Los Osos Eng. File
WWT Facilities

Metcalf & Eddy
An Air & Water Technologies Company

July 26, 1995

Honorable Board of Supervisors
San Luis Obispo County
County Government Center
San Luis Obispo, California 93408

Subject: Los Osos Wastewater Study

Dear Board Member:

Metcalf & Eddy is pleased to submit this report on Task G of our contract dated October 10, 1989, and amended October 1, 1993. The purposes of Task G are to (1) identify alternative technologies applicable to managing the wastewater from Los Osos; (2) evaluate these on a technical merit and cost basis; and (3) then from these remaining technologies develop alternative system plans that would achieve the combined result of reducing the nitrate contamination in the shallow groundwater and provide a lower cost system than has been proposed in previous studies.

In preparing this report, we worked closely with the Technical Advisory Committee (TAC). The TAC reviewed an earlier draft of this report and prepared comments. Those comments with M&E's responses are presented in Appendix A.

During the progress of the work, we made several assumptions that affected our calculations and the resulting conclusions. Some key assumptions were:

1. The area where shallow groundwater prevails must be served by a sewer system of some type and that wastewater must be treated and disposed of in another area.

2. The buildout population is based on land use and dwelling unit densities developed by the San Luis Obispo County Planning Department. We also assumed that growth would occur uniformly the next 20 years to buildout.

3. The present worth analysis was based on an evaluation period of 30 years to reflect the buildout basis of design for pipelines and pumping stations. We further assumed that the treatment plant would be built initially to Stage 1 and that the second stage of the treatment plant would be added after 12 years to reach buildout capacity. For OSRs and onsite systems, we assumed a uniform increase in the number of systems for 20 years to reach buildout and no further increases would

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occur from year 21 to 30. To make the cost analysis fair and equitable, all costs were converted to present worth values over 30 years at 7%/year interest.

Certain findings of the study are noted below so that their implications are not lost during the decision process and future preliminary and final design work.

1. The use of septic tanks as pretreatment devices followed by pressure or small gravity sewers (STEP/STEG) was found to be similar in cost to the conventional sewage collection system. Either system could be used, but the operational characteristics of a conventional system make it our recommended choice.

2. Several on-lot systems for upgrading the quality of the wastewater going to the leaching system were found to be similar in cost and treatment performance. One system, the "BESTEP" by Advanced Environmental Systems (AES), seemed to find favor among the TAC members. Although there is little long-term operating data on cost and reliability, we used AES as a generic system to reflect this group of "onsite reactor" systems (OSRs).

Our conclusions and recommendations are presented in Chapter 4 of this report. The recommendations are summarized as follows.

1. **The preferred plan is to adopt a conventional wastewater system for all areas in the community.** Construction costs are lower now than were expected in previous studies. Consequently, there is currently a window of opportunity to save money. This plan offers the most reliable operational characteristics and nitrogen removal. Further, this approach is uniform for all community members and lends itself to the presently established financing plan based on the assessment district.

2. If the County chooses a phased approach with two or more types of systems, then we recommend the following actions be adopted:

    a. All areas that contain shallow groundwater (generally less than 30 feet from the surface) should be served by a conventional sewer, treatment, and disposal/recharge system. This includes areas B, C, E, F, G, K as shown in Figure 3-1. The exact area should be verified by detailed analysis of groundwater depth data and, if necessary, additional monitoring wells.

b. In all other areas, existing onsite systems should be upgraded and maintained as part of an Onsite Wastewater Disposal Zone formed according to California Health and Safety Code, Sections 6955 ff.

c. Establish a groundwater monitoring system for nitrate concentrations to provide early warning for when the next phase of wastewater management improvements must be implemented.

d. Select six to ten sites in the nonsewered area for establishing a demonstration test of the OSR system. Both treatment performance and long-term operating and maintenance costs should be monitored. The test should be conducted over a 5-year period.

e. Implement Phase II if there are not substantial reductions in nitrate concentration in underlying groundwater to meet discharge requirements and other regulatory requirements. Phase II may consist of the extension of the conventional sewer system or the installation of OSRs, depending on the results of the demonstration program.

**M&E believes that this phased approach, while technically feasible, carries many risks, including inadequate nitrogen removal and the possible need to construct Phase II at considerable additional cost.**

3. Authorize M&E to begin studies on the infiltration site (Broderson site) to determine the feasibility of the site for recharge and any downgradient improvement needed to assure successful use of the site.

4. Authorize M&E to begin the preliminary design based on the County's choice of options. Preliminary design should also include study of alternative treatment plant sites closer to the community than the Turri Road site.

5. If the County chooses recommendation No. 2, then authorize a review of the present financing plan for any limitations or difficulties derived from that choice.

M&E again acknowledges and thanks the TAC and the County Engineering Department for their valuable input on the draft of this report. Many changes can occur during an internal review of the draft, but these changes (summarized in Appendix A) are transparent to outside reviewers until the report is again published as a final document. Their patience and support are appreciated.

We also appreciate the assistance of our subcontractors -- i.e. Engineering, Nolte and Associates, and Bookman-Edmonston Engineering -- for their contributions to this report in their respective fields of expertise. i.e. Engineering (Mike Parker) provided data and information, including costs, for alternative collection systems in Appendix B4; Nolte wrote most of Appendix B2 on onsite system alternatives; Bookman-Edmonston prepared a discussion of recharge sites in Appendix B1.

Respectfully submitted,

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# Chapter 1
# INTRODUCTION

## BACKGROUND

Los Osos is an unincorporated, suburban residential community that has grown from a population of 600 in 1950 to over 14,000 today. The method of wastewater disposal is onsite systems, primarily septic tanks and leachfields or seepage pits. In the late 1970s, the California Regional Water Quality Control Board, Central Coast Region (RWQCB) observed high nitrate levels in shallow monitoring wells and concluded that these nitrate levels appeared to increase with population and time. The RWQCB also concluded that most of the nitrates were the result of increasing numbers of onsite wastewater systems. Furthermore, some nitrate levels were above the Maximum Contaminant Limit (MCL) of 10 mg/L (as nitrogen). As a result of these high nitrate levels and other factors such as bacterial levels exceeding Basin Plan limits, small lot sizes, and documented health concerns and problems from the County Environmental Health Department and State Health Department, the RWQCB imposed a prohibition (Resolution 83-13) against individual wastewater discharges that became effective in 1988.

There is no direct evidence to indicate that existing domestic water supplies, which draw from deeper wells, are being contaminated by nitrates. The concern is that nitrate in shallow groundwater will eventually contaminate the deeper groundwater. This contamination does not appear imminent because the present quality of domestic water supply is good, i.e., nitrate levels are well below the MCL. However, there appears to be a slightly increasing trend of nitrate concentration in four of the 13 water supply production wells in the community.

As early as 1985, the RWQCB issued probable waste discharge requirements based on the beneficial uses of surface water and groundwater in the Los Osos area. A facilities plan,

preliminary design, and Environmental Impact Report were prepared in 1985-87 [1,2,3]. The proposed project in these documents was a conventional gravity and pressure sewer collection system: a 1.6-million-gallon/day advanced wastewater treatment plant and discharge of treated effluent into the groundwater basin via Los Osos Creek and a percolation basin at the south end of Broderson Avenue. The cost of these facilities, including design, construction, and financing costs, was estimated to be $71.5 million (1993 dollars), which represented a bonded assessment of over $11,500/single family dwelling. This cost has caused officials and citizens to search for less expensive alternatives and a better definition of wastewater problems in Los Osos.

In 1991, a Blue Ribbon Committee (BRC) was formed to advise the County on finding the best alternative solution to the wastewater problem and to consider flooding, recharge, and water supply sources for Los Osos. The BRC, County, and M&E worked together to develop a scope of work to perform a new, updated study of alternative wastewater management systems. In September 1993, a Technical Advisory Committee (TAC) was formed to further define that scope of work and to assist, advise, monitor, and confer with M&E during the study.

## OBJECTIVES

The study has the following objectives.

1. Determine the causes and sources of the observed high nitrate concentrations in shallow groundwater.
2. Determine the problems and potential problems of existing onsite wastewater systems.
3. Find ways to reduce the construction cost.

## SCOPE OF WORK

To achieve these objectives, M&E's 1989 agreement was amended to add the following three work elements.

1. **Nitrate Sources.** Estimate the relative contributions of various sources of nitrates in groundwater, i.e., wastewater, fertilizer and irrigation, natural vegetation, atmospheric sources, etc.

2. **Sanitary Survey.** Obtain information on factors that affect performance of onsite wastewater systems. Citizen volunteers will develop and administer a questionnaire to Los Osos residents and businesses and deliver the results to M&E. The San Luis Obispo County Engineering and Planning Departments will also provide data on nitrate concentrations, groundwater levels, building permits issued for onsite wastewater system repairs, land use, and septage pumper records.

3. **Alternative Technologies Evaluation.** Evaluate alternative technologies for wastewater collection, treatment, and disposal. The evaluation is based on specific criteria such as cost, technical feasibility, regulatory conformance, and environmental impacts, and consists of a two-step procedure.

   a. **Preliminary Screening.** The first step is a screening of alternatives on the basis of specific criteria. The screening is intended to reduce the number of alternatives to a more manageable number for more detailed analysis and ranking.

   b. **Detailed Evaluation.** The second step is a detailed evaluation of the technologies surviving the screening process above. These technologies are formulated into specific alternatives--i.e., combinations of collection, treatment, and disposal options--and rated based on specific criteria and estimated construction and operating costs. The evaluation criteria in this step are not the same as the criteria for the preliminary screening.

