

SECTION 6: EVALUATION OF FINAL ALTERNATIVES

6.1 REGIONAL OPTIONS

6.1.1 Area 1A

In Option 1, all wastewater from the subdivisions of concern is conveyed to the existing City of Port Lavaca WWTP. Each house in the subdivision would be connected to the collection system using a grinder pump system. The total monthly payment per lot for this option would include the cost of the grinder pump system, force main cost, lift station cost, contingencies, professional services, electricity cost for operating the lift station, and the City sewer fee. This option is shown schematically in **Figure 6-1**.

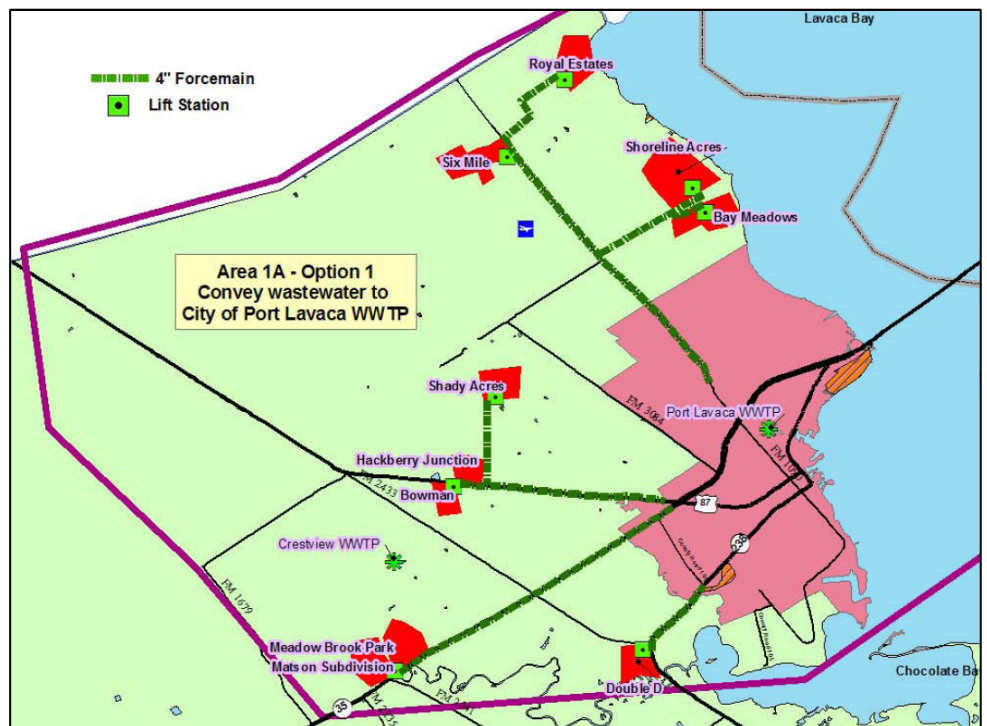


Figure 6-1 Area 1A Option 1

In Option 2, where all subdivisions get their own package WWTP, the total monthly payment per lot would include the cost of the grinder pump system, treatment plant cost, contingencies, professional services, and the operation and maintenance cost for the WWTP. This option is shown schematically in **Figure 6-2**

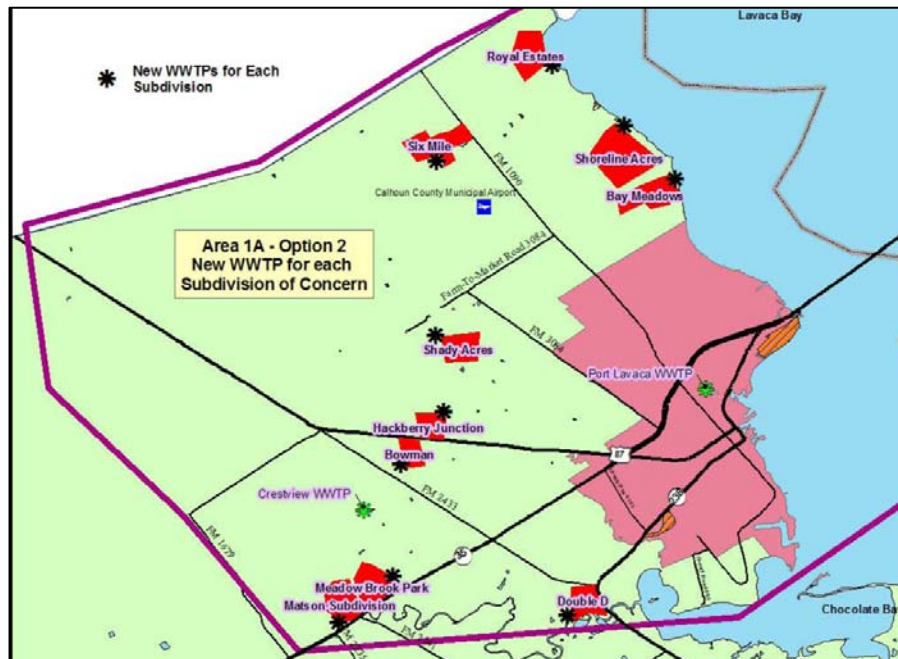


Figure 6-2 Area 1A Option 2

In Option 3 the subdivisions are grouped geographically and the combined flows are directed to a new regional WWTP. In addition to all the costs mentioned in Option 2, this would also include force main cost, lift station cost and electricity for operating the lift station. This option is shown schematically in **Figure 6-3**.

