San Luis Obispo County
Los Osos Wastewater Project Development

TECHNICAL MEMORANDUM

DECENTRALIZED TREATMENT

FINAL
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San Luis Obispo County
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1.0 INTRODUCTION

The purpose of this technical memorandum (TM) is to address the alternative of decentralized treatment for the community of Los Osos and develop conceptual information to assist in determining the viability of implementation. The concept of decentralized treatment is to treat the wastewater closer to where it is generated, rather than collecting the wastewater and conveying it to one centralized location for treatment. In the 1970's, regulatory agencies encouraged moving to centralized treatment for either single or multiple communities for the purpose of providing higher levels of treatment and improved water quality. However, where wastewater is reused near its source, the result of conveying wastewater away from the community to a centralized location is an increase in cost by having to return the treated water to the community for beneficial reuse. The increased interest in reuse in recent years has resulted in an increased interest in returning to decentralized treatment.

This TM reviews general issues with decentralized treatment, including treatment technology, operations, neighbor impacts and costs. It also identifies some of the specific issues facing implementation of decentralized treatment in Los Osos.

In June 2007, Lombardo Associates, Inc. (LAI) provided a conceptual-level proposal for a decentralized treatment alternative specific to Los Osos. In order to adequately compare this alternative to viable project alternatives (VPAs) identified in the project Fine Screening Analysis, LAI was retained to further detail its proposal. A summary of LAIs detailed proposal is provided in this TM.

2.0 GENERAL ISSUES

Decentralized treatment may be favorable for communities who wish to reduce the construction and annual energy costs associated with building a sewer and pumping wastewater to a central location. In a decentralized treatment system, wastewater is more easily distributed to residences for beneficial reuse close to where it is generated. However, there are several issues with decentralized treatment, including the ability to meet strict effluent quality limits and other regulations and potentially adverse neighbor impacts. In developed communities such as Los Osos, identifying sites sufficient in number and size to accommodate treatment facilities could also be difficult. By having to develop several sites, communities may lose the economy of scale for many aspects of centralized treatment, resulting in higher costs for some aspects of the project.

2.1 Treatment

Technologies for decentralized wastewater treatment are often similar to those processes used for centralized treatment. Typical secondary treatment processes include activated sludge, attached growth and pond or land based processes. Because the footprint associated with these technologies scales roughly with flow (i.e., the greater the flow the larger the footprint), the total land required for a decentralized system would be similar to that of a centralized system. Recirculating media filters and other attached growth systems are often used for smaller cluster systems. In mostly built-out communities, treatment technologies with smaller footprints are favorable due to the constraints associated with siting a facility in an undeveloped lot.

Depending on the regulatory requirements and reuse/disposal method to be used, higher levels of treatment may be required, such as filtration/disinfection for reuse or nitrogen removal for protection of the groundwater.

2.1.1 Nitrogen Removal

Because the upper aquifer in Los Osos is contaminated with nitrate, nitrogen removal will be one of the biggest issues for decentralized treatment in Los Osos. By themselves, most conventional treatment technologies for decentralized treatment are not able to consistently produce low effluent nitrogen levels (<7 mg/l). Technologies such as recirculating filters produce a nitrified effluent, where most of the organic nitrogen and ammonia have been converted to nitrate. An additional step, denitrification, is required to eliminate the nitrate. Denitrification is performed by heterotrophs (bacteria that require a carbon source) in an anoxic environment. Where the carbon source (BOD) has already been largely removed by aerobic processes, an additional carbon source must be added to the process.

There are several anoxic filters that are capable of reducing nitrate to low levels due to an organic filter medium that provides additional carbon. For example, the Nitrex™ system involves passing nitrified effluent through an organic filter medium that also provides the additional carbon source. The manufacturers claim that more than 95 percent of the nitrate is denitrified. At a 35-unit senior citizen's complex located in Burford, Ontario, the Nitrex™ system was installed in 1999 and has consistently allowed the development to attain the nitrate limit of 1.5 mg/L. No systems using Nitrex™ filters that are as large as Los Osos have so far been implemented, according to one of the technology's developers. Total nitrogen removal is strongly dependent on the nitrification step, since Nitrex™- will not remove organic or ammonia nitrogen, both of which will convert to nitrate after discharge to soils.

If effluent is reused for irrigation, then some of the nitrogen will be taken up and used as fertilizer by growing plants. However, for this to represent a true removal, the plants need to be harvested (collected) and taken offsite, so the nitrogen is not reintroduced to the groundwater when they decompose. Where the irrigation is a park or golf course, this may be standard practice with grass, however if the reuse is for residential irrigation, it is difficult to ensure proper removal is occurring. Additionally, nitrogen uptake is dependent on plant type and, therefore the uptake will be slower for residences where homeowners have slow growing plants or drought tolerant plants rather than lawns that are regularly mowed and cleared of clippings. For warm weather grasses such as Bermuda grass (Table 1) uptake is reduced in the winter when the plants become dormant although their ability to uptake nitrogen in the summer is high. Cool weather grasses such as Kentucky Bluegrass can continue to grow year-round in a climate lacking temperature extremes, such as Los Osos', but their total ability to uptake nitrogen is less than warm weather grass'. Other plants such as trees or vegetables have much less of an ability to uptake nitrogen than grass, with more than 50 percent of applied nitrogen being lost to leaching (Pettygrove and Asano, 1985).

The nitrogen uptake estimates for turf grass in Table 1 represent a best-case scenario for Los Osos, since many homes in the community have plants other than turf grass, or no landscaping at all. Wet weather increases downward transport of effluent during rainfall events, quickly moving nitrate beyond the range of plant roots. Sandy soils, like those underlying Los Osos, are particularly poor at retaining nitrate. Therefore, residential plant uptake cannot reliably remove enough nitrogen year-round from effluent to be protective of the groundwater if the effluent is not sufficiently denitrified.

Table 1 Estimated Nitrogen Uptake by Warm and Cool Weather Grasses[1]
Los Osos Wastewater Project Development
San Luis Obispo County

Grass type	Range of Nitrogen Uptake, lbs/day - Summer[2]	Range of Nitrogen Uptake, lbs/day - Winter[2]	Range of Untreated Wastewater, lbs/day[3]	Filter-Treated Wastewater, lbs/day[4]
Warm Weather Grass - Bermuda Grass	680-1200	0	400-900	300
Cool Weather Grass - Kentucky Bluegrass	170 - 230	170 - 230	400-900	300

Notes:
(1) Crites et al., 2000.
(2) Assuming 330 acres of irrigated land in the Los Osos Prohibition Zone (0.07 acres per home - approx half of the most common lot size). These are best-case scenarios, since much of Los Osos is landscaped with plants other than turf grass.
(3) Assuming 0.02-0.048 lbs/day/person, population 18,428.
(4) Assuming sand filter effluent concentration of 30 mg/L (Crites and Tchobanoglous, 1998).

2.1.2 Septic Tank Use

Most treatment technologies, and particularly attached growth reactors that are favored for small systems, would require primary-level pretreatment. This could consist of using onsite-septic tanks and pumping the liquid effluent to a neighborhood treatment site. This alternative retains the on-lot impacts that are inherent in using a STEP sewer, such as septic tank replacement (assuming new tanks are required) and power issues. In addition, septic tank effluent is low in oxygen and in carbon, thereby making it necessary to aerate it to enable nitrification and add an external carbon source to achieve denitrification.

2.2 Operational Issues

Biological wastewater treatment processes are strongly dependent on the stability of influent flows and loads. A larger number of households connected to a decentralized system can help maintain process stability. In general, the larger the facilities, and correspondingly, the fewer in number the facilities in a given community, the more likely they will be able to reliably meet discharge requirements.

Because decentralized systems are composed of multiple, unmanned treatment sites, automatic controls, sensors and alarms are a key component of this type of treatment. Due to the heavy reliance on automated components, back-up power would need to be provided at each site in the event of a power failure. Although decentralized systems are considered unmanned, operator attention is still required to regularly check on the decentralized facilities and do water quality monitoring.

According to Title 22, for reuse applications, daily sampling of some effluent parameters such as coliform and continuous monitoring of turbidity in the effluent is required. The turbidity could be monitored and reported automatically but the coliform tests would need to be collected from each of the treatment facilities and sent to a lab, where the cost per analysis would be approximately $50 per sample. Additionally, due to the nitrate contamination of the upper aquifer, the waste discharge requirement may include an interim provision for weekly total nitrogen monitoring, until it is demonstrated after a specified period that the effluent is consistently low in nitrogen and sampling frequencies can be reduced to monthly or quarterly. The cost of a total nitrogen analysis is approximately $150 per sample. These are just laboratory costs and do not include labor for collecting the samples of multiple treatment locations. All of these tests would have to be run on each of the treatment facilities, multiplying the project monitoring cost over those of centralized treatment by a factor of the number of facilities.

Additionally, if subsurface drip irrigation at individual homes is selected as a reuse application, then an extensive on-lot network of drip irrigation systems will need to be installed and maintained. This could be the responsibility of either the homeowner or the utility.

2.3 Community Issues/Environmental Impacts

Decentralized treatment necessitates the acquisition of multiple treatment sites in a community. Decentralized treatment offers potential construction and energy savings from siting a facility near the wastewater source (homes) as opposed to siting facilities out of town as is often favored for centralized systems. Therefore, several sites near developed areas need to be identified. These empty sites must have adequate area to site a treatment facility, and their location will affect the hydraulics of the system. While this can be planned into new developments, in existing communities, siting of the plants may provoke opposition from neighbors who fear aesthetic impacts from the plants. Additionally, odor control and impacts from maintenance personnel and sludge hauling truck traffic must be carefully considered.

2.4 Costs

While the costs for collection and effluent distribution of decentralized systems may be minimized compared to an analogous centralized system, the cost for treatment may be higher. In a typical treatment plant cost curve, the cost per MGD treated decreases with increasing flow. Figure 1, which shows the cost of construction for MBR/BNR plants (including headworks but excluding solids handling facilities), illustrates this for small-scale facilities. With decentralized treatment, this economy of scale is lost. However, this issue is mitigated if a less expensive treatment technology is selected that is suitable for smaller flows but would not be appropriate for a larger central treatment plant. Annual monitoring costs will be higher for a decentralized system with multiple facilities, as each site would have to be monitored independently to ensure compliance with regulations.

3.0 LOS OSOS SPECIFIC ISSUES

In addition to the general issues that are common to all communities contemplating installing a decentralized wastewater treatment system, Los Osos has specific characteristics that affect the viability of this option.

3.1 Residential Reuse/Disposal

As discussed in the Rough Screening Report and Fine Screening Report, the urban reuse demand for public sites (parks and schools) is insufficient for the volume of wastewater generated. Therefore, for Los Osos, the prime reuse/disposal for a decentralized system would be residential irrigation. While subsurface irrigation, or surface irrigation with Title 22-complaint effluent, would be tenable during most of the year, during storm events neither would be practicable. Therefore, each facility would need to include storage, as well as possible access to additional drainfields to dispose of stored effluent after a storm event. One option that could be explored for such events is to install on each lot a switch automatically activated by a rainfall sensor to connect to the existing leachfields. It is not

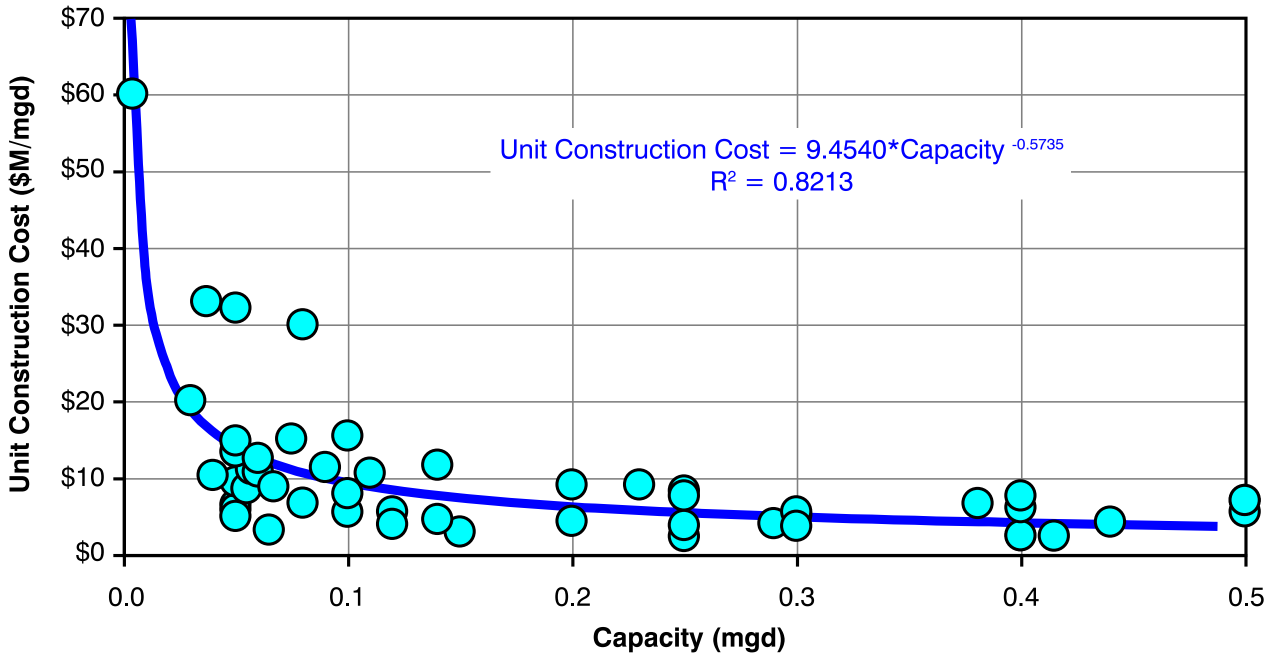

Figure 1
COST CURVE FOR MBRs/BNRs
LOS OSOS WASTEWATER PROJECT DEVELOPMENT
SAN LUIS OBISPO COUNTY

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expected that a connection to the leachfields would add significantly to the cost of the project.

In California, effluent reuse can be achieved with subsurface drip irrigation, or surface irrigation if the effluent is filtered to meet Title 22 standards. Each system would be subject to a Waste Discharge Requirement issued by the Regional Water Quality Control Board that would limit the concentration of contaminants in the effluent, receiving groundwater, or both. While a centralized system would only have one effluent sample tested on a monthly or quarterly basis, the owner of a decentralized system would have to test each facility, multiplying the monitoring costs by the number of facilities, as discussed in Section 2.2. Additionally, due to the distributed nature of the effluent disposal, more groundwater monitoring wells would likely have to be constructed than would be necessary for a centralized system.

3.2 Seawater Intrusion

Los Osos currently derives most of its drinking water from the lower aquifer underneath the town. The groundwater is being pumped out at approximately 460 acre feet yard (AFY) faster than it is being replenished, resulting in seawater intrusion. Collection of wastewater for decentralized treatment, as with centralized treatment, would reduce recharge to the upper aquifer and result in approximately 90 AFY of additional seawater intrusion into the lower aquifer, for a total of 550 AFY intrusion. If reuse distribution lines were connected to the existing leachfields then current conditions would be maintained.

Disposal of locally treated wastewater through reuse by subsurface irrigation to individual residences would reduce pumping of the lower aquifer groundwater that is currently being used for irrigation. Irrigation represents approximately 930 of annual water use. Assuming the purveyors reconfigured their pumping to maximize the mitigation benefit of this reduction, and that public areas such as parks could be irrigated using upper aquifer water as outlined in the Fine Screening Analysis, this reuse could result in a maximum seawater intrusion mitigation of up to 510 AFY (i.e., 930 AFY x 0.55 mitigation factor), nearly balancing the groundwater basin at current conditions. Project implementation could begin with distribution lines connecting to existing leachfields, then joining up with subsurface irrigation systems as they were installed, going from a Level 1 project (minimal seawater intrusion mitigation) to nearly a Level 3 project (balanced water basin at existing population) over time. However, the actual realized benefit of this reuse would likely be somewhat less than the maximum benefit since some lots will have higher irrigation needs, especially during hot weather, than can be met with their reused wastewater and will need to supplement with potable water, and some homeowners may not comply with a request to use only recycled water for irrigation.

3.3 Siting

Los Osos is a densely developed community. Most parcels have a street front width of 25 to 50 feet, and a length of 100 to 125 feet. This small size is a constraint on the type of treatment facility that can be sited. Assuming two adjacent undeveloped parcels with a combined area of 0.3 acres, this land could site a sand filter/Nitrex™ facility that treats the wastewater from approximately 150 homes.

LAI's Decentralized Wastewater Treatment Scenarios Technical Memorandum (see Appendix B) provides a more detailed review of potential treatment facility siting utilizing "paper streets" (areas identified as streets on parcel maps, but have not been built) to reduce the number of "undeveloped lots" required for treatment sites. Refer to Section 4.1 of this TM for a summary of LAIs conceptual layout.

3.4 Community Impacts

In addition to restricting the technological options for the treatment facilities, the small lot size necessitates that treatment plants would be located closely adjacent to neighboring homes. This could provoke neighbor opposition to the project, for fears of aesthetic impacts and the resultant decrease in home value. Additionally, acquiring multiple sites requires purchasing them from property owners who may not be willing sellers. Exercising eminent domain to acquire the properties could be utilized, but at increased cost and time to the project.

3.5 Regulatory Concerns

ESHA (Environmentally Sensitive Habitat Area) is defined by the state Coastal Act and the County Local Coastal Program. These areas of biological sensitivity are mapped in each jurisdiction. In Los Osos, ESHA is defined by soil as everything that has Los Osos Dune Sands. This includes all of the land west of Los Osos Creek, bordered on the north and west by Morro Bay and bordered on the south by the first ridgeline, where the sand diminishes.

Because in a decentralized scenario, all of the neighborhood plants would be located in town, they would need to go on ESHA. In total, the acreage that is ESHA-impacted is approximately 6 to 10 acres developed for treatment plant sites. The permitting constraints of developing several sites in ESHA could make this alternative unpermittable where an out-of-town (and out-of-ESHA) site is feasible.

Gaining a permit from the Central Coast Regional Water Quality Control Board (CCRWQCB) to discharge to the groundwater basin in the Prohibition Zone may be another potential problem for decentralized systems. In CCRWQCB Resolution 83-13, "discharges from individual and community sewage disposal systems are prohibited in the…groundwater prohibition zone." However, the CCRWQCB issued a permit for the previous project for centralized discharge to leachfields at the Broderson site, which is within the prohibition zone, but whose geotechnical characteristics have been studied extensively. It is uncertain whether the CCRWQCB Regional Board would approve discharges to decentralized sites within the prohibition zone.

3.6 Costs

LAI's Cost Estimates for Decentralized Scenarios Technical Memorandum (see Appendix B) provides capital cost estimates and O&M cost estimates for decentralized treatment alternatives. Refer to Section 4.2 of this TM for a summary of the cost estimates and a comparison to VPAs identified in the project Fine Screening Analysis. To date, project delays and interruptions have already increased the cost of implementation due to construction escalation and perceived contractor risk. Further delays to a decentralized system alternative due to neighbor opposition, multiple property owners being unwilling to sell, and permitting complications should be considered in conjunction with these cost estimates.

4.0 LAI DECENTRALIZED TREATMENT PROPOSAL

A conceptual-level proposal for a decentralized treatment alternative specific to Los Osos was provided by Lombardo Associates, Inc (LAI) as described in their June 8, 2007 letter to San Luis Obispo County (see Appendix A). The letter provided a conceptual-level description of the decentralized treatment alternative based on LAI having performed a "significant amount of preliminary engineering analysis" of the Los Osos Wastewater Project. Based on the benefits identified in the LAI proposal, the Los Osos project team believed that this alternative had merit for further consideration for the Los Osos Wastewater Project. However, the conceptual-level project description provided in the LAI letter needed more detail to provide a comparison to the VPAs identified in the Fine Screening Analysis.

As a result, LAI was retained to further develop their proposal and address a list of issues identified by the Los Osos project team. Three resulting technical memoranda (see Appendix B) were prepared by LAI further detailing their proposal. A summary is provided below.

4.1 Project Description

LAI's decentralized treatment proposal consists of two scenarios. Each scenario is broken down into two alternatives based on the disposal/reuse method.

- Scenario 1 - Multiple Treatment Locations: This scenario involves creating seven sub-zones within the project area, each having its own treatment site. The potential treatment sites consist of paper streets and undeveloped lots.

  - Alternative a - Residential Reuse & Disposal: This alternative for Scenario 1 consists of reuse and disposal at individual properties via drip irrigation systems to be installed at each property. These systems would be used as disposal during times of no reuse, thereby eliminating the need for drain field sites.
  - Alternative b - Non-residential Reuse & Disposal: This alternative for Scenario 1 consists of non-residential reuse via drip irrigation systems and disposal via drains fields. Non-residential reuse sites would include schools, cemeteries, and farmland. Disposal sites would include paper streets and undeveloped lots. Disposal sites would be required as the capacity of non-residential reuse sites is not sufficient for the wastewater flows produced.

- Scenario 2 - Two Treatment Locations: This scenario involves using two treatment locations, one in Midtown (Tri-W site) and one in the northeast region of Los Osos near the Los Osos Middle School.
  - Alternative a - Residential Reuse & Disposal: This alternative for Scenario 2 consists of reuse and disposal at individual properties similar to Scenario 1a.
  - Alternative b - Non-residential Reuse & Disposal: This alternative for Scenario 2 consists of non-residential reuse and disposal at locations similar to Scenario 1b.

For a detailed description of these scenarios, refer to LAI's Decentralized Wastewater Treatment Scenarios Technical Memorandum in Appendix B.

4.2 Costs

LAI has provided cost estimates for all scenarios of decentralized treatment in its Cost Estimates for Decentralized Scenarios Technical Memorandum (see Appendix B). In order to provide an equivalent comparison to the VPAs established in the Fine Screening Analysis, the basis for LAI's estimates were updated by the Los Osos project team to be consistent with the Fine Screening Analysis. Refer to the August 25, 2008 project memorandum contained in Appendix C for details of how these costs were updated.

Table 2 below provides a summary of the capital cost estimates for each decentralized treatment scenario. For a breakdown of costs, refer to the project memorandum contained in Appendix C.

Table 3 below provides a summary of the O&M cost estimates for each decentralized treatment scenario. For a breakdown of costs, refer to the project memorandum contained in Appendix C.

Table 2	Decentralized Treatment Scenarios Range of Capital Costs, Millions(1) Los Osos Wastewater Project Development San Luis Obispo County			
	Scenario 1a - Multiple Treatment Locations w/ Residential Reuse & Disposal	**Scenario 1b - Multiple Treatment Locations w/ Non-residential Reuse & Disposal**	**Scenario 2a - Two Treatment Locations w/ Residential Reuse & Disposal**	**Scenario 2b - Two Treatment Locations w/ Non-residential Reuse & Disposal**
Total Project Costs	$216 - $240	$171 - $185	$214 - $238	$169 - $182

Note:

(1) Based on LAI's Cost Estimates for Decentralized Scenarios Technical Memorandum (Appendix B) and updated by Los Osos project team per August 25, 2008 project memorandum (Appendix C) for comparison to VPAs from Fine Screening Analysis.

Table 3	Decentralized Treatment Scenarios O&M Costs, Millions(1) Los Osos Wastewater Project Development San Luis Obispo County			
	Scenario 1a - Multiple Treatment Locations w/ Residential Reuse & Disposal	**Scenario 1b - Multiple Treatment Locations w/ Non-residential Reuse & Disposal**	**Scenario 2a - Two Treatment Locations w/ Residential Reuse & Disposal**	**Scenario 2b - Two Treatment Locations w/ Non-residential Reuse & Disposal**
Total Annual O&M Cost	$2.1	$1.9	$1.5	$1.3

Note:

(1) Based on LAI's Cost Estimates for Decentralized Scenarios Technical Memorandum (Appendix B) and updated by Los Osos project team per August 25, 2008 project memorandum (Appendix C) for comparison to VPAs from Fine Screening Analysis.

4.2.1 Comparison to Viable Project Alternatives

Tables 4 and 5 below provide a summary of the capital cost estimates and O&M cost estimates for the VPAs from the Fine Screening Analysis. For a breakdown of costs, refer to the Fine Screening Analysis.

Table 4	Viable Project Alternatives Range of Capital Costs, Millions[1] Los Osos Wastewater Project Development San Luis Obispo County						
Total Project Costs	**Seawater Intrusion Mitigation Level 1**		**Seawater Intrusion Mitigation Level 2**		**Seawater Intrusion Mitigation Level 3**		**Tri-W Project**
	90 AFY	**140 AFY**	**190 AFY**	**240 AFY**	**550 AFY**	**600 AFY**	**~ 285 AFY**
STEP	$135-$174	$146-$181	$144-$180	$147-$181	$166-$202	$165-$199	N/A
Gravity	$153-$183	$163-$187	$161-$185	$163-$186	$182-$208	$182-$205	$205- $219

Note:
(1) Based on Viable Project Alternatives Fine Screening Analysis (August 2007).

Table 5	Viable Project Alternatives Range of O&M Costs, Millions[1] Los Osos Wastewater Project Development San Luis Obispo County						
Total Project Costs	**Seawater Intrusion Mitigation Level 1**		**Seawater Intrusion Mitigation Level 2**		**Seawater Intrusion Mitigation Level 3**		**Tri-W Project**
	90 AFY	**140 AFY**	**190 AFY**	**240 AFY**	**550 AFY**	**600 AFY**	**~ 285 AFY**
STEP	$1.4-$1.9	$1.8-$3.0	$2.0-$3.1	$2.1-$3.2	$1.8-$3.9	$2.0-$3.1	N/A
Gravity	$1.1-$1.9	$1.4-$2.9	$1.6-$3.0	$1.7-$3.2	$1.4-$3.8	$1.6-$3.0	$2.3-2.4

Note:
(1) Based on Viable Project Alternatives Fine Screening Analysis (August 2007).

In comparing the cost estimates for the decentralized treatment alternatives with the VPAs from the Fine Screening Analysis, the following considerations and finding are noted:

- Decentralized Treatment Scenarios 1b and 2b (non-residential reuse and disposal) appear to have the potential to provide Level 2 mitigation. A more detailed analysis is required to confirm actual mitigation benefits.

- Capital cost estimate ranges for Decentralized Treatment Scenarios 1b and 2b appear to be within the range of costs for Level 2 mitigation VPAs from the Fine Screening Analysis. O&M cost estimate ranges for decentralized treatment appear to be slightly lower.

- Decentralized Treatment Scenarios 1a and 2a (residential reuse) appear to have the potential to provide near Level 3 mitigation. In order to achieve Level 3 mitigation, these scenarios will likely require large storage facilities due to seasonal variability of irrigation demand and the essentially constant rate of wastewater generation. LAI has suggested exploring groundwater pumping (i.e., groundwater acts as a storage facility) as an alternative storage method. Storage has not been included in the cost estimates for these scenarios, and a more detailed analysis is required for confirmation of the level of seawater intrusion mitigation benefits.

- Capital cost estimate ranges for Decentralized Treatment Scenarios 1a and 2a appear to be higher than the capital cost estimate ranges for Level 3 mitigation VPAs from the Fine Screening Analysis. However, O&M cost estimate ranges for decentralized treatment appear to be slightly lower.

- LAI has indicated that the alternative of “shared” or “centralized” septic tanks in lieu of “dedicated” septic tanks to each property can provide potential cost savings. The Fine Screen Analysis cost estimates are based on the County’s current direction that properties are to have “dedicated” septic tanks. Therefore, costs for a decentralized system should have the same basis for comparison purposes. Either a decentralized or centralized system will have the option to re-evaluate this assumption for cost reduction in the future.

- LAI used a cost of $129 per linear foot for gravity sewers based on bid tabs for the previous project as the best available costs for local conditions. The decentralized system will have a slightly smaller average pipe size than the previous project (8-inch) and the average depth will likely be less than the previous project (8 feet). While the assumed unit price of $90 per linear foot in Section 7.1 of LAI’s Task 3 TM appears to overstate the potential savings, the County team will work to identify and further define the costs if this alternative moves forward to preliminary design. The goal of the analysis at this point is to encompass all project costs and the bid tab value of $129 per linear foot appears to be appropriate without documentation supporting a revised unit cost.

- LAI has indicated that the decentralized treatment scenarios carry costs for Title 22 compliant effluent and residential reuse (purple) piping that are not part of most of the VPAs from the Fine Screening Analysis. However, it is important to note that the benchmark for alternative comparison is based on seawater intrusion mitigation and not effluent quality levels. For example, from the Fine Screening Analysis, Level 3 mitigation can be achieved without Title 22 compliant effluent and residential reuse through the use of leachfields and harvest wells at Broderson.

4.3 Additional Conceptual Design Information on General and Los Osos Specific Issues

The decentralized treatment proposal has other issues in addition to cost that should be evaluated for feasibility of implementation. This section outlines these issues.

4.3.1 Treatment Facility Siting

The Los Osos project team has raised three concerns about locating multiple treatment plants throughout the community.

- The NWRI Peer Review Report suggested that the WWTP project be located outside (to the east) of town because of significant community concerns with a WWTP being located in town (i.e., the Tri-W project).
- The residents adjacent to the proposed treatment locations might vigorously oppose and delay the project (through the environmental review process) due to perceived disproportionate negative impacts associated with treatment plant construction and operation.
- If the previous project efforts are any insight into the future, the Coastal Commission will likely not look favorably on multiple in-town treatment plants over an out-of-town option, which could have significant impact on the project costs and schedule.

LAI has noted that resistance from adjacent residents and regulatory agencies will not be known until specific sites are presented as options for public comment and regulatory review. However, LAI has indicated that the proposed treatment facilities would be designed with features to try to minimize neighborhood impact including:

- Treatment facilities would be predominately below grade to minimize visual and noise impacts.
- Above grade portions of treatment facilities would be fenced and landscaped. Landscaping would include environmentally friendly project components (i.e., walking/bike paths, gardens, etc) to engender public acceptance in the interest of being a “good neighbor”.
- The Nitrex™ component of the system would be largely constructed below grade with the option of the Nitrex™ filters taking the form of a constructed wetland. LAI has indicated that this feature can be landscaped for an additional $2 million in capital cost.
- Emergency generators would be installed in acoustical enclosures or within a building with acoustical louvers to minimize noise associated with monthly exercising.
- Odor control systems would be included.
- Truck traffic to operate treatment facilities would be minimal.

4.3.2 Land Acquisition

LAI's proposal includes the use of vacant lots as treatment/disposal sites throughout the Los Osos community. However, it is unknown at this time whether these identified sites are those of willing sellers. Land acquisition for multiple sites may also be a lengthy and contentious process and could substantially increase the cost of the project.

LAI has noted that difficulties with land acquisition cannot be addressed until specific sites are selected. LAI has recommended that the next step in implementing a decentralized system would be determining the sites that are most feasible to acquire. LAI has indicated that there are additional site options available to those identified in their proposal.

The cost estimates for the decentralized treatment scenarios contain an allowance for land acquisition.

4.3.3 Treatment Technology

The LAI proposal consists of a combination of recirculating media filters (RMF) and the Nitrex™ system as its proposed treatment technology. While the Nitrex™ system can remove nearly all of the nitrate in its influent, total nitrogen removal depends on the nitrifying ability of the aerobic treatment step. LAI has indicated that all properly installed and operated RMF systems generally perform to the same level. However, specific RMF systems and nitrifying efficiencies were not included in the LAI proposal.

4.3.4 Regulatory Concerns

As is the case for all technologies being evaluated as part of the Los Osos Wastewater Project, regulatory approval for LAI's proposed RMF and Nitrex™ system is a critical consideration. LAI has indicated that the combination of RMF and the Nitrex™ system has been approved in numerous locations nationwide with documented performance levels. However, there are no existing installations in California for a community of similar size to Los Osos. The CCRWQCB's review of LAI's proposed treatment technology, as well as the ability to discharge within the prohibition zone, is a critical consideration that would need to be resolved.

LAI's proposal for decentralized treatment consists of treatment plant siting within ESHA. The Los Osos project team has raised the concern that permitting constraints for developing several sites within ESHA could make implementation of the decentralized treatment alternative unfeasible. LAI has indicated that this matter can only be addressed by submittal to the Coastal Commission and obtaining their opinion. However, LAI believes that since the proposed wastewater system is predominately below grade, and for paper streets, an enhancement of land from current use, ESHA issues can be addressed in a positive manner.

4.3.5 Greenhouse Gas Emissions

Greenhouse gas emissions are an important consideration when assessing the environmental benefits of a project. Offsetting/preventing release of greenhouse gases from the treatment process itself is more difficult with a decentralized system because septic tanks (anaerobic processes) release methane gases which have 23 times the greenhouse gas effect of carbon dioxide - the byproduct of aerobic treatment.

Estimates of the net greenhouse gas effect for the proposed decentralized system have not been performed to date. However, septic tank emissions have been estimated in the Project Alternatives Greenhouse Gas Emissions Inventory (Carollo, June 2008) in Section 4.1 per the 2006 IPCC Guidelines for National GHG Inventories followed by the US EPA. LAI has noted their opinion that there is no consensus in the industry as to if and how much methane is released from septic tanks and suggests measurements from existing septic tanks be taken to quantify. LAI has also indicated that active ventilation and destruction is an option should this be an issue, although specific examples on a similar scale to Los Osos are not known and no references were provided.

4.3.6 Disposal - Solids Handling

For a decentralized treatment alternative, septic tanks at each household will still need to be pumped at regular intervals. LAI has indicated that the existing method of disposal (trucking out of the community) is assumed for their proposal and included in the O&M cost estimates. LAI conservatively estimates an increase of 10 percent to 20 percent of sludge production above the existing volume currently being disposed of from septic tanks. It has not been confirmed if the receiving facility can handle this excess sludge. LAI suggests land application as a potential alternative for evaluation.

4.3.7 Project Delivery

The LAI proposal cites that the potential for modularity in the implementation of a decentralized treatment is a possible benefit. The Los Osos project team has no further comment on this issue, since the County is best able to assess the pros and cons of administering separate contractor bidding and financing for each potential cluster system.

4.3.8 References

LAI references their website for a list of operating decentralized systems and agency/owner references. Specific descriptions of the community and conditions with which these systems were installed, and costs for these projects were not summarized in the technical memoranda provided by LAI.

5.0 SUMMARY

In general, decentralized treatment can be a cost effective alternative to centralized treatment due to reduced collection system construction and energy costs. However, for Los Osos, the savings from not having to provide out-of-town conveyance in a decentralized system appears to be offset by the increased costs of construction for treatment facilities and effluent distribution systems (especially for the residential reuse scenarios). The non-residential reuse/disposal scenarios for decentralized treatment (Scenarios 1b and 2b) appear to be within the range of costs compared to Level 2 mitigation VPAs from the Fine Screening Analysis with lower annual O&M costs. The residential reuse/disposal scenarios for decentralized treatment (Scenarios 1a and 2a) have higher capital costs when compared to Level 3 mitigation VPAs from the Fine Screening Analysis, but slightly lower annual O&M costs.

Issues remain that could impact the application of decentralized treatment in Los Osos. Because the entire town is on ESHA land, this alternative may be extremely difficult to permit. There could also be permitting problems due to discharging effluent in the Prohibition Zone. Neighbor impacts from siting treatment facilities on small lots next to occupied homes, and property owners' willingness to sell could also be major stumbling blocks for project implementation. These risks could potentially lead to project delays, interruptions, and unforeseen compliance requirements that could increase the cost of implementation.

6.0 REFERENCES

Crites, Reed and Bastian, "Land Treatment Systems for Municipal and Industrial Wastes" McGraw-Hill, 2000.

Crites and Tchbanoglous, "Small and Decentralized Wastewater Management Systems" McGraw-Hill, 1998.

Pettygrove and Asano, "Irrigation with Reclaimed Municipal Wastewater - A Guidance Manual" Lewis Publishers, 1985.

APPENDIX A - LETTER PROPOSAL FROM LAI TO SAN LUIS OBISPO COUNTY, JUNE 8, 2007

Environmental Engineers/Consultants
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June 8, 2007

Mr. Paavo Ogren, Deputy Director
San Luis Obispo County
Department of Public Works
1050 Monterey Street
San Luis Obispo, CA 93408

Re: Los Osos Wastewater Project
Decentralized Wastewater Management Option

Dear Mr. Ogren:

Lombardo Associates, Inc. (LAI) has reviewed the Los Osos Wastewater Project Viable Project Alternatives Fine Screening Analysis prepared by Carollo Engineers, dated May 2007 along with many of the numerous reports on the wastewater and water resource issues in Los Osos. We are intimately familiar with the Los Osos wastewater situation as we proposed to assist the LOCSD with its engineering study in 2006 with the team of Professor George Tchobanoglous, Robert Jaques of Monterey County (who were both on the NWRI project review team) along with other national experts. We have also contacted Carollo Engineers offering our services, as we are nationally recognized on decentralized wastewater systems and have over $200 million of project experience as the Engineer of Record on projects similar to Los Osos. Based upon our extensive and detailed review of the May 2007 Alternatives Fine Screening Analysis and previous documents prepared under the County sponsored project, we note that there is no identification and evaluation of a Decentralized Wastewater Plan. Based upon our investigation, it appears that a Decentralized Wastewater Plan is technically viable, economically competitive and environmentally very attractive, as compared to the other options that have been considered in the current and previous studies.

The Decentralized Wastewater Management Option would serve all of the existing development and build-out, capable of producing reusable water complying with Title 22 standards and would address in a very positive manner (we believe solve) the water supply imbalance in Los Osos that has led to salt water intrusion and thereby endangering the community's groundwater water supply.