   Both steps were completed with the assistance of the TAC, whose members helped develop the criteria and ratings.

## REPORT ORGANIZATION

The first two work elements constitute Task F of M&E's amended agreement. A separate report was prepared on Task F work [4]; a summary of this work is presented below. The third element is Task G of M&E's amended agreement. This report deals with this third work element and is divided into the following chapters.

Chapter 2 - Preliminary Screening of Alternative Technologies

Chapter 3 - Detailed Analysis of Alternative Wastewater Management Plans

Chapter 4 - Conclusions and Recommendations

The TAC reviewed a draft of this report. TAC's comments and M&E's responses are included in Appendix A.

## SUMMARY OF TASK F WORK

### Findings

In general, average annual nitrate concentrations in shallow groundwater appear to be increasing since the 1950s. Because nitrate concentrations in individual monitoring wells differ widely within the community, the impact of onsite wastewater systems and other potential nitrate sources does not appear to be evenly distributed.

For the entire community, the estimated relative contribution of nitrates to shallow groundwater was derived by a mass loading calculation; the results are as follows.[a]

| | |
|---|---|
| Individual onsite wastewater systems | 61% |
| Natural | 18 |
| Horticultural fertilizer | 6 |
| Horse waste | 5 |
| Soil disturbance | 3 |
| Agricultural fertilizer | 3 |
| Weed abatement | 2 |
| Dog waste | 1 |
| Cat waste | 1 |
| | 100% |

Problems with existing onsite systems were indicated (1) in a sanitary survey prepared and administered by the BRC with community volunteers; and (2) by repair and permit records. In the survey, which covered approximately 2,000 residences, 16% reported at least one problem, such as wet spots, odors, or plumbing backups. From 1980 to 1994, the rate of repairs was 2% of the onsite systems/year. However, there were several areas with a significantly higher incidence of problems or repairs than these percentages[b].

As indicated by monitoring data [6], nitrogen transformations beneath onsite systems, i.e., nitrification and denitrification, appear to reach a maximum at 10 to 15 feet below the bottom of the effluent discharge. This is equivalent to 20 to 30 feet below the ground surface, depending on the type of system (i.e., leach field or leach pit). Thus, in areas where groundwater depth is 30 feet or more, denitrification is maximized at 50 to 85% (average, approximately 67%) and nitrates entering the groundwater are minimized (average,

---

a. The TAC does not agree with the results of this calculation and has stated that less than 25% of the nitrates in groundwater come from onsite systems [4] (Appendix A).

b. "Significantly higher" is defined as one or more standard deviations above these percentages. Areas are generally blocks as defined in the Assessment District report [5].

approximately 33%). Where groundwater depth is less than 30 feet, the fraction of nitrogen effluent entering the groundwater is believed to be significantly higher than 33%[c].

### Conclusions and Recommendations

Based on these findings, continued use of existing conventional onsite systems is not justified in portions of the community having shallow groundwater and a relatively high incidence of onsite system problems. In such areas, variations to conventional onsite systems that increase nitrate removal, as well as clustered or centrally located collection, treatment, and disposal technologies should be evaluated. In other areas, continued use of existing onsite systems should be evaluated but with appropriate design, maintenance, and operating criteria, standards, and regulations.

## SUMMARY OF TASK G WORK

The purpose of this task is to develop and evaluate alternative wastewater management systems to deal with water quality issues and recommend the best wastewater management plan for Los Osos.

The approach is a two-step procedure: (1) preliminary screening of alternative technologies and (2) a detailed analysis of specific alternatives using technologies surviving the preliminary screening. Over 50 different collection, treatment, and disposal/recharge technologies are reviewed. The most promising are a conventional system based on a mostly gravity collection system and one treatment plant based on a sequencing batch reactor; a local/neighborhood collection/treatment/disposal/recharge system; retrofitting existing septic tanks with equipment to convert them to aerobic onsite reactors (OSRs); and continuing to use existing onsite systems.

---

c. The TAC believes that the amount of nitrate entering the groundwater has not been established and is probably appreciably less than 33%.

The community is divided into 13 areas for analysis of these alternatives. In general, local/neighborhood systems are less cost-effective than the conventional systems. In almost any given area or combination of the 13 areas, there could be potential cost savings by using OSRs and/or existing onsite systems.

A phased approach, involving construction of a conventional system for about half the community with the other half using OSRs and/or onsite systems, is considered. This approach will result in reduced overall costs over a conventional system for the entire community. However, OSRs and onsite systems are not as effective and reliable in nitrogen reduction as the conventional system. Furthermore, OSRs have a limited record of long-term performance for nitrogen removal. If it is necessary to build a second phase of a conventional system to further improve nitrogen removal, then the overall costs would be higher than the conventional system for the entire community. With some residents and businesses on sewers and others on onsite systems and/or OSRs, a phased approach would also raise issues of fairness and equity.

The preferred plan of action is to implement the conventional system for the entire community. This has the advantage of being a uniform approach that would equally benefit all Los Osos residents. It would be the most effective at removing nitrogen and eventually remediating the groundwater. Since the assessment district is in place and there is a certified EIR, implementation can proceed without significant administrative delays.

# Chapter 2
# PRELIMINARY SCREENING OF ALTERNATIVE TECHNOLOGIES

There are numerous wastewater collection, treatment, and disposal technologies and options available to deal with the water quality issues in Los Osos as presented in the Task F report [4]. To evaluate these technologies, a two-step procedure is used.

1. Perform a preliminary screening of the technologies and options according to specific criteria.

2. Evaluate the technologies and options in greater detail according to specific criteria, including more detailed cost estimates.

This chapter is a summary of the first step, the preliminary screening procedure. A more complete version of the screening procedure was submitted as a separate draft report to the County and TAC in May 1995. The second step is developed in Chapter 3.

## ALTERNATIVE TECHNOLOGIES AND OPTIONS

The BRC prepared an initial list of alternatives in April 1993. This list was reviewed by M&E, and other technologies or options having potential application to solve wastewater problems in Los Osos were added. The TAC also added some alternatives. The result is the list shown in Table 2-1.

**Table 2-1. LIST OF ALTERNATIVES/OPTIONS**

| |
|---|
| **DISPOSAL/RECHARGE** |
| Landscape/agricultural irrigation |
| Deep well injection |
| Percolation ponds - alternative locations, off creek |
| Los Osos Creek |

| Table 2-1. LIST OF ALTERNATIVES/OPTIONS |
|---|
| **ONSITE TREATMENT (individual houses or small clusters)** |
| Septic tank with soil absorption (leach pits and fields) |
| Septic tank with shallow absorption fields |
| Septic tank with zeolite ion exchange and soil absorption field |
| Interseptic™ |
| RUCK blackwater retrofit |
| Septic tank with mound system |
| Septic tank with evapotranspiration system |
| Septic tank with constructed wetlands system |
| Septic tank with intermittent sand filter and soil absorption field |
| Septic tank with recirculating sand filter and soil absorption field |
| Septic tank with intermittent sand filter, recycle, and soil absorption field |
| Septic tank with internal nitrification/denitrification and soil absorption field |
| Onsite reactor (OSR) |
| Waterless toilet + grey water treatment |
| **OFFSITE TREATMENT (neighborhood or centralized)** |
| Sequencing batch reactor |
| Integrated ponding system |
| Constructed wetlands |
| Trickling filter with denitrification |
| Rotating biological contactors |
| Conventional activated sludge + variations |
| Oxidation ditch |
| Aquatic plant system - duckweed |
| Aquatic plant system - water hyacinths |
| Reverse osmosis/membrane filter |
| High efficiency distillation |

| Table 2-1. LIST OF ALTERNATIVES/OPTIONS |
|---|
| Breakpoint chlorination |
| Ion exchange |
| Biological nitrogen removal - Bardenpho |
| Biological nitrogen removal - alternating aeration |
| Biological nitrogen removal - Biostyr |
| Counter-current aeration |
| Dual-power, multiple cell aerated pond system |
| Rapid infiltration |
| **COLLECTION** |
| Gravity |
| Septic tank effluent pump or gravity system - single or multiple dwellings (cluster) |
| Vacuum pumping |
| Grinder pumps - single or multiple dwelling (cluster) |
| Trenchless construction |
| **SLUDGE AND SEPTAGE DISPOSAL** |
| Agricultural land application |
| Dedicated landfill |
| Compost |
| To other wastewater treatment plants (septage only) |
| **OTHER** |
| Water conservation |
| Grey water recycling |

## EVALUATION CRITERIA FOR PRELIMINARY SCREENING

The purpose of the preliminary screening is to focus on the most promising alternatives in Table 2-1, thereby reducing the list to a more manageable number.

Two sets of criteria are used for preliminary screening: fatal flaws and other factors. Each is discussed in the following paragraphs.

### Fatal Flaws

The fatal flaw criteria and specific tests are presented in Table 2-2. The fatal flaws include specific criteria on costs, technical feasibility, recharge capability, and operating experience. In general, if any technology cannot pass the fatal flaw tests, it is eliminated from further consideration.