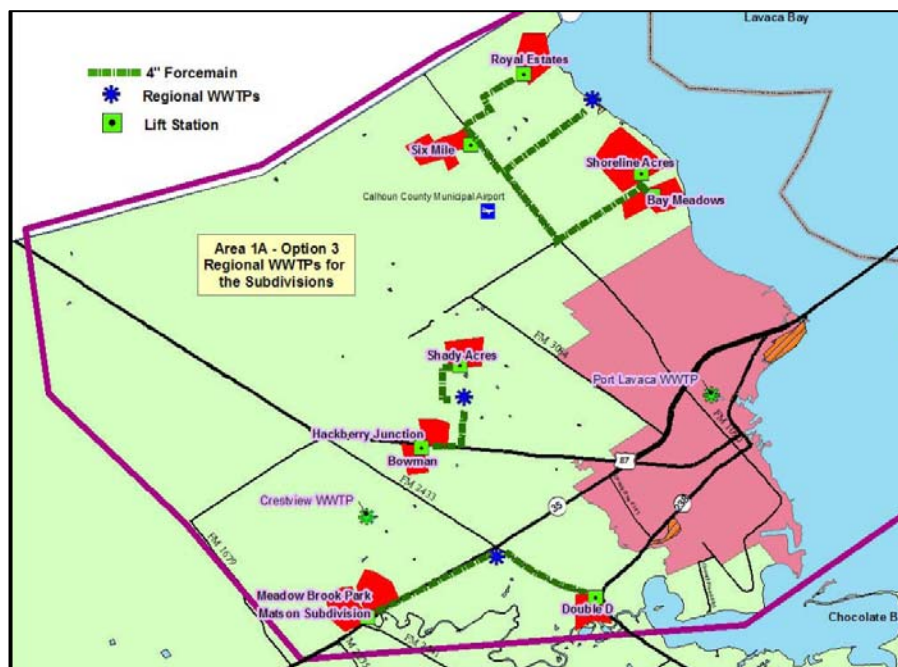


Figure 6-3 Area 1A Option 3

In Option 4 for Area 1A, Crestview WWTP extends its service to the nearby subdivisions, while subdivisions to the north of City of Port Lavaca get a new regional WWTP and City of Port Lavaca extends its service to the Double D subdivision. This option is shown schematically in **Figure 6-4**.

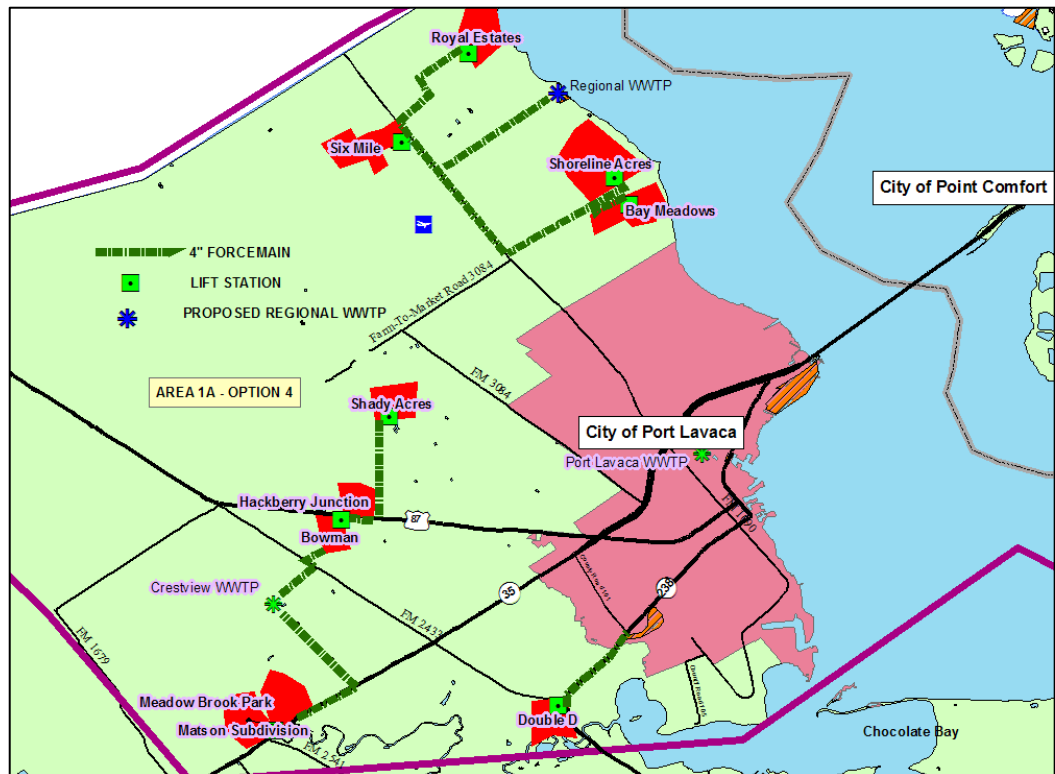


Figure 6-4 Area 1A Option 4

6.1.2 Area 1B

In Option 1, all wastewater from the subdivisions of concern is conveyed to the existing City of Point Comfort WWTP. Each house in the subdivision would be connected to the collection system using a grinder pump system. The total monthly payment per lot for this option would include the cost of the grinder pump system, force main cost, lift station cost, contingencies, professional services, electricity cost for operating the lift station, and the City sewer fee. This option is shown schematically in **Figure 6-5**.

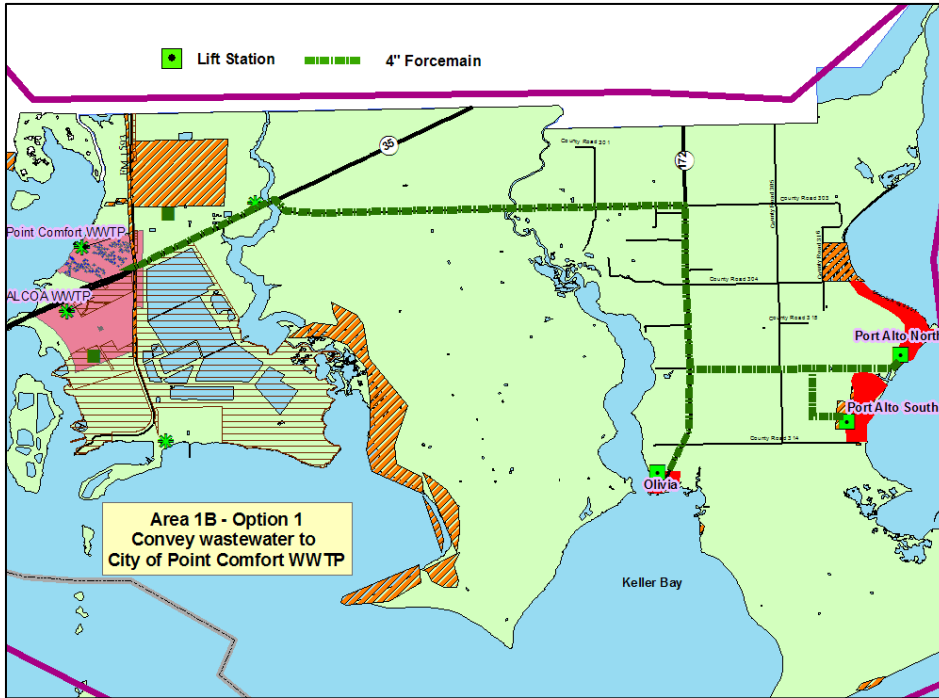


Figure 6-5 Area 1B Option 1

In Option 2, where each subdivision has their own package WWTP, the total monthly payment per lot would include the cost of the grinder pump system, treatment plant cost, contingencies, professional services, and the operation and maintenance cost for the WWTP. This option is shown schematically in **Figure 6-6**.