Based upon our review of existing development in Los Osos which included examining the aerial photos and lot sizes and performing a significant amount of preliminary engineering analysis, we are of the opinion that due to the large number of small lots, complete reliance on individual systems is not technically feasible. Consequently it is our opinion that communal/cluster systems need to be the core of a Decentralized Wastewater Management Option. An optimized Decentralized Wastewater Management Plan could be a combination of communal and individual systems, however for analytical simplicity we start by assuming all existing developed properties and build-out would be served by a complete wastewater collection, treatment and dispersal communal/neighborhood system. Where use of individual systems would be economically attractive would then be determined for the definition of the optimized Decentralized Wastewater Management Plan.

At the conceptual level, the Decentralized Wastewater Option would consist of a number of communal wastewater systems that would total the wastewater design flow of 1.2+/- MGD with the following components:

- Septic Tank Effluent Collection System – maximizing the use of gravity (i.e. STEG) and using pumps (STEP) when necessary
- Recirculating Media Filters for Advanced Secondary Treatment
- Nitrex™ system for nitrogen removal – which could have emergent wetlands if desired, however not necessary for treatment
- Disinfection with UV-Ozone that additionally addresses emerging contaminant issues
- Dispersal by returning the treated wastewater to the individual properties generating wastewater, for drip/landscape irrigation. Additional drainfields would be provided for "excess" treated effluent that is not disposed of via drip irrigation to individual wastewater generating properties. Drip irrigation is a year round activity and not subject to seasonal issues associated with surface land application, i.e. spray irrigation. Connection between communal systems for effluent dispersal would be used to address wastewater production-dispersal imbalances in any communal areas.

We have examined the topography of Los Osos, depth to groundwater, soils, and existing development patterns and have concluded at this level of planning, that sufficient undeveloped land exists throughout the community to site the needed communal wastewater treatment facilities. At each of the communal treatment sites, virtually all wastewater treatment facilities would be below ground. With appropriate landscaping, the communal systems could be an open space amenity in the community.

Operation and maintenance of these wastewater systems is simple, requiring little operator attention. Our current comparable facilities operate with monthly visits – primarily to collect samples for performance monitoring. Electrical needs are predominately to operate small pumps that operate intermittently. No chemicals are needed. There is little sludge production in the treatment system – significantly less than an activated sludge plant. Odor issues are mitigated as there is no sludge processing and soil or carbon filters are used for air venting of treatment processes. Our experience includes engineering a 0.9 MGD wastewater collection, treatment and dispersal system that has 11 sub-areas, some of which have multiple small cost-effective pump stations to address serving properties in areas with flat and undulating terrain.

The benefits of the Decentralized Option are:

1. Cost competitive. Some centralized wastewater systems costs are eliminated or traded for more productive/valued uses, such as:
   a. Elimination of force main to treatment plant

b. Dispersal system costs are traded for a water reuse/drip irrigation system that lowers property owners' water supply costs and produces the highest saltwater intrusion mitigation level. It is noted that landscape irrigation is a major water user in Los Osos, and, from what we can deduce, the major cause of saltwater intrusion.

c. Centralized sludge treatment, usually a major source of odors and costs, is significantly diminished if not eliminated, as slightly more than septage pumping is necessary. At 7,000 - 10,000+/- gpd of septage, simple subsurface land application or disposal at a centralized treatment site may be optimal. For your information, I co-authored the US EPA Septage Design Manual.

2. Modularity enables the project to be easily segmented and the individual total communal systems can be implemented quickly. Due to the lower bonding requirements, it may be wise to bid communal systems separately and sequentially to attract a wider number of contractors, many of which may be local, and to increase construction competition. Also, it may be desirable to have Proposition 218 votes on different communal areas. We have experience on all of these, and other innovative approaches, including design-build-operate (DBO), in CA as well, approaches. Our DBO experiences include being the Chief Engineer for municipalities procuring the DBO service as well as being part of the proposing organization.

3. Environmentally Benefits

   a. Low energy use

   b. No chemicals needed

   c. Working predominately within existing developed area, thereby eliminating impacts on new sites

4. Community Acceptability – although we cannot speak for the community, we anticipate acceptance with this simple, passive and effective treatment system that solves the water supply challenge and reduces their property water supply costs.

Although we have reviewed in detail the cost estimates in the Los Osos Wastewater Project Viable Project Alternatives Fine Screening Analysis and have prepared very conceptual economic comparison, the Decentralized Wastewater Option needs to be taken to the next level of analysis for full public comparison with the other options.

For your information, LAI received the national ACEC Engineering Excellence Award for our innovative wastewater project that served 3,000 connections with a septic tank effluent system (combination STEG & STEP), recirculating media filter, constructed wetlands and UV disinfection. We have engineered over 40 miles of septic tank effluent sewer systems in a number of states – which systems have been operating for over 20 years. LAI is intimately familiar with Federal and State funding program requirements and protocols for similar projects as Los Osos, as many of our projects have been funded by the USEPA and various States. I chaired the Water Environment Federation Small Community Committee, co-authored the upcoming WEF Alternative Sewers Manual and am author of many US EPA publications on decentralized wastewater management issues. We have championed the use of the passive Nitrex™ system, which produces Total Nitrogen levels < 5 mg/l, averaging 3 mg/l, in numerous applications throughout the US, including California installations, and Canada. We recently prepared the Cluster (i.e. Communal) Wastewater Systems Planning Manual for a national USEPA funded project – available at our web site www.LombardoAssociates.com. I have chaired and spoken at numerous WEFTEC workshops on decentralized wastewater systems, including the one scheduled for October 2007 in San Diego, http://www.weftec.org/Education/Workshops/.

We will welcome the opportunity to meet with you to discuss the Decentralized Approach and to discuss our assisting the County further develop a Los Osos Decentralized Option. Attached for your information are representative reference letters that speak to our unique engineering expertise. We have an office in the San Francisco Bay area.

I look forward to hearing from you.

Respectfully submitted,

Pio S. Lombardo
President

cc: Technical Advisory Committee
John Fouche
Rob Miller
Gail McPherson
Lidia Holmes, Carollo Engineers
Professor George Tchobanoglous
Supervisor Bruce Gibson

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
CINCINNATI, OH 45268

January 20, 1998

OFFICE OF
RESEARCH AND DEVELOPMENT

To Whom It May Concern:

I am pleased to offer a letter of recommendation for Mr. Pio Lombardo. Mr. Lombardo is one of the pioneers in the area of alternative decentralized wastewater treatment technologies, and has experienced it in the broadest possible fashion. as a researcher, designer, a builder, and a salesman. I believe that he has no peer in his ability to convince others of the value of these alternative technologies. Many of us who have dealt with these systems for the last 30 years have had the luxury of working in the more isolated research microcosm, but Mr. Lombardo actually went to the places which needed such technologies, and did not realize it, to convince them of that. This is a most difficult task, at which he has excelled.

Personally, I have always found Mr. Lombardo to be a gentleman and a man of his word. This quality has also been the hallmark of any professional dealings we have had over the years.

I would most heartily endorse Pio Lombardo in any role as an interface or spokesman for an alternative technology concept or project with local and regional governments.

If further details are required, I would happily supply them.

Sincerely,

James F. Kreissl
Environmental Engineer

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

January 9, 1998

To Whom It May Concern:

I am both delighted and honored to write a letter of recommendation for Mr. Pio Lombardo, whom I consider one of the pre-eminent national figures in the area of wastewater management.

My own experience in this field covers 29 years in the areas of research, engineering, regulation, writing and public speaking at sessions of virtually every major conference on small-scale wastewater management issues. I am also co-inventor of the highly successful Infiltrator™ leaching system.

Pio has a thorough grasp of all technological and business issues and solutions in the field of wastewater treatment. This knowledge forms the solid foundation for his work. What is unique is that he can apply technology with a sure and far reaching vision that is rare in the field of engineering. One only needs to examine some of his past projects to gain an understanding of this outstanding skill.

Based on sure technical knowledge, Pio has an unequaled ability to take on the difficult issue of wastewater system management. His ability to work with multiple levels of government and with citizens to create effective wastewater management solutions is without equal. My Department was so impressed with Pio's ability to create effective wastewater management systems that we asked him to share his insights with us on a pro-bono basis. This unusual request, and his helpful response, is a strong tribute to his skill, intelligence and commitment to the field.

I strongly endorse Pio Lombardo as a man of integrity, brilliance and possessed of unique insight and ability in the integration of citizenry in wastewater management issues. Please do not hesitate to call me at 860-424-3719 if further particulars are required

Sincerely

Randy May
Supervising Sanitary Engineer
Bureau of Water Management

RM/hs

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APPENDIX B - • DESIGN CRITERIA TM, LAI, MAY 2008
• DECENTRALIZED WASTEWATER TREATMENT SCENARIOS TM, LAI, JULY 3, 2008
• COST ESTIMATES FOR DECENTRALIZED SCENARIOS TM, LAI, AUGUST 27, 2008

San Luis Obispo County
Los Osos Wastewater Project Development

TECHNICAL MEMORANDUM

DESIGN CRITERIA

Task 1

May 2008

REGISTERED PROFESSIONAL ENGINEER
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No. C70679
Exp. 6/30/09
CIVIL
STATE OF CALIFORNIA

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1. Introduction

The purpose of this technical memorandum (TM) is to determine the design basis and regulatory requirements for a potential decentralized wastewater management system that could serve the Los Osos Community in San Luis Obispo County, CA.

In addition, concerns raised in the Los Osos Project January 2008 Technical Memorandum on Decentralized Systems will be addressed in this TM.

2. Service Area Definition

The Los Osos study area consists of the following two areas:

1. Prohibition Zone
2. Surrounding Community

with Environmental Sensitive Habitat Areas (ESHA) within each area.

3. Wastewater Flows and Loads

Table 3.1 summarizes water use rates in early 2005 – 2007 for the District customers, as presented in the Carollo February 2008 TM on Flows and Loads.

Table 3.1. 2005 – 2007 Water Use Estimate for the Los Osos Wastewater Project Development, San Luis Obispo County

Month	Gallons Billed			Water Usage (gpcd)[1]
	2005	2006	2007	
January	15,499,800	14,860,600	15,744,300	58
February	20,261,000	21,122,300	22,015,800	80
March	14,620,100	15,917,600	15,092,500	57
April	18,224,800	17,301,500	21,507,300	72
			Average:	**67**

Note:

(1) Gallons per capita per day (gpcd). Based on population served by LOCSD, estimated at 8,500 people. Water Usage = Gallons Billed / Population.

Tables 3.2 – 3.4 present the summary of flow estimates for each type of sewer and the projected characteristics of wastewater for a Gravity Collection System and a STEP system, respectively, from the Project's Flows and Loads TM, dated February 2008.

Table 3.2. Flow Estimates, 2006 Water Use Estimate for the District Los Osos Wastewater Project Development, San Luis Obispo County

Flow Estimates, 2006 Water Use Estimate

Collection System	Population Estimate	Water Use Estimate (gpcd/mgd)	Conservation (mgd)	$I/I_{average}$ (mgd)	ADWWF (mgd)[1]	PHWWF[2]
Gravity	18,428	66/1.2	0.1	0.3	1.4	2.5
STEP	18,428	1.2	0.1	0.1	1.2	1.7
Low Pressure	18,428	1.2	0.1	0.1	1.2	1.9

Note:

(1) Average Daily Wet Weather Flow = Water Use (mgd) - Conservation + $I/I_{average}$ Utilized for sizing processes.

(2) Peak Hourly Wet Weather Flow

Table 3.3. Projected Characteristics of Wastewater, Gravity Collection System

Parameter	Units	Average Day	Peak Day
BOD	mg/l	340	350
Suspended Solids	mg/l	390	400
Total Nitrogen	mg/l	56	58

Table 3.4. Projected Characteristics of Wastewater, STEP

Projected Characteristics of WW, STEP

Parameter	Units	Unfiltered	Filtered
BOD	mg/l	140	120
Suspended Solids	mg/l	80	40
Total Nitrogen	mg/l	56	56

4. Wastewater Management System Design Criteria

The wastewater management system will be designed to meet Title 22 requirements for water reuse as irrigation and toilet/urinal flushing, for spray irrigation. Drip irrigation is not required to meet Title 22 regulations. A schematic of the complete collection, treatment and dispersal system is presented for a Title 22 system in Figure 4-1. Figure 4-2 shows a schematic of a treatment system that will utilize drip dispersal and not be subject to Title 22 requirements.

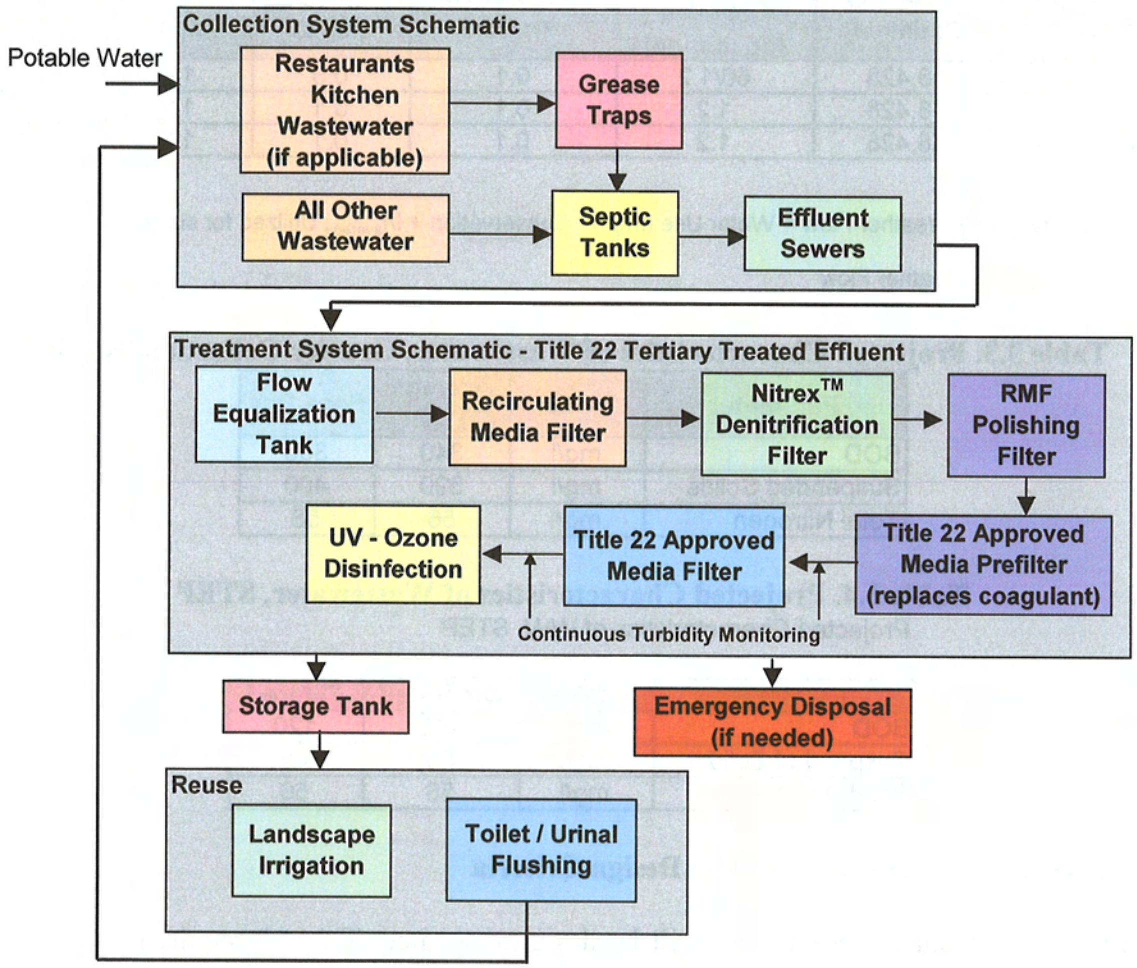
4.1. Collection System

The collection system alternatives that will be considered are as follows:

- Septic Tank Effluent by Pump (STEP)
- Septic Tank Effluent by Gravity (STEG)
- Septic Tank Effluent by Variable Grade Sewer (STVG)

The design criteria for each collection system alternative will be detailed in the following sections.

FIGURE 4-1: COLLECTION, TREATMENT AND DISPERSAL SCHEMATIC, TITLE 22 COMPLIANT

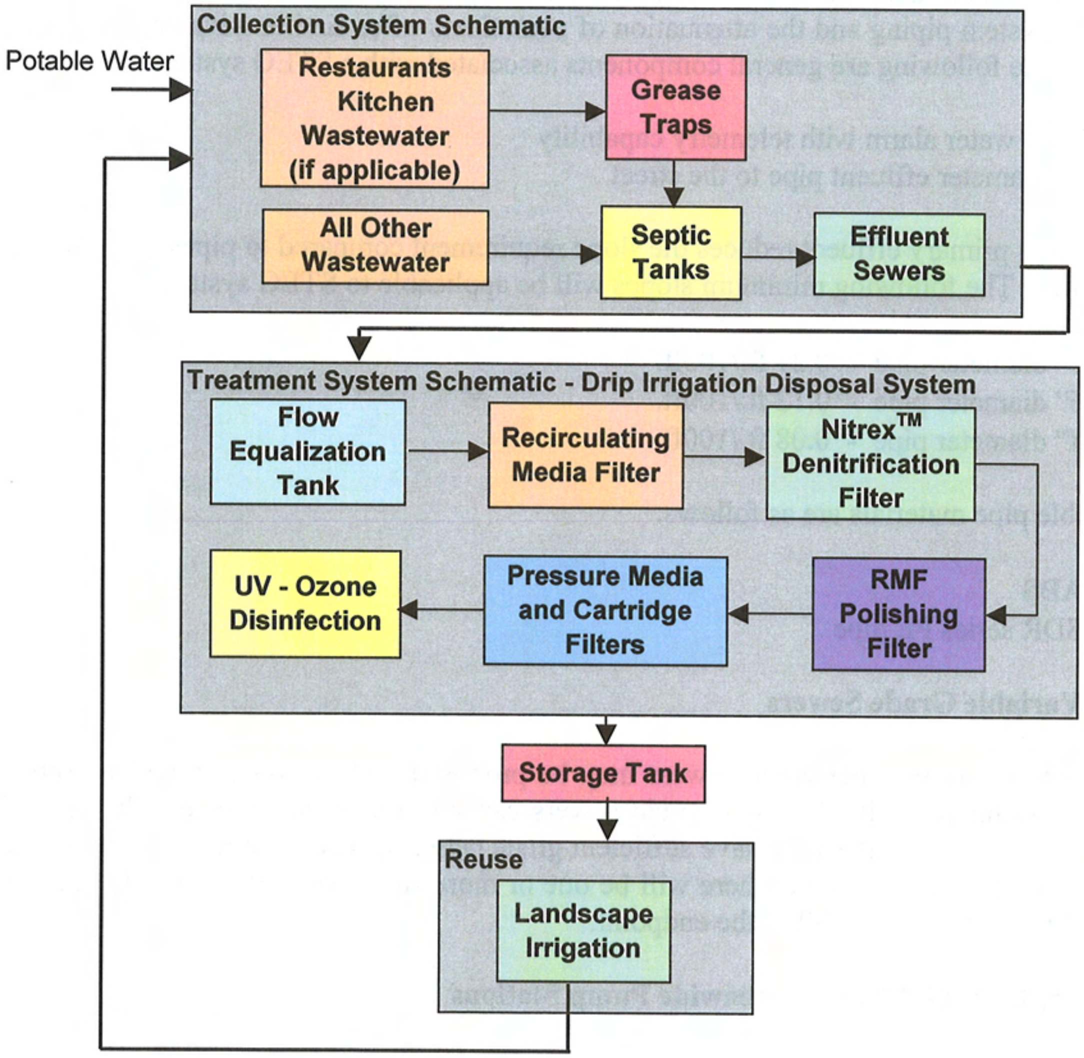


4.1.1. STEP Design Criteria

STEP systems can use lower power effluent pumps as compared to grinder pumps since the wastewater will have received primary treatment prior to pumping. The effluent pumps will have the following general components:

1. Effluent pump, 1/3 – 1/2 hp
2. Control panel with alarm and telemetry capability
3. 1-¼" minimum discharge pipe size

FIGURE 4-2: COLLECTION, TREATMENT AND DISPERSAL SCHEMATIC, DRIP IRRIGATION ONLY



Discharge pipe assembly and force main acceptable materials are as follows:

- PCV Schedule 40
- SDR series PE pipe
- PVC C900 series pipe

4.1.2. STEG Design Criteria

STEG systems can be used where the existing grade will allow gravity flow from an area of individual septic tanks to either an area pump station or to the treatment facility itself. Individual STEP house connections may discharge to a STEG system. Where applicable, STEG systems save on installation and operating costs by avoiding the need for a pump. The smaller diameter collection system piping and the attenuation of peak flows offer similar advantages as the STEP systems. The following are general components associated with a STEG system:

1. High water alarm with telemetry capability
2. 4" diameter effluent pipe to the street

Transmitting primary effluent reduces the slope requirement compared to pipes transmitting raw wastewater. The following minimum slopes will be applicable to STEG systems:

- 4" diameter pipe - 0.21 ft./100ft.
- 6" diameter pipe - 0.12 ft./100ft.
- 8" diameter pipe - 0.08 ft./100ft.

Acceptable pipe materials are as follows:

- ABS
- SDR series PE pipe

4.1.3. Variable Grade Sewers

Where applicable, variable grade sewers may be proposed. These systems will be septic tank effluent systems as well. Variable grade sewers can be used in areas where the grade is not consistent. Candidate sites may have sufficient grade between each connection and the treatment plant or pump station, however there will be one or more short sections where the grade locally rises before continuing its fall to the endpoint.

4.1.4. Septic Tank Effluent Areawide Pump Stations

Areawide septic tank effluent pump stations may be necessary to convey effluent to treatment site(s) from properties served by STEG system. These pump stations will have duplex pumps and either 24 hour design flow emergency capacity or emergency generators.

4.2. Preliminary Engineering Sizing and Layouts

Basic design criteria for the unit processes shown in Figure 4-1 are presented in this section. Actual sizing of the components will depend on the final service areas for each decentralized facility.

4.2.1. Grease Traps and Septic Tanks

Grease traps and septic tanks are sized based on local code for the design flows associated with the buildings they serve. In general, the following basic design criteria will be applied for the planning level sizing of septic tanks and grease traps:

Septic Tanks

- Residences up to 4 bedrooms - 1,500 gallon, 2-compartment tank
- Residence 5+ bedrooms - 1.5 day HRT, 2-compartment tank
- Office/Retail/Restaurant buildings - 1.5 day HRT, 2-compartment tank

Multiple buildings may be connected to a STEG tank.

Grease Traps

All restaurants are required to have the kitchen flows separated and diverted to a grease trap prior to introduction into the septic tank. The following design criteria will be applied to grease traps:

- 3 day HRT for all separated kitchen wastewater prior to entering the septic tank

Actual sizing and associated costs for septic tanks and grease traps will be completed in Tasks 2 and 3.

4.2.2. Flow Equalization Tank

The Decentralized Treatment TM correlates plant flow rate with reliability, stating that the higher the flow, the more stable the influent flows and loads and consequently the more stable the treatment. While this is true in a general sense, there are two factors that mitigate this issue. The first is treatment process selection. RMFs and other fixed film processes are inherently more stable than suspended growth (activated sludge) processes and therefore can withstand a greater degree of variability in the influent flow and load. The second mitigation factor is flow equalization, especially with an effluent sewer system as the septic tank attenuates flow. By equipping a decentralized system with an influent flow equalization tank, variations in flows and loads are further dampened. For this reason, a flow equalization (EQ) tank is included in the process to minimize influent flow and load variations. Normal peaks in daily flows will result in rising levels within the tank rather than spikes in flow through the treatment system. During the night and other low demand periods, the equalization tank will empty. The tank will be sized based on a total of 500,000 gallons, prorated for each sub-area.

4.2.3. Recirculation Tanks

The RMF treatment systems require recirculation tanks in addition to the treatment units. The first stage and polishing RMFs are sized based on flow and expected wastewater strength. The recirculation tank provides sufficient contact time between the treated RMF effluent and influent wastewater to facilitate partial denitrification. The effluent flow from this tank is controlled either by a recirculation valve or pump. The valve or pump maintains the operating level in the tank by increasing flow out as the level in the tank rises and preventing flow out during low flows. This results in an operating level that varies within the range of the valve or pump floats. Emergency storage volume is added on top of the operating volume to allow the operator time to respond in the event of a valve or pump failure. The design residence time plus operating and emergency storage volume allowances results in a design HRT of approximately 0.5 day.

4.2.4. 1st and 2nd Stage RMFs

The 1st and 2nd stage RMFs are designed based on the loading rate, measured in gdp/ft^2 of footprint. For high strength restaurant flows, the loading rate is 10-15 gpd/ft^2. For residential flows, a loading rate of 25-40 gpd/ft^2. A variety of RMFs exist and are under consideration for use. Figure 4-3 illustrates the Advantex™ System installed at the Malibu Creek Plaza. This is an above-grade system that will only be used where sufficient land is available. As space and neighbor impacts are important considerations, below grade systems such as the SeptiTech™ and other Biofilters are likely preferred. Figures 4-4 and 4-5 illustrate installation of a below grade Biofilter. Figure 4-6 illustrates the SeptiTech™ system. The design loading rate for systems that combine commercial and residential flows will be the flow weighted average of the loading rates presented above.

FIGURE 4-3. ADVANTEX™ SYSTEM – MALIBU CREEK PLAZA, MALIBU, CA

4.2.5. Nitrex™ Denitrification Filter

The Nitrex™ denitrification filter is sized based on LAI's extensive experience with this proprietary technology. The Nitrex™ system can be installed entirely below grade. The Nitrex™ denitrification filter can also be constructed as a wetland system and thereby achieve additional treatment and aesthetic improvements.

Figures 4-4 and 4-5 illustrate the design of the Nitrex™ Treatment cluster system installed in Mashpee, MA with a 5,226 gpd design flow at substantial completion and after completion, respectively. Figure 4-7 illustrates how the Nitrex™ filters can be integrated into the wetland approach at a 0.9 MGD LAI engineered wastewater nitrogen removal wetland system.

FIGURE 4-4. MASHPEE, MA NITREX™ WASTEWATER SYSTEM AT SUBSTANTIAL COMPLETION

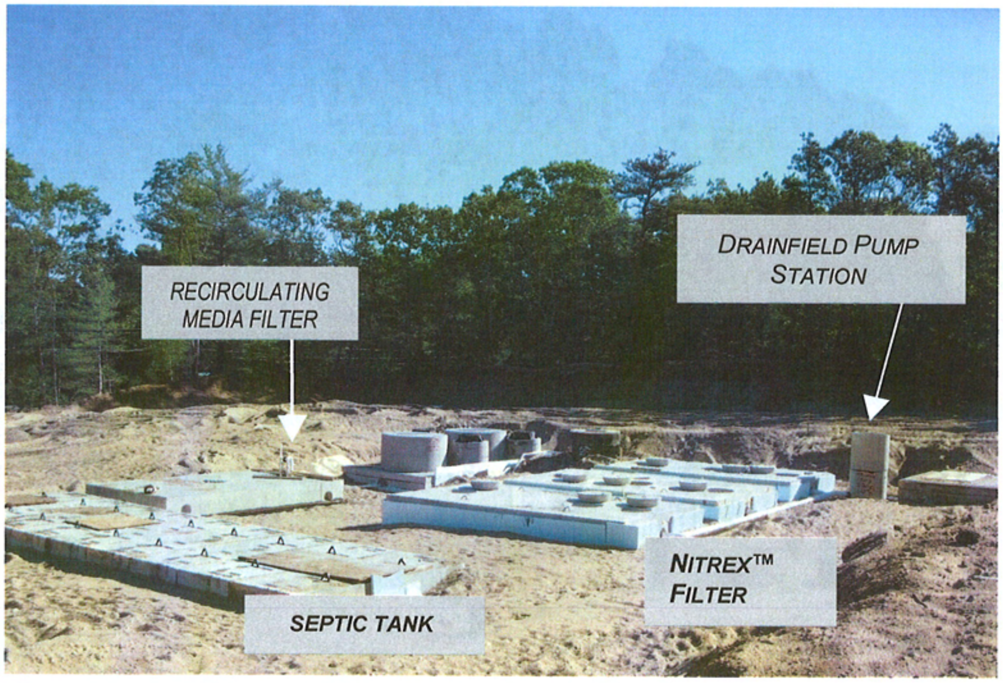


FIGURE 4-5. MASHPEE, MA NITREX™ WASTEWATER SYSTEM AFTER INSTALLATION COMPLETION

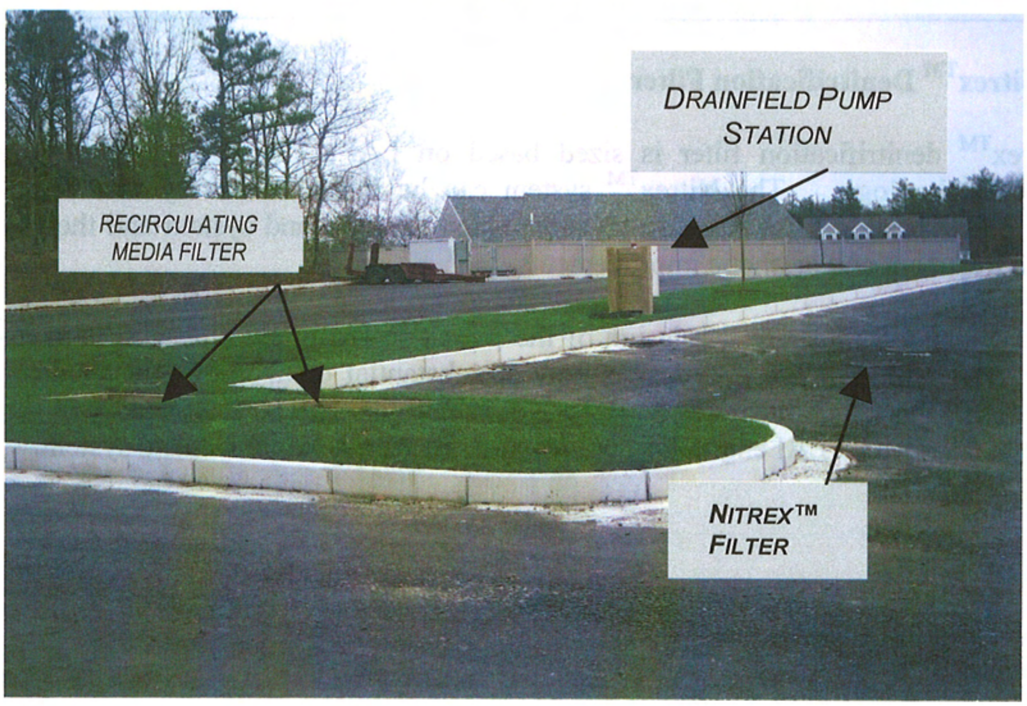


FIGURE 4-6. SEPTITECH™ SYSTEM

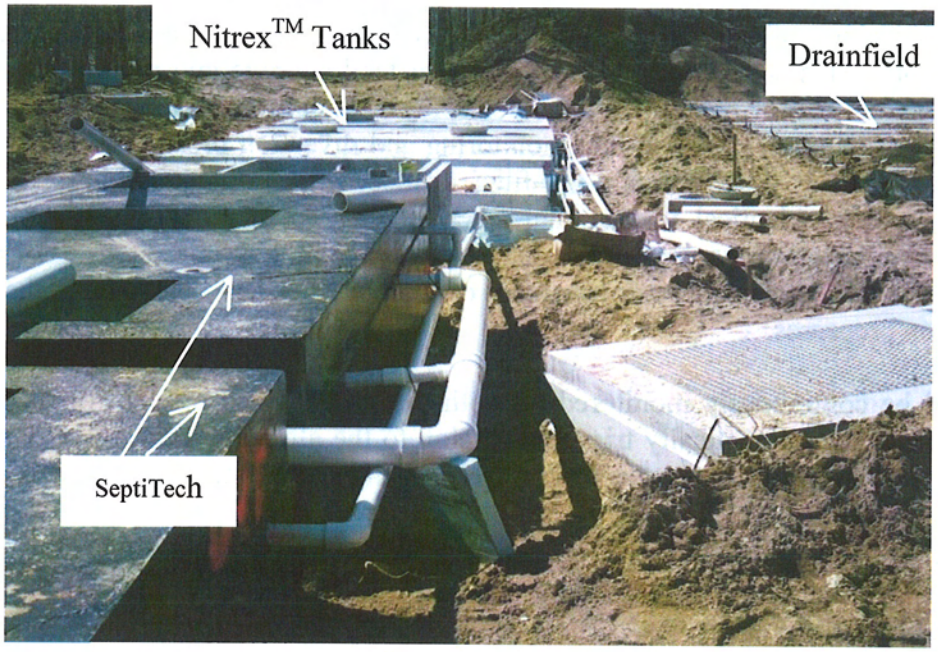


FIGURE 4-7. USE OF NITREX™ FILTERS AS WETLANDS

4.2.6. Filtration System – Title 22 Compliant System

The Title 22 definition of a tertiary disinfected wastewater includes a coagulation requirement prior to filtration. This step would involve chemical feed, storage and monitoring equipment. Due to the potential use of reclaimed water for spray irrigation and toilet and urinal flushing, coagulation is not required provided that monitoring and diversion provisions are in place. An approved media filter is proposed as a pre-filter to meet filter influent turbidity requirements. The pre-filter will be identical to the final filter feeding the disinfection system, providing redundancy as well as complying with the coagulation exception requirements. For monitoring purposes, the filter influent will be downstream of the pre-filter and upstream of the final filter and disinfection processes.

Turbidity will be continuously monitored on both the influent and effluent of the final filter. Alarms will be set to automatically trigger diversion to the alternate dispersal system if any of the following turbidity values are exceeded on the final filter effluent:

- An average of 2 NTU within a 24-hour period;
- 5 NTU more than 5 percent of the time within a 24-hour period;
- 10 NTU at any time.

In addition, due to relief from the coagulation requirement, alarms will also be set to trigger diversion if the following turbidity requirement is not met on the filter influent:

- Filter influent turbidity remains less than 5 NTU. Alarm set to divert if 5 NTU is exceeded for longer than 15 minutes.

4.2.7. Filtration System – Drip Irrigation

For drip irrigation, the only filtration requirement will be that for the UV disinfection system. A pressure media filter will be installed prior to the UV/Ozone system. 10 and 5 micron cartridge filters will be installed between the media filter and the UV/Ozone system as an added measure of protection against any potential breakthrough from the pressure filter.

4.2.8. Disinfection System

<u>Title 22 Tertiary Disinfected Wastewater Requirements</u>

To meet the disinfection requirements, an ozone - UV treatment system is proposed. This system will be designed to treat the full design flow with excess capacity. Treatment shall conform to the following performance standards, to be confirmed by daily total coliform testing:

- The median concentration over any 7 day period of total coliform bacteria measured in the disinfected effluent does not exceed an MPN of 2.2 per 100 milliliters.

- The number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period.
- No sample shall exceed an MPN of 240 total coliform bacteria per 100 milliliters.

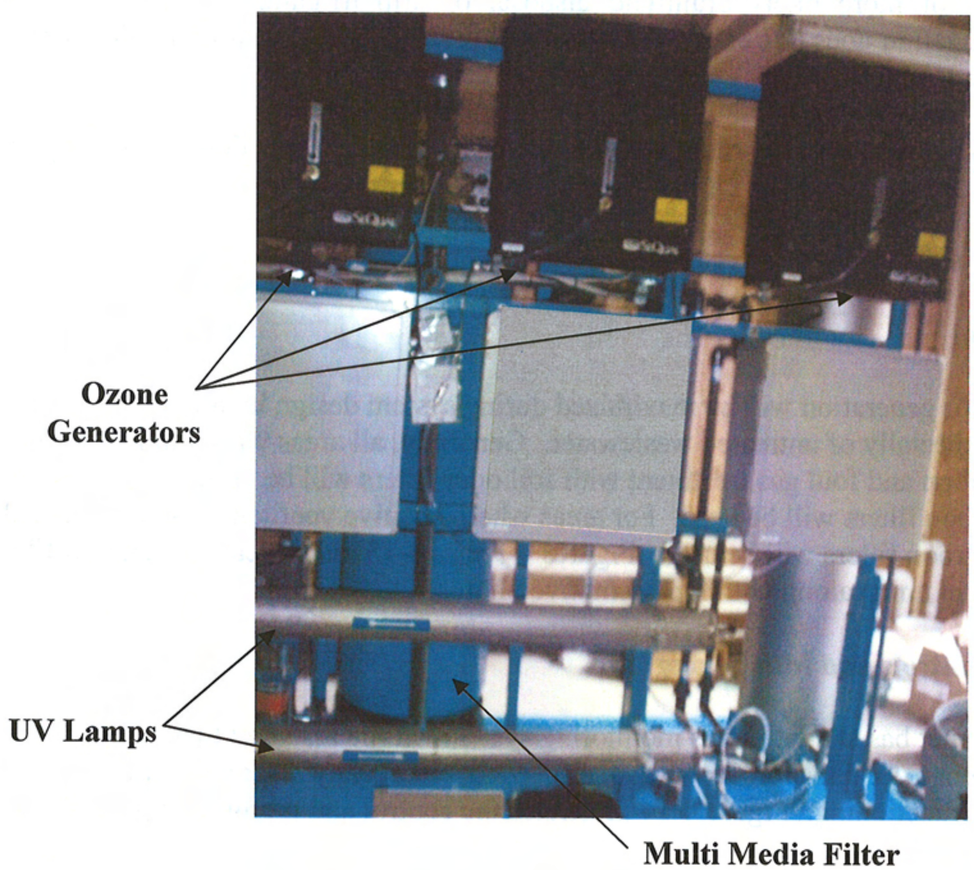
The UV system will provide disinfection in accordance with the "Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse," Second Edition, dated May 2003 and will be approved for use in a Title 22 system. The ozone system will inject up to 40 ppm of ozone into the wastewater with an approximated 5 minute contact time. All units are sized based on the design flow rate for the system it serves. The ozone system is for disinfection redundancy and as a BMP for removal of emerging contaminants. Figure 4-8 illustrates the 12 gpm ozone-UV system used at the Malibu Creek Plaza.