**Table 2-2. CRITERIA FOR PRELIMINARY SCREENING OF ALTERNATIVES**

| Criteria | Specific tests or definition |
|---|---|
| **FATAL FLAWS** | |
| Cost | Exceeds total present worth cost of currently proposed project by a significant amount, using same cost bases as done for currently proposed project.<br><br>Exceeds $9,120 "cash" payment per single family residence and $57,937,000 total cash cost by a significant amount. |
| Reclamation criteria (Title 22, Division 13, Chapter 3) | Cannot meet these standards and criteria. |
| Reliability - extent of servicing, repair, maintenance | Troublesome experiences, constant attention. |
| Flexibility - adapt to changing wastewater characteristics | Suitable only for special types of wastewater. |
| Precedents - operational history elsewhere | No or minimal operational experience. |
| Upper/lower aquifer recharge capability | Has no capability of recharging groundwater. |

| Table 2-2. CRITERIA FOR PRELIMINARY SCREENING OF ALTERNATIVES | |
|---|---|
| Criteria | Specific tests or definition |
| **OTHER FACTORS** | |
| Nitrogen removal | Percent removal |
| Land area | Area required (acres or square feet) |
| Technical aspects | Overall effectiveness of treatment for constituents other than nitrogen or overall effectiveness of recharging groundwater.<br><br>Ease/simplicity of operation; skill level of operators. |
| Environmental impacts | Potentially significant impacts which may be difficult to mitigate to insignificance (e.g., odors, public health concerns, loss of habitat, etc.).<br><br>Multiple land use opportunities.<br><br>Impacts from flooding and shallow groundwater. |
| Regulatory aspects | Applicability of other laws and regulations, such as RWQCB probable discharge requirements (but not nitrogen as noted above) and federal sludge/septage regulations. |

## Other Factors

The alternatives are also rated on other criteria which have no threshold values or specific tests. These criteria, also summarized in Table 2-2, are supplementary to the fatal flaw analysis and are also intended to bring forth the most promising alternatives in Table 2-1 to the next stage of analysis.

**Nitrogen Removal.** The California Regional Water Quality Control Board, Central Coast Region (RWQCB) staff has proposed discharge limits for wastewater treatment in Los Osos, based on the Basin Plan and water quality and health criteria. A probable limit for total nitrogen is 5 mg/L (as nitrogen) from a wastewater treatment facility and is a conservative, "worst case" figure equal to half of the Maximum Contaminant Limit (MCL) for nitrate (10

mg/L as nitrogen from California Code of Regulations, Title 22, Section 64431). In other words, a 100% safety factor is applied to the MCL so that the groundwater would not be degraded. However, a probable discharge requirement is further qualified by the statement that "[t]his limit will be based on the receiving water objective and determined after engineering justification is submitted on the treatment scheme (to give credit for treatment, operational techniques, and effect of the soil column, as appropriate)."[5] In other words, the proposed nitrogen limit may be revised if (1) a credit for denitrification in the soil column can be applied, or (2) a suitable alternative plan for returning groundwater quality to below the MCL of nitrate within a certain schedule can be presented. In any case, this effluent limit will not be higher than the MCL of 10 mg/L of total nitrogen.

Such limits have not been adopted officially by the RWQCB, but can serve as guidelines for planning and designing wastewater treatment facilities. Thus, if a technology could not meet a 5 mg/L discharge requirement for nitrate as an average value, it would be eliminated from further consideration. However, the TAC and County directed Metcalf & Eddy to consider "percent nitrogen removal" for each technology as the criteria instead of this specific probable limit. In most cases, nitrogen removal depends on the extent of prior treatment and operating parameters and in the case of soil- or land-based systems, depth to groundwater and soil characteristics. Consequently, a range of percent nitrogen removal is given.

In general, the alternatives with the highest nitrogen removal will be retained for further analysis, provided the alternatives are not screened out because of a fatal flaw or other factors.

**Land Area.** The alternatives in Table 2-1 require a wide range of land areas for facilities. Since there are few specific available vacant parcels within the Los Osos community, land area is a critical factor. Furthermore, acquisition of land for treatment and disposal/recharge facilities can be a long, involved process which could delay implementation of the project.

Also, for onsite systems, lot size could be a critical factor in densely developed portions of the community.

The only site-specific evaluation included in the scope of this report is for previously proposed recharge sites, including the Broderson site and Los Osos Creek. Other sites for treatment and disposal/recharge facilities include:

- Vacant parcels
- Nonmaintained public rights-of-way
- For treatment only, areas in the EIR [3] such as east of Junior High School, and west of Pecho Road, and areas not selected as recharge sites.

**Technical Aspects.** These are factors relating to overall effectiveness of treatment other than nitrogen removal. Principal constituents of concern stated in the probable discharge limits include settleable solids, biochemical oxygen demand, turbidity, and bacteria. Costs and effectiveness of recharge of groundwater are also part of this criteria. Also included are considerations relating to extent of skill required for the operation of the facility or process.

**Environmental Impacts.** These include impacts that may be significant and difficult to mitigate to a level of insignificance. Some examples include odors, public health hazards, and destruction of habitats. Also included are factors relating to multiple land use opportunities, i.e., using the site for more than just wastewater treatment (e.g., recreation). In some cases, a technology will be impacted by flooding and shallow groundwater.

**Regulatory Aspects.** This includes the applicability of other laws and regulations, such as RWQCB probable discharge requirements (but not nitrogen as noted above) and federal sludge/septage regulations.

## APPLICATION OF THE EVALUATION CRITERIA

### Format

Each of the technologies in Table 2-1 is analyzed for fatal flaws and other factors in Table 2-2. The analysis is presented in a series of technical memoranda (Appendix B) in the following format.

- Description of the technology
- Conformance with laws, regulations, and criteria
- Technical aspects, including system reliability, flexibility, precedents, and aquifer recharge capability, and nitrogen removal
- Costs, including capital and operation and maintenance, compared to the currently proposed project--discussed in further detail below
- Other factors, such as environmental impacts and land area requirements

### Costs

The costs of the technology are compared to the specific process(es) that would be replaced in the currently proposed project, which consists of the following components [2].

- Conventional gravity (192,000 ft) and pressure sewers (33,000 ft)
- Seven pumping stations
- 1.6-mgd tertiary treatment plant including:
  - Headworks
  - Sequencing batch reactors
  - Flocculation
  - Filtration
  - Disinfection

- Percolation basin for recharging effluent to the shallow aquifer in winter (when there is hydraulic continuity between Los Osos Creek and Morro Bay)

- Outfall for discharge to Los Osos Creek in summer to recharge the deep aquifer (when there is no hydraulic continuity between Los Osos Creek and Morro Bay)

Cost comparisons are only for analysis of alternative technologies. Comprehensive cost analyses are presented in later chapters when comparing whole systems for the project, including capital and O&M costs combined into a present worth value.

Onsite system alternative cost is compared to the entire project cost, as defined by the "cash" amount in the Assessment District Report [5], i.e., $9,120/single family unit. For offsite treatment and collection alternatives, costs are generally compared to the sequencing batch reactors. For collection systems, alternative costs are compared to the gravity system.

All costs include allowances for construction contingencies, engineering services, legal services, and administration, as follows.

- Contingencies: 20% of construction costs

- Engineering services (design, construction management), legal services, and administration: 20% of construction costs plus contingencies

For alternatives having large land area requirements (generally over 20 acres), land costs are also included.

Cost estimates are planning-level, sufficient for comparison and decision-making among alternatives, but subject to refinement as the project is designed. In the current bidding climate for public works projects, the cost estimates may be higher than would be actually bid.

Costs are adjusted to Engineering News-Record Construction Cost Index (ENR CCI) value of 7252 to correspond with assumptions made for deriving the assessments. The actual current ENR CCI for Los Angeles or San Francisco is approximately 6550. When the assessments were calculated in 1989, it was assumed that the then current ENR would increase 6%/yr from 1989 to the midpoint of construction, 1993. The actual increase was in fact only 3.1%/yr. The result was a conservative estimate for assessment district funds to allow for contingencies and further inflation from project delays.

**Results**

The results of the preliminary screening are summarized in Table 2-3. The technologies that survive the preliminary screening are listed in Table 2-4. The technologies that do not pass the preliminary screening along with the reasons are listed in Table 2-5.

## Table 2-3. SUMMARY OF PRELIMINARY SCREENING ANALYSIS

| Alternative | Fatal flaws (Table 2-2) | Nitrogen removal, % | Approximate total present worth cost, $[a] | Other factors; comments |
|---|---|---|---|---|
| **DISPOSAL/RECHARGE** | | | | |
| Landscape/agricultural irrigation | Recharge | NA | -- | Survey of potential users required. Seasonal application only; storage required for rainy months. |
| Deep well injection | Cost; recharge criteria | NA | -- | Costs and effectiveness dependent on further site-specific studies. To meet recharge criteria, TOC must be as low as 2 mg/L, which requires costly treatment processes. |
| Percolation ponds - alternative locations, off creek | -- | NA | -- | Potential disruption of habitat; costs and effectiveness dependent on further site-specific studies. |
| Los Osos Creek | -- | NA | | |
| **ONSITE TREATMENT** (individual houses or small clusters) | | | -- | All such systems may be rendered ineffective by flooding or shallow groundwater. |
| Septic tank with soil absorption (leach pits and fields) | -- | 0-90+ | 4,700 | Nitrogen removal as well as overall suitability depends on groundwater depth and soil characteristics. |
| Septic tank with shallow absorption fields | Precedent | No data | 6,100 | -- |
| Septic tank with zeolite ion exchange and soil absorption field | Precedent, reliability, flexibility | 20-90 | 9,700 | Little long-term data on nitrogen removal, performance, and costs. |
| Interseptic™ | Precedent | -- | -- | Not commercially available. |
| RUCK blackwater retrofit | Cost[b] | 40-95 | 14,100 | 300 sq ft area required in addition to septic tank and soil absorption system[c]. |