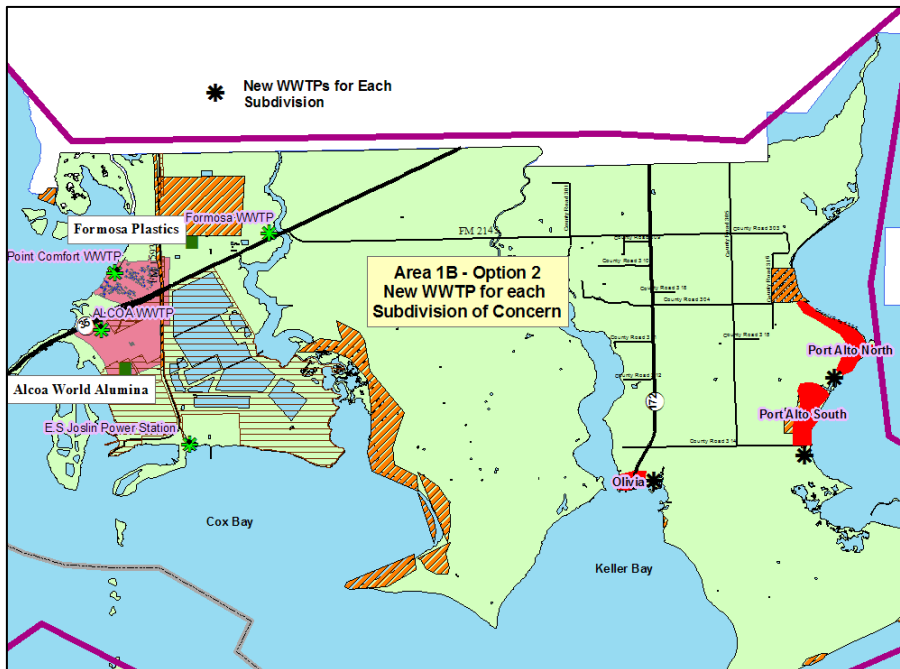


Figure 6-6 Area 1B Option 2

In Option 3 the flows from all the subdivisions are combined and treated at a new regional WWTP. In addition to all the costs mentioned in Option 2, this would also include force main cost, lift station cost and electricity for operating the lift station. This option is shown schematically in **Figure 6-7**.

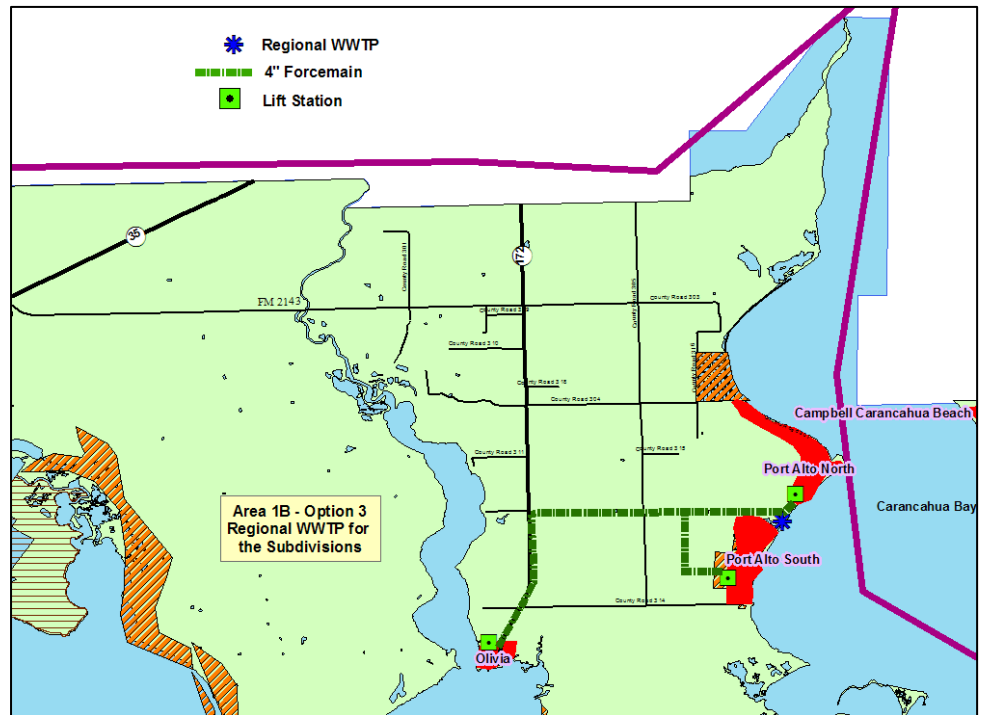


Figure 6-7 Area 1B Option 3

6.1.3 Area 2

In Option 1, all wastewater from the proposed subdivisions is conveyed to either City of Seadrift WWTP or the Port O'Connor MUD WWTP. Each lot in the subdivision would be responsible for installing an individual grinder pump system. The total monthly payment per lot for this option would include the cost of the grinder pump system, force main cost, lift station cost, contingencies, professional services, electricity cost for operating the lift station, and the City sewer fee. This option is shown schematically in **Figure 6-8**.

In Option 2, where each subdivision has an individual package WWTP, the total monthly payment per lot would include the cost of the collection system, treatment plant cost, contingencies, professional services, and the operation and maintenance cost for the WWTP. This option is shown schematically in **Figure 6-9**.