The 2nd Stage Recirculation Tank will have an integral pump station that feeds the disinfection system at a steady flow rate.

Non Title 22 Tertiary Disinfected Wastewater

Disinfection will be provided with the same system as described above without the sampling requirements.

FIGURE 4-8. OZONE-UV SYSTEM – MALIBU CREEK PLAZA



4.2.9. Effluent Dispersal

Non Title 22 Tertiary Disinfected Wastewater

Treated wastewater effluent will be used primarily for residential landscape irrigation as a dispersal technique and, very importantly to replace residential irrigation demand. Landscape irrigation will be via drip irrigation. When spray irrigation is proposed, Title 22 water will be supplied as described below. In Task 2, residential areas will be evaluated as to their ability to use subsurface drip irrigation vs the need for spray irrigation.

Title 22 Tertiary Disinfected Wastewater

Title 22 Disinfected Tertiary Treated Wastewater will be used for spray irrigation and, where possible, toilet flushing via a dual plumbed system (purple pipe) in commercial / public buildings. Task 2 will identify areas that can use spray irrigation and in building reuse of Title 22 Disinfected Tertiary Treated Wastewater. As required by CA DPH, drainfield disposal of off-spec wastewater will be provided. Automatic valves will be activated to direct wastewater to the drainfield system when continuous turbidity measurements or total coliform laboratory results indicate DPH standards for unrestricted water reuse are not being met. Facilities will be provided for storage or more likely drainfield disposal or drip irrigation for periods when demand for spray irrigation does not exist. Existing drainfields at individual properties will be considered for effluent disposal

.

A water balance will be prepared to illustrate effluent water management during the range of expected conditions.

Figure 4-9 illustrates a drip irrigation system.

4.2.10. Odor Control

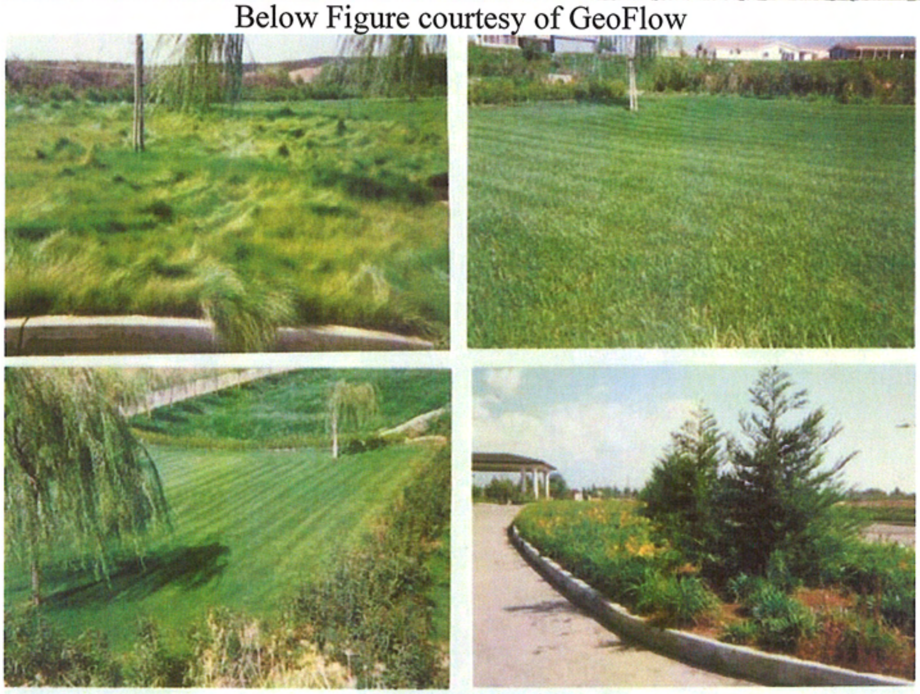
Reduction of foul odor generation will be maximized during system design by minimizing splashing in tanks, especially of untreated wastewater. Generally, all areas with foul gases will have positive ventilation and foul gas treatment with soil odor filters will be used. Where space constraints exist, carbon filters will be used. For areas where positive ventilation is not practical, passive vents with carbon filters will be used. Figures 4-9 thru 4-13 are typical plan and profiles of these odor treatment units, along with representative photos.

4.2.11. Electrical Controls and Monitoring

A telephone and internet based continuous monitoring system will be installed to monitor all vital project equipment to enable a proactive and, as needed, emergency response to the wastewater system's functioning. Figure 4-14 illustrates the control and monitoring panel for a similar facility at the Malibu Creek Plaza in Malibu, CA. Operators will be notified of emergency conditions and required response time will be specified for all types of emergency conditions.

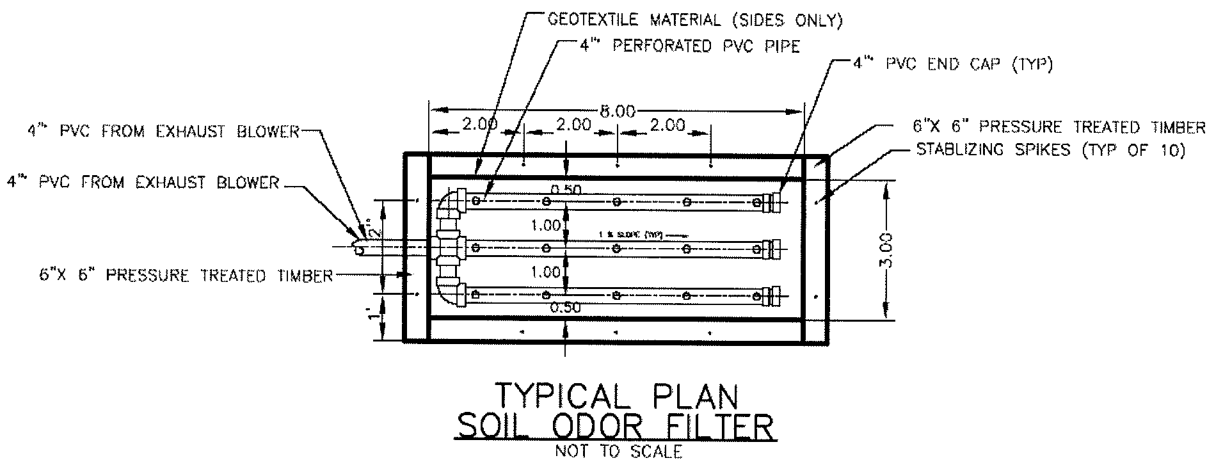
FIGURE 4-9. DRIP IRRIGATION SYSTEM

Below Figure courtesy of GeoFlow



PLANTATION BY THE LAKES RETIREMENT COMMUNITY, CALIMESA, CALIFORNIA

FIGURE 4-10. SOIL ODOR FILTER, TYPICAL PLAN AND SECTION



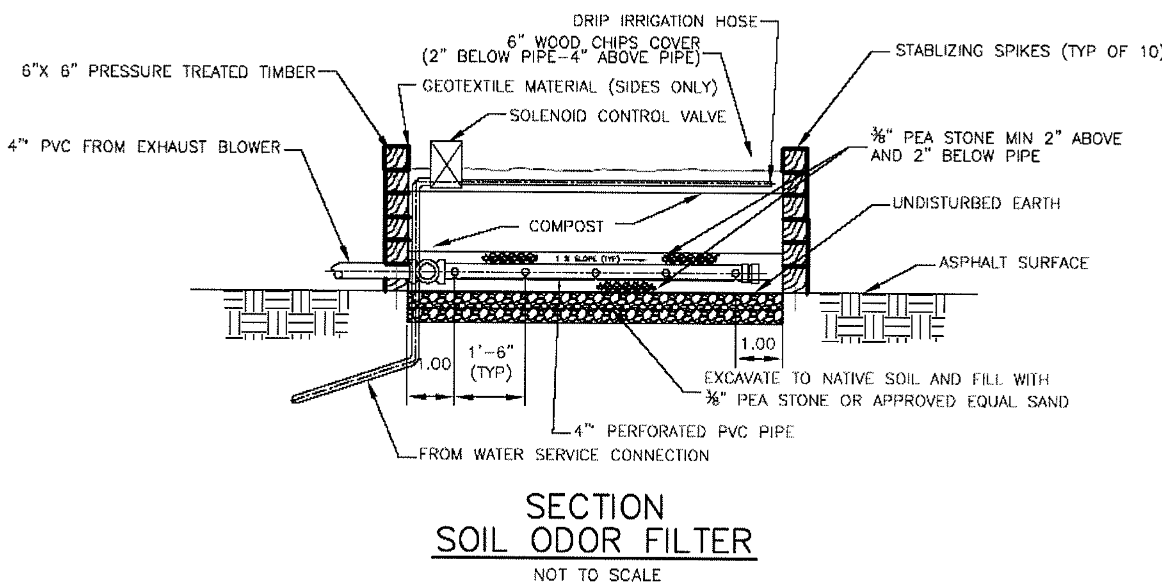


FIGURE 4-11. SOIL ODOR FILTER AT A PUMP STATION

FIGURE 4-12. CARBON ODOR FILTER

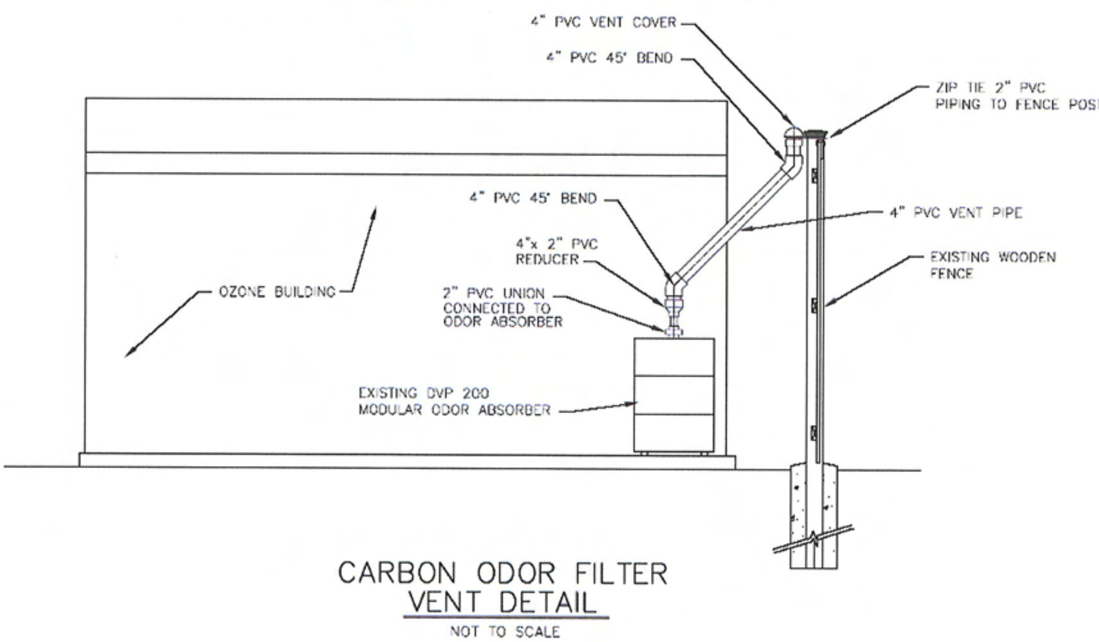


FIGURE 4-13. ODOR FILTER

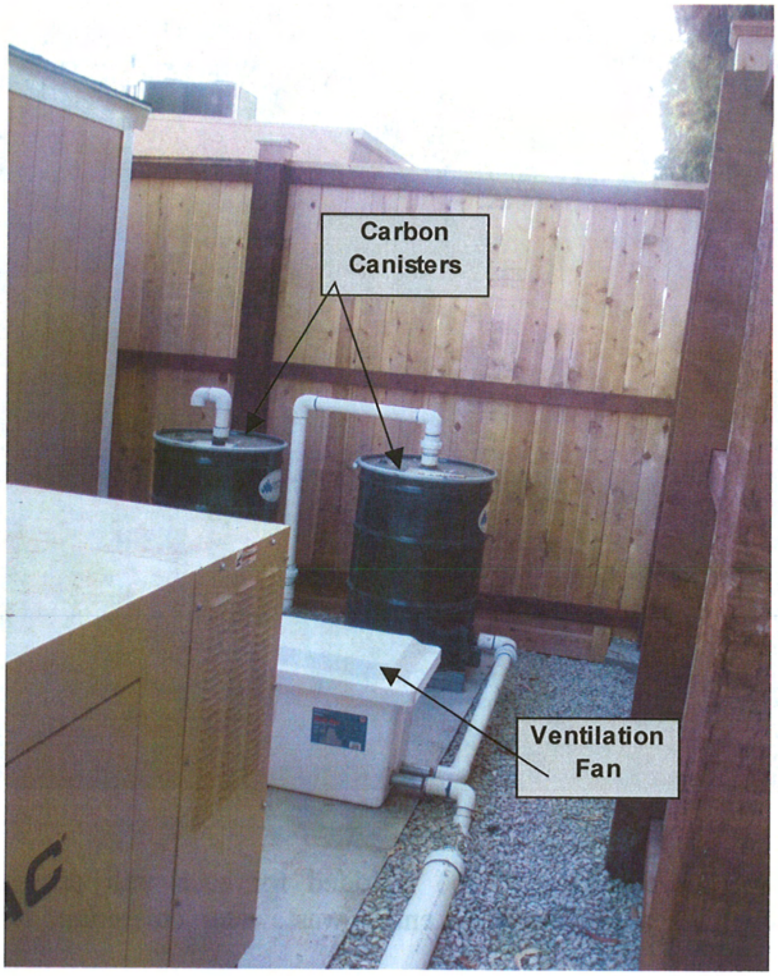
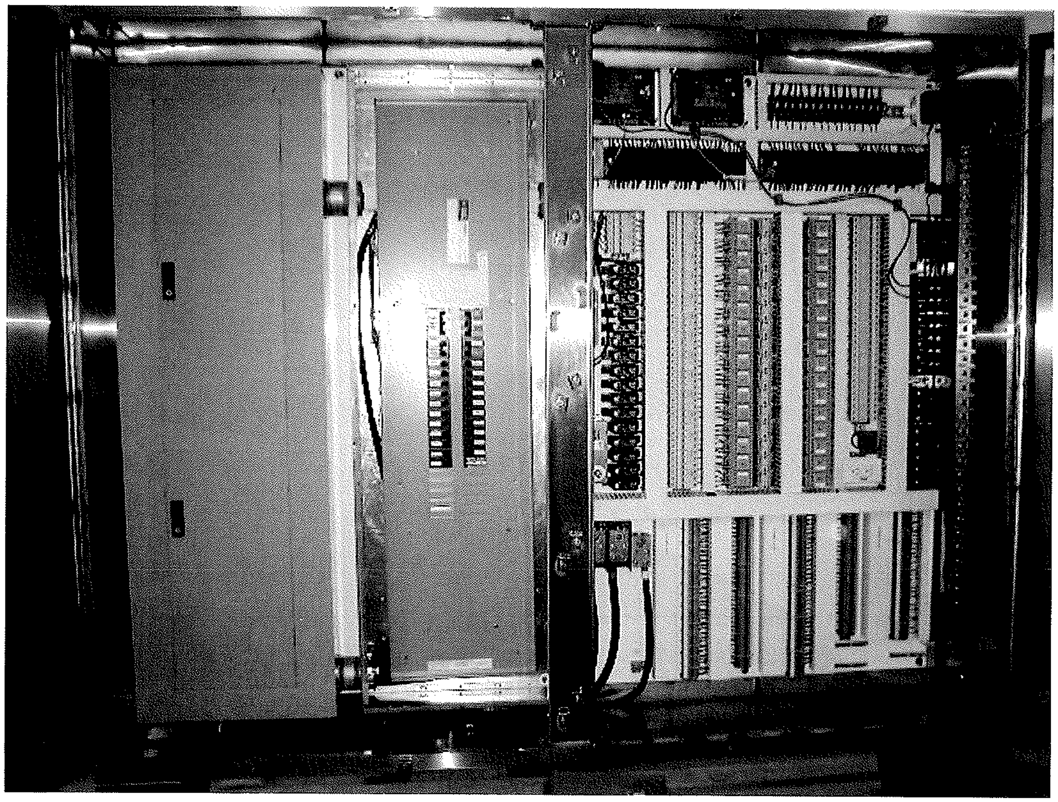


FIGURE 4-14. CONTROL PANEL – MALIBU CREEK PLAZA



4.2.12. Reliability
The following reliability features will be included for each unit process, along with an emergency generator that will power the entire wastewater collection, treatment and reuse system.

Septic Tank Effluent Areawide Pump Stations:

Duplex pump station and emergency power. Redundant high water alarms will be installed in each tank to notify the operator in the event of any clogging. A service contract will exist with a septic pumping company for emergency pump outs, if necessary.

Flow Equalization Tank:

Duplex pump station and emergency power. Redundant high water alarms will be installed in each tank to notify the operator in the event of any clogging. A service contract will exist with a septic pumping company for emergency pump outs, if necessary

RMF:

Redundant unit allowing full design flow to be processed with the largest unit out of service. All internal pump stations are duplex pump stations with emergency power provisions.

Title 22 Filters:

A bypass will be in place to divert effluent the water to the temporary dispersal area. This area will be capable of accepting the full design flow for up to 20 days.

UV / Ozone Disinfection System:

Each component of the disinfection system will be equipped with a redundant unit such that full design UV and Ozone dose can be delivered with the largest unit out of service.

Reuse Water Booster Pump Station:

The booster pump station supplying the reuse water to the individual properties and/or buildings will be designed such that the full peak flow can be maintained with the largest pump out of service.

4.3. Disposal/Reuse

Irrigation and reuse for toilet/urinal flushing are proposed for the reuse options. Each site will be equipped with an appropriately sized drainfield for emergency disposal and/or disposal that is required when the reuse demand is less than the volume of treated wastewater. The use of the existing drainfields as a means of disposal will be investigated.

4.4. Solids Handling

The RMF processes under consideration do not generate large amounts of sludge. The primary source of solids is the septic tanks at the individual properties. Septage is currently hauled to an existing treatment facility. Treating the septic tank effluent will generate little additional sludge, so the total increase in solids over the existing situation is not expected to adversely impact the current receiving facility. Table 4-1 shows the breakdown of annual septage generation. Should a solids handling facility be needed, this represents the approximate volume of septage it would have to treat.

Table 4-1: Annual Septage Generation

	Septic Tanks	
# of Connections	6,000	
Volume (gal)	1,500	
Frequency of Pumping (years)	5.0	
Annual Septage Volume (gal)	**1,800,000**	
	Flow Equalization	**Recirculaton Tanks**
Design Flow (gpd)	1,200,000	1,200,000
Design Total Volume (gal)	600,000	1,200,000
% Full at time of Pumping	25%	50%
Frequency of Pumping (years)	5.0	5.0
Annual Septage Volume (gal)	**30,000**	**120,000**
Total Annual Septage Volume (gal)	**1,950,000**	

Assuming a 200 day per year operation, a 10,000 gpd facility will be needed. Alternative management options are disposal at a treatment plant or an independent facility, with the options of land application (such as a sod farm).

4.5. Hydrogeology

Based upon the hydrogeologic studies performed to date, proposed effluent disposal sites will be evaluated with respect to their capacity to accept the proposed wastewater quantities.

5. Regulatory Issues

5.1. Regulatory Requirement for Using Recycled Wastewater for Spray Irrigation and Toilet Flushing

Treated wastewater that complies with CA Department of Public Health Title 22 Disinfection Tertiary Treated Standards may be used in DPH approved buildings for non-potable purposes with a dual piping water supply system. For residential and other properties, Title 22 water may be used for spray irrigation. Recycled water is conveyed in purple pipes with appropriate back flow preventors required to avoid connection to the potable water supply. No reuse is assumed in restaurants or inside private residences, per CADPH regulations.

For use as spray irrigation or urinal and toilet flushing, the recycled wastewater must be defined as "disinfected tertiary recycled water". To meet this requirement, filtration and disinfection in accordance with regulatory requirements is proposed. For planning purposes, it is assumed that any water quality violations that may occur, will result in partially treated wastewater being diverted to the drainfields system that would serve as an alternate disposal system for the 20 days of emergency discharge as required by DPH.

5.1.1. Process Requirements – No Alternate Disposal Site

If no alternate disposal site is approved or if it is not feasible to use the existing drainfields, then long term storage will be required. The requirement will be for 20 days worth of storage at the design flow for each facility. All provisions for odor control, pumps and pump back equipment must also be furnished.

5.1.2. Use Area Requirements

The use of Title 22 water for spray irrigation must meet the following requirements:

1. Irrigation must be greater than 50 feet from a domestic water supply well
2. In areas accessible to the public, appropriate signs shall be placed reading "Recycled Water – Do Not Drink".
3. No connections of any kind to potable water system will be allowed.
4. No hose bibs are allowed on recycled water lines (purple pipe).

5.1.3. General Requirements

- Recycled water shall not be delivered for any internal use to any individually-owned residential units including free-standing structures, multiplexes, or condominiums.

- Recycled water shall not be delivered for internal use except for fire suppression systems, to any facility that produces or processes food products or beverages. Cafeterias or snack bars in a facility whose primary function does not involve the production or processing of foods or beverages are not considered facilities that produce or process foods or beverages.

- Recycled water shall not be delivered to a facility using a dual plumbed system unless the report required pursuant to section 13522.5 of the Water Code, and which meets the requirements set forth in section 60314, has been submitted to, and approved by, the regulatory agency.

5.1.4. Potable Water Supply Back-up

The public water supply shall not be used as a backup or supplemental source of water for a dual-plumbed recycled water system unless the connection between the two systems is protected by an air gap separation which complies with the requirements of sections 7602 (a) and 7603 (a) of title 17, California Code of Regulations, and the approval of the public water system has been obtained.

5.1.5. Inspection Requirements for Dual Plumbing

Cross connection inspections will be conducted by a certified inspector in accordance with regulatory requirements and acceptable to San Luis Obispo County Public Health Cross-Connection and Water Pollution Control Program.

Should there be any incidence of backflow from the dual-plumbed recycled water system into the potable water system; CDPH will be notified within 24 hours of the discovery of the incident.

All backflow prevention devices installed to protect the public water system serving the dual-plumbed recycled water system shall be inspected and maintained in accordance with section 7605 of Title 17, California Code of Regulations.

5.1.6. Report Requirements

An Engineering Report will need to be prepared to detail the proposed recycled water system for the project, in accordance with Section 13522.5 of the Water Code. The Engineering Report will include the following:

1. A detailed description of the intended use area identifying the following:
    a. The number, location, and type of facilities within the use area proposing to use dual plumbed systems,
    b. The average number of persons estimated to be served by each facility on a daily basis
    c. The specific boundaries of the proposed use area including a map showing the location of each facility to be served
    d. The person or persons responsible for operation of the dual plumbed system at each facility, and
    e. The specific use to be made of the recycled water at each facility
2. Plans and specifications describing the following:
    a. Proposed piping system to be used,
    b. Pipe locations of both the recycled and potable systems,
    c. Type and location of the outlets and plumbing fixtures that will be accessible to the public, and
    d. The methods and devices to be used to prevent backflow of recycled water into the public water system.
3. The methods to be used to assure that the installation and operation of the dual plumbed system will not result in cross connections between the recycled water piping system and the potable water piping system. This shall include a

description of pressure, dye or other test methods to be used to test the system every four years.

5.2. California Coastal Commission

For all areas within the ESHA, the California Coastal Commission will have to approve the proposed wastewater management system. A map of the ESHA in Los Osos will be presented in the Task 2 Report.

5.3. RWQCB

There are no known additional requirements that are expected from the RWQCB.

5.4. Department of Public Health

There are no known additional requirements that are expected from the DPH.

5.5. SWRCB

There are no known additional requirements that are expected from the SWRCB. The most likely source of funding assistance would be from grant programs and/or the SRF. These funds, if available, will be subject to approval by the SWRCB. Water reuse is a regulatory priority, especially where saltwater intrusion into the aquifer is an issue, as it is in Los Osos. As such, the decentralized option may present opportunities for funding that may not exist for the centralized options.

6. Sitting Considerations

The decentralized option will consider the following options:

1. Multiple sites within the community where land is available
2. Multiple sites on the edge of the community – as considerable available undeveloped land exist.

The Task 2 report will identify the prospective treatment facilities candidate sites.

Sitting of the treatment systems within the community will require the use of undeveloped lots and "paper streets". Paper streets are areas that show up as streets on the assessors map but that are not currently cleared or paved. These areas add to the undeveloped lot areas and increase the total available area for sitting of treatment facilities. The potential available area will be calculated by offsetting the building perimeter and the property lines by setbacks – typically 10 feet. The remaining area is considered potentially available area for sitting of a treatment facility.

6.1. Neighbor Considerations/Impacts

Neighbor impacts will be minimized through the use of subsurface treatment units, landscaping, extensive odor control capacity and the potential configuration of a subsurface Nitrex™ wetland that can be visually appealing while retaining the treatment process below grade. A schematic of a typical system will be prepared in Task 2.

7. Environmental

The major environmental considerations are understood to be:

1. California Coastal Commission approval for use of any ESHA sites
2. Impact of the proposed project on water supply sustainability
3. Carbon Footprint of proposed system – the energy use of the proposed system will be determined in Task 3 along with consideration of impacts on climate change (such as methane gas release) and life cycle considerations
4. Affordability

San Luis Obispo County
Los Osos Wastewater Project Development

TECHNICAL MEMORANDUM

TASK 2 DECENTRALIZED WASTEWATER TREATMENT SCENARIOS

FINAL
July 3, 2008

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Los Osos Technical Memo
Design Criteria
July 3, 2008

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1. Introduction

The purpose of this technical memorandum (TM) is to develop decentralized wastewater treatment and dispersal scenarios for the Los Osos Community in San Luis Obispo County, CA. The study area will be defined followed by an analysis of available area for potential treatment and dispersal sites. The available area will be compared to the required area for treatment and disposal and specific sites will be identified. For each scenario, quantities will be generated for use in the Task 3 cost estimates.

The following scenarios will be developed:

1. Multiple locations within Los Osos
2. Two locations within Los Osos that maximize gravity flow and minimizing transmission piping

2. Study Area Definition and Characteristics

The Study Area has been defined as the Prohibition Zone. Figure 2-1 shows the delineation of the Prohibition Zone within the Los Osos Community. The Los Osos Community Service District and the Los Osos Community Jurisdictional boundary are also shown on Figure 2-1 for reference. LAI understands that the Study Area and the Prohibition Zone are the same. Based upon the land use data file provided to LAI by the San Luis Obispo County Department of Planning, Table 2-1 shows the land use distribution for Los Osos.

Table 2-1. Land Use Distribution within the Prohibition Zone

Land Use Categories	Area (sq ft)	Area (acres)	# of Parcels
Commercial	5,224,468	119.94	307
Public Area	3,944,058	90.54	26
Residential	51,368,403	1,179.26	4,906
Unclassified	2,544,954	58.42	6
Total	***63,081,883***	***1,448.16***	***5,245***

FIGURE 2-1. LOS OSOS COMMUNITY SERVICE DISTRICT AND THE LOS OSOS COMMUNITY JURISDICTIONAL BOUNDARY

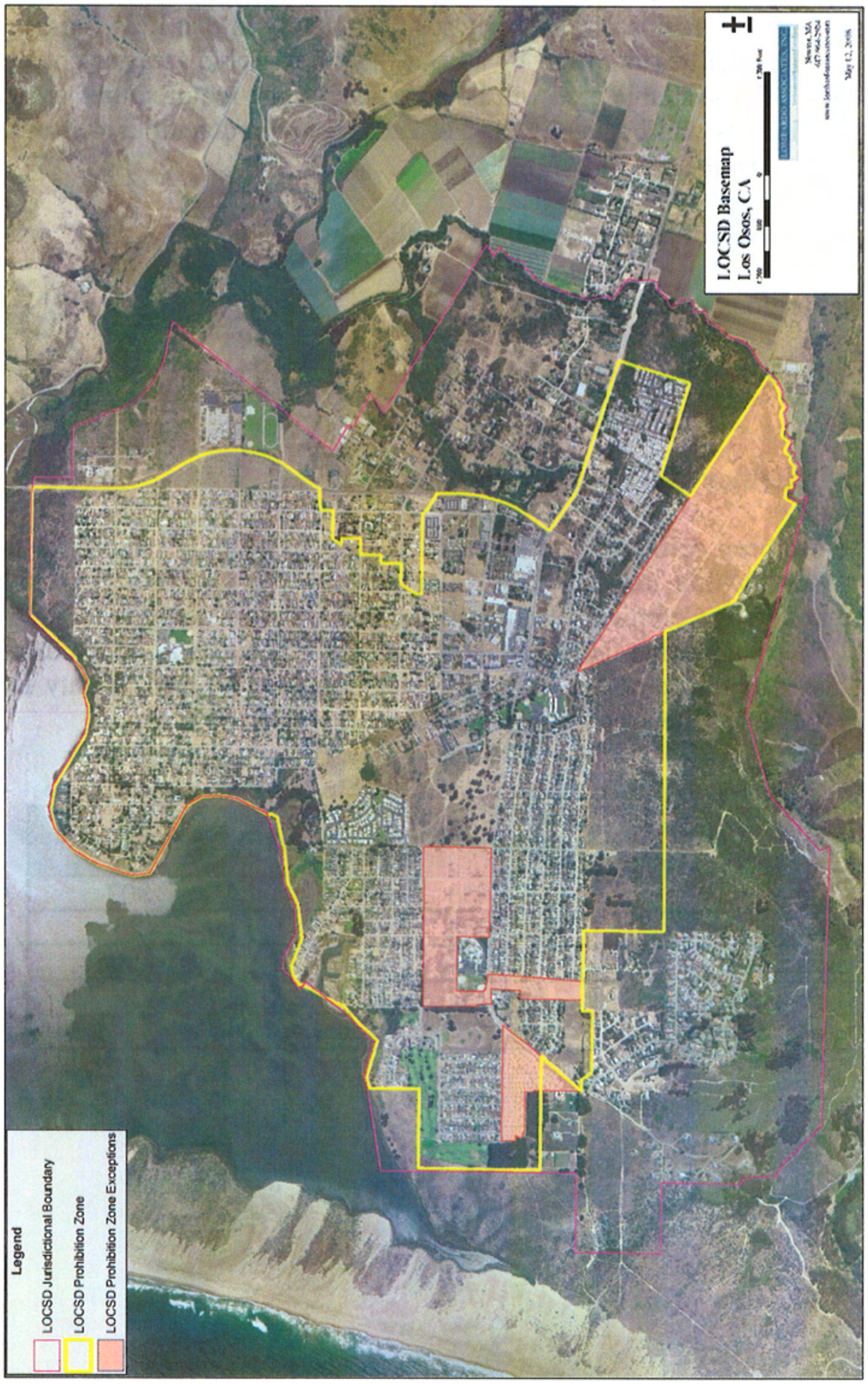


Figure 2-2 illustrates the Land Use / Zoning Map for the Los Osos Area. Figure 2-3 illustrates the areas within Los Osos that are served by the three water purveyors:

- Los Osos Community Service District
- Cal Cities Water Company
- S&T

Figure 2-4 illustrates the topography for the study area. Figure 2-5 illustrates groundwater contours and depth to groundwater, which is useful for understanding favorable locations for drainfields. Figure 2-6 illustrates the population and median incomes by the various census tracks in Los Osos. Table 2-2 summarizes the population and median income data, which is used for affordability analysis.

FIGURE 2-2. LOS OSOS COMMUNITY ZONING MAP

FIGURE 2-3. AREAS WITHIN LOS OSOS THAT ARE SERVED BY THE THREE WATER PURVEYORS

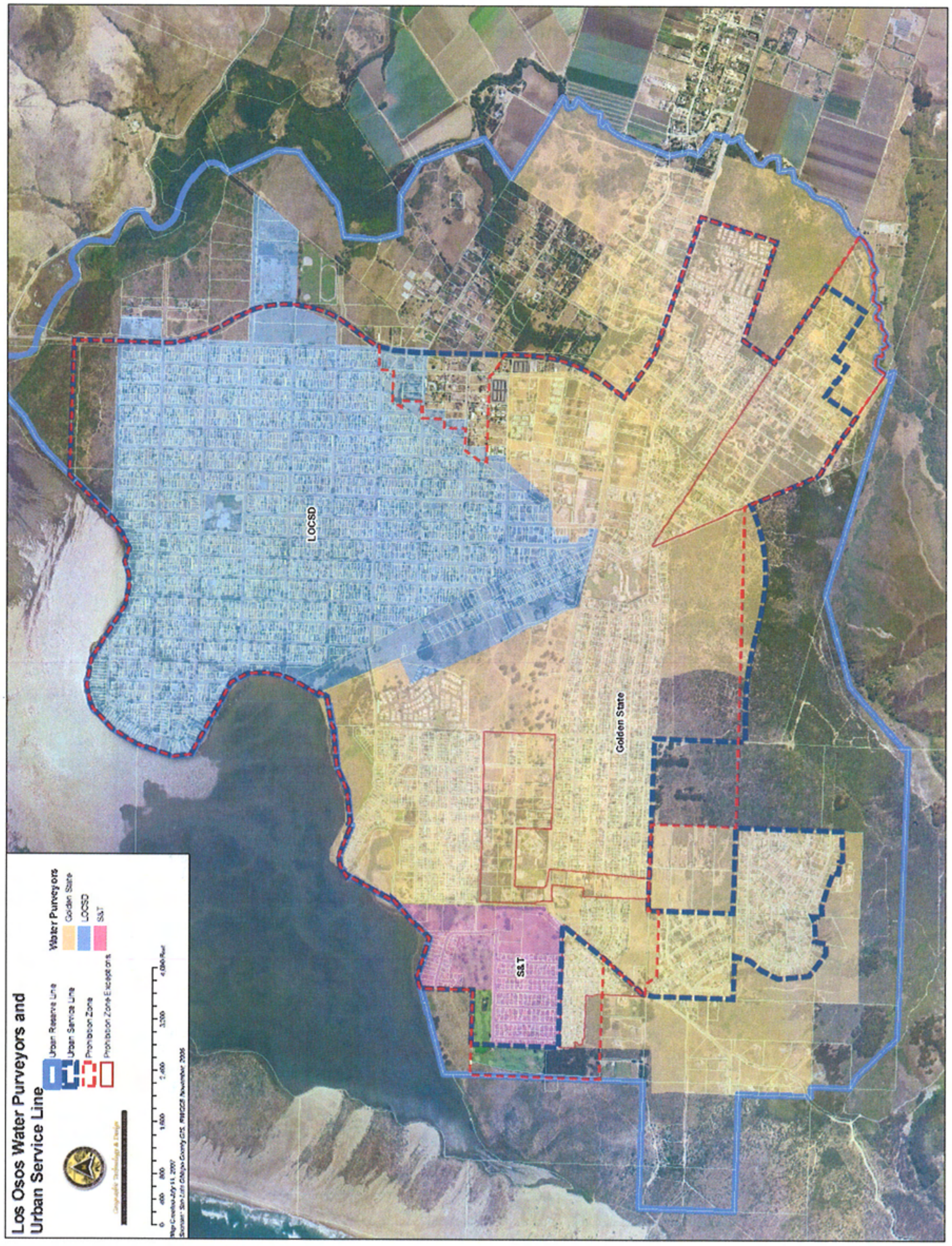


FIGURE 2-4. LOS OSOS COMMUNITY USGS TOPOGRAPHIC MAP

(shaded area represents developed portion of Los Osos)