## Table 2-3. SUMMARY OF PRELIMINARY SCREENING ANALYSIS

| Alternative | Fatal flaws (Table 2-2) | Nitrogen removal, % | Approximate total present worth cost, $[a] | Other factors; comments |
|---|---|---|---|---|
| Septic tank with mound system | -- | 45[b] | 9,200 | 1,500-2,000 sq ft area required, excluding septic tank[c]. Generally applicable to soils otherwise unsuitable for conventional onsite systems, but may be used in shallow groundwater areas. |
| Septic tank with evapotranspiration system | Cost[b], recharge | NA | 15,400 | 5,000 sq ft area required, excluding septic tank[c]. |
| Septic tank with constructed wetlands system | Precedent | Up to 90 | 10,900 | 250-300 sq ft area required in addition to septic tank and soil absorption system[c]. Potential health and safety hazard on individual lots. |
| Septic tank with intermittent sand filter and soil absorption field | -- | 45[b] | 11,400 | 100 sq ft area required in addition to septic tank and soil absorption system[c]. |
| Septic tank with recirculating sand filter and soil absorption field | -- | 29-82[b] | 9,400 | 100 sq ft area required excluding septic tank and soil absorption system[c]. |
| Septic tank with intermittent sand filter, recycling, and soil absorption field | -- | 75[b] | 10,200 | 100 sq ft area required excluding septic tank and soil absorption system[c]. |
| Septic tank with internal nitrification/ denitrification and soil absorption field | Precedent, reliability | 30-80[b] | 7,300 | Variable results; little long-term data on performance and costs. |
| Onsite reactor and soil absorption field | -- | Up to 90 | 11,000-13,100 | Little long-term data on performance and cost, but system is based on technology with many precedents. |

## Table 2-3. SUMMARY OF PRELIMINARY SCREENING ANALYSIS

| Alternative | Fatal flaws (Table 2-2) | Nitrogen removal, % | Approximate total present worth cost, $[a] | Other factors; comments |
|---|---|---|---|---|
| Waterless toilet + grey water treatment | Precedent, cost | Waterless toilet: 100 Greywater: unknown | 12,200-16,000[f] | Potential odor and health problems. |
| **OFFSITE TREATMENT (neighborhood or centralized)** | | | | |
| Sequencing batch reactor | -- | 75± | 3,396,000 | Proposed project |
| Integrated ponding system | Cost | Up to 90 | 7,059,000 | 45-50 acres required for entire community. |
| Constructed wetlands | Cost | Up to 90 | 7,092,000 | 50 acres required for entire community. |
| Trickling filter with denitrification | -- | Up to 80 | 3,668,000 | -- |
| Rotating biological contactors | Reliability | Up to 80 | 6,290,000 | -- |
| Conventional activated sludge + variations | -- | NA | 4,414,000 | Generally not used for nitrogen removal without other processes. See Biological Nitrogen Removal alternatives. |
| Oxidation ditch | -- | Up to 90 | 4,014,000 | -- |
| Aquatic plant system - duckweed | Precedents | 50-90 | 6,401,000 | 20-30 acres required for entire community. |
| Aquatic plant system - water hyacinths | Precedent, reliability | NA | 8,928,000 | Sensitive to weather and predators. |
| High efficiency distillation | Precedent | >90 | 14,121,000 | Problem of brine disposal. |
| Reverse osmosis/membrane filter | Cost | 80-95 | 14,192,000 | Applicable to treatment of wastewater or contaminated groundwater if recharge is by direct injection. Problem of brine disposal. |

| Table 2-3. SUMMARY OF PRELIMINARY SCREENING ANALYSIS | | | | |
|---|---|---|---|---|
| Alternative | Fatal flaws (Table 2-2) | Nitrogen removal, % | Approximate total present worth cost, $[a] | Other factors; comments |
| Breakpoint chlorination | Cost | 80-95 | 10,357,000 | Potential toxicity problems from chlorine gas; not generally applied as a wastewater nitrogen removal process. |
| Ion exchange | Cost, flexibility | 70-90 | 11,932,000 | Not generally applicable to municipal wastewater |
| Biological nitrogen removal - Bardenpho | -- | 80-95 | 3,508,000 | -- |
| Biological nitrogen removal - alternating aeration | Precedent | 70-90 | 3,588,000 | -- |
| Biological nitrogen removal - Biostyr | Precedent | 70-90 | 4,471,000 | Proprietary process used in Europe. |
| Counter-current aeration | Cost | 70-90 | 4,284,000 | Proprietary process. |
| Dual-power, multiple cell aerated ponds | Cost, precedent | NA | 6,173,000 | Additional processes required for denitrification. |
| Rapid infiltration | -- | 40-90 | -- | Nitrogen removal dependent on depth to groundwater and soil and wastewater characteristics. |
| **COLLECTION** | | | | |
| Gravity | -- | NA | 47,166,000[g] | Proposed project. |
| Septic tank effluent pump or gravity system - single or multiple dwellings (clusters) | -- | NA | 47,255,000[g] | -- |

| Table 2-3. SUMMARY OF PRELIMINARY SCREENING ANALYSIS | | | | |
|---|---|---|---|---|
| Alternative | Fatal flaws (Table 2-2) | Nitrogen removal, % | Approximate total present worth cost, $[a] | Other factors; comments |
| Vacuum pumping | Flexibility, precedent | NA | 52,888,000[g] | -- |
| Grinder pumps - single or multiple dwellings (clusters) | -- | NA | 51,312,000[g] | -- |
| Trenchless construction | -- | NA | -- | Construction technique only. |
| **SLUDGE AND SEPTAGE DISPOSAL** | | | | |
| Agricultural land application | -- | NA | -- | -- |
| Dedicated landfill | -- | NA | -- | -- |
| Compost | -- | NA | -- | -- |
| To other wastewater treatment plants (septage only) | -- | NA | -- | Septage currently accepted only at Santa Maria plant. |
| **OTHER** | | | | |
| Water conservation | Reliability | NA | -- | Results difficult to predict and would not significantly reduce costs of wastewater facilities. Future dry-weather per capita wastewater flows could be reduced, but peak flows and organic loads would not be significantly affected. |

## Table 2-3. SUMMARY OF PRELIMINARY SCREENING ANALYSIS

| Alternative | Fatal flaws (Table 2-2) | Nitrogen removal, % | Approximate total present worth cost, $[a] | Other factors; comments |
|---|---|---|---|---|
| Grey water recycling | Flexibility | NA | -- | Applicable to laundry and bath wastewater; need treatment for other wastewater. May be approved on case-by-case basis. Potential adverse impacts on soil. Need for disposal during rainy months. |

a. To facilitate comparison with costs of the proposed project [2,8], costs are based on ENR 7252, 20-year evaluation period and 8-3/8% interest. Costs also include 20% contingency and 20% engineering and administration.
b. Additional denitrification may occur in soil column.
c. For comparison purposes, this cost includes a new, replacement septic tank and leach field or pit plus the additional process. This cost could be reduced if the existing septic tank and/or leach field or leach pit can be used without replacement.
d. Land area requirement may be a significant obstacle to locating this system on smaller lots.
e. First figure is for retrofit into an existing septic tank; second figure is for a new installation.
f. First figure is for a compost toilet; second figure is for an incinerator toilet.
g. Estimated cost for entire community.

Notes:
1. NA: not applicable

| Table 2-4. TECHNOLOGIES SURVIVING PRELIMINARY SCREENING |
|---|
| **DISPOSAL/RECHARGE** |
| Broderson and other sites[a,b] |
| Los Osos Creek[a] |
| **ONSITE TREATMENT (individual homes or small clusters)** |
| Septic tank with soil absorption (conventional) |
| Septic tank with mound |
| Septic tank with intermittent sand filter and soil absorption field |
| Septic tank with recirculating sand filter and soil absorption field |
| Septic tank with intermittent sand filter, recycling, and soil absorption field |
| Onsite reactor (OSR) and soil absorption field[c] |
| **OFFSITE TREATMENT (neighborhood or centralized)** |
| Trickling filter with denitrification |
| Sequencing batch reactor |
| Oxidation ditch |
| Biological nitrogen removal - Bardenpho |
| Rapid infiltration |
| **COLLECTION** |
| Gravity |
| Grinder pumps |
| Septic tank effluent pumps or gravity |
| Trenchless construction |
| **SLUDGE AND SEPTAGE DISPOSAL** |
| Agricultural land application |
| Dedicated landfill |
| Compost |
| To other wastewater treatment plants (septage only) |

a. Subject to further field testing.
b. Also includes nonmaintained public rights-of-way and vacant parcels within the community.
c. Can also be an offsite treatment system.