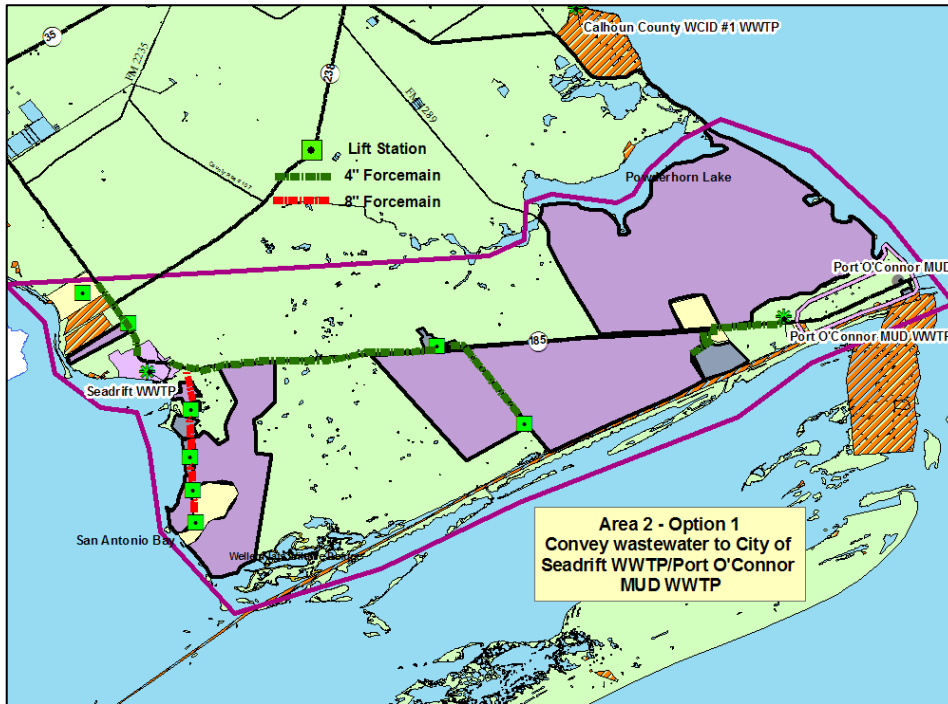


Figure 6-8 Area 2 Option 1

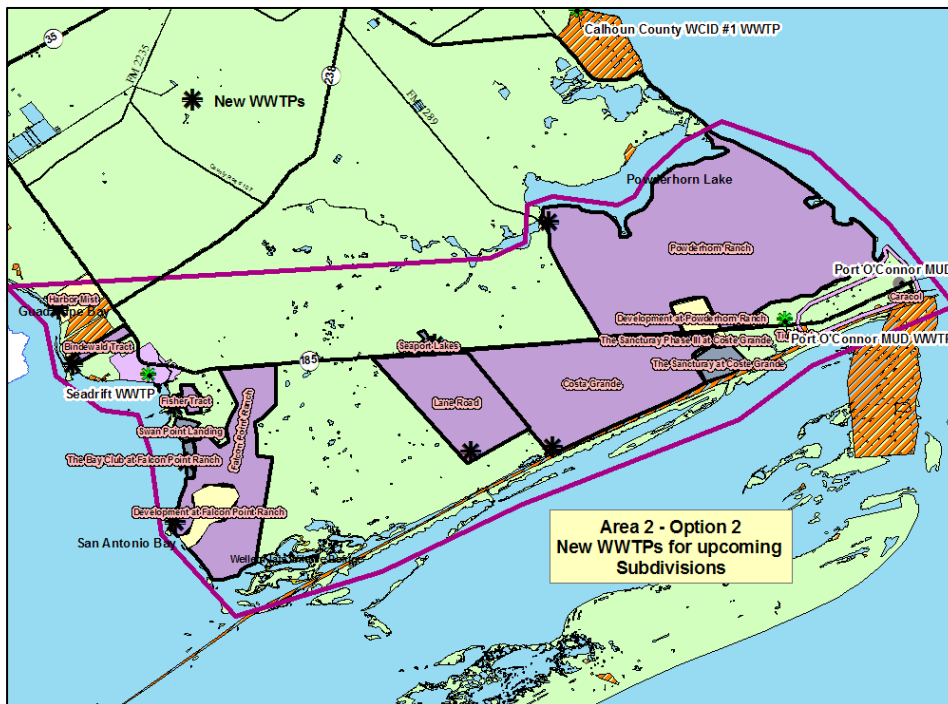


Figure 6-9 Area 2 Option 2

In Option 3, the flow from each of the subdivisions is directed to a proposed regional WWTP. In addition to all the costs mentioned in Option 2, this would also include force main cost, lift station cost and electricity for operating the lift station. This option is shown schematically in **Figure 6-10**.

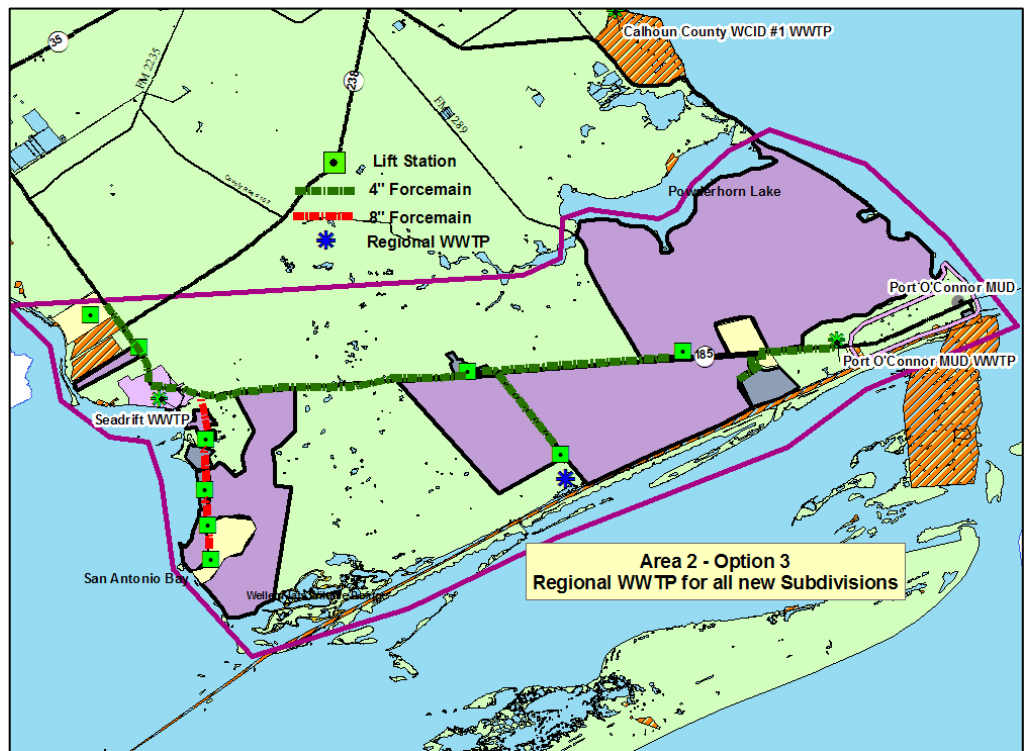


Figure 6-10 Area 2 Option 3

In Option 4, the flows from the subdivisions of Lane Road, Powderhorn Ranch, Seaport Lakes and Costa Grande are directed to a new regional WWTP and the remaining subdivisions convey wastewater to the closest regional WWTP either in City of Seadrift or in Port O'Connor MUD. This option is shown schematically in **Figure 6-11**.