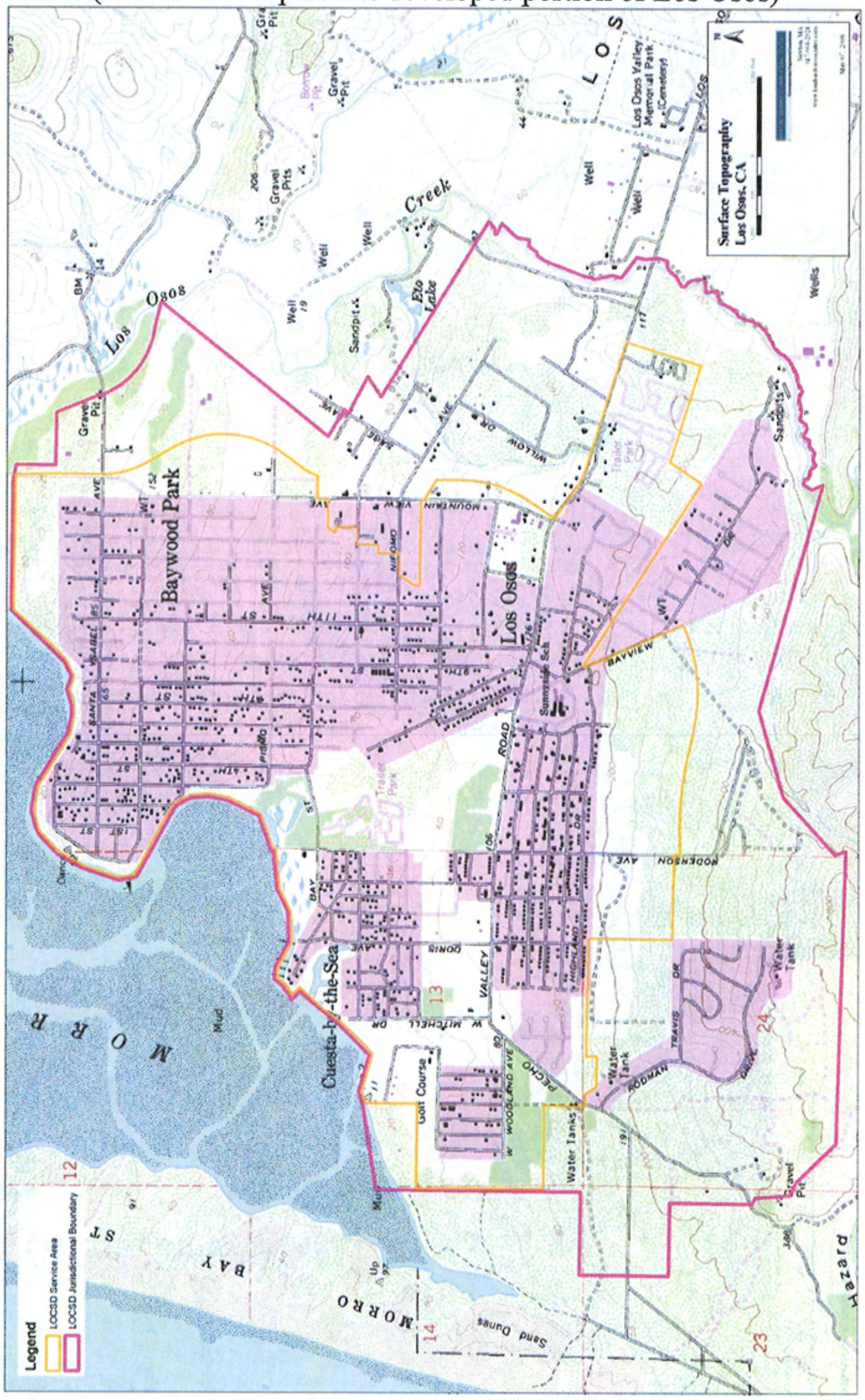


FIGURE 2-5. GROUNDWATER ELEVATIONS AND DEPTH TO GROUNDWATER CONTOURS

(Reference: Cleath & Associates, Inc., "Los Osos Nitrate Monitoring Program – October 2006 Groundwater Monitoring," Figure 1, December 2006

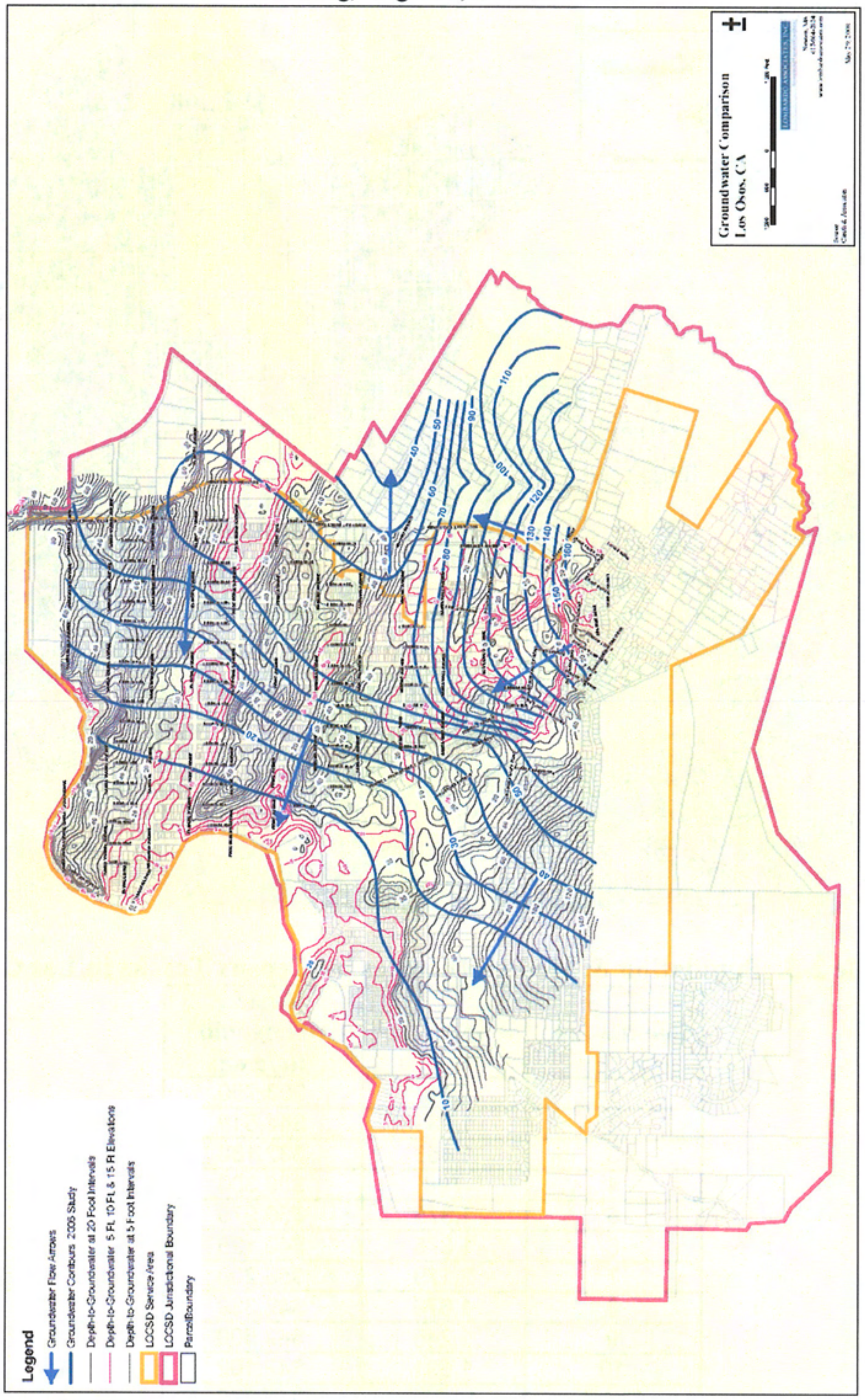


FIGURE 2-6. POPULATION & MEDIAN INCOMES BY CENSUS TRACKS IN LOS OSOS

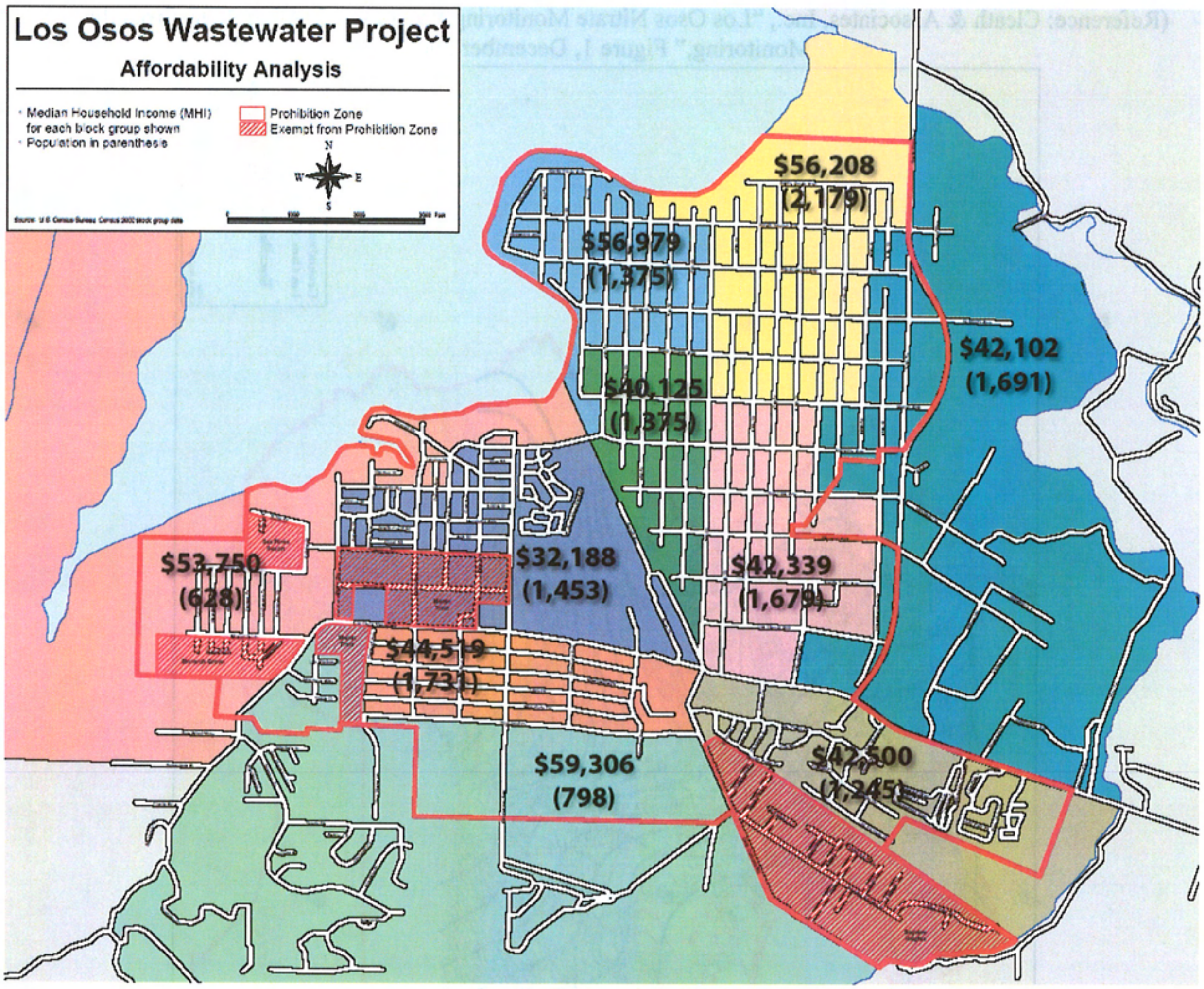


Table 2-2. Population & Median Incomes by Census Tracks in Los Osos

Census Area	Population	Median Household Income
1	628	$53,750
2	1,731	$44,519
3	1,453	$32,188
4	798	$59,306
5	1,375	$56,979
6	1,375	$40,125
7	2,179	$56,208
8	1,679	$42,339
9	1,245	$42,500
10	1,691	$42,102
Total	**14,154**	**$46,355**

Table 2-3 presents the Build-Out Population and Number of Connections for Los Osos, as presented in the March 2001 Montgomery Watson Final Project Report.

Table 2-3. Build-Out Population and Number of Connections

Area	County Population Estimate	Wastewater Committee Adjustment	Build-Out Population	Number of Connections
Baywood Pk, Walker et al.	4,443	0	4,443	1,580
Multifamily outside Baywood Pk, Bush/Ferrel, Cuesta by the Sea, Holland Tract, Morro Shores	7,030	0	7,030	1,035
Vista de Oro, New Anastasi Tract	330	0	330	2
Daisy Hill, Sea Oaks, Sunny Oaks (mobile home parks)	815	0	815	3
NE Baywood	933	0	933	366
Central Baywood	1,593	0	1,593	637
Redfield Woods	1,778	0	1,778	696
Bay Oaks	213	0	213	85
Bayridge	370	0	370	1
Sunset Terrace	418	0	418	167
Morro Palisades	1,325	-1,325	0	0
Portion Martin Tract	43	0	43	17
Commercial/Institutional	462	0	462	185
Total	***19,753***	***-1,325***	***18,428***	***4,774***

Source: Montgomery Watson 2001 Final Project Report

3. Existing and Projected Development

Based upon the database referenced in Section 2, Table 3-1 summarizes the developed and undeveloped parcels in the Study Area. Tables 3-2a and 3-2b show the distribution of ownership for parcels in the Study Area.

Table 3-1: Parcel Development Data

Table. PARCEL DEVELOPMENT			
Status	Number of Parcels	Total Area (Acres)	Total Area (ft^2)
Developed	4,644	911	39,671,556
Undeveloped	539	452	19,709,624
Undetermined[1]	62	85	3,700,703
Developed			
Undeveloped			
Developed Subtotal	4,644	911	39,671,556
Undeveloped Subtotal	539	452	19,709,624
Total	**5,245**	**1,448**	**63,081,883**

[1]Not specified in database provided to LAI. Allocated by LAI based upon aerial photographs.

Table 3-2a: Parcel Ownership Data

Table. PARCEL OWNERSHIP						
	PUBLICLY OWNED		PRIVATELY		TOTAL # OF PARCELS	TOTAL AREA (ACRES)
	PUBLICLY-OWNED TOTALS		INDIVIDUALS & ORGANIZATIONS			
Status	# of Parcels	Area (Acres)	# of Parcels	Area (Acres)		
Developed	**1**	**0.143**	4,643	911	4,644	911
Undeveloped	**8**	**161**	531	249	539	452
Undetermined	**29**	**104**	33	23	62	85
TOTALS	**38**	**266**	**5,207**	**1,182**	**5,245**	**1,448**

Table 3-2b: Parcel Ownership Data

Table. PARCEL OWNERSHIP								
	PUBLICLY OWNED							
	LOCSD		SLO COUNTY		CA STATE		PUBLICLY-OWNED TOTALS	
Status	# of Parcels	Area (Acres)	# of Parcels	Area (Acres)	# of Parcels	Area (Acres)	# of Parcels	Area (Acres)
Developed	0	0	1	0.143	0	0	**1**	**0.143**
Undeveloped	4	53	2	33	2	118	**8**	**161**
Undetermined	18	10	10	51	1	1	**29**	**104**
TOTALS	**22**	**53**	**13**	**84**	**3**	**119**	**38**	**266**

For purposes of the report, undeveloped areas also include "paper streets". Paper streets are areas that show up as streets on the parcel maps; however the streets have not been built. These areas are narrow, long stretches of undeveloped land that could potentially be used for treatment and/or dispersal sites. Some sites can be used for treatment and some sites could be used for dispersal. A summary of the number and size of paper streets is presented in Table 3-3. Figure 3-1 shows the undeveloped lots and paper streets within the Study Area. Figure 3-2 illustrates typical paper streets in Los Osos.

Table 3-3: Paper Streets Within the Study Area

# of Paper Streets	Total Area (ft^2)	Total Area (Acres)	Minimum Area		Maximum Area	
			(ft^2)	(acres)	(ft^2)	(acres)
44	564,118	13	4,394	0.101	14,252	0.327

FIGURE 3-1. UNDEVELOPED LOTS AND PAPER STREETS WITHIN STUDY AREA

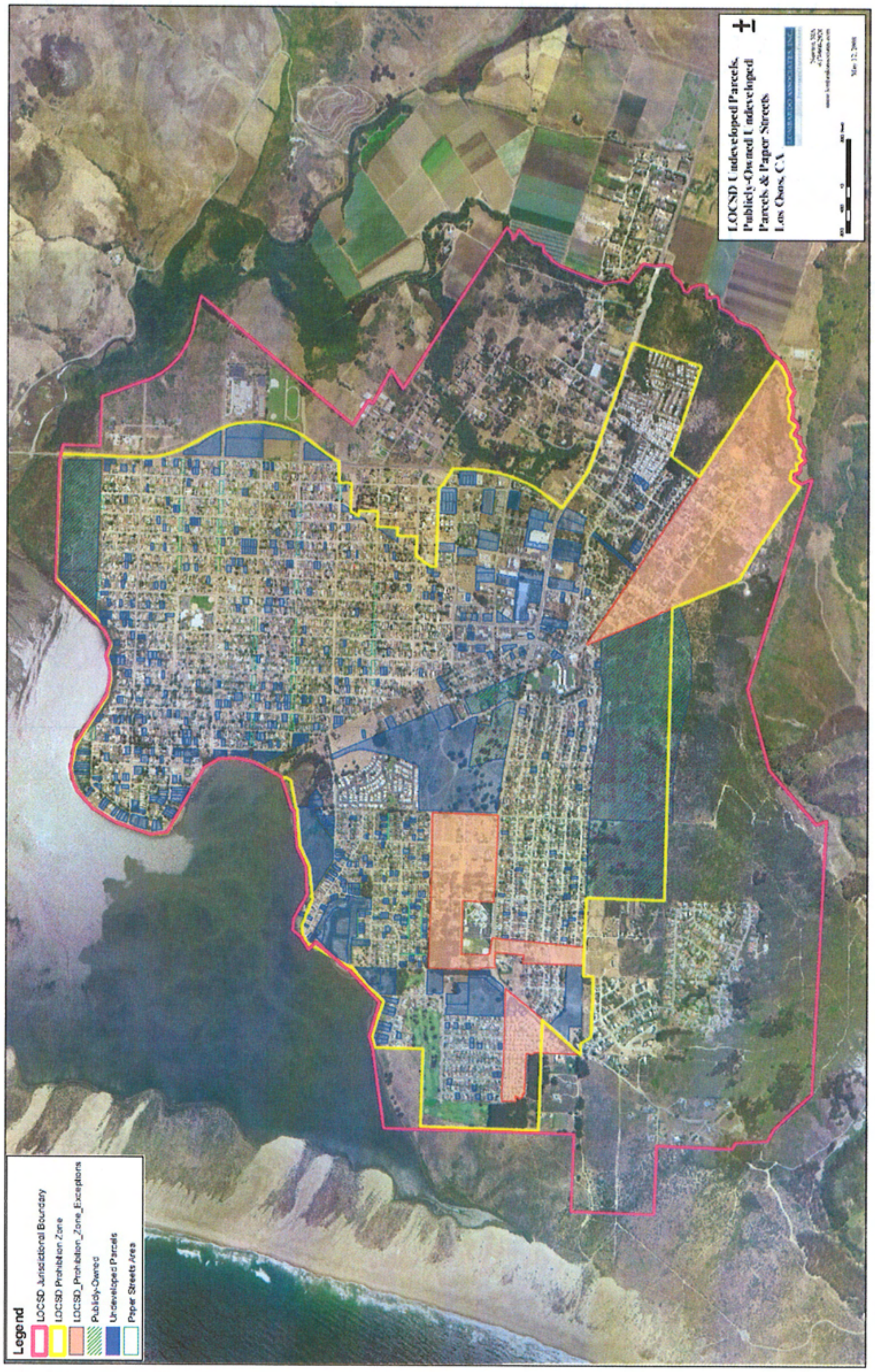


FIGURE 3-2. TYPICAL LOS OSOS PAPER STREETS

Existing and Buildout Wastewater Flows

Water use is commonly used to estimate wastewater generation for existing developments. During the months January – April, minimal irrigation and other non-wastewater generating water use is expected. Water use records for this period provide a current, measurable understanding of the wastewater generation patterns in Los Osos.

Table 3-4 presents the existing estimated wastewater generation for the Los Osos Community, using average daily water use taken from the Carollo 2008 Flows and Loads TM. Inflow and infiltration (I/I) is less in a STEP/STEG collection system, as compared to gravity collection systems due to smaller diameter pipes at shallower depths. Carollo estimated I/I at 100,000 gpd for a STEP system. Water conservation was also estimated at 100,000 gpd. As such, there is no net change in design flow due to I/I and water conservation.

Table 3-4: 2005 – 2007 Water Use and Wastewater Generation for Los Osos

Month	Average Daily Water Use[1] (gpd)	Average Daily Wastewater Generation
		Per Capita (gpcd)
January	495,749	58
February	782,705	80
March	490,647	57
April	633,707	72
	Average:	**67**

[1]Taken from Carollo 2008 Flows & Loads TM

Future flow, calculated as a projection based on per capita and per parcel flows is presented below.

As stated in the April 2008 Septage Receiving Station Option Technical Memorandum, which references the Engineer's Report, there are the following:

Table 3-5. Prohibition Zone Septic Tanks

Prohibition Zone	Existing Septic Tanks	Buildout	Benefit Units	
			Existing	Buildout
Inside	4,281	4,769		5,353
Outside	605	749		
Total	**4,886**	**5,518**		

Source: The Wallace Group

Based upon the 2000 Census information presented above in Figure 2-7, the population within the Prohibition Zone is 14,154 and the buildout population within the Prohibition Zone is 18,428.

Table 3-6. Wastewater Flows Based upon Per Capita Wastewater Flow of 67 gpd

	Existing	Buildout
Population	14,154	18,428
Developed Parcels	4,281	4,769
Wastewater Generation (gpd)	948,381	1,200,000
I/I Total		

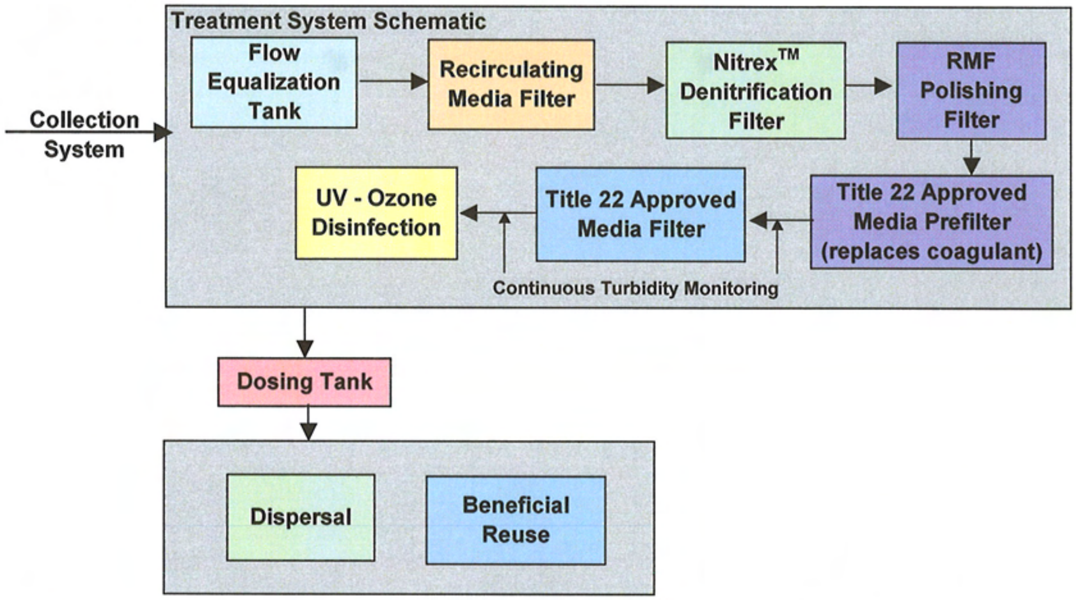
Source: The Wallace Group Assessment Database associated with the Engineer's Report

4. Treatment and Dispersal / Reuse Areas

4.1. Required Area – Entire Community

Based on LAI's experience with layouts for decentralized wastewater treatment systems, the required area for each proposed treatment site was estimated. A schematic of the proposed treatment system is presented in Figure 4-1.

FIGURE 4-1: PROCESS FLOW DIAGRAM FOR TITLE 22 COMPLIANT NITREX™ SYSTEM



Based on these unit processes, an average size of 0.23 ft^2 / gpd of design flow for will be used. Treatment plant and dispersal system sizing does not provide for set backs or buffer areas. Setbacks and buffer areas are addressed later in this report when available areas are identified and quantified. Dispersal area requirements assume an application rate of 1.0 gpd/sf with no consideration of hydrogeologic factors – which is beyond the scope of this technical memorandum. A comparison of previously reported application rates is presented later in Tables 4-3 and 4-4.

Table 4-1 summarizes the required area for the buildout flows associated with a septic tank effluent collection system.

Table 4-1: Required Area for Treatment and Dispersal

Design Flow (gpd)	Net WWTF Area Required (ft^2)	Net Dispersal Area Required (ft^2) (at 1 gpm/sf)[1]
1,200,000	282,916	1,200,000

[1]Hydrogeological conditions dictate required areas needed, which is beyond the scope of this project.

4.1.1. Sub Area Requirements

LAI examined Los Osos in four distinct sub-areas, as illustrated in Figure 4-2. LAI used the number of developed parcels in each sub-area and used the reported flow per parcel based upon the Benefit Units in the Assessment Engineer's Report prepared by the Wallace Group to calculate the expected buildout flow per sub-area. Table 4-2 presents the buildout wastewater flow data by sub-area. There is not a readily available database of parcel by parcel breakdown of the future growth to enable a parcel by parcel differentiation between existing and buildout flows.

Table 4-2. Los Osos Wastewater Flow by Sub-Area

Sub-Area		Number of Parcels	Buildout Wastewater Flow (gpd)[1]
1	North	2,906	630,200
2	East	193	83,500
3	Southeast	297	102,600
4	West	1,781	388,100
Total		***5,177***	***1,200,000***

[1]Derived from Benefit Units in Engineer's Report = 225 gpd * BU

FIGURE 4-2. LOS OSOS WASTEWATER FLOW BY SUB-AREA

4.2. Available Areas

4.2.1. Previously Identified / Proposed Areas

Figure 4-3 illustrates previously proposed wastewater treatment and disposal sites and Table 4-3 illustrates the pre-determined capacities based upon hydrogeologic considerations, along with Table 4-4 presenting the previously proposed design criteria. The actual loading rates will have to be finalized once sites are selected. Hydraulic analyses will be performed by Cleath & Associates and are not within the scope of this report. Based on the data in Tables 4-3 and 4-4, an average loading rate of 1.0 gpd/ft^2 will be used to estimate the capacity of prospective sites that have not been previously analyzed.

FIGURE 4-3. EFFLUENT DISPOSAL SITES

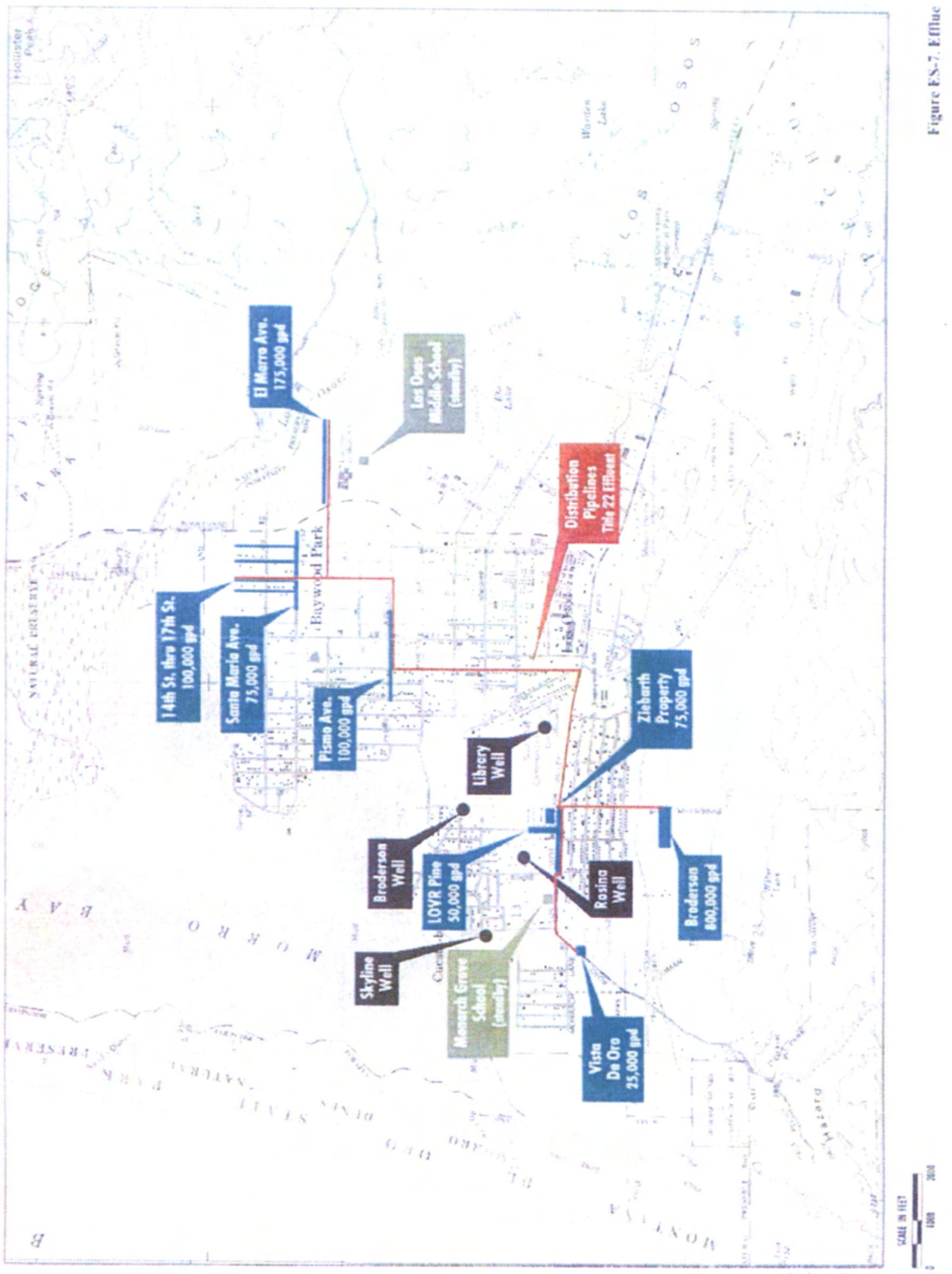


Table 4-3. Disposal Capacities, Loadings and Distance to Nearest Municipal Well

Site	Area (ft^2)	Disposal Capacity (gpd)	Hydraulic Loading (in/min)	Approx. Distance to Nearest Municipal Well (ft)	Application Rate (gpd/sf)
Broderson Site	300,000	800,000	0.003	600	2.67
Westside					
Los Osos Valley Rd/Pine St.	48,000	50,000	0.003	550	1.04
Ziebarth Property	86,000	75,000	0.003	700	0.87
Vista de Oro	16,000	25,000	0.002	800	1.56
Monarch Grove Elementary School	43,560	26,400	-	400	0.61
Westside Subtotal	***193,560***	***176,400***			***0.91***
Eastside					
Pismo Avenue	108,000	100,000	0.001	1,200	0.93
Santa Maria Avenue	68,000	75,000	0.001	1,500	1.10
14th Street thru 17th Street	56,000	100,000	0.002	1,500	1.79
El Morro Avenue	87,000	175,000	0.002	3,000	2.01
Los Osos Middle School	20,000	131,400	-	3,400	6.57
Eastside Subtotal	***339,000***	***581,400***			***1.72***
Total	**832,560**	**1,557,800**			**1.87**

Source: Montgomery Watson 2001 Final Project Report, Table 5-5.

Table 4-4. Effluent Disposal – Design Criteria

Description	Capacity (gpd)	Approx. Area (ft x ft)	Approx. Area (sf)	Number of Zones	Capacity Per Zone (gpd)	Application rate (gpd/sf)
Westside						
Sea Pines	30,000	NA	NA	1	30,000	-
Vista de Oro	20,000	80 x 200	16,000	1	20,000	1.25
Monarch Grove Elementary School	stand by	220 x 240	52,800	1	70,000	-
Pine	50,000	40 x 500	20,000	1	50,000	2.50
Broderson Ave.	40,000	40 x 400	16,000	1	40,000	2.50
Broderson	800,000	270 x 1,300	351,000	6	133,000	2.28
Westside Subtotal	***940,000***		***455,800***	***11***		***2.06***
Eastside						
Pismo	160,000	40 x 2,300	92,000	2	80,000	1.74
Santa Maria / 18th	160,000	40 x 1,700	68,000	2	80,000	2.35
Los Osos Middle School	stand by	20,000 sf	20,000	1	30,000	-
El Morro	175,000	40 x 1,700	68,000	2	87,500	2.57
East Ysabel / Scenic	40,000	40 x 1,000	40,000	1	40,000	1.00
South Bay	125,000	40 x 1,400	56,000	2	62,500	2.23
Eastside Subtotal	***660,000***		***344,000***	***10***		***1.92***
Total	**1,600,000**		**799,800**	**21**	**723,000**	**2.00**
Average zone capacity					76,000	

Source: Montgomery Watson 2003 Revised Project Report. Section preceding table references Cleath and Associates work in assigning above capacities. Application rates calculated by LAI based on capacity and area.

4.2.2. Additional LAI Identified Sites

LAI identified additional undeveloped sites for treatment or dispersal. Tables 4-5 and 4-6 summarize these sites. Potential developed sites that could be used for treatment or dispersal (as virtually all facilities could be underground, including under parking areas) are listed on Table 4-7. Additional developed properties may be candidate sites. The potential areas for drainfields at Monarch Grove School, Sunnyside Elementary School, Baywood Elementary School and Los Osos Middle School are illustrated on Figures 4-4 through 4-7.

Table 4-5: Potential Treatment or Dispersal Sites*

Zone		Benefit Units	Buildout Flow (gpd)	Total Parcels	Existing Developed Parcels	Potential Treatment and/or Dispersal Site	Type: Paper Street (PS) or Undeveloped Lots (UL)	Available Area Area (ft^2)	Capacity for Treatment (gpd) Based upon 0.23 SF/gpd	Capacity for Dispersal (gpd) Based upon 1.0 SF/gpd
North	N-1	989	222,500	1,061	909	N1-A	PS	52,000	226,100	52,000
						N1-B	UL	31,100	135,200	31,100
						N1-C	UL	48,200	209,600	48,200
						N1-D	UL,PS	64,800	281,700	64,800
						N1-E	PS	39,000	169,600	39,000
						N1-F	PS	39,000	169,600	39,000
							Subtotal	***274,100***	***1,191,800***	***274,100***
	N-2	959	215,800	1,042	934	N2-A	UL	185,000	804,300	185,000
						N2-B	UL	225,000	978,300	225,000
						N2-C	UL	31,500	137,000	31,500
						N2-D	UL	121,400	527,800	121,400
							Subtotal	***562,900***	***2,447,400***	***562,900***
	N-3	853	191,900	803	743	N3-A	PS	75,300	327,400	75,300
						N3-B	UL	62,000	269,600	62,000
						N3-C	UL	42,600	185,200	42,600
						N3-D	PS	23,000	100,000	23,000
							Subtotal	***202,900***	***782,200***	***179,900***
East	E-1	371	83,500	193	178	E1-A	UL	85,900	373,500	85,900
						E1-B	UL	40,000	173,900	40,000
						E1-C	UL	35,000	152,200	35,000
						E1-D	UL	58,100	252,600	58,100
						E1-E	UL	67,300	292,600	67,300
						E1-F	UL	48,100	209,100	48,100
							Subtotal	***334,400***	***1,453,900***	***334,400***
Southeast	SE-1	456	102,600	297	264	SE-B	UL	62,200	270,400	62,200
						SE-A	UL	57,500	250,000	57,500
						SE-C	UL	216,600	941,700	216,600
						SE-D	UL	85,400	371,300	85,400
						SE-E	UL	18,800	81,700	18,800
						SE-F	UL	73,400	319,100	73,400
							Subtotal	***513,900***	***2,234,200***	***513,900***
West	W-1	793	178,400	941	786	W1-A	UL	516,000	2,243,500	516,000
						W1-B	UL	217,000	943,500	217,000
						W1-C	UL	105,100	457,000	105,100
						W1-D	UL	552,000	2,400,000	552,000
						W1-E	UL	519,200	2,257,400	519,200
							Subtotal	***1,909,300***	***8,301,400***	***1,909,300***
	W-2	932	209,700	840	800	W2-A	UL	475,100	2,065,700	475,100
						W2-B	UL	69,000	300,000	69,000
						W2-C	UL	272,600	1,185,200	272,600
							Subtotal	***816,700***	***3,550,900***	***816,700***
							TOTAL	**4,614,200**	**19,961,800**	**4,591,200**

*Site A within each zone has been selected as the treatment site.