| Table 2-5. TECHNOLOGIES NOT SURVIVING PRELIMINARY SCREENING | |
|---|---|
| Alternative | Reasons |
| **DISPOSAL/RECHARGE** | |
| Landscape/agricultural irrigation | Fatal flaw = recharge. Reliability uncertain--depends on willingness of users and weather. |
| Deep well injection | Fatal flaw = costs. See also reverse osmosis/membrane filter or high efficiency distillation alternative. |
| **ONSITE TREATMENT (individual homes or small clusters)** | |
| Septic tank with shallow absorption fields | Fatal flaw = precedent. |
| Septic tank with zeolite and soil absorption field | Fatal flaws = precedent and reliability, flexibility. No long-term data on performance and costs. |
| Interseptic | Fatal flaw = precedent. Not commercially available. |
| RUCK blackwater retrofit | Fatal flaw = cost. |
| Septic tank with evapotranspiration system | Fatal flaws = cost and recharge. No ability to recharge groundwater. Large area required. |
| Septic tank with constructed wetlands system | Fatal flaw = precedent. |
| Septic tank with internal nitrification/ denitrification and soil absorption field | Fatal flaws = precedent and reliability. Variable results; little long-term data on performance and costs. |
| Waterless toilet + grey water treatment | Fatal flaws = precedent and cost. Potential health and odor problems. No data on greywater system performance. |
| **OFFSITE TREATMENT (neighborhood or centralized)** | |
| Integrated ponding system | Fatal flaw = cost. |
| Constructed wetlands | Fatal flaw = cost. Large land area required. |
| Rotating biological contactors | Fatal flaws = precedent and reliability. Requires additional processes for nitrogen removal. Operating experience has been troublesome. |
| Conventional activated sludge + variations | Not used for nitrogen removal. |
| Aquatic plant systems - duckweed | Fatal flaw = precedent. |
| Aquatic plant systems - water hyacinths | Fatal flaws = precedent and reliability. Sensitive to weather and predators. |
| High efficiency distillation | Fatal flaw = precedent. Problem of brine disposal. |
| Reverse osmosis/membrane filter | Fatal flaw = cost. Problem of brine disposal. |

| Table 2-5. TECHNOLOGIES NOT SURVIVING PRELIMINARY SCREENING | |
|---|---|
| Alternative | Reasons |
| Breakpoint chlorination | Fatal flaws = Cost and precedent. Potential toxicity problems from chlorine gas. |
| Ion exchange | Fatal flaws = cost and flexibility. |
| Counter current aeration | Fatal flaw = cost. Proprietary process. |
| Dual-power, multiple cell aerated ponds | Fatal flaws = cost and precedent. Requires additional processes for nitrogen removal. |
| Biological nitrogen removal - alternating aeration | Fatal flaw = precedent. |
| **COLLECTION** | |
| Vacuum pumping | Fatal flaws = Flexibility and precedent. Best applied in areas flatter than Los Osos. |
| **OTHER** | |
| Water conservation | Fatal flaw = reliability. Results of program will not significantly affect wastewater collection and treatment costs and performance. |
| Grey water recycling | Fatal flaw = flexibility. Potential adverse impacts on soil. Need for disposal during rainy months. See also waterless toilet alternative. |

## SUMMARY AND CONCLUSIONS

### Disposal/Recharge

Based on limited available data, the Broderson and Los Osos Creek sites appear to be the best available locations for groundwater recharge. However, additional field testing and study should be done to verify the feasibility of using these sites. The field tests and study are for assessing long-term infiltration and include excavated test pits and modeling studies to understand the effect of effluent recharge on existing groundwater hydrology. Specific work is listed in Appendix B1. It may also be necessary to update the previous environmental studies for the presence of sensitive habitats or animals.

There are also several nonmaintained public rights-of-way within the community that have the physical potential to be used as recharge sites. These sites are generally long and narrow, 6 to 12 blocks long and 80 feet wide; the total area is about 24 acres, but with setbacks and cross-streets would be smaller. Such sites, if available, would be subject to the same infiltration testing as suggested for the Broderson and Los Osos Creek sites.

Alternative treatment plant sites include areas closer to the community than the proposed Turri Road site. Consequently, use of these sites, if available and feasible, represent an opportunity for cost savings by (1) reducing the length of interceptor sewers and effluent force main and (2) avoiding environmentally-disruptive creek crossings.

Irrigation of agricultural land or landscaped areas with treated effluent has many precedents. There is enough land potentially available to accommodate up to about 3/4 of the treated effluent from Los Osos. However, the feasibility depends on location of the irrigated land in relation to the treatment plant and the availability and cost of alternate water sources. Since most of this land is east of Warden Creek, the feasibility is questionable. Furthermore, for

land east of Los Osos Creek, irrigation may not meet the criteria for groundwater recharge. Consequently, no further work is warranted.

### Onsite Treatment

Of the onsite treatment technologies listed in Table 2-1, all but one represent variations of the conventional leach field or pit and use a standard septic tank. All have ample precedents and proven nitrogen removal capabilities. The exception is the onsite reactor (OSR). The OSR can be a retrofit into an existing septic tank or a new installation and can use an existing leach field or pit. Although the OSR has few precedents and limited data on nitrogen removal, it is based on generally well-proven batch treatment technology. The OSR will be used to represent a generic onsite treatment alternative to existing septic tanks.

Mound systems are typically applicable to special conditions where leach fields or pits are unsuitable, such as clay soils or extremely shallow groundwater. Mounds are not considered in subsequent analysis, but their use should not be precluded where appropriate.

### Offsite Treatment

There are many alternatives to the sequencing batch reactor technology in the proposed project. However, none of the technologies in Table 2-1 would (1) result in significant cost savings over the proposed project; and (2) provide significantly higher levels of nitrogen removal. Consequently, none of these technologies warrant further evaluation.

### Collection System

The vacuum system does not survive the preliminary screening primarily because of lack of precedent and flexibility. The septic tank effluent pump/gravity and grinder pump system may offer construction cost savings, especially if trenchless construction methods can be

used. However, O&M costs are higher than gravity sewers primarily because of greater maintenance and energy requirements. Overall, total present worth costs among gravity, STEP/STEG, and grinder pump systems are not significantly different (Table 2-3). Grinder pumps are not further analyzed, but STEP/STEG systems are considered along with recirculating or intermittent sand filters.

**Sludge and Septage**

All sludge and septage disposal methods are technically feasible, but their cost-effectiveness depends on specific location of the disposal site. More detailed site-specific studies should be conducted during the preliminary design of the project. Since there are no specific sites in San Luis Obispo County that accept sludge or septage, it may be worthwhile to evaluate sludge and septage disposal on a county-wide basis. For the purposes of the analysis in Chapter 3, the sludge disposal method assumed is what was proposed in 1987 [2], i.e., drying beds and lagoons.

**Other**

Water conservation is a desirable practice to reduce the use of a limited and valuable resource: potable water. However, its impact on a wastewater system is not significant. Greywater recycling for irrigation can reduce wastewater volumes and loads to a collection and treatment system, but only during irrigation season.

These methods are appropriate for Los Osos, but their impact on a wastewater system would be minimal. Water conservation only affects average dry-weather wastewater flow. Wastewater collection and treatment systems are typically sized to accommodate peak wet-weather flows (from infiltrtion and inflow) and organic loads. Water conservation measures do not affect these parameters and would have minimal impact on collection and treatment costs. Consequently, no further consideration is justified. This does not preclude existing

water agencies from conducting water conservation programs or the County from allowing or permitting grey water recycling projects.

# CHAPTER 3

## DETAILED ANALYSIS OF WASTEWATER MANAGEMENT PLANS

Wastewater collection, treatment, and disposal technologies and options are subjected to further analysis in this chapter, with emphasis on options that collectively comprise whole community systems. This analysis is based primarily on (1) cost comparisons with a conventional sewer project (i.e., the proposed project as defined in reference [2]), (2) nitrogen contribution to groundwater, and (3) other criteria as described below.

- **Cost comparison.** The costs of the conventional project have been stated to be $71.5 million, of which $58.0 million is construction and construction-related (other studies, design, management, administration) [5]; the remaining $13.5 million is for financing and bonding costs. However, these figures are based on estimates in previous reports [2,8] inflated at 6%/year to Engineering News-Record Construction Cost Index (ENR CCI) of 7252. The actual construction cost may be much less, since the current ENR CCI (first quarter 1995) index for Los Angeles is 6550. Furthermore, based on experience with recent bids for wastewater facilities, unit prices are generally lower than would be estimated by using ENR indexes for either Los Angeles or San Francisco. In other words, cost comparisons will be based on an updated cost of the conventional project, not the $71.5 million or $58.0 million figures.

- **Nitrogen contribution.** No specific discharge limits have been set for Los Osos by the California Regional Water Quality Control Board - Central Coast Region (RWQCB). However, the RWQCB staff has proposed a total nitrogen discharge limit of 5 mg/L for the conventional project [9]. In the Basin Plan [10], there is a design criterion for nitrogen discharges from onsite system of 40 gm/acre/day and a prohibition level of 80 gm/acre/day. These figures apply to undeveloped areas only without water quality impairment and not to Los Osos. The RWQCB has set an initial nitrogen loading criterion of 12.4 gm/acre/day (10 lb/acre/year) for the San Lorenzo Valley [11]. Because this area is similar to Los Osos in terms of water quality issues, it is likely that a similar criterion will be developed for Los Osos. In other words, alternative systems will be evaluated in terms of resulting nitrogen loading over the service area of that system.

- **Other Criteria.** These include social and economic issues, land area requirements, and administrative factors.

Based on the findings and conclusions in the Task F report [4] (summarized in Chapter 1), the community can be divided into two general categories of wastewater management.

- Existing onsite systems **not allowed**, i.e., consider only local or centralized collection and treatment, including enhancements to existing onsite systems (i.e., OSRs).
- Existing onsite systems **allowed**, i.e., consider use of existing onsite systems as well as collection and treatment as above.

If some areas do not necessarily require a collection system, the question then becomes: what is the effect of removing portions of the community from a conventional community-wide project? Is there a cost saving by not building a conventional project in some areas of the community and instead constructing a different project, including establishing an onsite wastewater management district? What is the impact on nitrate loading to groundwater?

Thus, the method of analysis in this chapter consists of the following steps.