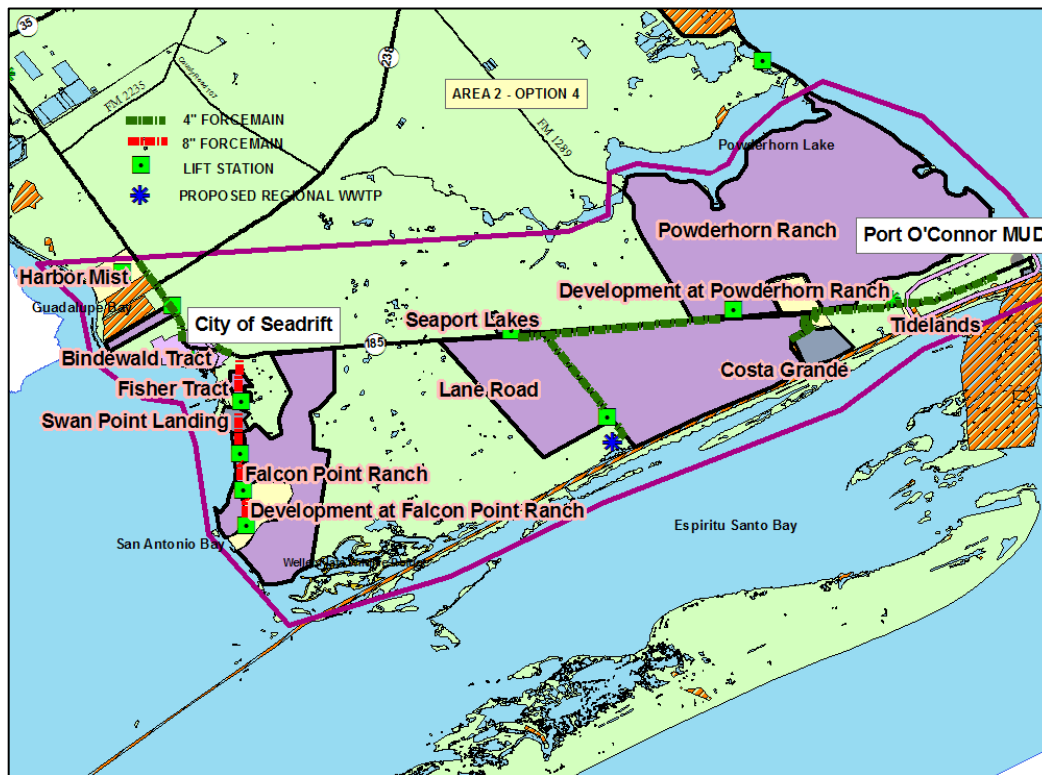


Figure 6-11 Area 2 Option 4

6.1.4 Area 3

In Option 1, all wastewater from the subdivisions of concern is conveyed to SCC WCID No.1 WWTP. Each house in the subdivision would be connected to the collection system using a grinder pump systems. The total monthly payment per lot for this option would include the cost of the grinder pump system, force main cost, lift station cost, contingencies, professional services, electricity cost for operating the lift station, and the Port O'Connor MUD sewer fee. This option is shown schematically in Figure 6-12.

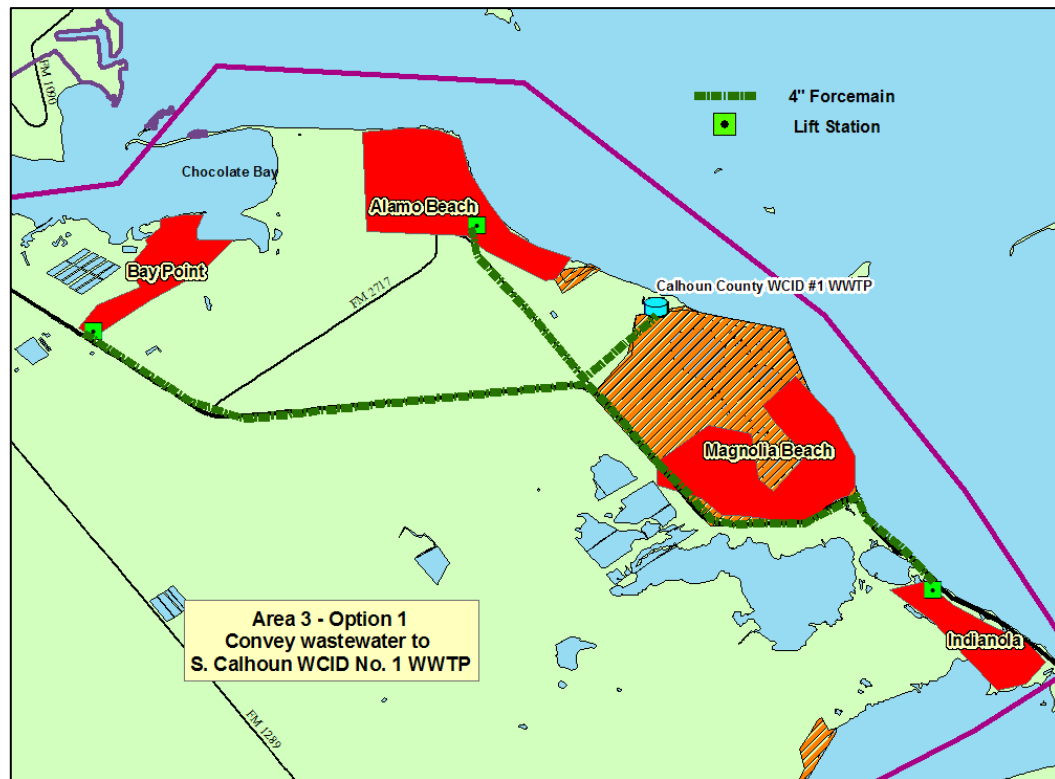


Figure 6-12 Area 3 Option 1

In Option 2, where each subdivision will have its own package WWTP, the total monthly payment per lot would include the cost of the collection system, treatment plant cost, contingencies, professional services, and the operation and maintenance cost for the WWTP. This option is shown schematically in **Figure 6-13**.