Table 4-6: Potential Treatment or Dispersal Sites Summary

Zone	Buildout Flow (gpd)	Available Area Area (ft^2)	Capacity for Treatment (gpd) Based upon 0.23 SF/gpd	Capacity for Dispersal (gpd) Based upon 1.0 SF/gpd
North				
N-1	222,500	274,100	1,191,800	274,100
N-2	215,800	562,900	2,447,400	562,900
N-3	191,900	202,900	782,200	179,900
Subtotal	***630,200***	***1,039,900***	***4,421,400***	***1,016,900***
East	83,500	334,400	1,453,900	334,400
Southeast	102,600	513,900	2,234,200	513,900
West				
W-1	178,400	1,909,300	8,301,400	1,909,300
W-2	209,700	816,700	3,550,900	816,700
Subtotal	***388,100***	***2,726,000***	***11,852,300***	***2,726,000***
Total	**1,200,000**	**4,614,200**	**19,961,800**	**4,591,200**

Table 4-7: Potential Developed Sites for Treatment and/or Dispersal

Name	Zone	Drainfield Disposal Capacity (gpd)	Reuse Water Recycle (gpd)
North			
Pismo Ave.	N-1	100,000	-
Baywood Elem. School	N-2	39,300	13,100
14th - 17th Street	N-2	100,000	-
Santa Maria Ave.	N-2	75,000	-
	Subtotal	***314,300***	***13,100***
West			
Sea Pines Resort	W-1	87,900	-
Mid-Town Site	W-1	115,200	-
Ziebarth Property	W-1	75,000	-
Monarch Grove School	W-2	26,400	8,800
LOVR/Pine Ave.	W-2	50,000	-
Tri W Site	W-2	-	-
South Bay Community Center	W-2	26,400	8,800
Sunnyside Elem. School	W-2	26,400	8,800
	Subtotal	***407,300***	***26,400***
El Morro Ave.	outside boundary	175,000	-
Los Osos Middle School	outside boundary	131,400	43,800
Los Osos Valley Memorial Park Cemetary	outside boundary	249,600	83,200
	Subtotal	***556,000***	***127,000***
	Total	**1,277,600**	**166,500**

FIGURE 4-4. POTENTIAL AREA FOR DRAINFIELD – MONARCH GROVE SCHOOL

FIGURE 4-5. POTENTIAL AREAS FOR DRAINFIELDS – SUNNYSIDE ELEMENTARY SCHOOL

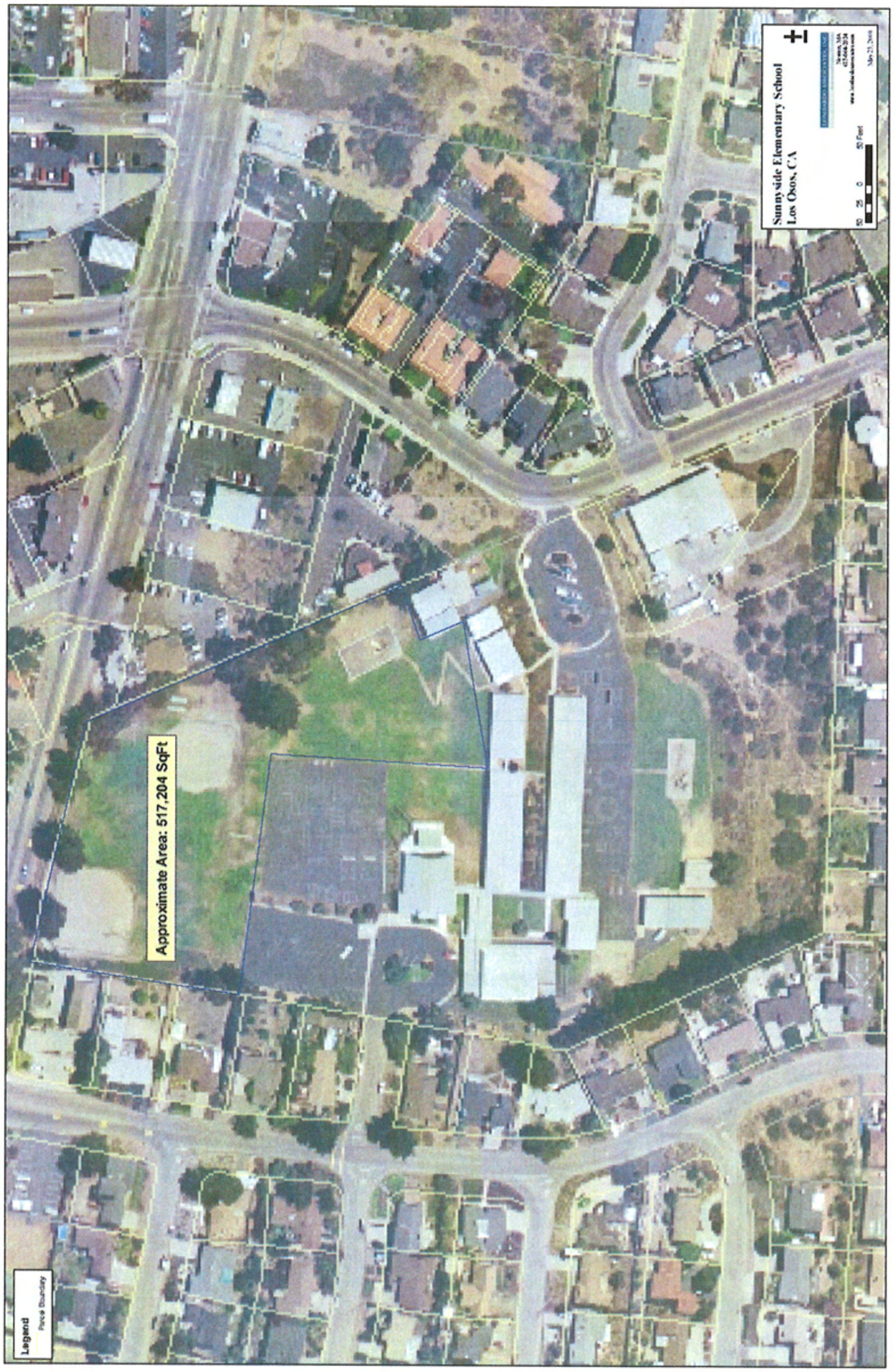
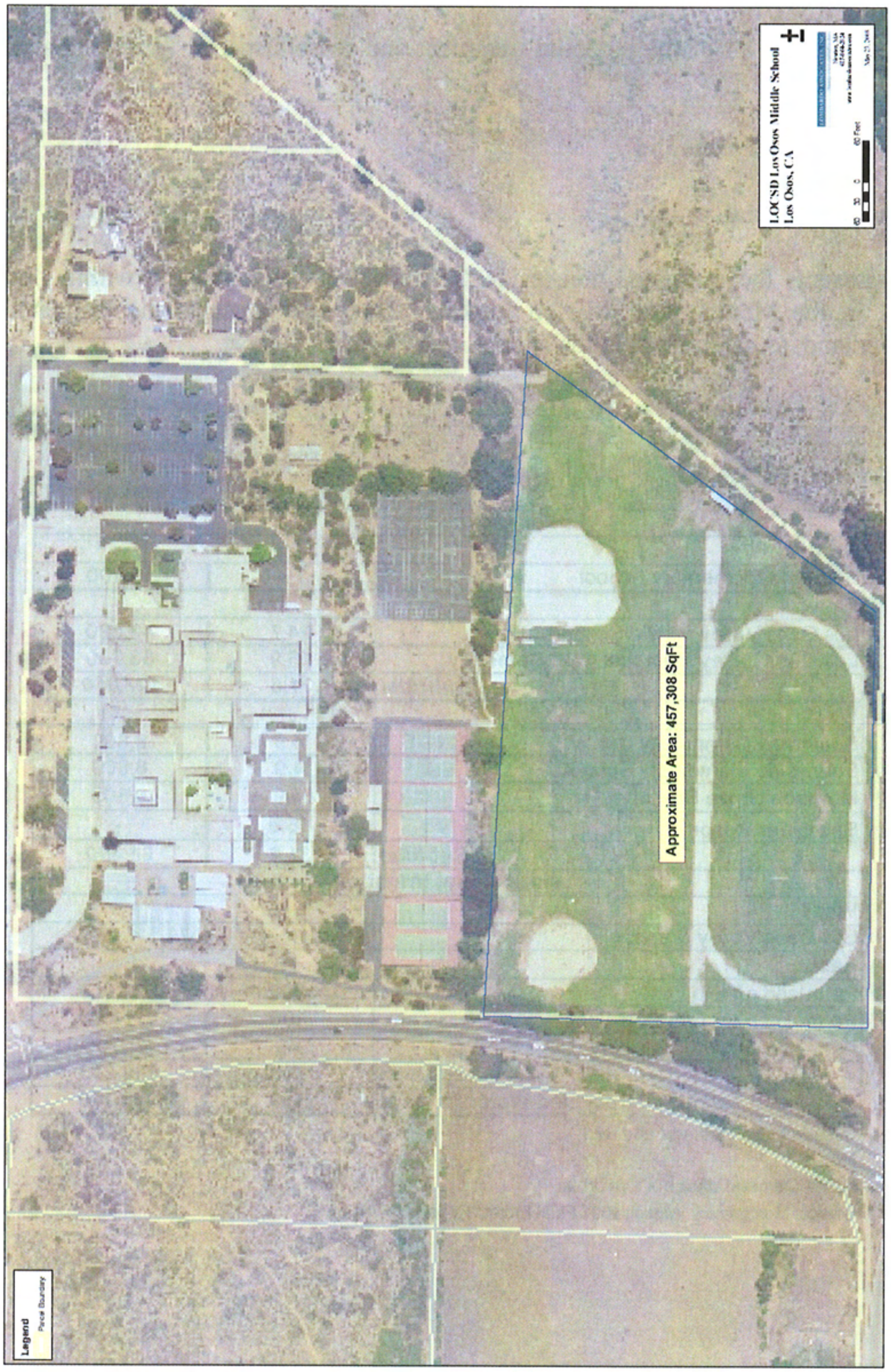


FIGURE 4-6. POTENTIAL AREAS FOR DRAINFIELDS – BAYWOOD ELEMENTARY SCHOOL

FIGURE 4-7. POTENTIAL AREAS FOR DRAINFIELDS – LOS OSOS MIDDLE SCHOOL



4.2.3. Summary of All Sites

Figure 4-8 illustrates all of the potential treatment and reuse/dispersal (drainfields) sites in the Prohibition Zone.

4.3. Recycle Water Demand

4.3.1. Non-Residential

Table 4-8 presents the estimated non-residential recycled water demand within Los Osos, as determined in the Montgomery Watson Report. Table 4-9 presents the estimated monthly irrigation demand, as determined in the Montgomery Watson Report.

Table 4-8. Estimated Non-Residential Recycled Water Demand within Los Osos

Customer Name	Average Annual Demand (afy)	Average Day Peak Month (July) (gpd)
Landscape Irrigation		
North		
Baywood Elementary School	7.4	13,100
East		
Los Osos Valley Middle School	24.7	43,800
Los Osos Valley Memorial Park Cemetery	46.9	83,200
Subtotal	***71.6***	***127,000***
West		
South Bay Community Center	4.9	8,800
Sunnyside Elementary School	4.9	8,800
Monarch Grove School	4.9	8,800
Sea Pines Resort[1]	16.5	-
Subtotal	***31.2***	***26,400***
Agricultural Irrigation		
West		
Los Osos Valley Nursery	N/A	N/A
East		
Farmland off Eto Lane	300	532,900
Farmland near Cimarron Way	100	177,600
Farmland behind Cemetery	46	81,700
Subtotal	***446***	***792,200***
Total Estimated Recycled Water Demand	**556**	**958,700**

[1]Needs to be verified / updated.
Notes:
N/A = Demand data not available.
Source: Montgomery Watson 2001 Final Project Report, Table 5-1.

FIGURE 4-8. POTENTIAL TREATMENT AND REUSE/DISPERSAL (DRAINFIELDS) IN PROHIBITION ZONE

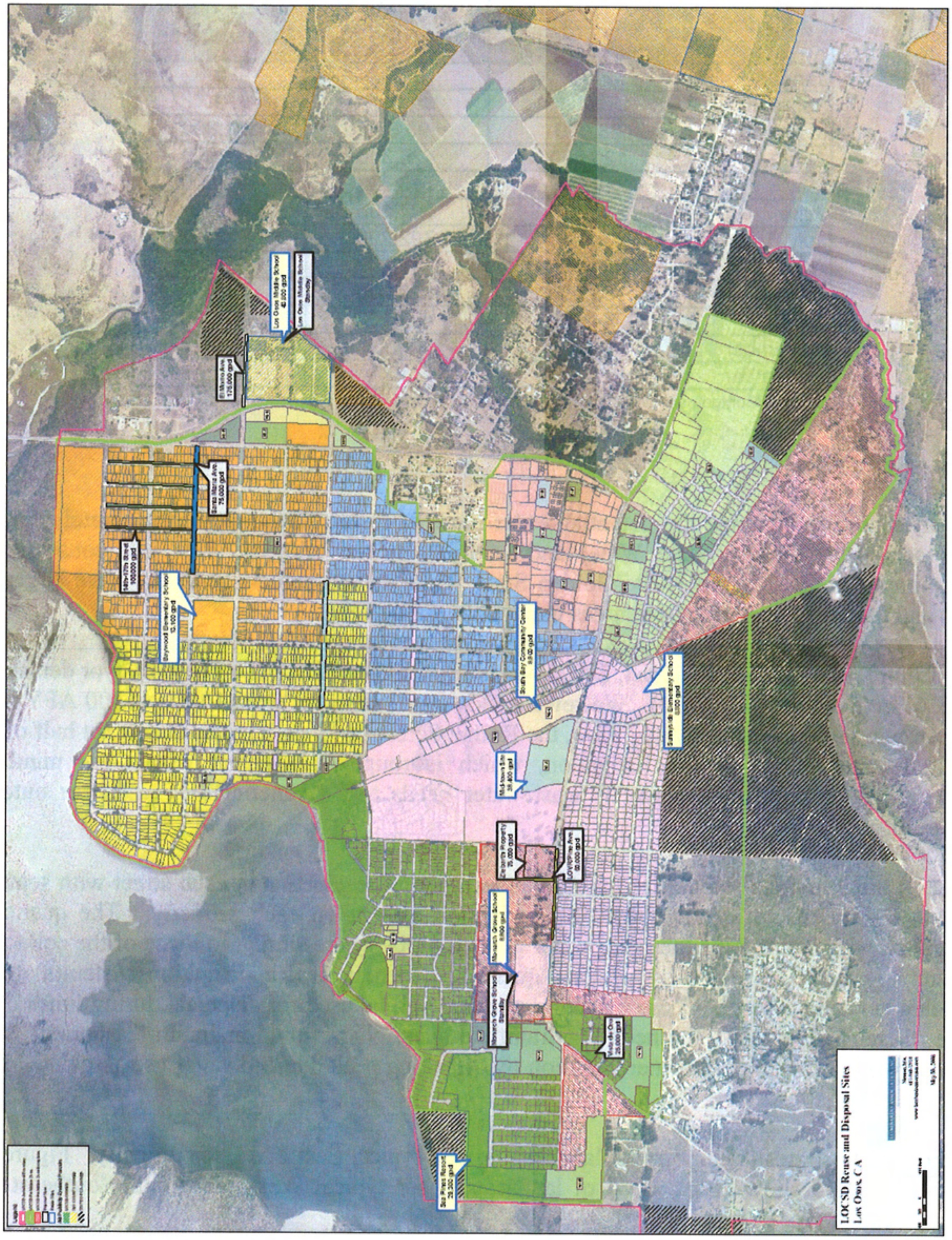


Table 4-9. Estimated Monthly Irrigation Demand

Month	Non-Residential Landscape Irrigation (gpd)	Agricultural Irrigation (gpd)	Total Estimated Demand (gpd)
January	0	0	0
February	0	0	0
March	28,000	93,800	121,800
April	125,600	426,300	551,900
May	210,300	713,500	923,800
June	236,600	804,100	1,040,700
July	234,200	792,200	1,026,400
August	233,700	792,200	1,025,900
September	183,500	620,000	803,500
October	144,900	492,200	637,100
November	4,800	14,500	19,300
December	0	0	0

Source: Montgomery Watson 2001 Final Project Report, Table 5-2.

4.3.2. Residential

LAI attempted to examine the potential water reuse at residential properties separately for the areas served by Golden State Water and LOCSD, as the property sizes and consequently irrigation areas are different. The Golden State Water served parcels generally have larger lot sizes and therefore larger irrigated areas than the LOCSD areas.

According to the LOCSD's August, 2002, Water Master Plan, the total urban purveyor demand is 3100 AFY (average 2.77 MGD). Wastewater flows are estimated from 1000 to 1300 AFY from start up to build-out, respectively. Also, the Rough Screening Report states that about half of the urban demand is for outdoor irrigation, which is roughly consistent with these numbers. Consequently a large percentage of wastewater needs to be beneficially reused for outdoor irrigation.

Reuse at the individual properties involves a separate reuse pipeline in each street with separate lateral connections to an individual drip irrigation system on each property. The quantities associated with distributing the reuse water to each property are similar to those of the collection system. In addition to the distribution quantities, there is a drip irrigation system(s) to be installed at each property. These irrigation systems will be used for dispersal during times of no reuse, thereby eliminating the need for drainfield sites. This would maintain the current water balance while mitigating seawater intrusion by offsetting peak demand water use associated with residential irrigation.

Figure 4-9 illustrates the amount of landscaping at a typical East Los Osos property. Figures 4-10 through 4-13 show aerial views of landscaping for typical West, North and Southeast Los Osos blocks of properties.

FIGURE 4-9. LANDSCAPING AT TYPICAL EAST LOS OSOS PROPERTY

FIGURE 4-10. AERIAL VIEW FOR TYPICAL WEST LOS OSOS BLOCKS OF PROPERTY

FIGURE 4-11. AERIAL VIEW FOR TYPICAL NORTH LOS OSOS BLOCKS OF PROPERTY

FIGURE 4-12. AERIAL VIEW FOR TYPICAL NORTH LOS OSOS BLOCKS OF PROPERTY

FIGURE 4-13. AERIAL VIEW FOR TYPICAL SOUTHEAST LOS OSOS BLOCKS OF PROPERTY

Table 4-10: Reuse & Dispersal Options

Zone	Zone Buildout Flow (gpd)	Reuse Sites	Dispersal Sites	Reuse Capacity (gpd)	Drainfield Capacity[1] (gpd)	Subtotals	Capacity Needed (gpd)
N-1	222,500		Pismo Ave.		100,000	218,000	0
			Paso Robles (N1-E)		39,000 [3]		
		Baywood Elem. School		13,100	40,000 [2]		
			Pismo Ave. (N1-F)		39,000 [3]		
N-2	215,800		Santa Maria Ave.		75,000	840,000	0
			14th - 17th Street		100,000		
		Los Osos Middle School		43,800	132,000 [2]		
			Same as Treatment (N2-A)		133,000 [3]		
			N2-B		225,000 [3]		
			El Morrow Ave.		175,000 [3]		
N-3	191,900		Undeveloped Properties at edge of Town boundary (N3-B & N3-C)		104,500 [3]	127,500	64,400
			Unused Paper Street area next to Treatment Site (N3-D)		23,000 [3]		
E-1	83,500		Same Parcel as Treatment (E1-A)		66,000 [3]	141,000	0
			E1-B		40,000 [3]		
			E1-C		35,000 [3]		
SE-1	102,600		Same Parcel as Treatment (SE-A)		33,000 [3]	95,000	0
			SE-B		62,000 [3]		
W-1	178,400		Same Parcel as Treatment (W1-A)		474,000 [3]	587,800	0
		Sea Pines Resort[4]		29,300	88,000 [2]		
		Monarch Grove School		8,800	26,400 [2]		
W-2	209,700	Sunnyside Elem. School		8,800	26,400 [2]	477,800	0
		South Bay Community Center		8,800	26,400 [2]		
			Same Parcel as Treatment (W2-A)	-	425,000 [3]		
Totals	***1,200,000***			***112,600***		***2,487,100***	***0***

[1] The Dispersal Capacities are those provided to LAI unless otherwise specified.

[2] The Reuse Capacities are provided for these sites. LAI estimated the Drainfield Capacity by assuming it is three (3) times the Reuse Capacity.

[3] Combination Treatment and Drainfield sites. LAI estimated the Drainfield Capacity by assuming 1 gpd/sf of Available Area. The Available Area was estimated by subtracting the Treatment Site Required Area from the available area of the Parcel/Paper Street.

[4]Needs to be verified / updated.

5. Decentralized Scenario Development

5.1. Scenario 1 – Multiple Locations Within Los Osos

This scenario involves creating 7 sub-zones for the project area, each having its own treatment and dispersal sites. The potential treatment and dispersal sites consist of undeveloped land either on paper streets or on undeveloped lots. These sites, along with their associated treatment and dispersal capacities, are detailed in Table 4-4 and illustrated on Figure 4-3. Dispersal and treatment sites are not confined to being located in the same zone or sub-area. Sites not utilized for treatment can be available for potential dispersal, and reuse sites were assigned disposal capacities equal to 3 times the reuse demand.

Figure 5-1 shows boundaries and total flow for each zone along with preliminary identification of treatment site candidates. Figure 4-3 illustrates potential reuse/dispersal sites.

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FIGURE 5-1: SCENARIO 1 TREATMENT ZONES

Based upon a preliminary engineering judgment, LAI created Figure 5-2, which illustrates the complete decentralized plan with initially proposed treatment and reuse/drainfield dispersal areas.

Figure 5-3 illustrates the preliminary layout for zone N-1. Figure 5-4 illustrates the layout for zone N-2, Figure 5-5 for zone N-3, Figure 5-6 for zone E-1 and Figure 5-7 for zone SE-1. Zones W-1 and W-2 are as shown on Figure 5-2. In each of the layout figures, site "A" is the selected treatment site.

For each zone, reuse/dispersal at the individual properties will be considered as an alternate disposal method.

FIGURE 5-2: DECENTRALIZED PLAN – WITH 7 SUB-ZONES

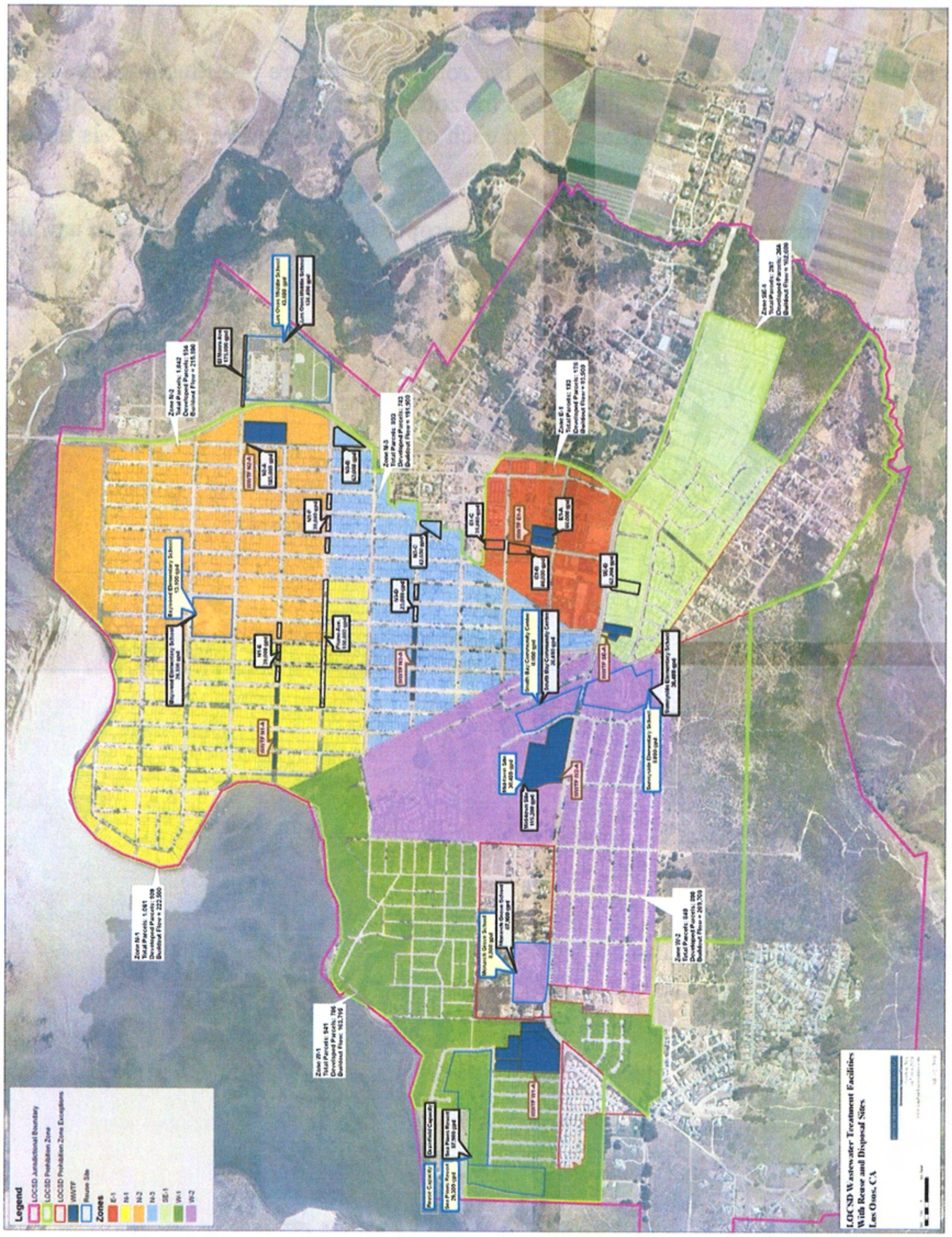


FIGURE 5-3: PROPOSED TREATMENT SITE LAYOUT FOR ZONE N-1

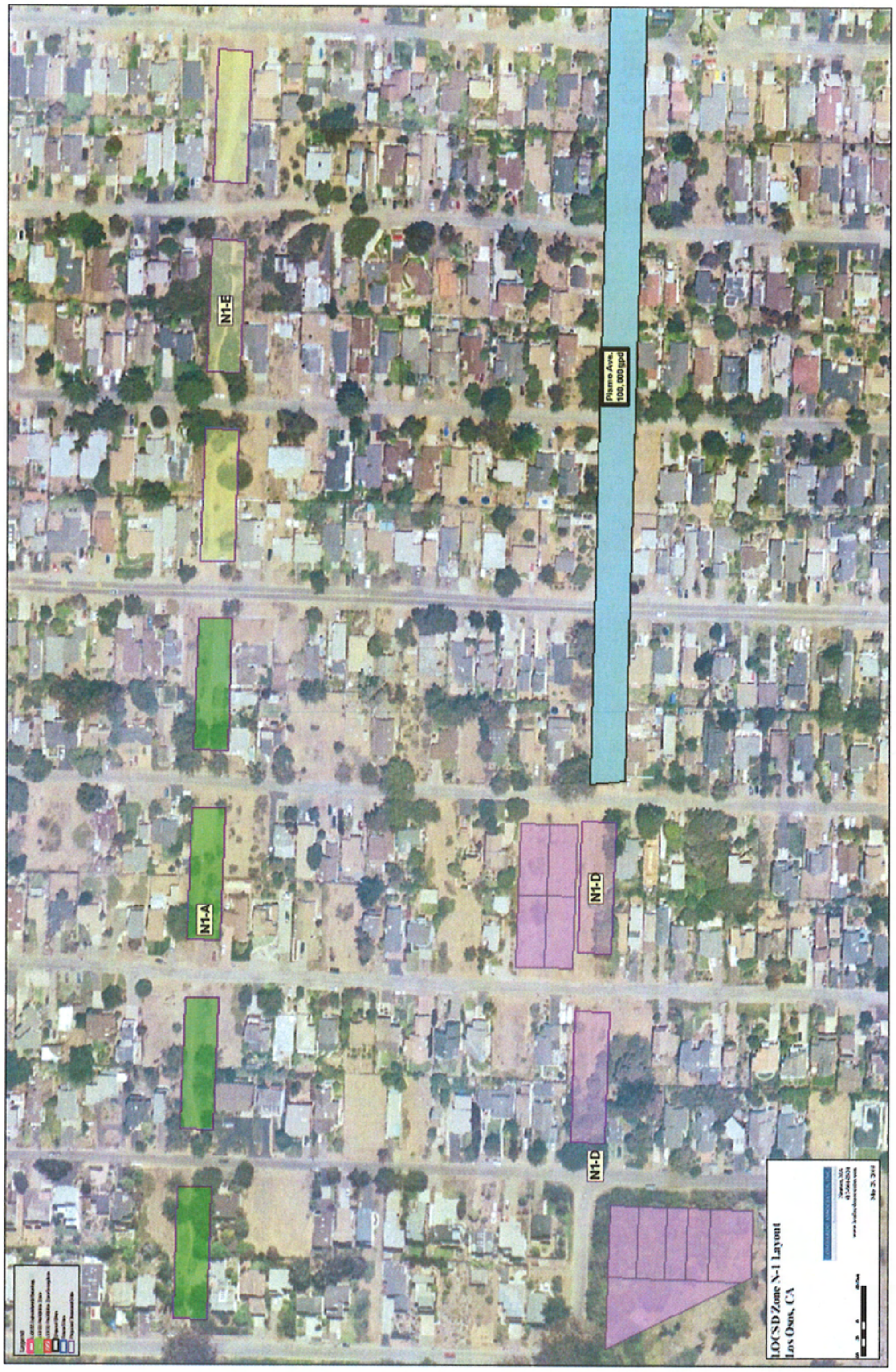


FIGURE 5-4: PROPOSED TREATMENT SITE LAYOUT FOR ZONE N-2

FIGURE 5-5: PROPOSED TREATMENT SITE LAYOUT FOR ZONE N-3

FIGURE 5-6: PROPOSED TREATMENT SITE LAYOUT FOR ZONE E-1

FIGURE 5-7: PROPOSED TREATMENT SITE LAYOUT FOR ZONE SE-1

Following is a commentary on the flows, collection, treatment and reuse/dispersal for each sub-zone.

5.1.1. Zone N-1

Zone N-1 is located in the northwest area of the Prohibition Zone. There are a significant number of undeveloped lots, however many of these are discontinuous and/or are along the waterfront where the combinations of permitting, dewatering and land acquisition issues are likely to be prohibitive. There are a total of 1,061 parcels, of which 909 are currently developed. Based on the benefit units assigned to these parcels, the buildout flow for Zone N-1 is approximately 205,000 gpd. Benefit units can be viewed as the wastewater capacity or wastewater generation rate per parcel.

Collection and Treatment

Site N1-A is the proposed location of the treatment system. This area is a string of paper streets along the western end of Paso Robles Avenue. The southwestern portion of Zone N-1 can drain by gravity to this site, with the remaining flow draining to the northwest. A pump station will be needed in the northwest portion of the area, as close to the water as possible. There are a number of undeveloped lots and one paper street that are candidate sites for a medium sized pump station, which will be sized for a peak hourly flow in the 500 – 600 gpm range.

Dispersal and Reuse

Reuse and disposal can occur on the same site via the same drip irrigation system. During times of irrigation demand, this will decrease the net flow of water into the ground and decrease water supply demand. During times when there is no irrigation demand, the full flow will go into the drip irrigation system, which is the basis of design.

The Pismo Avenue paper streets were previously identified as having a disposal capacity of 100,000 gpd. LAI has estimated the disposal capacity of site N1-E at 39,000 gpd, based on a loading rate of 1gpm/ft^2. Baywood Elementary School will be a dual site where reuse water will be used when needed and disposed of when not needed. LAI has estimated the disposal capacity of this site at 39,300 gpd. This leaves a deficit of 26,000 gpd that needs to be disposed of. There are three paper streets along Pismo Avenue, one block east of the previously identified disposal area. This site, N1-F, has an estimated capacity of 39,000 gpd and provides the additional capacity needed for Zone N-1.

5.1.2. Zone N-2

Zone N-2 is located in the northeast area of the Prohibition Zone. There are four large, undeveloped lots along the eastern edge of the Prohibition Zone in this zone that can accommodate treatment and dispersal, if needed as well as El Morrow Avenue and Los Osos Valley Middle School immediately to the east of Zone N-2. There are a total of 1,042 parcels, of which 934 are currently developed. Based on the benefit units assigned to these parcels, the buildout flow for Zone N-2 is approximately 198,000 gpd.

Collection and Treatment

Site N2-A is the proposed location of the treatment system. This large, undeveloped lot is at a relative low point to which some of the parcels in the southeast portion of this zone can drain by gravity. This area has topography that makes draining to any one location difficult. A combination of localized pressure sewers and a minimum of two small pump stations will be needed to convey the rest of the wastewater to the selected treatment site.

Dispersal and Reuse

Zone N-2 and the adjacent area off El Morrow Avenue have an excess of potential disposal capacity. Beneficial reuse is proposed at the school, making the use of El Morrow Avenue optimal. Reuse and disposal can occur on the same site via drip irrigation. The combination of these two sites can accommodate the entire dispersal requirements for this zone.

The treatment site has excess area that can also be used for dispersal. The treatment site excess capacity combined with the El Morrow Avenue capacity can also satisfy the demand in the event that irrigation and/or disposal at the school meets too much resistance. There are a number of paper streets in this zone along with the Santa Maria Avenue and 14^{th} – 17^{th} Street sites previously identified. In addition, Site N2-B has a capacity of 225,000 gpd and is also an option for dispersal.

5.1.3. Zone N-3

Zone N-3 is located in the center of the Prohibition Zone. This zone does not have sufficient available area to site both a treatment plant and dispersal sites. There are a total of 803 parcels, of which 743 are currently developed. Based on the benefit units assigned to these parcels, the buildout flow for Zone N-3 is approximately 176,000 gpd.

Collection and Treatment

Site N3-A is the proposed location of the treatment system. This is a string of paper streets along San Luis Avenue. The majority of this zone can drain by gravity to this site. The parcels in the northwest portion of the zone will require a small pump station to convey wastewater to this site.

Dispersal and Reuse

The treatment site does not use all the available area associated with the paper streets along San Luis Avenue. The remaining area, Site N3-D, has a capacity of 23,000 gpd. The two undeveloped lots, Site N3-B and Site N3-C, have a combined capacity of 105,000 gpd. This leaves a deficit of approximately 49,000 gpd that will need to be sent to another zone for dispersal. Site E1-C and the unused portion of Site E1-B have enough capacity to meet the remaining demand. An alternative would be to use a small portion of Site N2-B.

There are no previously identified reuse sites within Zone N-3

5.1.4. Zone E-1

Zone E-1 is located in the eastern area of the Prohibition Zone. This zone has a number of large, undeveloped lots that have capacity to site both a treatment plant and dispersal sites. There are a total of 193 parcels, of which 178 are currently developed. Based on the benefit units assigned to these parcels, the buildout flow for Zone N-E-1 is approximately 77,000 gpd.

Collection and Treatment

Site E1-A is the proposed location of the treatment system. This site consists of two large, undeveloped lots in the center of this zone. The majority of this zone can drain by gravity to this site, however a small pump station or pressure sewers will be needed.

Dispersal and Reuse

The treatment site does not use all the available area, with the remaining area having a capacity of 66,000 gpd. This leaves a deficit of approximately 11,000 gpd that will need to be sent to another site for dispersal. Site E1-B is across the street and has approximately 35,000 gpd of capacity, easily accommodating the remaining flow. The excess capacity from this site is reserved for flows from Zone N-E-1.

There are no previously identified reuse sites within Zone E-1.

5.1.5. Zone SE-1

Zone SE-1 is located in the southeastern portion of the Prohibition Zone. This zone also has a number of large, undeveloped lots. There are a total of 297 parcels, of which 264 are currently developed. Based on the benefit units assigned to these parcels, the buildout flow for Zone SE-1 is approximately 95,000 gpd.

Collection and Treatment

Site SE-A is the proposed location of the treatment system. This site consists of a one large and one small undeveloped lot. The small lot appears to be landlocked. This zone can drain entirely by gravity to the treatment site.

Dispersal and Reuse

The treatment site does not use all the available area, with the remaining area having a capacity of 33,000 gpd. This leaves a deficit of approximately 62,000 gpd that will need to be sent to another site for dispersal. Site SE-B is nearby and has approximately 62,000 gpd of capacity to accommodate the remaining flow.

Los Osos Valley Memorial Park Cemetery is to the east of this Zone and has a potential reuse demand of 83,200 gpd. The quantities will be generated for reuse at this site so that a cost/benefit analysis can be performed. Disposal is not proposed at this site.

5.1.6. Zone W-1

Zone W-1 is located in the northwest portion of the Prohibition Zone. This zone also has a number of large, undeveloped lots. There are a total of 941 parcels, of which 786 are currently developed. Based on the benefit units assigned to these parcels, the buildout flow for Zone W-1 is approximately 164,000 gpd.

Collection and Treatment

Site W1-A is the proposed location of the treatment system. This site consists of a four adjacent, undeveloped lots. Approximately half of this area can drain by gravity to the northwestern portion of this site. The remaining areas will require a pump station located in the northern end of this zone. Some of the properties in the northern end are isolated and will require pressure sewers to with outlets to the gravity-pump station system that will serve the northern portion of this zone.

Dispersal and Reuse

The treatment site has sufficient capacity to serve as a dispersal site. The excess capacity once treatment area has been accounted for is approximately 474,000 gpd.

The Sea Pines Resort is across the street from this site and has a previously identified potential reuse demand of 29,300 gpd. Given the large area of this site, there may be room for additional reuse at this site.

5.1.7. Zone W-2

Zone W-2 is located in the southwest portion of the Prohibition Zone. This zone has one previously identified undeveloped lot with an excess of available area. There are a total of 840 parcels, of which 800 are currently developed. Based on the benefit units assigned to these parcels, the buildout flow for Zone W-1 is approximately 193,000 gpd.

Collection and Treatment

Site W2-A is the proposed location of the treatment system. This site is a large, undeveloped lot located in the center of the Prohibition Zone. Topography is favorable in this zone and appears to allow an all gravity collection system. No pump stations or pressure sewers are anticipated for this zone.

Dispersal and Reuse

The treatment site has sufficient capacity to serve as a dispersal site. The excess capacity once treatment area has been accounted for is approximately 425,000 gpd.

Previously identified reuse sites include the South Bay Community Center and the Sunnyside Elementary School. Reuse and disposal can occur on the same site via drip irrigation.

5.2. Scenario 2 – Two Locations – One in Mid-Town and one in Northeast Region of Los Osos

This option will utilize two treatment locations in combination with multiple disposal and reuse locations. Figure 5-8 shows the proposed location of the treatment sites. The flows and available reuse/drainfield areas are the same as was presented in Section 5.1. Collection system quantities are similar with the exception of longer distribution piping and pump station force mains. There will be fewer pump stations that will be larger in size and conveying wastewater over a greater distance compared to Scenario 1.

5.2.1. Northeast System

The Northeast System is a combination of Zone N-1 and N-2. There are a total of 2,103 parcels, of which 1,843 are currently developed. Based on the benefit units assigned to these parcels, the buildout flow for the Northeast System is 439,000 gpd.

Collection and Treatment

Site N2-A is the proposed location of the treatment system. This large, undeveloped lot is at a localized low point to which some of the parcels in the southeast of the service area can drain by gravity. This area has topography that makes draining to any one location difficult. A combination of localized pressure sewers, one duplex and two pocket pump stations is proposed to convey the rest of the wastewater to the selected treatment site.

Dispersal and Reuse

Baywood Elementary School and Los Osos Middle School will be dual sites where reuse water will be used when needed and disposed of when not needed. The combined disposal capacity of these two sites is estimated at 172,000 gpd. The remaining disposal capacity will be achieved through use of the excess area at the treatment site and the previously identified El Morrow Ave site. These sites represent the optimal use of dispersal piping while maximizing beneficial reuse.

5.2.2. Mid-Town System

The Mid-Town System combines Zones N-3, E-1, SE-1, W-1 and W-2. There are a total of 3,074 parcels, of which 2,771 are currently developed. Based on the benefit units assigned to these parcels, the buildout flow for the Mid-Town System is 767,000 gpd.