1. Divide the community into areas for the above wastewater management categories based on specific criteria.
2. Develop alternatives for each area, including the use and further evaluation of technologies surviving the preliminary screening in Chapter 2.
3. Estimate costs for each alternative in each area.
4. Estimate nitrogen contribution of each alternative in each area.
5. Select the most promising alternative plans.
6. Rate the alternatives on the TAC subjective criteria and other factors.
7. Identify and present the apparent best alternative.

## CATEGORIES AND AREAS

As previously mentioned, there are two categories:

- Where onsite systems **are not** allowed
- Where onsite systems **may** be allowed

### Criteria for Categories

The following criteria are used to define areas to which these categories apply.

- Groundwater depth -- shallow or deep. "Shallow" means less than 30 feet, based on depth at which nitrification-denitrification of wastewater effluent is maximized, as discussed in the Task F report [4]. The shallow groundwater area is shown as the shaded area of Figure 3-1 (which is the same as Figure 4-4 of the Task F report [4]). The groundwater contours shown in Figure 3-1 are based on available data on groundwater elevations for Spring 1993 and ground surface elevations. Contour maps such as Figure 3-1 are drawn from discrete data points and their precision depends on the density of such points and the accuracy of the elevations. Although 33 specific points were used to develop this figure, the 30-foot contour line should not be interpreted as a fixed and rigid boundary.

- Flooding and drainage problems. Areas of historical flooding have been identified by the County Engineering Department maps on flooded areas, sumps, and localized drainage problems. These areas are shown in Figure 3-2 [12]. In such areas, there may be problems with use of onsite systems when there is standing water resulting from heavy rainfall [13].

- Problems with onsite systems as defined by sanitary survey and permit data in the Task F report [4], as shown in Figure 3-3.

- Land use, i.e., residential or commercial, to account for variations in density of development in the community, as shown in Figure 3-4.

- Drainage basins in the conventional project [2]. This was done primarily to facilitate the compilation of data on pipeline lengths and dwelling units served used for cost calculations. These drainage areas are shown in Figure 3-5.

### Definition of Areas

Each of the areas is described by the above criteria and the results are shown in Table 3-1 and Figure 3-6. Subsequent analyses of these areas are based on the assumption that the presence of "shallow" groundwater, if noted in Table 3-1, is applicable to the entire area. Similarly, if the groundwater is noted "deep" in Table 3-1, the entire area is assumed to have deep groundwater. In reality, not all of each area is "shallow." However, the 30-foot contour that defines "shallow" is not a precise line and a buffer is used to determine area boundaries. Furthermore, the areas are defined for analysis purposes only and not meant to have rigid boundaries. While conclusions can be drawn on the preferred wastewater management system based on these areas, the actual boundaries of the areas may be adjusted as part of detailed analysis during preliminary design.

## WASTEWATER FLOWS IN EACH AREA

Wastewater flow estimates for each area are based on the following parameters:

- Approximate existing number of services and dwelling unit equivalent (DUE) count based on [2], as shown in Table 3-2A.
- Buildout DUE based on unit densities developed by the County Planning Department [7] and land areas for each land use category in Figure 3-4, as shown in Tables 3-2B and 3-2C.
- 200 gpd/DUE based on data in Appendix D of the Task F report [4].

The subsequent analysis is for Stage 1 of the conventional project [2], which is based on a wastewater flow equal to two-thirds of buildout wastewater flow as calculated by the above parameters. In cases where applying the factor would result in fewer DUEs than the present, Stage 1 is based on 2/3 of the growth between current and buildout. Wastewater flow estimates for each area are presented in Table 3-2D.

## Table 3-1. AREAS FOR ANALYSIS

| Area | Wastewater management category | Groundwater depth | | Flooding[b] | Onsite system problems[c] | Drainage area[d] | Land uses |
|---|---|---|---|---|---|---|---|
| | | Classification[a] | Approx. portion of area overlying groundwater ≤30-ft depth | | | | |
| A - Northeast Baywood Park | Onsite systems may be allowed | Deep | 0% | No | 16% | DB-1 | Residential single family |
| B - North Baywood Park | Onsite systems not allowed | Shallow | 50% | Yes | 22% | DB-4 | Residential single family, residential multifamily, commercial |
| C - East Baywood Park | Onsite systems not allowed | Shallow | 50% | Yes | 25% | LS-2 | Residential single family |
| D - Southeast Baywood Park | Onsite systems may be allowed | Deep | 25% | Yes | 22% | Part of DB-3 | Residential single family |
| E - West Baywood Park | Onsite systems not allowed | Shallow | 75% | Yes | 16% | Part of DB-3 | Residential single family |
| F - Cuesta-by-the-Sea | Onsite systems not allowed | Shallow | 90% | Yes | 11% | Part of DB-2 | Residential single family, residential multifamily |

## Table 3-1. AREAS FOR ANALYSIS

| Area | Wastewater management category | Groundwater depth | | Flooding[b] | Onsite system problems[c] | Drainage area[d] | Land uses |
|---|---|---|---|---|---|---|---|
| | | Classification[a] | Approx. portion of area overlying groundwater ≤30-ft depth | | | | |
| G - Sunset Terrace | Onsite systems not allowed | Shallow | 67% | No | 10% | LS-1 | Residential single family |
| H - Martin Tract | Onsite systems may be allowed | Deep | 0% | Yes | 8% | Part of DB-2 | Residential single family |
| I - Redfield Woods, Upland, Highland | Onsite systems may be allowed | Deep | 0% | Yes | 13% | Part of DB-2 | Residential single family |
| J - Vista de Oro | Existing sewer system and community septic tank and leach field | Deep | 0% | No | NA | Part of DB-2 | Residential single family |
| K - Commercial core | Onsite systems not allowed | Shallow | 50% | Yes | 16% | Part of DB-3 | Commercial, residential multifamily |
| L - Bayview Heights | Onsite systems may be allowed | Deep | 0% | No | 19% | Part of DB-3 | Residential single family |

## Table 3-1. AREAS FOR ANALYSIS

| Area | Wastewater management category | Groundwater depth | | Flooding[b] | Onsite system problems[c] | Drainage area[d] | Land uses |
|---|---|---|---|---|---|---|---|
| | | Classification[a] | Approx. portion of area overlying groundwater ≤30-ft depth | | | | |
| M - Bayridge Estates, mobile homes | Existing sewer system and community septic tank and leach field | Shallow | 50% | No | NA | Part of DB-3 | Residential single family |

a. [3], Figure 4-4. Deep: generally greater than 30 ft; shallow: generally less than 30 ft.
b. San Luis Obispo County Engineering Department. Map of historically flooded areas and sumps [12]. For the "Yes" responses, the portion of each area susceptible to flooding is typically less than 10% of the total of each area.
c. [3], pages 4-1 to 4-10 and Appendix J, unless otherwise indicated. The figure represents the approximate percentage of each area with onsite system problems and is calculated as the average of:
   - Number of responses on the Sanitary Survey indicative of a problem ([3], Table 4-1) ÷ number of lots surveyed.
   - Number of permits (for onsite system repair) and complaints ÷ number of nonvacant lots.
d. Based on terminology in [2]. "DB" is a basin draining to a pumping or lift station, numbered 1, 2, 3, or 4; "LS is a basin draining to a lift station, numbered 1 or 2.

## Table 3-2A. ESTIMATED CURRENT NUMBER OF EXISTING SERVICES AND DWELLING UNIT EQUIVALENTS

| Area | Total services | Adjusted total DUEs |
|---|---|---|
| A - Northeast Baywood Park | 230 | 230 |
| B - North Baywood Park | 1,090 | 1,090 |
| C - East Baywood Park | 248 | 248 |
| D - Southeast Baywood Park | 460 | 590 |
| E - West Baywood Park | 472 | 640 |
| F - Cuesta-by-the-Sea, including trailer parks | 607 | 607 |
| G - Sunset Terrace | 193 | 193 |
| H - Martin Tract | 47 | 47 |
| I - Redfield Woods/Upland | 674 | 674 |
| J - Vista de Oro | 74 | 74 |
| K - Commercial core | 310 | 868 |
| L - Bayview Heights | 122 | 122 |
| M - Bayridge Estates, Mobile Homes | 466 | 466 |
| Total | 4,993 | 5,849 |

NOTE: Based on [2, 7] adjusted by an aerial photograph and information on 400-scale maps of land use categories from San Luis Obispo County Planning Department.

## Table 3-2B. LAND USE AT BUILDOUT, GROSS ACRES

| Area | Residential | | | Commercial | Subtotal | Other[a] | Total |
|---|---|---|---|---|---|---|---|
| | Suburban | Single family | Multi-family | | | | |
| A - Northeast Baywood Park | 0 | 65 | 0 | 0 | 65 | 25 | 90 |
| B - North Baywood Park | 0 | 284 | 16 | 33 | 333 | 9 | 342 |
| C - East Baywood Park | 0 | 78 | 0 | 0 | 78 | 0 | 78 |
| D - Southeast Baywood Park | 0 | 96 | 17 | 0 | 113 | 0 | 113 |
| E - West Baywood Park | 0 | 114 | 16 | 0 | 130 | 9 | 139 |
| F - Cuesta-by-the-Sea, including trailer parks | 0 | 135 | 18 | 0 | 153 | 44 | 197 |
| G - Sunset Terrace | 0 | 94 | 9 | 0 | 103 | 18 | 121 |
| H - Martin Tract | 0 | 76 | 16 | 0 | 92 | 27 | 119 |
| I - Redfield Woods/Upland | 0 | 317 | 8 | 0 | 325 | 19 | 344 |
| J - Vista de Oro | 0 | 15 | 0 | 0 | 15 | 2 | 17 |
| K - Commercial core | 0 | 17 | 37 | 128 | 182 | 0 | 182 |
| L - Bayview Heights | 46 | 106 | 0 | 0 | 152 | 0 | 152 |
| M - Bayridge Estates, Mobile Homes | 0 | 125 | 0 | 0 | 125 | 11 | 136 |
| Total | 46 | 1,521 | 137 | 161 | 1,866 | 164 | 2,030 |

NOTE: Based on [2,10] adjusted by an aerial photograph and information on 400-scale maps of land use categories from San Luis Obispo County Planning Department.

a. Golf course, recreation, parks, open space, schools, other public facilities.