In Option 3, all the subdivisions convey wastewater to a regional WWTP. In addition to all the costs mentioned in Option 2, this would also include force main cost, lift station cost and electricity for operating the lift station. This option is shown schematically in **Figure 6-14**.

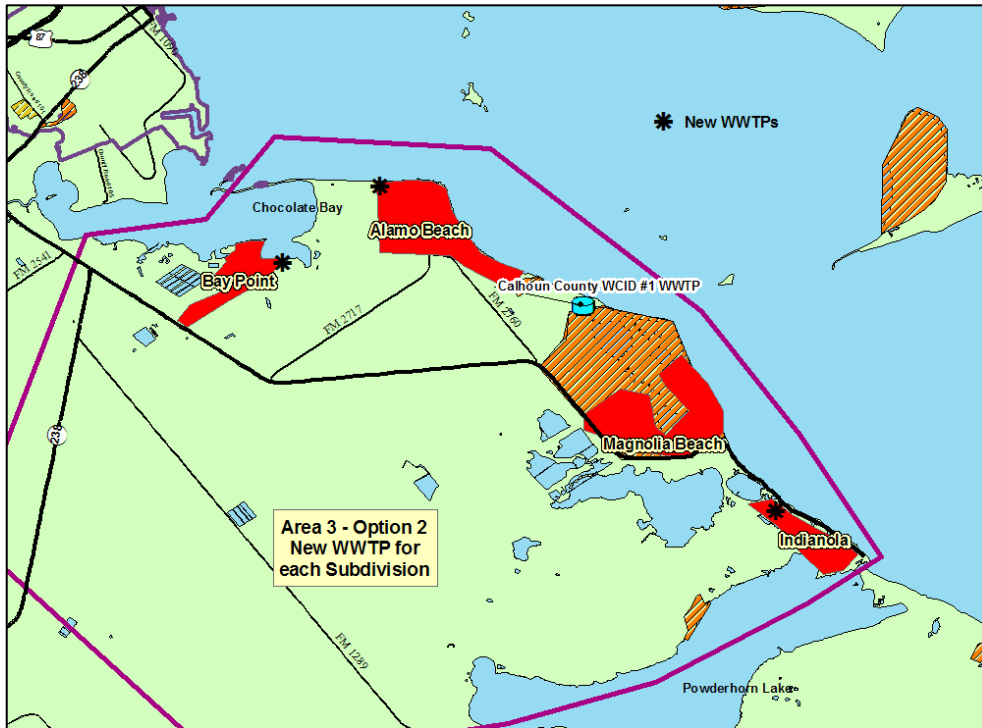


Figure 6-13 Area 3 Option 2

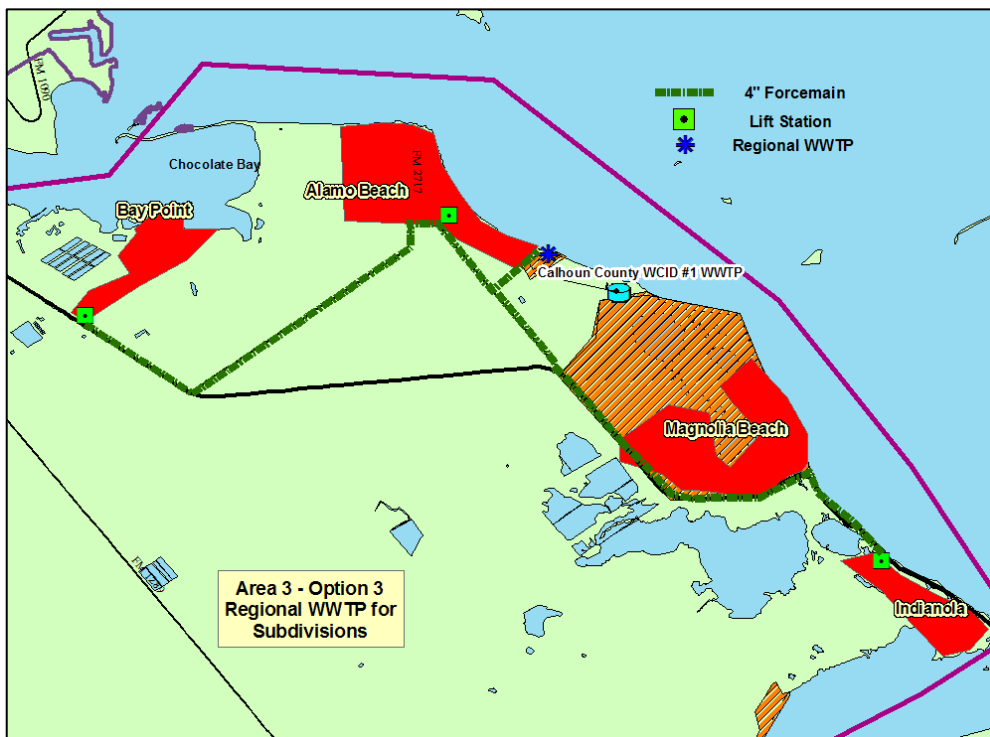


Figure 6-14 Area 3 Option 3

6.1.5 Area 4

DOW

There are two water reduction mechanisms that have been identified for Dow. The first is using treated wastewater as a source of cooling water. The second is using a recirculating cooling device such as a cooling tower instead of the existing cycled cooling system. Further evaluation would be required to assess the viability of one or both of these options.

Dow believes that the quality of the treated effluent could allow it to be used as cooling water with little if any treatment. Because the cooling water flow is greater than the flow of treated effluent, a reduced quantity of source water would still be required to meet cooling demand. Dow has considered this opportunity in the past but there has not been an economic driver to justify implementation. The technical feasibility of this option would need to be further evaluated by comparing the effluent quality to the required cooling water criteria. A cost estimate for this option would need to be developed.

Dow has previously considered implementing cooling towers, but has rejected the idea in the past because of elevated levels of water hardness. Elevated hardness causes fouling and cooling towers would tend to further increase hardness levels due to evaporation. Although water softening can be implemented, this process would cause Dow to incur additional capital and operating costs. Another cooling option that could be considered for Dow is wet surface air cooler technology. In a wet surface air cooler, the process fluid to be cooled flows through tubes in the unit and cooling water is sprayed onto the tubes. These units permit the use of poor-quality cooling water and allow greater cycles of concentration for the cooling water (i.e. lower blowdown, or cooling water discharge) than is typical for cooling towers. Further study would be required to assess the technical feasibility and economic viability of these options. However, these options could lead to substantial reductions in cooling water usage and have the single greatest water reduction potential for any of the industrial opportunities considered in this study.

