lowest impact on estimated user charges and greatest acceptance by citizens of Rehoboth Beach. | |

**Table 12 Comparison of Alternatives**

| Issue | No Action (1) | New Land Application Facility (2A) | Land Application at Existing Facilities (2B/2C/ 2D/2E) | Ocean Outfall (3) |
|---|---|---|---|---|
| Public Acceptance | - | + | + | - |
| Environmental Impacts | - | + | + | 0 |
| Nutrient Loading to Inland Bays | - | 0 | 0 | + |
| Permitting Issues | - | + | + | 0 |
| Reliability | 0 | 0 | 0 | + |
| Operability | + | 0 | 0 | + |
| Construct-ability | + | 0 | 0 | 0 |
| Long Term Solution | - | 0 | 0 | + |
| Groundwater Recharge | - | + | + | - |
| Land Requirement | + | - | 0 | + |
| Risk | - | + | + | + |
| Cost | 0 | 0 | 0 | + |
| Summary | | | | |
| + | 3 | 5 | 5 | 7 |
| 0 | 2 | 6 | 7 | 3 |
| - | 7 | 1 | 0 | 2 |

Notes:

1. A (+) indicates that, in regards to the particular issue the alternative is generally considered to be positive or beneficial.
2. A (0) indicates a neutral response.
3. A (-) indicates that the alternative is negative or detrimental with regards to the issue.
4. Indicates an issue, which essentially eliminates the alternative from further consideration.

**Table 13 Estimated User Charges Analysis (Stearns & Wheler, 2009)**

| Alternative | No. | Description | Estimated Annual User Charge |
|---|---|---|---|
| No Action | 1 | No Action (Current User Rate) | $ 326 |
| Land Application | 2B | Raw wastewater to County | $ 1,160 |
| | 2C | Raw wastewater to County/Private | $ 1,430 |
| | 2D | Treated wastewater to County | $ 1,010 |
| | 2E | Treated wastewater to County/Private | $ 1,420 |
| | | Land Application Average | $ 1,255 |
| Ocean Outfall | 3 | Dedicated City outfall | $ 635 |

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