Collection and Treatment

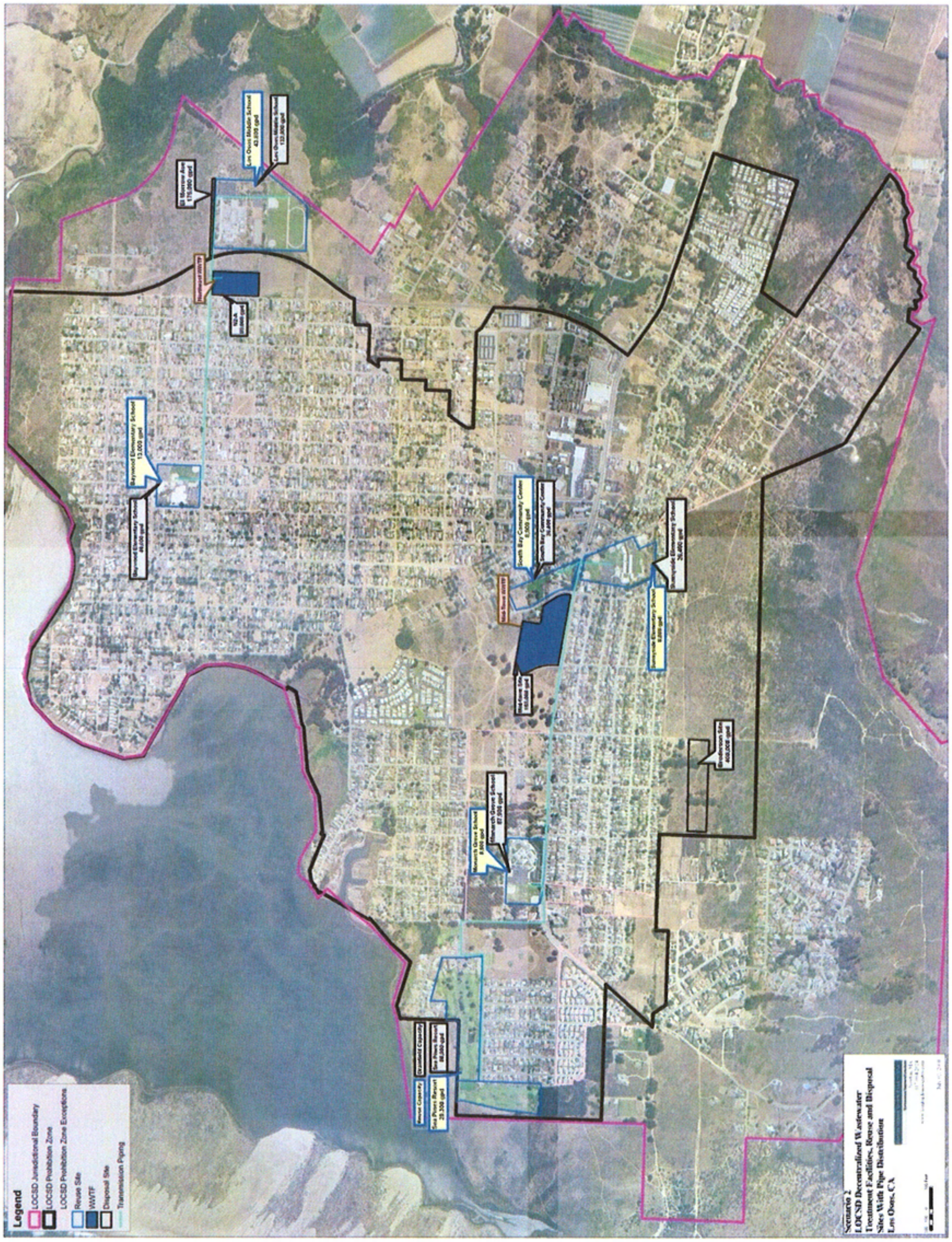
Site W1-A is the proposed location of the treatment system. This large, undeveloped lot is at a low point to which a significant number of parcels can drain by gravity. This area has favorable topography for draining large subareas via STEG systems to a pump station. A combination of localized pressure sewers, one duplex and one triplex pump station is proposed to convey the rest of the wastewater to the selected treatment site.

Dispersal and Reuse

The treatment site has sufficient capacity to serve as a dispersal site. The excess capacity once treatment area has been accounted for is approximately 474,000 gpd.

Sea Pines Resort, Monarch Grove School, Sunnyside Elem. School and South Bay Community Center will be dual sites where reuse water will be used when needed and disposed of when not needed. The combined disposal capacity of these four sites is estimated at 167,200 gpd. The remaining disposal capacity will be achieved through use of the excess area not used for treatment and the Broderson site, which is desirable due to saltwater intrusion mitigation. These sites represent the optimal use of dispersal piping while maximizing beneficial reuse and saltwater intrusion mitigation.

FIGURE 5-8: LOCATION OF TREATMENT SITES FOR SCENARIO 2



6. Lower Aquifer Seawater Intrusion Issues

The lower aquifer is presently experiencing seawater intrusion at approximately 460 acre-feet per year (AFY) or an average of 410,634 gallons per day. Discharges from Los Osos residents' septic tanks currently provide mitigation for seawater intrusion of approximately 90 AFY (or 80,342 gpd).

Various levels of seawater intrusion mitigation have been described as:

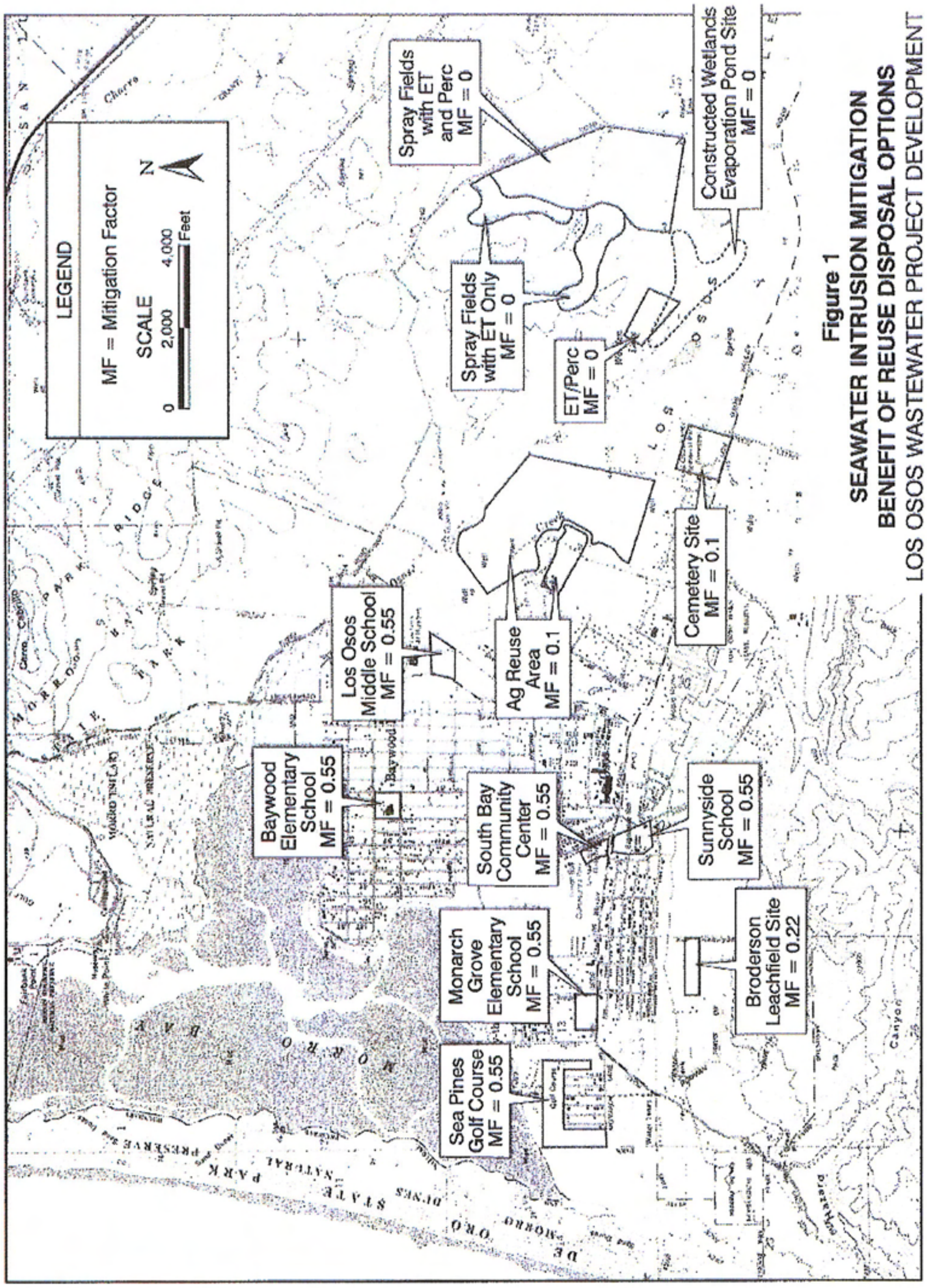
- Level 1 – maintain seawater intrusion at current levels by mitigating the impacts from the project of 90 AFY (removal of septic discharges to the groundwater basin).

- Level 2 – provide the maximum level of seawater intrusion mitigation possible for the wastewater project without significant water purveyor participation (190 to 240 AFY)

- Level 3 – provide mitigation for the current level of seawater intrusion with septic system collection (550 to 600 AFY). Mitigation projects will require purveyor participation.

The mitigation factor (MF) describes the ratio of seawater intrusion mitigated per volume of effluent reused or disposed with a particular alternative. As developed in the April 2008 TM Effluent Reuse and Disposal, Figure 6-1 shows possible locations of potential reuse/disposal alternatives and their accompanying MFs. In general, more seawater intrusion mitigation is obtained as production is reduced in lower aquifer wells on the west side of the basin closer to the leading edge of seawater in the aquifer.

FIGURE 6-1. POSSIBLE LOCATIONS OF POTENTIAL REUSE/DISPOSAL ALTERNATIVES AND THEIR MFS



Source: April 2008 TM Effluent Reuse and Dispersal Alternatives.

Using a mitigation factor of 0.55, the following flows need to be applied to offset stated seawater intrusion rates:

Table 6.1: Water Application based on Seawater Intrusion Rate and MF = 0.55

Seawater Intrusion Rate	Decreased Water Demand Required
410,634 gpd	746,607 gpd
490,976 gpd	892,683 gpd

For reference purposes, Figure 6-2 illustrates the location of the groundwater production wells and their annual production as determined by Cleath & Associates. Figure 6-3 illustrates the saltwater intrusion of the past years with Figures 6-4 and 6-5 illustrating the cross sections identified in plan view on Figure 6-3.

Options to achieve Level 3 include use of treated wastewater for deep well injections to create a hydraulic barrier, as well as reuse at residential properties. Reuse at non-residential properties does not sufficiently address Level 3 mitigation needs.

To precisely determine the demand for and whether reuse at residential properties is sufficient to achieve Level 3 mitigation requires a detailed analysis of water use – however, based upon the following analysis, relying on residential reuse will need groundwater pumping, as described below, as a supplement / storage mechanism.

According to the LOCSD's August, 2002, Water Master Plan, the total urban purveyor demand is 3100 AFY (average 2.77 MGD). Wastewater flows are estimated from 1000 to 1300 AFY from start up to build-out, respectively. Also, the Rough Screening Report states that about half of the urban demand is for outdoor irrigation, which is roughly consistent with these numbers. Consequently a large percentage of wastewater needs to be beneficially reused for outdoor irrigation.

As Table 6.1 makes clear, a large percentage of the wastewater effluent of 1.2 MGD (at buildout) needs to be beneficially used as a substitute for residential irrigation to achieve Level 3 Mitigation. Due to the normal seasonal variability of irrigation demand and essentially constant rate of wastewater generation, it is unlikely that this can be achieved without large storage facilities and/or groundwater pumping (i.e. groundwater acts as a storage facility). During summer high demand periods, groundwater from the upper aquifer could be extracted and beneficially used for irrigation and thereby reduce water supply demand.

A detailed analysis of the water use for irrigation needs to be performed to determine that wastewater reuse with supplemental upper aquifer groundwater will offset demand to achieve Level 3 Mitigation. It appears at this stage of planning that it is achievable.

As an option, use of injection wells as a saltwater barrier may be needed to achieve Level 3 mitigation. Source water could potentially be treated wastewater. The efficacy of this option is beyond the scope of this TM.

FIGURE 6-2. LOCATION OF GROUNDWATER PRODUCTION WELLS AND ANNUAL

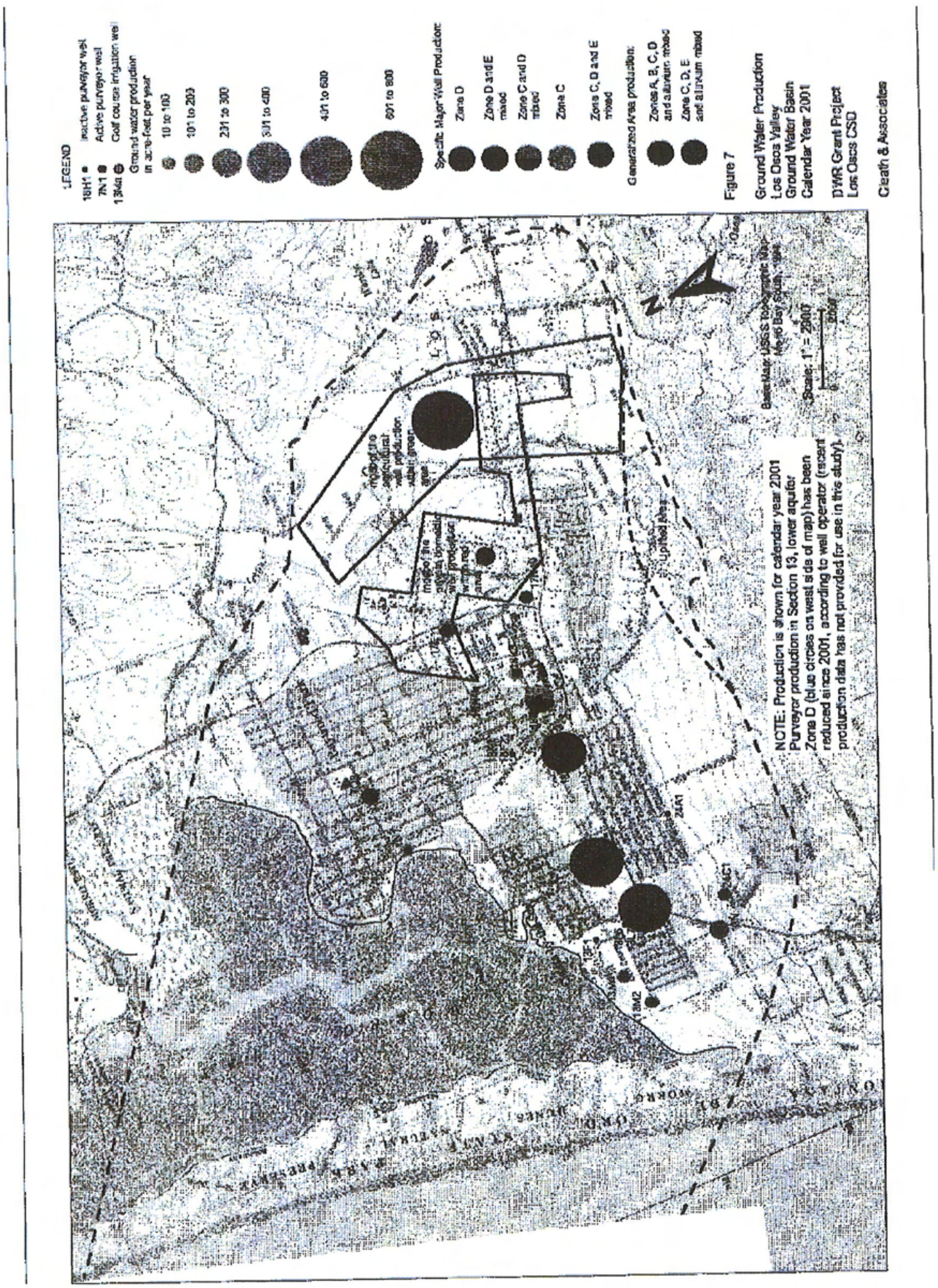


FIGURE 6-3. SALTWATER INTRUSION OF PAST YEARS

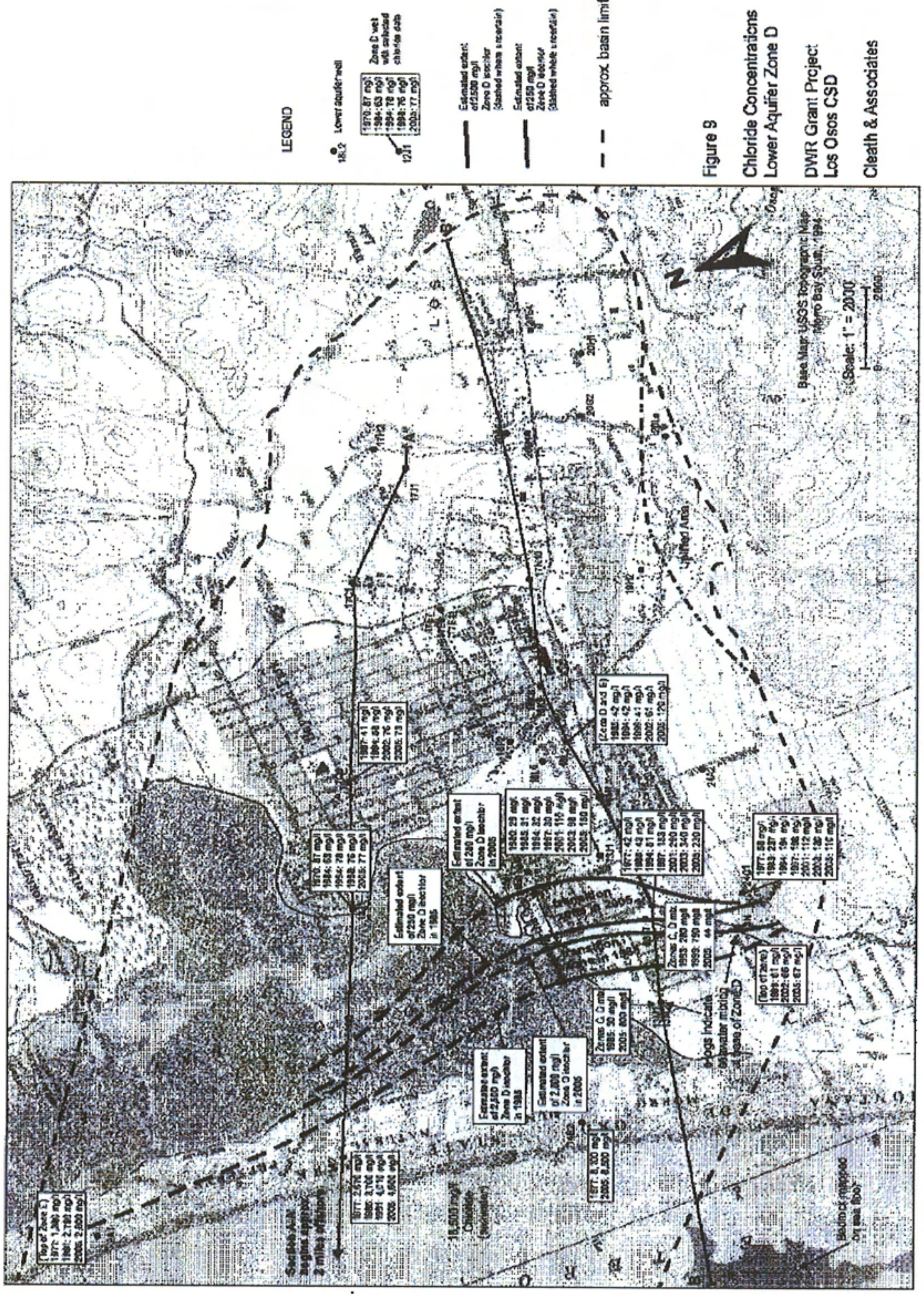


FIGURE 6-4. HYDROGEOLOGIC CROSS SECTION – LOS OSOS

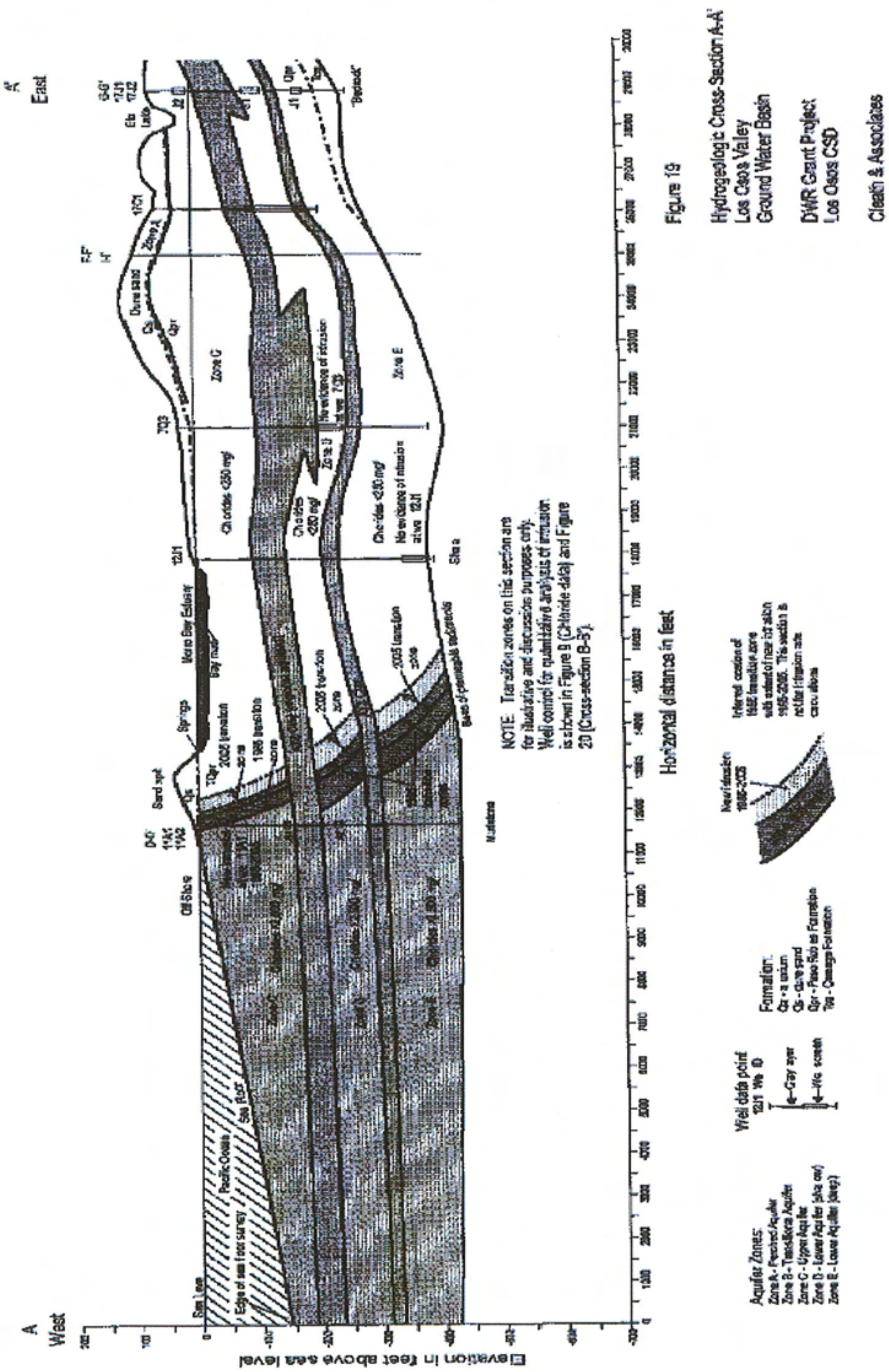
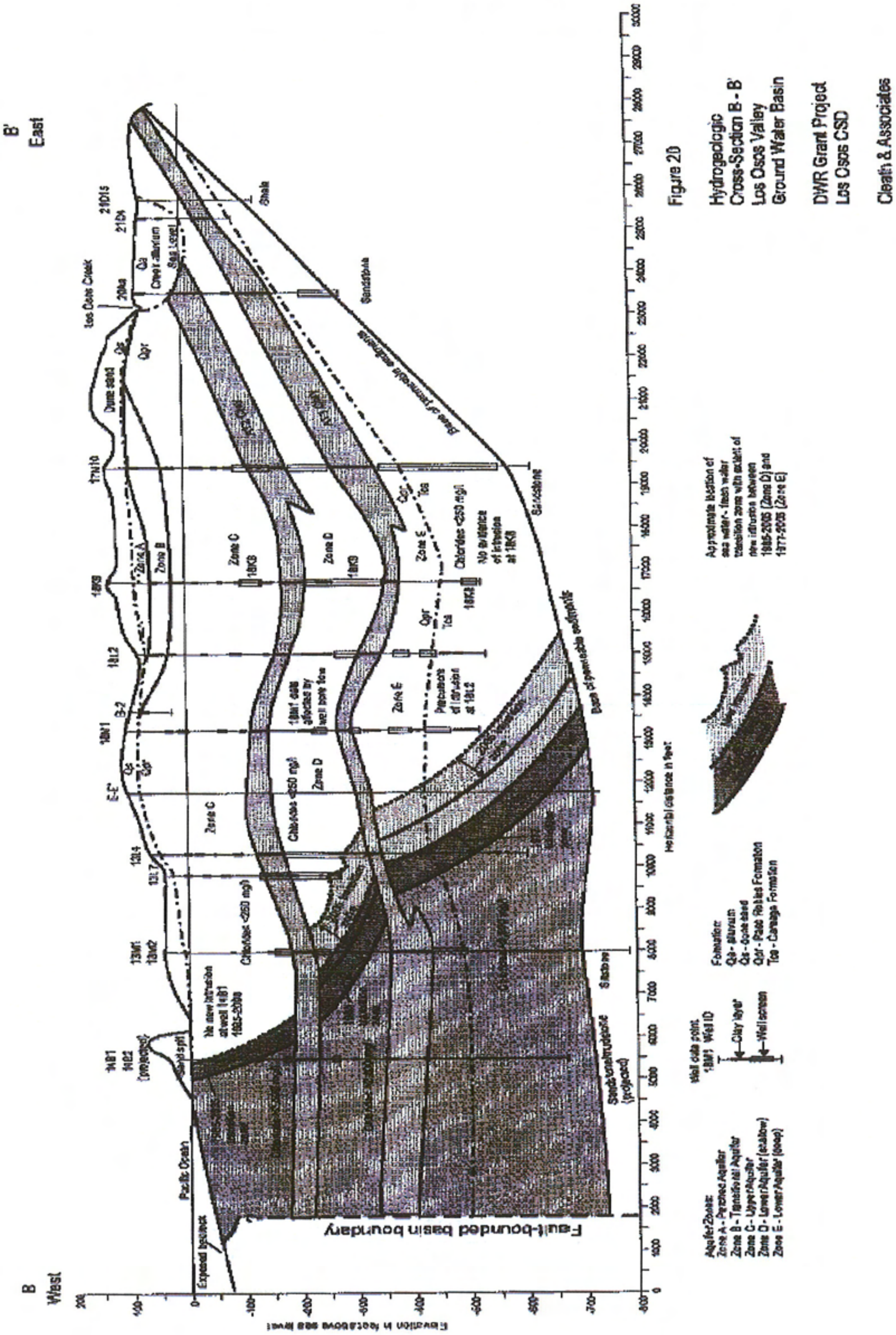


FIGURE 6-5. HYDROGEOLOGIC CROSS SECTION – LOS OSOS



7. Wastewater System Quantities

A review of previous quantities estimates for an all-gravity system is presented in Table 7-1. Table 7-2 presents our estimates of components quantities for a STEG system with minimal STEP systems and pump stations as needed. The on-lot laterals, 100% septic tank replacement and electrical/controls as needed will be included under separate line items for each type of lot in the Task 3 cost estimates. Table 7-3 presents the quantities associated with reuse/dispersal piping and required area.

Quantities associated with Scenarios 2 and 3 will be similar with respect to length of pipe. There will be a small difference in the length of force mains and in the length of dispersal/reuse piping. The other difference will be in the size of pipe required for collection and dispersal. These pipe sizes and minor pipe length differences will be accounted for in the unit costs used in the Task 3 cost estimates. The Task 3 report will have greater detail on the quantity differences between the two scenarios.

Table 7-1: All-Gravity System Quantities

Item	Quantity(1)
Gravity Sewers and Force Mains(2)	230,000
Manholes	807
Duplex Pump Station	6
Triplex Pump Station	2
Pocket Pump Station	12
Standby Power Supply	7
Laterals in Right of Way	4,769

Notes:

(1) Taken from Table 3-1, Carollo August 2007 *Viable Alternatives Analysis Fine Screening Analysis*

(2) Quantity does not include lateral in right-of-way listed separately.

Table 7-2: Quantities for Wastewater Collection, by Zone

Zone	# of Conn.	% Pressure Sewer	# of STEP Systems	# of STEG Systems	Interceptor Length (ft)			Pump Stations		
					Total	Pressure	Gravity	Pocket	Duplex	Force Main (ft)
N-1	909	2.0%	19	890	44,800	900	43,900	0	1	2,900
N-2	934	10.0%	94	840	43,500	4,400	39,100	2	0	4,500
N-3	743	2.0%	15	728	38,700	800	37,900	1	0	1,500
E-1	178	2.0%	4	174	9,300	200	9,100	1	0	1,300
SE	264	0.0%	0	264	17,000	0	17,000	0	0	0
W-1	786	10.0%	79	707	40,000	4,000	36,000	0	1	4,400
W-2	840	0.0%	0	840	38,000	0	38,000	0	0	0
Totals	**4,654**		**211**	**4,443**	**231,300**	**10,300**	**221,000**	**4**	**2**	**14,600**

Table 7-3: Scenario 1 Quantities for Treatment and Reuse/Dispersal*

Zone	Residential Reuse		Dispersal Area (ft^2)	WWTF Design Flow (gpd)	Piping to Dispersal Sites (ft)
	Reuse Lateral Pipe (ft)	Reuse Transmission Pipe (ft)			
N-1	72,720	44,800	222,500	222,500	3,000
N-2	74,720	43,500	215,800	215,800	3,700
N-3	59,440	38,700	191,900	191,900	7,500
E-1	14,240	9,300	83,500	83,500	730
SE	21,120	17,000	102,600	102,600	1,300
W-1	62,880	40,000	178,400	178,400	4,300
W-2	67,200	38,000	209,700	209,700	2,400
Totals	**372,400**	**231,300**	**1,204,400**	**1,200,000**	**23,000**

*Reuse lateral and distribution pipe are quantities associated with reuse/dispersal at individual properties. Dispersal piping is associated with the selected dispersal sites for each zone.

8. Responses to Decentralized TM Issues

The January 2008 Final Draft of the Decentralized Treatment TM identified a number of potential issues with the decentralize treatment scenario. This section provides responses to these issues.

8.1. Project Configuration

This TM addresses the general questions concerning the number and proposed locations of treatment sites. Cost issues will be addressed in the Task 3 report on project costs.

8.2. Disposal

This TM addresses issues on location and proposed volumes of dispersal and reuse sites.

8.3. References

Information concerning LAI's operating decentralized systems is readily available on our web site and is public record.

8.4. Regulatory Concerns

The combination of an RMF and the Nitrex^{TM} technology has been approved in numerous locations nationwide. While there are no identical installations, the technology is in use with a documented performance level. LAI has experience with comparable first-of-their-kind facilities, including one in Malibu, CA and the 0.9 MGD Mayo, MD STEG/STEP system with 3,000 connections using RMF and bulrush wetland for nitrogen removal discharged to a constructed offshore submerged aquatic vegetation wetland – permitted enthusiastically by State regulators and independently reviewed by Professors from John Hopkins University and the University of Maryland. The Mayo system was engineered in 1985 – 1990 and continues to meet permit requirements.

For the option that includes reusing/disposing of treated effluent on individual properties, the drip systems would be managed by the same public agency that regulates the septic tanks. Both of these "on lot" components are proposed to be within the scope of this project.

8.5. Treatment Facility Sitting

Land acquisition, resistance from potential abutters and regulatory resistance to sitting treatment facilities within the Prohibition Zone will not be known until specific sites are presented as options for public comment and regulatory review. A major reason for the residents to have decentralized systems is for lower cost and energy use and to convert vacant land to beneficial use with open space and wetland amenities.

8.6. Environmental Impacts

LAI has positive successful experience in dealing with the key environmental review issues for decentralized systems in the Chesapeake Bay area and in Malibu, CA.

8.7. Collection System

As a matter of quality control and to account for the total costs associated with a STEP/STEG system, LAI proposes to have the contractor be responsible for all of the "on lot" work. The costs for all work associated with installation of a STEP/STEG system, with 100% replacement of the existing septic tanks will be accounted for in the cost estimates, as well as the 10' house connection.

Estimates will be made for the energy use associated with the collection, treatment and disposal of wastewater in the Task 3 report on project costs.

8.8. Treatment

It has been LAI's experience that properly installed and operated RMF systems generally perform to the same level. Fixed film processes do not rely on clarifiers, or settling, as many suspended growth systems do. As such, they are inherently more stable and resistant to upsets due to peak flows and loads. LAI has experienced opinions on most appropriate RMF for specific applications. Equivalency of costs and performance is assumed for planning purposes.

Greenhouse gasses have not been quantified for septic tanks, and there is no consensus in the industry as to if and how much methane is released from septic tanks. This issue is beyond the scope of this study. Measurements could easily be taken from existing septic tanks so that the issue could be quantified and taken into consideration. Active ventilation and destruction is an option should this issue prove to be relevant.

8.9. Treatment Plant Sites

An allowance will be made for land acquisition. The issue of difficulty in attaining the land cannot be addressed until specific sites are selected. As stated in this TM, the sites that have been selected on a preliminary basis are not the only options. The next logical step is to select the sites that are the most feasible and proceed with the necessary analyses.

8.10. Disposal – Solids Handling

The existing method of disposal is assumed for septage. The O&M costs for the system will include pumping out the septic tanks every 5 years. Sludge associated with RMFs is minimal, and no real data exist on specific quantities. RMFs do not experience the same degree of sloughing as traditional trickling filters, and what solids do make their way into the recirculation tank will be anaerobically digested to a degree. A conservative estimate of sludge production would be to assume an increase of 10% -20% above the existing septage volume currently being disposed of from septic tanks. The receiving facility will need to confirm that they can handle this excess sludge.

Land application and potentially beneficial reuse is an option that should be explored for any scenario. This option should be evaluated for feasibility.

8.11. Cost Information

On-lot expenses will be included in the project costs.

9. Environmental Issues and Caveats

Caveats:

1. It is noted that existing flows are approximately 77% of the buildout flows. The potential savings associated with a water conservation program could be further quantified by examining water use records and plumbing fixtures in representative properties.

Environmental Issues:

1. Energy Use

Estimates of the energy use associated with the decentralized options will be provided, in the Task 3 Report.

2. Energy Generation / Sustainability

Energy generation to at least offset consumptive use of the wastewater system could be a project component. Treatment and disposal sites could have solar panels. Wind power may be a cost-competitive option. We will provide opinions on these matters in the Task 3 Report.

3. Carbon Footprint

Due to the passive nature of the proposed decentralized system, its carbon footprint is expected to be the lowest amongst options. Energy use of the different components will be provided in the Task 3 Report.

As methane will be produced in the proposed septic tanks, it is suggested that the collection system incorporate ventilation design to concentrate these gases for destruction, or if economically viable, productive use.

4. Wetlands

The Nitrex™ component can be a subsurface flow wetland with or without open water to support varying types of aquatic vegetation.

5. Landscape Design

The landscape of the treatment units can be visually appealing at modest cost, and can serve a multitude of uses such as walking/bike paths, gardens, etc. to engender public acceptance and in the interest of being a "good neighbor", it is proposed that creative landscaping with community input would be a major feature of the decentralized approach, such as illustrated on Figure 8-1.

6. Methane Emission

Although theoretical methodologies exist, it is recommended that the project measure actual methane generation rates from representative septic tanks. LAI understands from researchers that methane generation in septic tanks is extremely low.

FIGURE 8-1: SOUTHWEST CORRIDOR, BOSTON, MA – LANDSCAPE DESIGN OVER TRAIN TRACKS

San Luis Obispo County
Los Osos Wastewater Project Development

TECHNICAL MEMORANDUM

TASK 3 Cost Estimates for Decentralized Scenarios

Final Report

August 22, 2008

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1. Introduction

The Task 2 Technical Memorandum (TM) developed two Los Osos Decentralized Wastewater Management scenarios and the associated planning level quantities. This TM will use develop preliminary cost estimates based on these quantities and the unit price structure used in the Fine Screening Analysis.

2. Scenarios & Associated Quantities

Each scenario serves the entire Prohibition Zone. The drainfield and potential reuse sites are essentially the same for each scenario. The differences are the number and location of each treatment facility and the associated pump stations, force mains and effluent dispersal piping and the disposal options of residential reuse / dispersal vs. common drainfields with non-residential reuse.

2.1. Scenario 1 – Multiple Locations Within Los Osos

This scenario divides the Prohibition Zone into 7 smaller zones, each having its own treatment and dispersal sites. Treatment, disposal and potential reuse sites were identified for each zone. Residential irrigation reuse is considered as a separate option.

2.2. Scenario 2 – Two Locations in Mid-Town Los Osos and Northeast Region of Los Osos

This option will utilize two treatment locations – one in the northeast area of Los Osos and the Mid-Town site, minimizing transmission costs, in combination with multiple disposal and reuse locations. Residential irrigation reuse is considered as a separate option.