INEOS Nitriles

In order to evaluate the feasibility of water reuse opportunities, a water balance study would need to be performed. INEOS has developed a water balance, which is the first step. Next, water quality constraints need to be identified for facility processes that use water and individual waste streams, including treated effluents, need to be characterized for

comparison with the identified constraints. Treatment requirements, as applicable, can be considered to facilitate reuse. Water reduction potential within the facility must be evaluated on a case-by-case basis.

Candidate streams for potential reuse by other facilities include stormwater runoff and Outfall 001 effluent.

FORMOSA

Formosa already reuses several wastewater streams internally.

- Condensate from many of the process units is routed to the cooling towers for use as makeup water.
- Effluent from Biological Treatment Train C is used as cooling tower makeup water.
- The majority of sanitary wastewater flow for the facility is used for cooling tower makeup water following treatment.
- Boiler blowdown is used for cooling tower makeup water.
- IEM Condensate is reused with the Ultra Pure water which is used in many of the process plants.
- Filter backwash returns to Raw Water Ponds A and B for reuse.
- Stormwater is reused within the Olefins Unit.

Additional water reuse opportunities and water reduction strategies may be discovered upon further evaluation. Formosa is exploring the additional reuse of stormwater. Formosa is also studying the further use of biological effluent in the cooling towers. However, the average reported Total Dissolved Solids (TDS) concentration for four recent effluent samples was approximately 17,000 mg/L. Elevated TDS concentrations likely limit additional reuse opportunities.

At present, the discharge from the Formosa complex represents approximately 20% of the water purchased from LNRA based on dry weather conditions. This relatively low discharge percentage results from the substantial water reuse measures already implemented by Formosa and from evaporative losses associated with process cooling requirements.

As previously mentioned, the cooling tower blowdown stream shown in Table 4-5 could be made available to Alcoa for dust suppression and process wastewater use.

ALCOA

Much of the water used at Alcoa for processing and cooling is already being reused for other purposes. Consequently, the discharge flow from Alcoa is minimal. Discharge data provided by Alcoa for 2010 show that the average dry weather flow was 25,300 gallons per day (gpd) and that the average wet weather flow was 45,500 gpd.

Since much of the water used at Alcoa is already being reused internally, the most prominent reuse opportunity would involve importing effluent water from another facility for dust suppression and process water needs. Alcoa, in conjunction with the Formosa Plastics Complex (Formosa), has been evaluating the feasibility of utilizing sources of water from Formosa for reuse at Alcoa.

SEADRIFT COKE L.P.

Potential opportunities for reuse at Seadrift Coke L.P. include the following:

- capturing stormwater;
- reusing treated sanitary effluent;
- reusing RO reject and/or cooling tower blowdown; and
- reusing treated combined effluent.

In order to evaluate the feasibility of water reuse opportunities, a water balance study would need to be performed. In such a study, water quality constraints are identified for facility processes that use water and individual waste streams, including treated effluents, are characterized for comparison with the identified constraints. Treatment requirements, as applicable, can be considered to facilitate reuse. The potential for reuse is often unique to each facility, but CDM has participated in projects in which RO or cooling tower blowdown has been used for irrigation, washdown, ion exchange resin regeneration, filter backwash, and many other applications. There may also be opportunity to improve the efficiency of RO separation, producing a more concentrated brine and resulting in a reduced RO feed volume to meet boiler feed requirements. Water reduction potential within the facility must be evaluated on a case-by-case basis.

Seadrift Coke L.P. has undertaken a project to improve segregation of stormwater from their process area runoff. Stormwater runoff could potentially be captured and stored in a pond for reuse.

Seadrift Coke L.P. treats industrial wastewater through a corrugated plate interceptor (CPI) oily water separator, a dissolved air flotation

(DAF) separator, and carbon polishing. The use of carbon polishing likely increases the reuse opportunity for the treated effluent. A reported average Total Dissolved Solids (TDS) concentration of 910 mg/L for four samples of treated effluent further suggests reuse opportunity. However, additional study would be required to assess the potential for reuse.

6.2 COST COMPARISONS

6.2.1 Area 1

Area 1A cost comparisons are tabulated below in **Table 6-1**. In Option 1, the wastewater is conveyed to the City of Port Lavaca WWTP. In Option 2, all subdivisions have their own package WWTP. In Option 3, the subdivisions were divided based on proximity and three new regional WWTPs are proposed. In Option 4, the wastewater from subdivisions of Matson, Meadow Brook Park, Bowman and Hackberry Junction are conveyed to the nearby Crestview WWTP, flows from the remaining subdivisions are combined and conveyed to a new regional WWTP, and flows from Double D would be conveyed to the City of Port Lavaca. All costs indicate monthly payment per lot at full development. The phasing option for existing subdivisions is not practical. These systems were sized for the lots in the subdivision and the majority of the lots already contain residences. The sizes of the facilities to be constructed for these subdivisions are not conducive to phasing.

Table 6-1 Cost Comparisons for Area 1A

Subdivision	Option 1*	Option 2*	Option 3*	Option 4*
Double D	\$123.51	\$177.08	\$157.35	\$123.51
Matson	\$141.05	\$186.11	\$157.40	\$134.05
Meadow Brook	\$137.14	\$186.11	\$154.78	\$130.79
Royal Estate	\$190.91	\$186.11	\$183.87	\$183.87
Shoreline Acres	\$129.57	\$177.08	\$148.10	\$148.10
Six Mile	\$127.66	\$177.08	\$139.72	\$139.72
Hackberry Junction	\$132.96	\$186.11	\$166.36	\$134.05
Bay Meadows	\$154.13	\$186.11	\$173.27	\$173.27
Bowman	\$140.60	\$186.11	\$173.64	\$134.05
Shady Acres	\$164.08	\$186.11	\$179.96	\$164.08

*Costs are indicated in \$/month/lot

The most financially most attractive option for each subdivision is highlighted in the table. In general, it is financially more feasible to have the wastewater conveyed to and treated by an existing regional wastewater treatment plant as included in Option 1 or Option 4. Option 2, which included an individual treatment plant for each subdivision was typically the most expensive option and was not identified as the most financially feasible for any of the subdivisions of interest.