## Table 3-2C. UNIT DENSITIES AT BUILDOUT, DUE/ACRE

| Area | Residential | | | Commercial |
|---|---|---|---|---|
| | Suburban | Single family | Mult. family | |
| A - Northeast Baywood Park | -- | 7 | 15 | -- |
| B - North Baywood Park | -- | 7 | 15 | 5 |
| C - East Baywood Park | -- | 7 | 15 | -- |
| D - Southeast Baywood Park | -- | 7 | 15 | -- |
| E - West Baywood Park | -- | 7 | 15 | -- |
| F - Cuesta-by-the-Sea, including trailer parks | -- | 7 | 15 | -- |
| G - Sunset Terrace | -- | 2 | 15 | -- |
| H - Martin Tract | -- | 4 | 15 | -- |
| I - Redfield Woods/Upland | -- | 6 | 16 | -- |
| J - Vista de Oro | -- | 7 | -- | -- |
| K - Commercial core | -- | 7 | 26 | 5 |
| L - Bayview Heights | 1 | 1 | -- | -- |
| M - Bayridge Estates, Mobile Homes | -- | 7 | -- | -- |

NOTES:
1. Based on [7]. The DUE/acre for commercial areas is an estimate based on a typical lot size and the assumption that 1 commercial lot = 1 DUE.
2. DUE/acre for other areas is not included since no significant wastewater volumes are generated.

| Table 3-2D. WASTEWATER FLOWS | | | | |
|---|---|---|---|---|
| Area | Stage 1 | | Buildout | |
| | Total DUE[c] | Total wastewater flow, mgd[b] | Total DUE[a] | Total wastewater flow, mgd[b] |
| A - Northeast Baywood Park | 303 | 0.06 | 340 | 0.07 |
| B - North Baywood Park | 1,194 | 0.24 | 1,791 | 0.36 |
| C - East Baywood Park | 272 | 0.05 | 408 | 0.10 |
| D - Southeast Baywood Park | 659 | 0.13 | 694 | 0.14 |
| E - West Baywood Park | 733 | 0.15 | 779 | 0.16 |
| F - Cuesta-by-the-Sea, including trailer parks | 609 | 0.12 | 913 | 0.18 |
| G - Sunset Terrace | 222 | 0.04 | 236 | 0.05 |
| H - Martin Tract | 273 | 0.05 | 409 | 0.08 |
| I - Redfield Woods/Upland | 1,017 | 0.20 | 1,526 | 0.31 |
| J- Vista de Oro | 78 | 0.02 | 80 | 0.02 |
| K - Commercial core | 1,151 | 0.23 | 1,298 | 0.26 |
| L - Bayview Heights | 122 | 0.02 | 122 | 0.02 |
| M - Bayridge Estates, Mobile Homes | 591 | 0.12 | 654 | 0.13 |
| Total | 7,228 | 1.44 | 9,249 | 1.85 |

NOTE: Figures may not add because of rounding.

a. Based on acreages in Table 3-2B and unit densities in Table 3-2C. Includes 75% factor for site coverage [7] and conversion from gross to net acreage or density.
b. 200 gpd/DUE [4, Appendix D].
c. 2/3 of buildout [2], or 2/3 of growth from current to buildout.

## ALTERNATIVES FOR EACH AREA

For each area A through M up to four alternatives are developed and discussed below. These alternatives are:

1. **Conventional collection, treatment, and disposal/recharge.** This represents the components of the conventional project as defined in [2] within each respective area and those facilities outside the area that are attributable to the flow in each area, including sewers, lift and pumping stations, forcemains, interceptors, treatment plant, and disposal/recharge facilities. In effect, the cost of this alternative is computed as a credit for the part of the conventional project that would not be built in this area. In other words, if the conventional project is not built in a given area, the lift and pumping stations, force mains, interceptors, treatment plant, and disposal/recharge facilities for the remainder of the community could be built smaller.

2. **Local collection, treatment, and disposal/recharge.** This alternative is a collection, treatment, and disposal/recharge system within the area for the flow in that area. The collection system can be gravity or pressure sewers. There are many options available within this alternative, but three representative types of systems are considered.

   - Gravity sewers with treatment and disposal/recharge similar to the conventional project, but scaled down for the flow in that area
   - Gravity sewers with a package plant and disposal/recharge similar to the conventional project
   - STEP/STEG systems, pressure sewers, and an intermittent or recirculating sand filter

   The cost used in subsequent analysis is the average of these systems.

3. **Enhanced onsite systems.** This includes an onsite reactor (OSR), which can be an individual batch reactor or other treatment unit adapted to an existing septic tank or installed in a new tank for each residence or business.

   There are two scenarios for this alternative, representing a range of possibilities between newly installed and retrofitted units. At one end of the range, all of the existing systems can be retrofitted, i.e., 0% of the systems would require new installations. At the other end of the range, the existing number of residences or

businesses requiring new units because of poor operations, i.e., they could not be retrofitted, are assumed to be reflected by the percentages in the column "Onsite system problems" in Table 3-1.

In other words, the minimum percentage of new units required would be zero and the maximum percentage of new units required would be as stated in the column "Onsite system problems" in Table 3-1. The cost used in subsequent analyses is an average of these two scenarios.

This alternative also includes formation of an Onsite Wastewater Management District (per California Health and Safety Code ¶6955 ff, this is termed an "onsite wastewater disposal zone" or OWDZ). The functions of this district or zone are described further below.

4. **Existing onsite systems.** There are also two scenarios for this alternative, representing a range of possibilities between replacement of existing onsite system and use of existing onsite systems. At one end of the range, all of the existing systems can be used, i.e., 0% of the systems would require replacements. At the other end of the range, the existing number of residences or businesses requiring a replacement system are assumed to be reflected by the percentages in the column "Onsite system problems" in Table 3-1.

   In other words, the minimum percentage of replacement onsite systems would be zero and the maximum percentage of replacement onsite system would be as stated in the column "Onsite system problems" in Table 3-1. The cost used in subsequent analyses is an average of these two scenarios.

   This alternative also includes formation of an Onsite Wastewater Management District (per California Health and Safety Code ¶6955 ff, this is termed an "onsite wastewater disposal zone" or OWDZ). The functions of this district or zone are described further below.

For Alternatives 3 and 4 above, the OWDZ is assumed to have the following responsibilities (in addition to basic administration, budgeting, scheduling, etc.). This list is based on the activities of current OWDZs in California (Sea Ranch, Paradise, Stinson Beach, and Georgetown), as summarized in Appendix E.

- Develop standards and criteria for design, operation, and maintenance of systems, including educational materials.

- Issue permits for retrofit and installation.
- Periodically inspect each onsite unit.
- Perform water quality sampling and analysis.
- Monitor all aspects of system performance, including septage pumping.
- Prepare and submit annual operating reports to the RWQCB.

It is further assumed that the individual resident or business would be responsible for system maintenance and repair.

Because of the categories in Table 3-1, not all of these alternatives apply to each area, as shown in Table 3-3.

## COST DATA

### Bases

In general, costs for the alternatives are based on current (mid-1995) construction costs applicable to San Luis Obispo County. Data sources include other construction bids, vendor and manufacturer quotes, and cost curves in various references [2,8,14,15]. This is not the same basis as the costs developed in the preliminary screening in Chapter 2. The costs in Chapter 2 were developed to compare alternative technologies only; in this chapter, while comparisons among alternatives are being made, costs are more refined and intended to be a more accurate estimate of actual project construction and operating costs. **As previously mentioned, direct comparisons between costs in this chapter and those developed for the Assessment District formation [2,8] should be done with caution.**

| Table 3-3. SUMMARY OF ALTERNATIVES | | | | |
|---|---|---|---|---|
| Area | 1. Conventional system | 2. Local collection, treatment, disposal | 3. Enhanced onsite systems | 4. Existing onsite systems |
| A - Northeast Baywood Park | A-1 | A-2 | A-3 | A-3 |
| B - North Baywood Park | B-1 | B-2 | B-3 | --[a] |
| C - East Baywood Park | C-1 | C-2 | C-3 | --[a] |
| D - Southeast Baywood Park | D-1 | D-2 | D-3 | D-3 |
| E - West Baywood Park | E-1 | E-2 | E-3 | --[a] |
| F - Cuesta-by-the-Sea, including trailer parks | F-1 | F-2 | F-3 | --[a] |
| G - Sunset Terrace | G-1 | G-2 | G-3 | --[a] |
| H - Martin Tract | H-1 | H-2 | H-3 | H-3 |
| I - Redfield Woods/Upland | I-1 | I-2 | I-3 | I-3 |
| J - Vista de Oro | J-1 | J-2 | J-3 | J-4 |
| K - Commercial core | K-1 | K-2 | K-3 | --[a] |
| L - Bayview Heights | L-1 | L-2 | L-3 | L-3 |
| M - Bayridge Estates | M-1 | M-2 | M-3 | M-4 |

a. From Table 3-1, onsite systems not considered within this area.