2.3. Wastewater System Quantities

Table 2-1 presents our estimates of components quantities for the wastewater collection, treatment and reuse/disposal system by sub-zone and totals. Table 2-2 presents the quantities for the dual treatment sites and multiple dispersal/reuse system scenarios.

The Fine Screening Analysis referenced four types of lots with respect to installing a STEP system (the same four types will apply to STEG systems). These types are as follows:

1. Type 1 – Existing septic tank in front yard to be removed and new STEP/STEG tank placed in same location.

2. Type 2 – Existing septic tank in front yard to be abandoned and new STEP/STEG tank placed in new location.

3. Type 3 – Existing septic tank in back yard to be abandoned and new STEP/STEG tank placed in front yard.

4. Type 4 – Existing septic tank in back yard to be abandoned and new STEP/STEG tank placed in front yard. Grade is such that a grinder pump is to be installed in the back yard to pump up to a STEP/STEG tank located in the front yard.

The distribution of each type of lot, as reported in the Fine Screening Analysis is as follows:

- Type 1 – 7.5%
- Type 2 – 67.5%
- Type 3 – 20.0%
- Type 4 – 5.0%

Estimates of the number of STEP systems required in each zone were made in the Task 2 TM. All other parcels were assumed to have STEG systems. The above distribution was used to determine the number of each type of STEP and STEG systems. The final individual lot quantities are presented in Table 2-1. The quantities for intercepting sewers, treatment and dispersal are the same as presented in the Task 2 TM.

Table 2-1: Scenarios Quantities for Wastewater Collection

Item Description	Type 1 STEG Conn.	Type 2 STEG Conn.	Type 3 STEG Conn.	Type 4 STEG Conn.	Number of STEG Conn.	Type 1 STEP Conn.	Type 2 STEP Conn.	Type 3 STEP Conn.	Type 4 STEP Conn.	Number of STEP Systems	Total Number of Systems
Units	EA	EA	EA	EA		EA	EA	EA	EA		
Scenario 1 Quantities	341	3,073	911	228	4,553	16	146	43	11	216	4,769
Scenario 2 Quantities	339	3,051	904	226	4,520	19	168	50	12	249	4,769

Item Description	Pressure Sewers / Force Mains	4" Gravity Sewer	Pocket Pump Station	Duplex Pump Station	Triplex Pump Station
Units	LF	LF	EA	EA	EA
Scenario 1 Quantities	24,900	221,000	4	2	0
Scenario 2 Quantities	26,100	220,100	2	2	1

Other quantities associated with the collection, treatment and dispersal systems are listed in Tables 2-2 and 2-3. Quantities are included for the option of returning water to the individual properties for reuse and/or dispersal.

Table 2-2: Scenario 1 Quantities for Wastewater Treatment and Dispersal/Reuse

Zone	Residential Reuse		Dispersal Area (ft^2)	WWTF Design Flow (gpd)	Piping to Dispersal Sites (ft)
	Reuse Lateral Pipe (ft)	Reuse Transmission Pipe (ft)			
N-1	74,560	44,800	222,500	222,500	3,000
N-2	76,560	43,500	215,800	215,800	3,700
N-3	60,880	38,700	191,900	191,900	7,500
E-1	14,560	9,300	83,500	83,500	730
SE	21,680	17,000	102,600	102,600	1,300
W-1	64,400	40,000	178,400	178,400	4,300
W-2	68,880	38,000	209,700	209,700	2,400
Totals	**381,600**	**231,300**	**1,204,400**	**1,200,000**	**23,000**

Table 2-3: Scenario 2 Quantities for Wastewater Treatment and Dispersal/Reuse

Zone	Residential Reuse		Dispersal Area (ft^2)	WWTF Design Flow (gpd)	Piping to Dispersal Sites (ft)
	Reuse Lateral Pipe (ft)	Reuse Transmission Pipe (ft)			
Northeast	151,120	88,300	438,300	438,300	5,500
Mid-Town	230,400	143,000	766,100	766,100	12,000
Totals	**381,520**	**231,300**	**1,204,400**	**1,200,000**	**17,500**

3. Unit Prices

The components and costs for each type of lot connection were detailed in the Fine Screening Analysis for STEP systems. Those tables presented costs separated into homeowner costs and contractor costs. Total costs only are presented in this analysis

A summary of costs for each STEP connection type, consolidated from the tables presented in the Fine Screening Analysis, is shown in Table 3-1. The only difference between a STEP and a STEG system is the pumps and controls that are not part of a STEG system. The costs for each type of STEG system are shown in Table 3-2.

In addition to the connection costs, a cost range of $1,900 – $3,000 was reported in the Fine Screening Analysis for electrical work associated with STEP systems. For consistency with the Fine Screening Analysis, this range has been added to the cost tables.

Table 3-3 presents other preliminary unit prices associated with collection and dispersal piping and pump stations, based on bid tab unit costs and other previously developed cost estimates.

The cost analysis presented below uses the Carollo provided cost estimates. LAI's opinion on the unit pricing is presented in Section 7.

Table 3-1: STEP System Connection Costs by Lot

Type	Demolish Existing Septic	STEP Septic Tank	Effluent Pump / Controls	Electrical Connection*		Sewer Lateral	Limited Access to Backyard	Abandon Existing Septic Tank	Grinder Pump	Yard Restoration	Contingency (10%)		Total	
				Low	High						Low	High	Low	High
1	$500	$2,000	$2,200	$1,900	$3,000	$500				$500	$760	$870	$8,360	$9,570
2		$2,000	$2,200	$1,900	$3,000	$700		$300		$500	$760	$870	$8,360	$9,570
3		$2,000	$2,200	$1,900	$3,000	$1,600	$300	$300		$750	$905	$1,015	$9,955	$11,165
4		$2,000	$2,200	$1,900	$3,000	$1,200		$300	$2,800	$750	$1,115	$1,225	$12,265	$13,475

Source: Tables 3.10 - 3.13, Carollo "Viable Project Alternatives Fine Screening Analysis," August 2007

*Electrical connection costs taken from Table 3.15, Carollo "Viable Project Alternatives Fine Screening Analysis", August 2007

Table 3-2: STEG System Connection Costs by Lot Type[1]

Type	Demolish Existing Septic	STEG Septic Tank	Effluent Pump / Controls	Electrical Connection*		Sewer Lateral	Limited Access to Backyard	Abandon Existing Septic Tank	Grinder Pump	Yard Restoration	Contingency (10%)		Total	
				Low	High						Low	High	Low	High
1	$500	$2,000				$500				$500	$350	$350	$3,850	$3,850
2		$2,000				$700		$300		$500	$350	$350	$3,850	$3,850
3		$2,000				$1,600	$300	$300		$750	$495	$495	$5,445	$5,445
4		$2,000		$1,900	$3,000	$1,200		$300	$2,800	$750	$895	$1,005	$9,845	$11,055

Source: Tables 3.10 - 3.13, Carollo "Viable Project Alternatives Fine Screening Analysis," August 2007

*Electrical connection costs taken from Table 3.15, Carollo "Viable Project Alternatives Fine Screening Analysis", August 2007

[1]Table 3-1 costs minus the pump and controls and electrical connection costs.

Table 3-3 presents other preliminary unit prices associated with collection and dispersal piping and pump stations, based on bid tab unit costs and other previously developed cost estimates.

Table 3-3: Unit Pricing for Collection and Dispersal Components

Item	Quantity(1)	Bid Tab Cost ($M)(1,3)	Apparent Bid Tab Unit Cost ($/unit)
Gravity Sewers and Force Mains(1)	230,000	29.7	$129
Force Mains and Laterals(2)	254,000	15.2	$60
Duplex Pump Station(3)	6	2.6	$433,333
Triplex Pump Station(3)	2	1.2	$600,000
Pocket Pump Station(3)	12	2.4	$200,000

(1) Taken from Table 3-1, Carollo August 2007 *Viable Alternatives Analysis Fine Screening Analysis*

(2) Taken from Table 3-18, Carollo August 2007 *Viable Alternatives Analysis Fine Screening Analysis*

(3) Taken from Table 3-17, Carollo August 2007 *Viable Alternatives Analysis Fine Screening Analysis*

4. Construction Costs

Tables 4-1 and 4-2 detail the collection system and treatment system costs for Scenario 1 based on the preliminary unit prices and quantities presented in the preceding sections, with and without Residential Reuse to new drip irrigation fields, respectively. Tables 4-3 and 4-4 details the collection system and treatment system costs for Scenario 2, with and without Residential Reuse to new drip irrigation fields, respectively.

Bid tab prices taken from Table 3-3 do not have a range of costs. In addition, the treatment unit processes were derived from LAI's experience in constructing Nitrex™ based treatment systems. Contractor overhead and profit, contingency and sales tax are included. As no other treatment process is proposed, a range of costs for treatment is not applicable. Similarly, the drip irrigation costs have the same basis, with the same adders for consistency with the Fine Screening Analysis. Contractor overhead and profit, contingency and sales tax were only applied to the drip irrigation costs as the other costs are based on bid tab values. A range of costs is not presented for dispersal/reuse system costs. The range of costs for the various types of STEG and STEP connections are based on the range of costs associated with the electrical connection. Due to the fact that the majority of the systems proposed are STEG systems, this does not affect the price materially as can be seen in the narrow range of high and low costs. Table 4-5 presents the Fine Screening Report Construction Cost Estimates from the August 2007 Fine Screening Analysis Report. The "High" costs from tables 4-1 through 4-4 were used for comparison.

Table 4-1: Construction Costs – Scenario 1, with Residential Reuse / Drip Irrigation

Item No	Item Description	Quantity	Units	Unit Cost		Total Cost	
				Low	High	Low	High
	Collection System						
1	Mobilization/Demobilization	1	EA	5%			$2,826,000
2	Type 1 STEG Connection	341	EA	$ 3,850	$ 3,850	$ 1,315,000	$ 1,315,000
3	Type 2 STEG Connection	3,073	EA	$ 3,850	$ 3,850	$ 11,833,000	$ 11,833,000
4	Type 3 STEG Connection	911	EA	$ 5,445	$ 5,445	$ 4,959,000	$ 4,959,000
5	Type 4 STEG Connection	228	EA	$ 9,845	$ 11,055	$ 2,242,000	$ 2,517,000
6	Type 1 STEP Connection	16	EA	$ 8,360	$ 9,570	$ 136,000	$ 156,000
7	Type 2 STEP Connection	146	EA	$ 8,360	$ 9,570	$ 1,219,000	$ 1,396,000
8	Type 3 STEP Connection	43	EA	$ 9,955	$ 11,165	$ 431,000	$ 483,000
9	Type 4 STEP Connection	11	EA	$ 12,265	$ 13,475	$ 133,000	$ 146,000
10	Pressure Sewer/Force Mains	24,900	LF	$60			$1,494,000
11	4" Gravity Sewer	221,000	LF	$129			$28,538,000
12	Road Restoration	1	EA	$2,000,000			$2,000,000
13	Pocket Pump Station	4	EA	$200,000			$800,000
14	Duplex Pump Station	2	EA	$433,333			$867,000
15	Triplex Pump Station	0	EA	$600,000			$0
16	Odor Control	6	EA	$50,000			$300,000
17	Standby Power Facilities	2	EA	$360,000			$720,000
					Subtotal	***$ 59,813,000***	***$ 60,350,000***
	Treatment System						
1	EQ / Recirculation / Dosing Tanks						$4,320,000
2	Biofilters						$8,880,000
3	Nitrex™						$4,560,000
4	Disinfection / Filtration / Controls						$2,760,000
5	Contractor Overhead and Profit			15%			$3,078,000
6	Treatment Processes Contingency			30%			$6,156,000
7	Sales Tax			8%			$1,641,600
8	Land Acquisition	9.0	acres	$500,000			$4,500,000
9	Standby Power Facilities	7	EA	$360,000			$2,520,000
10	Odor Control	7	EA	$50,000			$350,000
					Subtotal		***$38,766,000***
	Dispersal / Reuse System - Residential Drip						
1	Distribution Force Main	231,300	ft	$60			$ 13,878,000
2	Laterals to Property	381,600	ft^2	$60			$ 22,896,000
3	Drainfield/Drip Irrigation	3,613,200	ft^3	$2.00			$ 7,226,400
4	Contractor Overhead and Profit			15%			$ 1,083,960
5	Contingency			30%			$ 2,167,920
6	Sales Tax			8%			$ 578,112
					Subtotal		***$47,831,000***
	Scenario 1 Total Construction Costs - Residential Reuse Option					**$ 146,410,000**	**$ 146,947,000**

Table 4-2: Construction Costs – Scenario 1, without Residential Reuse

Item No	Item Description	Quantity	Units	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
	Collection System						
1	Mobilization/Demobilization	1	EA	5%			$2,826,000
2	Type 1 STEG Connection	341	EA	$ 3,850	$ 3,850	$ 1,315,000	$ 1,315,000
3	Type 2 STEG Connection	3,073	EA	$ 3,850	$ 3,850	$ 11,833,000	$ 11,833,000
4	Type 3 STEG Connection	911	EA	$ 5,445	$ 5,445	$ 4,959,000	$ 4,959,000
5	Type 4 STEG Connection	228	EA	$ 9,845	$ 11,055	$ 2,242,000	$ 2,517,000
6	Type 1 STEP Connection	16	EA	$ 8,360	$ 9,570	$ 136,000	$ 156,000
7	Type 2 STEP Connection	146	EA	$ 8,360	$ 9,570	$ 1,219,000	$ 1,396,000
8	Type 3 STEP Connection	43	EA	$ 9,955	$ 11,165	$ 431,000	$ 483,000
9	Type 4 STEP Connection	11	EA	$ 12,265	$ 13,475	$ 133,000	$ 146,000
10	Pressure Sewer/Force Mains	24,900	LF	$60			$1,494,000
11	4" Gravity Sewer	221,000	LF	$129			$28,538,000
12	Road Restoration	1	EA	$2,000,000			$2,000,000
13	Pocket Pump Station	4	EA	$200,000			$800,000
14	Duplex Pump Station	2	EA	$433,333			$867,000
15	Triplex Pump Station	0	EA	$600,000			$0
16	Odor Control	6	EA	$50,000			$300,000
17	Standby Power Facilities	2	EA	$360,000			$720,000
					Subtotal	***$ 59,813,000***	***$ 60,350,000***
	Treatment System						
1	EQ / Recirculation / Dosing Tanks						$4,320,000
2	Biofilters						$8,880,000
3	Nitrex™						$4,560,000
4	Disinfection / Filtration / Controls						$2,760,000
5	Contractor Overhead and Profit			15%			$3,078,000
6	Treatment Processes Contingency			30%			$6,156,000
7	Sales Tax			8%			$1,641,600
8	Land Acquisition	9.0	acres	$500,000			$4,500,000
9	Standby Power Facilities	7	EA	$360,000			$2,520,000
10	Odor Control	7	EA	$50,000			$350,000
					Subtotal		***$38,766,000***
	Dispersal / Reuse System - Non Residential						
1	Distribution Force Main	23,000	ft	$60			$1,380,000
2	Drainfield/Drip Irrigation	1,204,400	ft^2	$2			$2,408,800
3	Contractor Overhead and Profit			15%			$361,320
4	Contingency			30%			$722,640
5	Sales Tax			8%			$192,704
6	Land Acquisition	27.7	acres	$500,000			$13,850,000
					Subtotal		***$18,916,000***
	Scenario 1 Total Construction Costs - No Residential Reuse					**$ 117,495,000**	**$ 118,032,000**

Table 4-3: Construction Costs – Scenario 2, with Residential Reuse / Drip Irrigation

Item No	Item Description	Quantity	Units	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
	Collection System						
1	Mobilization/Demobilization	1	EA	5%			$2,843,000
2	Type 1 STEG Connection	339	EA	$ 3,850	$ 3,850	$ 1,306,000	$ 1,306,000
3	Type 2 STEG Connection	3,051	EA	$ 3,850	$ 3,850	$ 11,747,000	$ 11,747,000
4	Type 3 STEG Connection	904	EA	$ 5,445	$ 5,445	$ 4,923,000	$ 4,923,000
5	Type 4 STEG Connection	226	EA	$ 9,845	$ 11,055	$ 2,225,000	$ 2,499,000
6	Type 1 STEP Connection	19	EA	$ 8,360	$ 9,570	$ 157,000	$ 179,000
7	Type 2 STEP Connection	168	EA	$ 8,360	$ 9,570	$ 1,406,000	$ 1,609,000
8	Type 3 STEP Connection	50	EA	$ 9,955	$ 11,165	$ 496,000	$ 557,000
9	Type 4 STEP Connection	12	EA	$ 12,265	$ 13,475	$ 153,000	$ 168,000
10	Pressure Sewer/Force Mains	26,100	LF	$60			$1,566,000
11	4" Gravity Sewer	220,100	LF	$129			$28,422,000
12	Road Restoration	1	EA	$2,000,000			$2,000,000
13	Pocket Pump Station	2	EA	$200,000			$400,000
14	Duplex Pump Station	2	EA	$433,333			$867,000
15	Triplex Pump Station	1	EA	$600,000			$600,000
16	Odor Control	5	EA	$50,000			$250,000
17	Standby Power Facilities	3	EA	$360,000			$1,080,000
					Subtotal	***$ 60,441,000***	***$ 61,016,000***
	Treatment System						
1	EQ / Recirculation / Dosing Tanks						$4,320,000
2	Biofilters						$8,880,000
3	Nitrex™						$4,560,000
4	Disinfection / Filtration / Controls						$2,760,000
5	Contractor Overhead and Profit			15%			$3,078,000
6	Treatment Processes Contingency			30%			$6,156,000
7	Sales Tax			8%			$1,641,600
8	Land Acquisition	7.0	acres	$500,000			$3,500,000
9	Standby Power Facilities	2	EA	$360,000			$720,000
10	Odor Control	2	EA	$50,000			$100,000
					Subtotal		***$35,716,000***
	Dispersal / Reuse System - Residential Drip						
1	Distribution Force Main	231,300	ft	$60			$13,878,000
2	Laterals to Property	381,520	ft^2	$60			$22,891,200
3	Drainfield/Drip Irrigation	3,613,200	ft^3	$2.00			$7,226,400
4	Contractor Overhead and Profit			15%			$1,083,960
5	Contingency			30%			$2,167,920
6	Sales Tax			8%			$578,112
					Subtotal		***$47,826,000***
	Scenario 2 Total Construction Costs - Residential Reuse Option					**$ 143,983,000**	**$ 144,558,000**

Table 4-4: Construction Costs – Scenario 2, without Residential Reuse

Item No	Item Description	Quantity	Units	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
Collection System							
1	Mobilization/Demobilization	1	EA	5%			$2,843,000
2	Type 1 STEG Connection	339	EA	$ 3,850	$ 3,850	$ 1,306,000	$ 1,306,000
3	Type 2 STEG Connection	3,051	EA	$ 3,850	$ 3,850	$ 11,747,000	$ 11,747,000
4	Type 3 STEG Connection	904	EA	$ 5,445	$ 5,445	$ 4,923,000	$ 4,923,000
5	Type 4 STEG Connection	226	EA	$ 9,845	$ 11,055	$ 2,225,000	$ 2,499,000
6	Type 1 STEP Connection	19	EA	$ 8,360	$ 9,570	$ 157,000	$ 179,000
7	Type 2 STEP Connection	168	EA	$ 8,360	$ 9,570	$ 1,406,000	$ 1,609,000
8	Type 3 STEP Connection	50	EA	$ 9,955	$ 11,165	$ 496,000	$ 557,000
9	Type 4 STEP Connection	12	EA	$ 12,265	$ 13,475	$ 153,000	$ 168,000
10	Pressure Sewer/Force Mains	26,100	LF	$60			$1,566,000
11	4" Gravity Sewer	220,100	LF	$129			$28,422,000
12	Road Restoration	1	EA	$2,000,000			$2,000,000
13	Pocket Pump Station	2	EA	$200,000			$400,000
14	Duplex Pump Station	2	EA	$433,333			$867,000
15	Triplex Pump Station	1	EA	$600,000			$600,000
16	Odor Control	5	EA	$50,000			$250,000
17	Standby Power Facilities	3	EA	$360,000			$1,080,000
					Subtotal	***$ 60,441,000***	***$ 61,016,000***
Treatment System							
1	EQ / Recirculation / Dosing Tanks						$4,320,000
2	Biofilters						$8,880,000
3	Nitrex™						$4,560,000
4	Disinfection / Filtration / Controls						$2,760,000
5	Contractor Overhead and Profit			15%			$3,078,000
6	Treatment Processes Contingency			30%			$6,156,000
7	Sales Tax			8%			$1,641,600
8	Land Acquisition	7.0	acres	$500,000			$3,500,000
9	Standby Power Facilities	2	EA	$360,000			$720,000
10	Odor Control	2	EA	$50,000			$100,000
					Subtotal		***$35,716,000***
Dispersal / Reuse System - Non Residential							
1	Distribution Force Main	23,000	ft	$60			$ 1,380,000
2	Drainfield/Drip Irrigation	1,204,400	ft^2	$2			$ 2,408,800
3	Contractor Overhead and Profit			15%			$ 361,320
4	Contingency			30%			$ 722,640
5	Sales Tax			8%			$ 192,704
6	Land Acquisition	27.7	acres	$500,000			$ 13,850,000
					Subtotal		***$18,916,000***
Scenario 2 Total Construction Costs - No Residential Reuse						**$115,073,000**	**$115,648,000**

Table 4-5: Fine Screening Report Construction Cost Estimates

Project Element		Seawater Intrusion						Tri-W	LAI STEG Scenarios			
		Mitigation Level 1		Mitigation Level 2		Mitigation Level 3		Project	Scenario 1		Scenario 2	
		90 AFY ($1M)	140 AFY ($1M)	190 AFY ($1M)	240 AFY ($1M)	550 AFY ($1M)	600 AFY ($1M)	~285 AFY ($1M)	Non-Residential Reuse ($1M)	Residential Reuse ($1M)	Non-Residential Reuse ($1M)	Residential Reuse ($1M)
Collection System	STEP	$65 - 81	$65 - 81	$65 - 81	$65 - 81	$65 - 81	$65 - 81	$N/A	$60.4	$60.4	$61.0	$61.0
	Gravity	$83 - 90	$83 - 90	$83 - 90	$83 - 90	$83 - 90	$83 - 90	$81 - 82				
Treatment (Liquids & Solids)	STEP	$14 - 18	$23 - 25	$20 - 22	$23 - 25	$23 - 25	$23 - 25	N/A	$38.8	$38.8	$35.7	$35.7
	Gravity	$15 - 22	$23 - 26	$20 - 22	$23 - 26	$23 - 26	$23 - 26	$55				
Disposal / Reuse		$13 - 16	$13 - 14	$15 - 17	$13 - 14	$26 - 30	$26 - 27	$20 - 23	$18.9	$47.8	$18.9	$47.8
Treatment Facility Site		$1 - 3	$1 - 3	$1 - 3	$1 - 3	$1 - 3	$1 - 3	$1 - 3	Included in Treatment			
Permitting / Mitigation		$1 - 2	$1 - 2	$1 - 2	$1 - 2	$1 - 2	$1 - 2	$1 - 2	$2.00	$2.00	$2.00	$2.00
Total Construction Costs	STEP	$94 - 120	$103 - 126	$102 - 125	$103 - 126	$116 - 142	$116 - 139	N/A	$120.0	$148.95	$117.65	$146.56
	Gravity	$113 - 132	$121 - 135	$120 - 134	$122 - 135	$135 - 151	$134 - 148	$158 - 165				
Total Construction Costs Escalated to Mid-Point of Construction	STEP	$117 - 150	$128 - 157	$126 - 156	$129 - 157	$144 - 176	$144 - 173	N/A	$149.4	$185.44	$146.47	$182.46
	Gravity	$141 - 164	$151 - 168	$149 - 167	$152 - 168	$168 - 188	$167 - 184	$197 - 205				
Project Costs	STEP	$18 - 24	$18 - 24	$18 - 24	$18 - 24	$21 - 26	$21 - 26	N/A	$24.0	$29.79	$23.53	$29.31
	Gravity	$16 - 21	$16 - 21	$16 - 21	$16 - 21	$19 - 23	$19 - 23	$12 - 17				
Total Project Costs (Capital Costs)	STEP	$135 - 174	$146 - 181	$144 - 180	$147 - 181	$166 - 202	$165 - 199	N/A	$173.4	$215.23	$170.00	$211.78
	Gravity	$157 - 185	$167 - 189	$165 - 188	$168 - 189	$187 - 211	$186 - 207	$209 - 222				

5. O&M Costs

O&M costs were generated for the collection/dispersal systems as well as the treatment facilities associated with both scenarios. Typical breakdowns of O&M costs for the treatment zones, at differing design flows associated with the zones of Scenarios 1 and 2 are presented in Appendix A. Tables 5-1 and 5-2 summarize the O&M costs for Scenario 1 with and without residential reuse. Tables 5-3 and 5-4 summarize the O&M costs for Scenario 2 with and without residential reuse. Table 5-5 summarizes the O&M costs for the treatment facilities associated with Scenarios 1 and 2. The proposed treatment system is a Title 22 compliant system that will not differ with residential reuse.

Table 5-1: Scenario 1 Collection and Dispersal System O&M Costs – Residential Reuse

#	Description			Total
1	**Labor**	**Collection**	**Dispersal**	**$ 416,000**
	FTE	2	3	
	Total Hours	4,160	6,240	
	hourly rate	$40.00	$40.00	
2	**Sludge Disposal**			**$ 143,100**
	Frequency of pumping (years)	5	n/a	
	Total # Pumped per year	954	n/a	
	Cost / Pumpout	$150.00	n/a	
3	**Electricity**	**Collection**	**Dispersal**	**$ 53,800**
	Design Flow (gpd)	1,200,000	1,200,000	
	% Pumped	30%	100%	
	Power Unit Cost ($/kWh)	$ 0.12	$ 0.12	
	Total Pumping Cost	*$12,394*	*$41,354*	
4	**Equipment Maintenance/Replacement**			**$ 153,500**
	STEP Pump Maintenance / Replace			*$ 12,400*
	Frequency of Replacement (yr.)	7		
	# / year	31		
	Cost / Replacement	$400		
	Pump Station Maintenance / Replace			*$ 81,080*
	% of Construction Cost	2.0%		
	Odor Control Maintenance / Replace			*$ 60,000*
	% of Construction Cost	20.0%		
		Total O & M Cost		**$ 766,400**

Table 5-2: Scenario 1 Collection and Dispersal System O&M Costs – No Residential Reuse

#	Description			Total
1	**Labor**	**Collection**	**Dispersal**	**$ 249,600**
	FTE	2	1	
	Total Hours	4,160	2,080	
	hourly rate	$40.00	$40.00	
2	**Sludge Disposal**			**$ 143,100**
	Frequency of pumping (years)	5	n/a	
	Total # Pumped per year	954	n/a	
	Cost / Pumpout	$150.00	n/a	
3	**Electricity**	**Collection**	**Dispersal**	**$ 53,800**
	Design Flow (gpd)	1,200,000	1,200,000	
	% Pumped	30%	100%	
	Power Unit Cost ($/kWh)	$ 0.12	$ 0.12	
	Total Pumping Cost	*$12,394*	*$41,354*	
4	**Equipment Maintenance/Replacement**			**$ 153,500**
	STEP Pump Maintenance / Replace			*$ 12,400*
	Frequency of Replacement (yr.)	7		
	# / year	31		
	Cost / Replacement	$400		
	Pump Station Maintenance / Replace			*$ 81,080*
	% of Construction Cost	2.0%		
	Odor Control Maintenance / Replace			*$ 60,000*
	% of Construction Cost	20.0%		
		Total O & M Cost		**$ 600,000**

Table 5-3: Scenario 2 Collection and Dispersal System O&M Costs – Residential Reuse

#	Description			Total
1	**Labor**	**Collection**	**Dispersal**	**$ 416,000**
	FTE	2	3	
	Total Hours	4,160	6,240	
	hourly rate	$40.00	$40.00	
2	**Sludge Disposal**			**$ 143,100**
	Frequency of pumping (years)	5	n/a	
	Total # Pumped per year	4,769	n/a	
	Cost / Pumpout	$150.00	n/a	
3	**Electricity**	**Collection**	**Dispersal**	**$ 70,400**
	Design Flow (gpd)	1,200,000	1,200,000	
	Power Unit Cost ($/kWh)	$ 0.12	$ 0.12	
	Total Pumping Cost	*$28,961*	*$41,354*	
4	**Equipment Maintenance/Replacement**			**$ 160,600**
	STEP Pump Maintenance / Replace			*$ 14,229*
	Frequency of Replacement (yr.)	7		
	# / year	36		
	Cost / Replacement	$400		
	Pump Station Maintenance / Replace			*$ 96,280*
	% of Construction Cost	2.0%		
	Odor Control Maintenance / Replace			*$ 50,000*
	% of Construction Cost	20.0%		
		Total O & M Cost		**$ 790,100**

Table 5-4: Scenario 2 Collection and Dispersal System O&M Costs – No Residential Reuse

#	Description			Total
1	**Labor**	**Collection**	**Dispersal**	**$ 249,600**
	FTE	2	1	
	Total Hours	4,160	2,080	
	hourly rate	$40.00	$40.00	
2	**Sludge Disposal**			**$ 143,100**
	Frequency of pumping (years)	5	n/a	
	Total # Pumped per year	4,769	n/a	
	Cost / Pumpout	$150.00	n/a	
3	**Electricity**	**Collection**	**Dispersal**	**$ 70,400**
	Design Flow (gpd)	1,200,000	1,200,000	
	% Pumped	70%	100%	
	Power Unit Cost ($/kWh)	$ 0.12	$ 0.12	
	Total Pumping Cost	*$28,961*	*$41,354*	
4	**Equipment Maintenance/Replacement**			**$ 160,600**
	STEP Pump Maintenance / Replace			*$ 14,229*
	Frequency of Replacement (yr.)	7		
	# / year	36		
	Cost / Replacement	$400		
	Pump Station Maintenance / Replace			*$ 96,280*
	% of Construction Cost	2.0%		
	Odor Control Maintenance / Replace			*$ 50,000*
	% of Construction Cost	20.0%		
		Total O & M Cost		**$ 623,700**

Table 5-6 presents the a comparison of the Fine Screening Report O&M cost estimates from the August 2007 Fine Screening Analysis Report to the O&M cost estimates developed for the LAI decentralized scenarios. As with the capital cost comparison, the costs presented include all contingencies and allowances and therefore are comparable to the high end of the ranges presented in the Fine Screening Analysis Report. In addition, only one treatment and collection system were analyzed, eliminating the need for a "Low" end of the costs. The LAI Scenarios O&M costs represent the "High" end of O&M cost estimates.

Table 5-5: Summary of Treatment Facilities O&M Costs

Treatment Site	Design Flow (gpd)	Contract Operations	Sludge Disposal	Electricity	Equipment Maintenance / Replacement	Odor Control Maintenance / Replacement	Sampling - Lab Costs	Admin.	Permit Compliance Fees	Annual Misc. O&M Costs	Total
N-1	205,000	$29,120	$2,010	$20,200	$65,200	$10,000	$33,000	$12,000	$12,000	$19,000	$202,600
N-2	198,000	$29,120	$1,950	$19,900	$63,300	$10,000	$33,000	$12,000	$12,000	$19,000	$200,300
N-3	176,000	$29,120	$1,730	$18,400	$56,300	$10,000	$33,000	$12,000	$12,000	$18,000	$190,600
E-1	77,000	$29,120	$760	$12,200	$24,500	$10,000	$33,000	$12,000	$12,000	$14,000	$147,600
SE-1	95,000	$29,120	$930	$13,300	$30,100	$10,000	$33,000	$12,000	$12,000	$15,000	$155,500
W-1	164,000	$29,120	$1,610	$17,700	$52,300	$10,000	$33,000	$12,000	$12,000	$17,000	$184,800
W-2	193,000	$29,120	$1,890	$19,500	$61,500	$10,000	$33,000	$12,000	$12,000	$18,000	$197,100
Scenario 1 Total	**1,108,000**	**$203,840**	**$10,880**	**$121,200**	**$353,200**	**$70,000**	**$231,000**	**$84,000**	**$84,000**	**$120,000**	**$1,278,500**
Northeast	440,000	$29,120	$3,950	$32,700	$128,500	$10,000	$33,000	$12,000	$12,000	$27,000	$288,300
Midtown	770,000	$29,120	$6,900	$51,600	$224,500	$10,000	$33,000	$12,000	$12,000	$38,000	$417,200
Scenario 2 Total	**1,210,000**	**$58,240**	**$10,850**	**$84,300**	**$353,000**	**$20,000**	**$66,000**	**$24,000**	**$24,000**	**$65,000**	**$705,500**

Table 5-6: Comparison of O&M Cost Estimates

Project Element		Seawater Intrusion						Tri-W	LAI STEG Scenarios			
		Mitigation Level 1		Mitigation Level 2		Mitigation Level 3		Project	Scenario 1		Scenario 2	
		90 AFY ($1M)	140 AFY ($1M)	190 AFY ($1M)	240 AFY ($1M)	550 AFY ($1M)	600 AFY ($1M)	~285 AFY ($1M)	Non-Residential Reuse ($1M)	Residential Reuse ($1M)	Non-Residential Reuse ($1M)	Residential Reuse ($1M)
Collection System	STEP	0.8	0.8	0.8	0.8	0.8	0.8	N/A	$0.6	$0.8	$0.6	$0.8
	Gravity	0.5	0.5	0.5	0.5	0.5	0.5	0.7				
Treatment	STEP	$0.5 - 0.6	$0.9 - 1.8	$0.8 - 1.7	$0.9 - 1.8	$0.9 - 1.8	$0.9 - 1.8	N/A	$1.3	$1.3	$0.7	$0.7
	Gravity	$0.5 - 0.7	$0.8 - 1.8	$0.7 - 1.7	$0.8 - 1.8	$0.8 - 1.8	$0.8 - 1.8	$1				
Solids (Sub Class B)	STEP	$0.03 - 0.3	$0.03 - 0.3	$0.03 - 0.3	$0.03 - 0.3	$0.03 - 0.3	$0.03 - 0.3	N/A	Included in Collection and Treatment O&M Costs			
	Gravity	$0.04 - 0.5	$0.04 - 0.5	$0.04 - 0.5	$0.04 - 0.5	$0.04 - 0.5	$0.04 - 0.5	0.5				
Disposal / Reuse	STEP	$0.1 - 0.3	$0.1 - 0.2	0.4	0.4	$0.1 - 1.1	0.3	N/A	Included in Collection System O&M Costs			
	Gravity	$0.1 - 0.3	$0.1 - 0.2	0.4	0.4	$0.1 - 1.1	0.3	$0.4 - 0.5				
Total O&M Costs	STEP	$1.4 - 1.9	$1.8 - 3.0	$2.0 - 3.1	$2.1 - 3.2	$1.8 - 3.9	$2.0 - 3.1	N/A	$1.9	$2.04	$1.33	$1.50
	Gravity	$1.1 - 1.9	$1.4 - 2.9	$1.6 - 3.0	$1.7 - 3.2	$1.4 - 3.8	$1.6 - 3.0	$2.3 - 2.4				

6. Cost Analysis Summary

Table 6-1 summarizes the costs for Scenarios 1 and 2 and compares them to the Fine Screening Report Estimates, using a total of 5,353 Benefit Units (BU) from the Assessment Engineers Report.

Table 6-1: Summary of Capital and Annual O&M Costs

Scenario			Project Cost ($1M)		Project Cost Per BU[3]		Annual O&M Cost ($1M)		Annual O&M / BU		Annual Power Use[1] (kWhr)	Average Annual Power Use[1] (kW)
			Level 2	Level 3	Level 2	Level 3	Level 2	Level 3	Level 2 (Low)	Level 3 (High)		
Scenario 1	7 Zones		$173	$215	$32,402	$40,207	$1.88	$2.04	$351	$382	1,600,000	183
Scenario 2	2 Zones		$170	$212	$31,758	$39,562	$1.33	$1.50	$248	$279	1,160,000	132
Fine Screening Report - Level 2 Mitigation	190 AFY	STEP	$144 - 180		$30,263		$2.0 - 3.1		$374	$579		
	190 AFY	Gravity	$165 - 188		$32,972		$1.6 - 3.0		$299	$560		
	240 AFY	STEP	$147 - 181		$30,637		$2.1 - 3.2		$392	$598		
	240 AFY	Gravity	$168 - 189		$33,346		$1.7 - 3.2		$318	$598		
Fine Screening Report - Level 3 Mitigation	550 AFY	STEP		$166 - 202		$34,373	$1.8 - 3.9		$336	$729		
	550 AFY	Gravity		$187 - 211		$37,175	$1.4 - 3.8		$262	$710		
	600 AFY	STEP		$165 - 199		$34,000	$2.0 - 3.1		$374	$579		
	600 AFY	Gravity		$186 - 207		$36,708	$1.6 - 3.0		$299	$560		

[1]Power use will be comparable for Residential Reuse and conventional reuse/dispopsal, as minor differences in dispersal power use are negligible compared to total collection/treatment/dispersal power use.

7. Caveats and LAI Opinions on Cost Estimates

In an effort to maintain as much consistency as possible between cost estimates developed in the Fine Screening Analysis Report, a number of assumptions were used for which LAI has a varying opinion. The preceding tables present cost data that is consistent with the Fine Screening Analysis. This section discusses items for which LAI has a varying opinion and the implications on the estimated costs.

7.1. Gravity Collection Pipe Costs

LAI has a varying opinion on the assertion that costs are similar between the STEG collection system and the conventional gravity collection system, and that $129/LF is the best available information for these costs.