Area 1B cost comparisons for the different options are given below in **Table 6-2**. In Option 1, wastewaters from all the subdivisions are conveyed to the City of Point Comfort WWTP. In Option 2, each subdivision has an individual package WWTP. In Option 3, wastewater flow from all three subdivisions is conveyed to a new regional WWTP. All costs indicate monthly payment per lot at full development. The most financially attractive option for Area 1B is Option 1.

Table 6-2 Cost Comparisons for Area 1B

Subdivisions	Option 1 *	Option 2*	Option 3*
Olivia	\$136.24	\$145.22	\$142.13
Port Alto South	\$100.14	\$142.22	\$109.07
Port Alto North	\$92.88	\$177.08	\$106.97

*Costs are indicated in \$/month/lot

6.2.2 Area 2

Area 2 cost comparisons for the different options are given below in **Table 6-3**. In Option 1, the wastewater from the new developments will be sent to the closest WWTP either in City of Seadrift or in Port O'Connor MUD. In Option 2, all the each subdivision will build and operate its own package WWTP. In Option 3, flow from all the subdivisions is proposed to be conveyed to a new regional WWTP. In Option 4, flows from the subdivisions of Lane Road, Seaport Lakes, Powderhorn Ranch and Costa Grande are conveyed to a new regional WWTP. The remaining subdivisions convey their wastewater to the closest WWTP either in City of Seadrift or in Port O'Connor MUD. All costs indicate monthly payment per lot at 50% development.

Table 6-3 Cost Comparisons for Area 2

Subdivisions	Option 1*	Option 2*	Option 3 *	Option 4*
Harbor Mist	\$114.17	\$180.85	\$119.02	\$114.17
Bindewald	\$105.59	\$170.96	\$107.85	\$105.59
Fisher	\$109.55	\$170.96	\$111.81	\$109.59
Swan Point Landing	\$200.76	\$224.96	\$186.20	\$200.76
Falcon Point	\$89.16	\$104.77	\$89.47	\$146.08
Seaport Lakes	\$239.76	\$224.96	\$194.67	\$202.27
Lane Road	\$101.78	\$159.93	\$96.27	\$103.88
Costa Grande	\$85.43	\$81.17	\$81.48	\$89.09
Powderhorn	\$93.86	\$141.29	\$116.99	\$124.59

*Costs are indicated in \$/month/lot

Option 1 and Option 4 which involves pumping wastewater to the nearest treatment plant is the most financially viable option for Harbor Mist, Bindewald, Fisher, Falcon Point and Powderhorn subdivisions. These subdivisions are close to the existing plants in Seadrift and Port O' Connor MUD. For the subdivision of Swan Point Landing, Seaport Lakes, Lane Road and Costa Grande Option 3, constructing a regional plant to meet their needs, is the most financially viable option. These subdivisions are more distant from the existing plants in Seadrift and Port O'Connor MUD and the cost of building and operating a new plant is offset by the conveyance cost to transport wastewater to the distant existing facilities. The cost per month assumes that all capital costs are included in the monthly wastewater bill. In reality, a great deal of the infrastructure to install the wastewater collection and treatment system will be incurred by the developer and these costs will be included in the development cost of the lots. Phasing of improvements for Area 2 could be considered because there are few lots developed at this time and a large number are included in year 2040. However, improvements for these new developments, with the notable exception of the regional WWTP, will be borne by the developer and passed onto the homeowner in the cost of

the lot. Therefore, the phasing costs will be dependent on the schedule of the developer and is difficult to estimate in a study of this scope.

6.2.3 Area 3

Area 3 cost comparisons for the different options are given below in **Table 6-4**. In Option 1, the Southern Calhoun County WCID No.1 WWTP extends its service to the subdivisions of Indianola, Alamo Beach and Bay Point. In Option 2, all the subdivisions get their own package WWTP. In Option 3, wastewater flow from all the subdivisions is proposed to be sent to a new regional WWTP. All costs indicate monthly payment per lot at full development. The most financially feasible option for Area 3 is Option 1.

Table 6-4 Cost Comparisons for Area 3

Subdivisions	Option 1*	Option 2*	Option 3*
Indianola	\$97.08	\$129.30	\$146.46
Alamo Beach	\$83.47	\$139.05	\$132.84
Bay Point	\$79.04	\$139.05	\$128.41

*Costs are indicated in \$/month/lot

6.2.4 Area 4

Area 4 cost comparisons for the different reclaimed water options are given below in **Table 6-5**. In Option 1, reclaimed wastewater from the City of Port Lavaca will be pumped across the bay in a new pipeline installed using directional drilling construction to the industries of Formosa and Alcoa for reuse. In Option 2, the effluent for reuse would be pumped in a new pipeline installed using conventional construction techniques to the industries of DOW, INEOS Nitriles and Seadrift Coke.

Table 6-5 Cost comparison for Reclaimed water options

Type of Activity	Option 1 – To Formosa/Alcoa	Option 2 – To DOW/INEOS Nitriles/Seadrift Coke L.P.
Reclaimed water from City of Port Lavaca WWTP and Point Comfort WWTP	\$878.90*	N/A
Reclaimed water from City of Port Lavaca WWTP	N/A	\$632.36*

*annual cost per acre foot

The costs include an annual debt service payment to liquidate the capital cost and an O & M component to pump the reclaimed water to the user. Because this reclaimed water should be compared to the cost of alternative water supplies, the cost is expressed in \$/ac-ft as opposed to a monthly cost. The supply available in Option 1 is approximately 1.11 MGD and 0.045 MGD from Port Lavaca WWTP and Point Comfort WWTP, respectively. The supply available in Option 2 is approximately 1.11 MGD from the Port Lavaca WWTP. It was determined that it would be infeasible to build facilities to pump and pipe 0.045 MGD from Point Comfort across the bay to the industries in western Calhoun County.

6.3 AFFORDABILITY INDEX

The cost to the individual homeowner was the basis of analysis for the evaluation of the wastewater service options. As a point of comparison, these monthly costs need to be compared to an affordability index. The Environmental Protection Agency's guidance on the affordability of wastewater systems uses an average household rate of 2 percent of Median Household Income (MHI), as cited in "National Level Affordability Criteria Under the 1996 Amendments to the Safe Drinking Water Act (Final Draft Report)". The MHI for Calhoun County as per the 2009 U.S. Census Estimate is \$43,405.00. Therefore the average monthly wastewater cost per household for Calhoun County is \$72.34.