LAI is of the opinion that there is a significant difference between the installed cost of 4" vs. 8" gravity pipe. Material costs as well as installation costs are higher for 8" pipe and fittings. In addition, with Scenario 1, there will be no pipe greater than 8" with the vast majority being 4". LAI does not have local comparable bid tab values for the smaller pipe diameter and does not wish to render an opinion on the local installation costs. It is simply noted in this section that LAI believes a savings of $8+ million is reasonable with the STEG collection system due to pipes that will be half the size of conventional gravity pipe across most of the system. This savings is based on an assumed unit price of $90/LF. These savings are not reflected in the preceding analysis that uses the $129/LF for STEG gravity collection pipe that was taken from bid tab values for 8" gravity sewer.

This caveat is summarized below:

Fine Screening Analysis Unit Cost - $129 / LF

LAI's Opinion of Appropriate Unit Cost - $90 / LF

Total Potential Savings - $8 million

7.2. Gravity Collection Pipe Type Issues

STEG systems have costs/savings associated with septic tanks and smaller, shallower pipes. The septic tanks have a construction cost of around $10 million. Normally, these costs are offset by the savings associated with the smaller diameter, shallower pipe and potential treatment system cost savings. However, the methodology used in this analysis carries the costs of the septic tanks without crediting the savings of the smaller, shallower pipe.

In consideration of this attribute of the cost estimating procedure, the alternative of a conventional gravity collection system with a large septic tank at the treatment sites may be desired/preferred. Construction costs for the "centralized" septic tanks would be approximately $2 - $3 million. This would result in a savings of approximately $7 - $8 million using this cost estimating methodology.

In addition, this approach would mitigate the alleged concern that septic tanks are major contributors to greenhouse gases (in particular methane) and would allow recovery of the methane from the centralized locations for beneficial use.

7.3. Treatment Facility Costs

The costs for the LAI scenarios presented in this report are for wastewater facilities that produce a Title 22 compliant effluent. The range of costs presented in the Fine Screening Analysis appears to encompass a variety of treatment facilities most of which will not produce Title 22 compliant effluent as analyzed. In comparing the options, this should be factored in so that the appropriate values are used for comparison.

7.4. Reuse (Purple) Piping Costs

The Residential Reuse option carries the $47.8 million construction costs associated with purple pipe back to each individual residence in lieu of the drainfield option of $18.9 million construction costs. Capital costs are approximately 149.4% of construction costs. This option is unique to the LAI Residential Reuse scenarios.

7.5. Shared Septic Tanks

It is understood that a policy decision has been made that septic tanks are not to be shared and that this decision may be revisited as the project team explores cost saving measures. Given the density of development, there exists the potential to save approximately $4+/- million by sharing septic tanks. In addition, given the complicating issue of shared electrical service, LAI submits that STEG systems are the only systems that can feasibly utilize shared septic tanks. The majority of connections in LAI's scenarios are STEG systems.

Potential Savings with Shared Septic Systems - $4 million

7.6. O&M Costs

Allowances were made in this report for the following costs that do not appear to be included in the Fine Screening Analysis:

- Administrative costs required for maintaining operations staff and equipment
- Daily sampling of effluent required by Title 22 as well as periodic sampling required by the permit
- Miscellaneous/Contingency for unanticipated operational expenses

There is a generic "Allowance" added to the Labor, Power, Maintenance/Replacement costs in the amount of $50,000 for most gravity collection system treatment facilities and $20,000 for STEP collection system treatment facilities. LAI believes that this is insufficient to cover the above listed costs. LAI has a total of $76,000 for these costs included in the O&M cost estimates presented in this report. This represents a difference of $26,000 - $56,000 on the annual O&M costs between the Fine Screening Analysis and this report.

7.7. Aesthetics

The Nitrex™ system will be largely below grade with the Nitrex™ filters taking the form of a constructed wetland. This feature can be landscaped into an area that has aesthetic value for minimal added expense. If this is desired, LAI estimates the additional landscaping costs to be approximately $2 million.

7.8. Total Potential Savings

The implications of our opinions on shared septic tanks and unit pricing on installed 4" vs. 8" pipe and fittings represents a total potential savings of $12 million dollars on the collection system costs. When project costs and escalation are added, this represents a total savings of $15 - $17.3 million that can be deducted from the bottom line in Table 4.5.

It is LAI's opinion that the $7 - $8 million "savings" from replacing the septic tanks with centralized tanks is not representative of actual project costs. However, given that costs representative of a conventional gravity system are being carried forward, the $2 - $3 million cost of adding centralized septic tanks is appropriate and may wish to be considered if there is a strong sentiment against individual septic tanks and/or if the greenhouse gas issue is of significance.

Appendix A – Typical O&M Costs for One Treatment Facility

- Table A-1: O&M Costs for Design Flow = 205,000 gpd
- Table A-2: O&M Costs for Design Flow = 198,000 gpd
- Table A-3: O&M Costs for Design Flow = 77,000 gpd
- Table A-4: O&M Costs for Design Flow = 176.000 gpd
- Table A-5: O&M Costs for Design Flow = 95,000 gpd
- Table A-6: O&M Costs for Design Flow = 164,000 gpd
- Table A-7: O&M Costs for Design Flow = 193,000 gpd
- Table A-8: O&M Costs for Design Flow = 440,000 gpd
- Table A-9: O&M Costs for Design Flow = 770,000 gpd

Table A-1: O&M Costs for One Treatment Facility, Flow = 223,000 gpd

#	Description		Total
1	**Contract Operations**		**$ 29,120**
	# hours per visit	2	
	# visits per week	7	
	FTE	0.35	
	hourly rate	$40.00	
2	**Sludge Disposal**		**$ 2,010**
	Frequency of pumping (years)	5	
	Total Volume Pumped (gal)	66,750	
	Rate ($/gal)	$0.15	
3	**Electricity**		**$ 20,200**
	Total Pumping Cost		*$12,900*
	Design Flow (gpd)	222,500	
	Power Unit Cost ($/kWh)	$ 0.12	
	Annual Power Cost, Disinfection System		*$5,184*
	Disinfection System Power Use (kWh/year)	43,200	
	Annual Misc. Power Cost		*$2,102*
	Miscellaneous Power for Plant (kWh/day)	2.00	
4	**Equipment Maintenance/Replacement**		**$ 65,200**
5	**Odor Control Maintenance/Replacement**		**$ 10,000**
	% of Construction Cost	20.0%	
6	**Sampling - Lab Costs**		**$ 33,000**
7	**Administration**		**$ 12,000**
8	**Permit Compliance Fees**		**$ 12,000**
9	**Annual Misc. O&M Costs**		**$ 19,000**
		Total O & M Cost	**$ 202,530**

Table A-2: O&M Costs for One Treatment Facility, Flow = 216,000 gpd

#	Description		Total
1	**Contract Operations**		**$ 29,120**
	# hours per visit	2	
	# visits per week	7	
	FTE	0.35	
	hourly rate	$40.00	
2	**Sludge Disposal**		**$ 1,950**
	Frequency of pumping (years)	5	
	Total Volume Pumped (gal)	64,740	
	Rate ($/gal)	$0.15	
3	**Electricity**		**$ 19,900**
	Total Pumping Cost		*$12,600*
	Design Flow (gpd)	215,800	
	Power Unit Cost ($/kWh)	$ 0.12	
	Annual Power Cost, Disinfection System		*$5,184*
	Disinfection System Power Use (kWh/year)	43,200	
	Annual Misc. Power Cost		*$2,102*
	Miscellaneous Power for Plant (kWh/day)	2.00	
4	**Equipment Maintenance/Replacement**		**$ 63,300**
5	**Odor Control Maintenance/Replacement**		**$ 10,000**
	% of Construction Cost	20.0%	
6	**Sampling - Lab Costs**		**$ 33,000**
7	**Administration**		**$ 12,000**
8	**Permit Compliance Fees**		**$ 12,000**
9	**Annual Misc. O&M Costs**		**$ 19,000**
		Total O & M Cost	**$ 200,270**

Table A-3: O&M Costs for One Treatment Facility, Flow = 192,000 gpd

#	Description		Total
1	**Contract Operations**		**$ 29,120**
	# hours per visit	2	
	# visits per week	7	
	FTE	0.35	
	hourly rate	$40.00	
2	**Sludge Disposal**		**$ 1,730**
	Frequency of pumping (years)	5	
	Total Volume Pumped (gal)	57,570	
	Rate ($/gal)	$0.15	
3	**Electricity**		**$ 18,400**
	Total Pumping Cost		*$11,100*
	Design Flow (gpd)	191,900	
	Power Unit Cost ($/kWh)	$ 0.12	
	Annual Power Cost, Disinfection System		*$5,184*
	Disinfection System Power Use (kWh/year)	43,200	
	Annual Misc. Power Cost		*$2,102*
	Miscellaneous Power for Plant (kWh/day)	2.00	
4	**Equipment Maintenance/Replacement**		**$ 56,300**
5	**Odor Control Maintenance/Replacement**		**$ 10,000**
	% of Construction Cost	20.0%	
6	**Sampling - Lab Costs**		**$ 33,000**
7	**Administration**		**$ 12,000**
8	**Permit Compliance Fees**		**$ 12,000**
9	**Annual Misc. O&M Costs**		**$ 18,000**
		Total O & M Cost	**$ 190,550**

Table A-4: O&M Costs for One Treatment Facility, Flow = 84,000 gpd

#	Description		Total
1	**Contract Operations**		**$ 29,120**
	# hours per visit	2	
	# visits per week	7	
	FTE	0.35	
	hourly rate	$40.00	
2	**Sludge Disposal**		**$ 760**
	Frequency of pumping (years)	5	
	Total Volume Pumped (gal)	25,050	
	Rate ($/gal)	$0.15	
3	**Electricity**		**$ 12,200**
	Total Pumping Cost		*$4,900*
	Design Flow (gpd)	83,500	
	Power Unit Cost ($/kWh)	$ 0.12	
	Annual Power Cost, Disinfection System		*$5,184*
	Disinfection System Power Use (kWh/year)	43,200	
	Annual Misc. Power Cost		*$2,102*
	Miscellaneous Power for Plant (kWh/day)	2.00	
4	**Equipment Maintenance/Replacement**		**$ 24,500**
5	**Odor Control Maintenance/Replacement**		**$ 10,000**
	% of Construction Cost	20.0%	
6	**Sampling - Lab Costs**		**$ 33,000**
7	**Administration**		**$ 12,000**
8	**Permit Compliance Fees**		**$ 12,000**
9	**Annual Misc. O&M Costs**		**$ 14,000**
		Total O & M Cost	**$ 147,580**

Table A-5: O&M Costs for One Treatment Facility, Flow = 105,000 gpd

#	Description		Total
1	**Contract Operations**		**$ 29,120**
	# hours per visit	2	
	# visits per week	7	
	FTE	0.35	
	hourly rate	$40.00	
2	**Sludge Disposal**		**$ 930**
	Frequency of pumping (years)	5	
	Total Volume Pumped (gal)	30,780	
	Rate ($/gal)	$0.15	
3	**Electricity**		**$ 13,300**
	Total Pumping Cost		*$6,000*
	Design Flow (gpd)	102,600	
	Power Unit Cost ($/kWh)	$ 0.12	
	Annual Power Cost, Disinfection System		*$5,184*
	Disinfection System Power Use (kWh/year)	43,200	
	Annual Misc. Power Cost		*$2,102*
	Miscellaneous Power for Plant (kWh/day)	2.00	
4	**Equipment Maintenance/Replacement**		**$ 30,100**
5	**Odor Control Maintenance/Replacement**		**$ 10,000**
	% of Construction Cost	20.0%	
6	**Sampling - Lab Costs**		**$ 33,000**
7	**Administration**		**$ 12,000**
8	**Permit Compliance Fees**		**$ 12,000**
9	**Annual Misc. O&M Costs**		**$ 15,000**
		Total O & M Cost	**$ 155,450**

Table A-6: O&M Costs for One Treatment Facility, Flow = 180,000 gpd

#	Description		Total
1	**Contract Operations**		**$ 29,120**
	# hours per visit	2	
	# visits per week	7	
	FTE	0.35	
	hourly rate	$40.00	
2	**Sludge Disposal**		**$ 1,610**
	Frequency of pumping (years)	5	
	Total Volume Pumped (gal)	53,520	
	Rate ($/gal)	$0.15	
3	**Electricity**		**$ 17,700**
	Total Pumping Cost		*$10,400*
	Design Flow (gpd)	178,400	
	Power Unit Cost ($/kWh)	$ 0.12	
	Annual Power Cost, Disinfection System		*$5,184*
	Disinfection System Power Use (kWh/year)	43,200	
	Annual Misc. Power Cost		*$2,102*
	Miscellaneous Power for Plant (kWh/day)	2.00	
4	**Equipment Maintenance/Replacement**		**$ 52,300**
5	**Odor Control Maintenance/Replacement**		**$ 10,000**
	% of Construction Cost	20.0%	
6	**Sampling - Lab Costs**		**$ 33,000**
7	**Administration**		**$ 12,000**
8	**Permit Compliance Fees**		**$ 12,000**
9	**Annual Misc. O&M Costs**		**$ 17,000**
		Total O & M Cost	**$ 184,730**

Table A-7: O&M Costs for One Treatment Facility, Flow = 210,000 gpd

#	Description		Total
1	**Contract Operations**		**$ 29,120**
	# hours per visit	2	
	# visits per week	7	
	FTE	0.35	
	hourly rate	$40.00	
2	**Sludge Disposal**		**$ 1,890**
	Frequency of pumping (years)	5	
	Total Volume Pumped (gal)	62,910	
	Rate ($/gal)	$0.15	
3	**Electricity**		**$ 19,500**
	Total Pumping Cost		*$12,200*
	Design Flow (gpd)	209,700	
	Power Unit Cost ($/kWh)	$ 0.12	
	Annual Power Cost, Disinfection System		*$5,184*
	Disinfection System Power Use (kWh/year)	43,200	
	Annual Misc. Power Cost		*$2,102*
	Miscellaneous Power for Plant (kWh/day)	2.00	
4	**Equipment Maintenance/Replacement**		**$ 61,500**
5	**Odor Control Maintenance/Replacement**		**$ 10,000**
	% of Construction Cost	20.0%	
6	**Sampling - Lab Costs**		**$ 33,000**
7	**Administration**		**$ 12,000**
8	**Permit Compliance Fees**		**$ 12,000**
9	**Annual Misc. O&M Costs**		**$ 18,000**
		Total O & M Cost	**$ 197,010**

Table A-8: O&M Costs for One Treatment Facility, Flow = 440,000 gpd

#	Description		Total
1	**Contract Operations**		**$ 29,120**
	# hours per visit	2	
	# visits per week	7	
	FTE	0.35	
	hourly rate	$40.00	
2	**Sludge Disposal**		**$ 3,950**
	Frequency of pumping (years)	5	
	Total Volume Pumped (gal)	131,490	
	Rate ($/gal)	$0.15	
3	**Electricity**		**$ 32,700**
	Total Pumping Cost		*$25,400*
	Design Flow (gpd)	438,300	
	Power Unit Cost ($/kWh)	$ 0.12	
	Annual Power Cost, Disinfection System		*$5,184*
	Disinfection System Power Use (kWh/year)	43,200	
	Annual Misc. Power Cost		*$2,102*
	Miscellaneous Power for Plant (kWh/day)	2.00	
4	**Equipment Maintenance/Replacement**		**$ 128,500**
5	**Odor Control Maintenance/Replacement**		**$ 10,000**
	% of Construction Cost	20.0%	
6	**Sampling - Lab Costs**		**$ 33,000**
7	**Administration**		**$ 12,000**
8	**Permit Compliance Fees**		**$ 12,000**
9	**Annual Misc. O&M Costs**		**$ 27,000**
		Total O & M Cost	**$ 288,270**

Table A-9: O&M Costs for One Treatment Facility, Flow = 770,000 gpd

#	Description		Total
1	**Contract Operations**		**$ 29,120**
	# hours per visit	2	
	# visits per week	7	
	FTE	0.35	
	hourly rate	$40.00	
2	**Sludge Disposal**		**$ 6,900**
	Frequency of pumping (years)	5	
	Total Volume Pumped (gal)	229,830	
	Rate ($/gal)	$0.15	
3	**Electricity**		**$ 51,600**
	Total Pumping Cost		*$44,300*
	Design Flow (gpd)	766,100	
	Power Unit Cost ($/kWh)	$ 0.12	
	Annual Power Cost, Disinfection System		*$5,184*
	Disinfection System Power Use (kWh/year)	43,200	
	Annual Misc. Power Cost		*$2,102*
	Miscellaneous Power for Plant (kWh/day)	2.00	
4	**Equipment Maintenance/Replacement**		**$ 224,500**
5	**Odor Control Maintenance/Replacement**		**$ 10,000**
	% of Construction Cost	20.0%	
6	**Sampling - Lab Costs**		**$ 33,000**
7	**Administration**		**$ 12,000**
8	**Permit Compliance Fees**		**$ 12,000**
9	**Annual Misc. O&M Costs**		**$ 38,000**
		Total O & M Cost	**$ 417,120**

APPENDIX C - SUMMARY OF COST ESTIMATES FOR DECENTRALIZED TREATMENT SCENARIOS PROJECT MEMORANDUM, CAROLLO ENGINEERS, AUGUST 25, 2008

PROJECT MEMORANDUM

Project Name:	Los Osos Wastewater Project Development	**Date:**	08/25/2008
Client:	County of San Luis Obispo	**Project Number:**	7630D.00 T03
Prepared By:	Karl Hadler		
Reviewed By:	Lou Carella		
Subject:	Summary of Cost Estimates for Decentralized Treatment Scenarios		
Distribution:	County, Lydia Holmes, Todd Yamello, Lorien Fono		

Decentralized treatment scenarios in the community of Los Osos were developed by Lombardo Associates, Inc. (LAI). As part of the scope of work, the Cost Estimates for Decentralized Scenarios Technical Memorandum (LAI, August 2008) presented conceptual level costs for two scenarios:

- Scenario 1 - Multiple (Seven) Treatment Locations Within Los Osos
- Scenario 2 - Two Treatment Locations Within Los Osos.

Each scenario included two effluent dispersal/ reuse options. One included residential reuse and drainfields. The other option included common drainfields only.

Capital Cost Estimate

Construction costs presented in Table 4-1 through 4-4 of the TM were modified to be consistent with the Fine Screening Analysis in order to develop an equivalent comparison to viable project alternatives. The modified tables are presented in Table 1 through 4 of this memorandum. Modifications from the LAI TM include:

Collection System

- Item No. 1 through 10 of the Collection System in Table 4-1 through 4-4 are **not** based on bid tab costs. Contractor overhead and profit and sales tax for these items were not included in the TM by LAI. The attached cost estimates include contractor overhead and profit and sales tax for these line items.

Treatment System

- While contractor overhead and profit and sales tax were included for Item No.1 through 4 of the Treatment System in Table 4-1 through 4-4, these costs were not applied to the treatment process contingency. These factors have been applied to the contingency in the attached cost estimates to be consistent with the Fine Screening Analysis.

Dispersal/Reuse System

- Drainfield/drip irrigation unit costs used in the LAI TM are not consistent with previous information developed which used a range of $2/sf to $5/sf. The high range of costs was not presented in the TM (Table 4-1 through 4-4) and documentation to justify using the low cost was not provided. The attached cost estimates include the range of costs ($2/sf to $5/sf) to correlate to previous estimates.

- Distribution force mains and laterals to the property in the Dispersal/Reuse System in Table 4-1 through 4-4 are **not** based on bid tab costs. Contractor overhead and profit and sales tax for these items were not included in the LAI TM. The attached cost estimates include contractor overhead and profit and sales tax for these line items.

Note that the modifications to include contractor overhead and profit on the items noted above added approximately $10 million to the scenarios with residential reuse and $5 million dollars to scenarios without residential reuse. This change impacted both the low range and high range costs.

Including the high range cost for drip irrigation of $5/sf increased the high end cost estimate only for the residential reuse options by $13.3 million. The high end cost estimates assuming scenarios without residential reuse increased by $4.4 million due to this modification.

Table 5 provides a summary of the costs developed in Table 1 through 4. In addition, permitting/mitigation costs, escalation and project costs are added to develop the total project cost estimate. These costs are identical to those used in Table 7.4 of the Fine Screening Analysis and included in other viable project alternatives.

No documentation was provided by LAI as to why County project development costs would be significantly higher for decentralized treatment than viable project alternatives in the Fine Screening Analysis. Development of project costs is detailed in Appendix C of the Basis of Cost Memorandum (Carollo, May 2007). Project costs in the attached estimate **have been reduced** from the LAI TM to be consistent with the Fine Screening Analysis. This modification reduced the low range cost for scenarios with residential reuse by $3 to $8 million dollars. Low range costs for scenarios without residential reuse were reduced by $6 million.

The cumulative impact of these changes results in almost no cost differential in the low range costs from the LAI memorandum. The high range costs are approximately $12 to $26 million higher than the LAI memorandum for scenarios without residential reuse and those with residential reuse, respectively.

Operation and Maintenance Cost Estimate

Table 6 provides a summary of the total annual operation and maintenance costs for the decentralized scenarios. Costs are identical to those presented in Table 5-1 through 5-5 of the LAI TM.

Table 1: Construction Costs - Scenario 1 with Residential Reuse and Drainfields

Item No.	Item Description	Quantity	Units	Low Unit Cost	Low Range Cost	High Unit Cost	High Range Cost
		Collection System					
1	Mobilization/Demobilization	1	EA	5%	$2,847,763	5%	$2,874,625
2	Type 1 STEG Connection	341	EA	$3,850	$1,312,850	$3,850	$1,312,850
3	Type 2 STEG Connection	3,073	EA	$3,850	$11,831,050	$3,850	$11,831,050
4	Type 3 STEG Connection	911	EA	$5,445	$4,960,395	$5,445	$4,960,395
5	Type 4 STEG Connection	228	EA	$9,845	$2,244,660	$11,055	$2,520,540
6	Type 1 STEP Connection	16	EA	$8,360	$133,760	$9,570	$153,120
7	Type 2 STEP Connection	146	EA	$8,360	$1,220,560	$9,570	$1,397,220
8	Type 3 STEP Connection	43	EA	$9,955	$428,065	$11,165	$480,095
9	Type 4 STEP Connection	11	EA	$12,265	$134,915	$13,475	$148,225
10	Pressure Sewer/Force Mains	24,900	LF	$60	$1,494,000	$60	$1,494,000
11	4" Gravity Sewer	221,000	LF	$129	$28,509,000	$129	$28,509,000
12	Road Restoration	1	EA	$2,000,000	$2,000,000	$2,000,000	$2,000,000
13	Pocket Pump Station	4	EA	$200,000	$800,000	$200,000	$800,000
14	Duplex Pump Station	2	EA	$433,000	$866,000	$433,000	$866,000
15	Triplex Pump Station	0	EA	$600,000	$0	$600,000	$0
16	Odor Control	6	EA	$50,000	$300,000	$50,000	$300,000
17	Standby Power Facilities	2	EA	$360,000	$720,000	$360,000	$720,000
				SUBTOTAL	$59,803,018		$60,367,120
		Treatment System					
1	EQ/Recirculation/Dosing Tanks	1	LS	$4,320,000	$4,320,000	$4,320,000	$4,320,000
2	Biofilters	1	LS	$8,880,000	$8,880,000	$8,880,000	$8,880,000
3	Nitrex™	1	LS	$4,560,000	$4,560,000	$4,560,000	$4,560,000
4	Disinfection/Filtration/Controls	1	LS	$2,760,000	$2,760,000	$2,760,000	$2,760,000
	Contingency (Item 1-4)			30%	$6,156,000	30%	$6,156,000
5	Odor Control	7	EA	$50,000	$350,000	$50,000	$350,000
6	Standby Power Facilities	7	EA	$360,000	$2,520,000	$360,000	$2,520,000
7	Land Acquisition	9	AC	$500,000	$4,500,000	$500,000	$4,500,000
				SUBTOTAL	$34,046,000		$34,046,000
		Dispersal/Reuse System - Residential					
1	Distribution Force Main	231,300	FT	$60	$13,878,000	$60	$13,878,000
2	Laterals to Property	381,600	FT	$60	$22,896,000	$60	$22,896,000
3	Drip Irrigation	3,613,200	FT^2	$2	$7,226,400	$5	$18,066,000
				SUBTOTAL	$44,000,400		$54,840,000
				Contractor Overhead and Profit (15%)[1]	$14,592,663		$16,303,218
				Sales Tax (8%)[2]	$3,891,377		$4,347,525
				TOTAL	**$156,333,457**		**$169,903,863**

Notes:
1. Included contractor overhead and profit for all items except for land acquisition and items where the unit costs are based on previous project collection system bid tabs.
2. Included sales tax for materials except for items where the unit costs are based on the previous project collection system bid tabs.

Table 2: Construction Costs - Scenario 1 without Residential Reuse and Drainfields

Item No.	Item Description	Quantity	Units	Low Unit Cost	Low Range Cost	High Unit Cost	High Range Cost
		Collection System					
1	Mobilization/Demobilization	1	EA	5%	$2,847,763	5%	$2,874,625
2	Type 1 STEG Connection	341	EA	$3,850	$1,312,850	$3,850	$1,312,850
3	Type 2 STEG Connection	3,073	EA	$3,850	$11,831,050	$3,850	$11,831,050
4	Type 3 STEG Connection	911	EA	$5,445	$4,960,395	$5,445	$4,960,395
5	Type 4 STEG Connection	228	EA	$9,845	$2,244,660	$11,055	$2,520,540
6	Type 1 STEP Connection	16	EA	$8,360	$133,760	$9,570	$153,120
7	Type 2 STEP Connection	146	EA	$8,360	$1,220,560	$9,570	$1,397,220
8	Type 3 STEP Connection	43	EA	$9,955	$428,065	$11,165	$480,095
9	Type 4 STEP Connection	11	EA	$12,265	$134,915	$13,475	$148,225
10	Pressure Sewer/Force Mains	24,900	LF	$60	$1,494,000	$60	$1,494,000
11	4" Gravity Sewer	221,000	LF	$129	$28,509,000	$129	$28,509,000
12	Road Restoration	1	EA	$2,000,000	$2,000,000	$2,000,000	$2,000,000
13	Pocket Pump Station	4	EA	$200,000	$800,000	$200,000	$800,000
14	Duplex Pump Station	2	EA	$433,000	$866,000	$433,000	$866,000
15	Triplex Pump Station	0	EA	$600,000	$0	$600,000	$0
16	Odor Control	6	EA	$50,000	$300,000	$50,000	$300,000
17	Standby Power Facilities	2	EA	$360,000	$720,000	$360,000	$720,000
				SUBTOTAL	$59,803,018		$60,367,120
		Treatment System					
1	EQ/Recirculation/Dosing Tanks	1	LS	$4,320,000	$4,320,000	$4,320,000	$4,320,000
2	Biofilters	1	LS	$8,880,000	$8,880,000	$8,880,000	$8,880,000
3	Nitrex™	1	LS	$4,560,000	$4,560,000	$4,560,000	$4,560,000
4	Disinfection/Filtration/Controls	1	LS	$2,760,000	$2,760,000	$2,760,000	$2,760,000
	Contingency (Item 1-4)			30%	$6,156,000	30%	$6,156,000
5	Odor Control	7	EA	$50,000	$350,000	$50,000	$350,000
6	Standby Power Facilities	7	EA	$360,000	$2,520,000	$360,000	$2,520,000
7	Land Acquisition	9	AC	$500,000	$4,500,000	$500,000	$4,500,000
				SUBTOTAL	$34,046,000		$34,046,000
		Dispersal/Reuse System - Residential					
1	Distribution Force Main	23,000	FT	$60	$1,380,000	$60	$1,380,000
2	Drip Irrigation	1,204,400	FT^2	$2	$2,408,800	$5	$6,022,000
3	Land Acquisition	27.7	AC	$500,000	$13,850,000	$500,000	$13,850,000
				SUBTOTAL	$17,638,800		$21,252,000
		Contractor Overhead and Profit (15%)(1)			$8,560,923		$9,187,518
				Sales Tax (8%)(2)	$2,282,913		$2,450,005
				TOTAL	**$122,331,653**		**$127,302,643**

Notes:

1. Included contractor overhead and profit for all items except for land acquisition and items where the unit costs are based on previous project collection system bid tabs.
2. Included sales tax for materials except for items where the unit costs are based on the previous project collection system bid tabs.

Table 3: Construction Costs - Scenario 2 with Residential Reuse and Drainfields

Item No.	Item Description	Quantity	Units	Low Unit Cost	Low Range Cost	High Unit Cost	High Range Cost
		Collection System					
1	Mobilization/Demobilization	1	EA	5%	$2,878,095	5%	$2,906,833
2	Type 1 STEG Connection	339	EA	$3,850	$1,305,150	$3,850	$1,305,150
3	Type 2 STEG Connection	3,051	EA	$3,850	$11,746,350	$3,850	$11,746,350
4	Type 3 STEG Connection	904	EA	$5,445	$4,922,280	$5,445	$4,922,280
5	Type 4 STEG Connection	226	EA	$9,845	$2,224,970	$11,055	$2,498,430
6	Type 1 STEP Connection	19	EA	$8,360	$158,840	$9,570	$181,830
7	Type 2 STEP Connection	168	EA	$8,360	$1,404,480	$9,570	$1,607,760
8	Type 3 STEP Connection	50	EA	$9,955	$497,750	$11,165	$558,250
9	Type 4 STEP Connection	12	EA	$12,265	$147,180	$13,475	$161,700
10	Pressure Sewer/Force Mains	26,100	LF	$60	$1,566,000	$60	$1,566,000
11	4" Gravity Sewer	220,100	LF	$129	$28,392,900	$129	$28,392,900
12	Road Restoration	1	EA	$2,000,000	$2,000,000	$2,000,000	$2,000,000
13	Pocket Pump Station	2	EA	$200,000	$400,000	$200,000	$400,000
14	Duplex Pump Station	2	EA	$433,000	$866,000	$433,000	$866,000
15	Triplex Pump Station	1	EA	$600,000	$600,000	$600,000	$600,000
16	Odor Control	5	EA	$50,000	$250,000	$50,000	$250,000
17	Standby Power Facilities	3	EA	$360,000	$1,080,000	$360,000	$1,080,000
				SUBTOTAL	$60,439,995		$61,043,483
		Treatment System					
1	EQ/Recirculation/Dosing Tanks	1	LS	$4,320,000	$4,320,000	$4,320,000	$4,320,000
2	Biofilters	1	LS	$8,880,000	$8,880,000	$8,880,000	$8,880,000
3	Nitrex™	1	LS	$4,560,000	$4,560,000	$4,560,000	$4,560,000
4	Disinfection/Filtration/Controls	1	LS	$2,760,000	$2,760,000	$2,760,000	$2,760,000
	Contingency (Item 1-4)			30%	$6,156,000	30%	$6,156,000
5	Odor Control	2	EA	$50,000	$100,000	$50,000	$100,000
6	Standby Power Facilities	2	EA	$360,000	$720,000	$360,000	$720,000
7	Land Acquisition	7	AC	$500,000	$3,500,000	$500,000	$3,500,000
				SUBTOTAL	$30,996,000		$30,996,000
		Dispersal/Reuse System - Residential					
1	Distribution Force Main	231,300	FT	$60	$13,878,000	$60	$13,878,000
2	Laterals to Property	381,520	FT	$60	$22,891,200	$60	$22,891,200
3	Drip Irrigation	3,613,200	FT^2	$2	$7,226,400	$5	$18,066,000
				SUBTOTAL	$43,995,600		$54,835,200
				Contractor Overhead and Profit (15%)(1)	$14,628,404		$16,344,867
				Sales Tax (8%)(2)	$3,900,908		$4,358,631
				TOTAL	**$153,960,907**		**$167,578,181**

Notes:
1. Included contractor overhead and profit for all items except for land acquisition and items where the unit costs are based on previous project collection system bid tabs.
2. Included sales tax for materials except for items where the unit costs are based on the previous project collection system bid tabs.

Table 4: Construction Costs - Scenario 2 without Residential Reuse and Drainfields

Item No.	Item Description	Quantity	Units	Low Unit Cost	Low Range Cost	High Unit Cost	High Range Cost
		Collection System					
1	Mobilization/Demobilization	1	EA	5%	$2,878,095	5%	$2,906,833
2	Type 1 STEG Connection	339	EA	$3,850	$1,305,150	$3,850	$1,305,150
3	Type 2 STEG Connection	3,051	EA	$3,850	$11,746,350	$3,850	$11,746,350
4	Type 3 STEG Connection	904	EA	$5,445	$4,922,280	$5,445	$4,922,280
5	Type 4 STEG Connection	226	EA	$9,845	$2,224,970	$11,055	$2,498,430
6	Type 1 STEP Connection	19	EA	$8,360	$158,840	$9,570	$181,830
7	Type 2 STEP Connection	168	EA	$8,360	$1,404,480	$9,570	$1,607,760
8	Type 3 STEP Connection	50	EA	$9,955	$497,750	$11,165	$558,250
9	Type 4 STEP Connection	12	EA	$12,265	$147,180	$13,475	$161,700
10	Pressure Sewer/Force Mains	26,100	LF	$60	$1,566,000	$60	$1,566,000
11	4" Gravity Sewer	220,100	LF	$129	$28,392,900	$129	$28,392,900
12	Road Restoration	1	EA	$2,000,000	$2,000,000	$2,000,000	$2,000,000
13	Pocket Pump Station	2	EA	$200,000	$400,000	$200,000	$400,000
14	Duplex Pump Station	2	EA	$433,000	$866,000	$433,000	$866,000
15	Triplex Pump Station	1	EA	$600,000	$600,000	$600,000	$600,000
16	Odor Control	5	EA	$50,000	$250,000	$50,000	$250,000
17	Standby Power Facilities	3	EA	$360,000	$1,080,000	$360,000	$1,080,000
				SUBTOTAL	$60,439,995		$61,043,483
		Treatment System					
1	EQ/Recirculation/Dosing Tanks	1	LS	$4,320,000	$4,320,000	$4,320,000	$4,320,000
2	Biofilters	1	LS	$8,880,000	$8,880,000	$8,880,000	$8,880,000
3	Nitrex™	1	LS	$4,560,000	$4,560,000	$4,560,000	$4,560,000
4	Disinfection/Filtration/Controls	1	LS	$2,760,000	$2,760,000	$2,760,000	$2,760,000
	Contingency (Item 1-4)			30%	$6,156,000	30%	$6,156,000
5	Odor Control	2	EA	$50,000	$100,000	$50,000	$100,000
6	Standby Power Facilities	2	EA	$360,000	$720,000	$360,000	$720,000
7	Land Acquisition	7	AC	$500,000	$3,500,000	$500,000	$3,500,000
				SUBTOTAL	$30,996,000		$30,996,000
		Dispersal/Reuse System - Residential					
1	Distribution Force Main	23,000	FT	$60	$1,380,000	$60	$1,380,000
2	Drip Irrigation	1,204,400	FT^2	$2	$2,408,800	$5	$6,022,000
3	Land Acquisition	27.7	AC	$500,000	$13,850,000	$500,000	$13,850,000
				SUBTOTAL	$17,638,800		$21,252,000
				Contractor Overhead and Profit (15%)(1)	$8,597,384		$9,229,887
				Sales Tax (8%)(2)	$2,292,636		$2,461,303
				TOTAL	**$119,964,815**		**$124,982,673**

Notes:
1. Included contractor overhead and profit for all items except for land acquisition and items where the unit costs are based on previous project collection system bid tabs.
2. Included sales tax for materials except for items where the unit costs are based on the previous project collection system bid tabs.

Table 5: Decentralized Scenario Range of Project Costs

Project Element	Non-Residential Reuse Costs ($M)				Residential Reuse Costs ($M)			
	Scenario 1		Scenario 2		Scenario 1		Scenario 2	
	Low	High	Low	High	Low	High	Low	High
Collection, Treatment and Disposal/Reuse[1]	$122	$127	$120	$125	$156	$170	$154	$168
Treatment Facility Site	Included in Treatment Costs				Included in Treatment Costs			
Permitting/Mitigation[2]	$1	$2	$1	$2	$1	$2	$1	$2
Total Construction Cost	$123	$129	$121	$127	$157	$172	$155	$170
Total Construction Costs Escalated to Mid-Point of Construction[3]	$153	$161	$151	$158	$195	$214	$193	$212
Project Costs[4]	$18	$24	$18	$24	$21	$26	$21	$26
Total Project Cost	$171	$185	$169	$182	$216	$240	$214	$238

Notes:
1. Total construction costs including contingencies, contractor overhead and profit and sales tax on materials as presented in Table 1 through 4.
2. Costs do not include land restoration costs of $20,000 to $50,000 per acre.
3. Assumes mid-point of construction is June 2011. Escalation at 24.5% of construction cost subtotal per the Basis of Cost Evaluation (Carollo Engineers, May 2007).
4. Project costs include design, construction management, administration and legal costs as detailed in the Basis of Cost Evaluation (Carollo Engineers, May 2007)

Table 6: Decentralized Scenario Range of O&M Costs

Project Element	Non-Residential Reuse Costs ($M)		Residential Reuse Costs ($M)	
	Scenario 1	**Scenario 2**	**Scenario 1**	**Scenario 2**
Collection System[(1)]	$0.6	$0.6	$0.8	$0.8
Treatment Facilities[(2)]	$1.3	$0.7	$1.3	$0.7
Disposal/Reuse	Included In Collection System Costs		Included In Collection System Costs	
Total Annual O&M Cost	$1.9	$1.3	$2.1	$1.5

Notes:

1. From Table 5-1 through 5-4 of the Cost Estimates for Decentralized Scenarios (Lombardo Associates, Inc., August 2008)
2. From Table 5-5 of the Cost Estimates for Decentralized Scenarios (Lombardo Associates, Inc., August 2008)