Total capital costs include allowances for contractor overhead and profit, contingencies, engineering, administration, and management as follows.

- Contingencies, 20% of construction cost. This percentage is appropriate for this level of cost estimating.
- Engineering, administration, management, 20% of construction cost, based on [2].
- Financing and bonding cost, 23% of construction cost.

Operation and maintenance (O&M) costs include labor, energy, and materials and are based on the following general parameters.

- Labor at $30/hr, including salary and benefits and related overhead allowances
- Electricity at $0.10/kWh

Further details on unit costs and cost curves used for various cost elements are presented in Appendixes C and D. Costs of an OWDZ are based on data in Appendix E.

**Cost Elements**

Cost elements of each alternative are listed in Table 3-4. They include both public components, such as sewers and treatment plant, and private components, such as septic tank abandonment, house laterals, and plumbing hookups.

## Table 3-4. COST ELEMENTS FOR ALTERNATIVES IN EACH AREA

| Alternative | Elements | |
|---|---|---|
| | Construction | O&M |
| 1. Conventional project | • Gravity sewers<br>• Pressure sewers[a]<br>• STEP systems[a]<br>• Y-connections and street laterals<br>• Septic tank abandonment<br>• House laterals<br>• Lift and pumping stations<br>• Forcemains<br>• Interceptor sewers<br>• Treatment plant<br>• Disposal/recharge facilities<br>• Land for treatment plant and disposal/recharge sites | • Labor, materials, energy to operate and maintain facilities |
| 2. Local collection, treatment, and disposal | • Gravity sewers[b]<br>• Pressure sewers[b]<br>• STEP systems[b]<br>• Y-connections and street laterals[b]<br>• Septic tank abandonment[b]<br>• House laterals[b]<br>• Either of two treatment and disposal/recharge facilities:<br>- Based on SBR (similar to conventional project)<br>- Other package plant<br>• Land for treatment plant and disposal/recharge sites | • Labor, materials, energy to operate and maintain facilities |
| Local collection, treatment, and disposal with STEP/STEG systems | • Pressure sewer<br>• STEP units<br>• Street and house lateral<br>• Septic tank abandonment<br>• Treatment and disposal facilities - recirculating or intermittent sand filter<br>• Land for treatment plant and disposal/recharge sites | • Labor, materials, energy to operate and maintain facilities<br>• Inspection of onlot facilities |

| Table 3-4. COST ELEMENTS FOR ALTERNATIVES IN EACH AREA | | |
|---|---|---|
| Alternative | Elements | |
| | Construction | O&M |
| 3. Enhanced onsite systems | • Retrofit or installation of OSRs[d]<br>• Formation of OWDZ<br>• Installation of future OSRs | • Labor, materials, energy to operate and maintain facilities<br>• Standards, criteria, inspection, permitting, monitoring for OWDZ |
| 4. Existing onsite systems[e] | • Replacement of some existing systems<br>• Formation of OWDZ<br>• Installation of (future) new systems | |

a. May not be present in some areas.
b. Assumed to be the same as the conventional project.
c. Credit for reduced costs of some processes in treatment plant as a result of treating septic tank effluent, which has reduced biochemical oxygen demands and solids over untreated municipal effluent.
d. For Areas J and M, this alternative includes continued operation of the existing community sewer system and retrofit of the existing septic tank with OSR technology.
e. For Areas J and M, this alternative includes continued operation of the existing community sewer system, septic tank, and leach field.

## COST ANALYSIS

### Cost Comparison Method

Estimated capital and O&M costs of each alternative are compared with the capital and O&M costs of the conventional project [2], i.e., Alternative 1. For each area, Alternatives 2, 3, and 4 represent projects that would be built if the project facilities of Alternative 1 were "removed" from that area.

The costs of Alternatives 2, 3 and 4 are based on the elements in Table 3-4. The reduction in cost of removing Alternative 1 facilities is computed as a credit against the cost facilities for Alternatives 2, 3, or 4. In other words, if Alternative 1 is not built in a given area, the lift and pumping stations, force mains, interceptors, treatment plant, and disposal facilities

for the remainder of the community can be built smaller by the wastewater flow in that area. The resulting saving is used to offset the cost of the respective alternative. The credit is based on the difference in cost between the proposed 1.6-mgd treatment plant and disposal facilities and (1.6 minus $Q_i$)-mgd facilities, where $Q_i$ = flow in area i.

For example, the credit for Area A would be the difference between the 1.6-mgd facilities and 1.6−0.07 = 1.53-mgd facilities, where 0.07 mgd = flow in Area A (at buildout) from Table 3-2.

For each area, the conventional project costs would be modified by the following formula.

$$C_n = C_1 + (c_n - c_1) \qquad \{3.1\}$$

where $C_n$ = total cost <u>for all areas</u> if the conventional project (Alternative 1) were removed from the conventional project <u>in the area</u> and Alternative "n" substituted <u>in the area</u>

$n$ = the number of the Alternative, i.e., 2, 3, or 4

$C_1$ = total cost of Alternative 1 <u>for all areas</u>

$c_n$ = total incremental cost of Alternative "n" <u>in the area</u>

$c_1$ = total incremental credit for Alternative 1 <u>in the area</u>

The credit for costs of other common facilities in the conventional project--i.e., lift and pumping stations, forcemain, and interceptors--is proportional to the flow attributable to that area in relation to the total capacity of that facility. The credit is calculated based further on typical exponential curves of construction or O&M costs versus capacity, i.e.,

$$C \propto Q^m \qquad \{3.2\}$$

where C = construction or O&M cost.

Q = capacity (mgd or other units) or another parameter such as volume, surface area, etc.

m = a fraction usually between 0.3 and 0.8 for most treatment processes or facilities; values of m used for this study are shown in Table 3-5 and are based on M&E internal cost data and references [16,17,18,19].

**Table 3-5. EXPONENT "m" FOR COST ESTIMATING IN FORMULA {3.2}**

| Process/facility | Construction | O&M |
|---|---|---|
| Forcemain, interceptor | 0.35 | 0.5 |
| Lift/pumping stations | 0.3 | 0.5 |
| Treatment Plant | | 0.5 |
| Headworks | 0.8 | |
| Secondary treatment | 0.5 | |
| Tertiary treatment | 0.5 | |
| Biosolids handling | 0.8 | |
| Effluent pumping station | 0.8 | |
| Ancillary facilities | 0.6 | |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.67 |
| Land | 0.67 | -- |

Sources: M&E internal cost data and references [15,16,17,18].

**Present Worth**

The following assumptions and parameters are used in calculating present worth values.

- In general, treatment plant and disposal/recharge capital costs are based on capacity at Stage 1 flows. Collection system capital costs, including pipelines and pumping stations, are usually based on buildout flows. The cost bases are summarized in Table 3-6 [2].

**Table 3-6. DESIGN BASIS FOR CONVENTIONAL PROJECT**

| Facility | Stage 1 | Buildout |
|---|---|---|
| All pipelines | | X |
| Lift and pumping stations | | X[a] |
| Treatment plant | | |
| Headworks, ancillary facilities (buildings) | | X |
| Secondary treatment, tertiary treatment, biosolids handling, effluent pumping station | X | |
| Land | | X |
| Effluent forcemain | | X |
| Disposal/recharge | X | |
| Land | | X |

a. One lift and one pumping station are apparently designed for Stage 1. However, the only incremental cost for Stage 1 to buildout is for the pumps, which is small fraction of the total station cost. Consequently, these cost of these facilities are assumed to reflect buildout flows [2].

- The next stage of the treatment plant and disposal/recharge, increasing capacity from Stage 1 to buildout flows, will occur after 12 years.

- Capital costs for local/neighborhood treatment plants in Alternative 2 are based on buildout flows, i.e., there is no Stage 1 for these relatively small plants.

- O&M for the conventional system and local/neighborhood treatment plants are assumed to be for Stage 1 flows, since this would represent an average of current and buildout flows.

- Buildout is assumed to be reached after 20 years. Over this 20-year period, there would be a uniform increase in the number of OSRs or onsite systems built. After 20 years (to year 30) no additional new units are built. The O&M cost over the 30-year period is an increasing gradient from year 1 to 20 and then constant to year 30.

**Cost of the Conventional Project (Alternative 1)**

The cost of the conventional project, $C_1$ in formula {3.1}, is summarized in Table 3-7. This figure represents an updated estimate of the costs of the conventional project as defined in References [2,5,8]. The unit prices of facilities and equipment have been updated to reflect current bid prices in San Luis Obispo County and in California. The total includes sewers, lift and pumping stations, forcemains, interceptor sewers, treatment plant, disposal/recharge facilities, and onlot private costs such as septic tank abandonment and house laterals. Both Stage 1 and Buildout construction costs are shown. These private costs were not included as part of previous cost estimates in References [2,5,8]. Also included in Table 3-6 are costs associated with financing and administering the assessment district; based on [5], this would be approximately 23% of total project cost. Comparisons between the figures in Table 3-6 and previous estimates in References [2,5,8] should be done carefully so that corresponding cost items are being compared.

## Table 3-7. COSTS OF CONVENTIONAL PROJECT (ALTERNATIVE 1)

| | Construction, $ | | O&M Stage 1 only, $/yr |
|---|---|---|---|
| | Stage 1 | Buildout | |
| Collection system (gravity sewers, STEP/STEG systems, manholes, street laterals) | 15,873,000 | 15,873,000 | 164,000 |
| Lift and pumping stations | 3,048,000 | 3,048,000 | 135,000 |
| Force mains | 498,000 | 498,000 | 9,000 |
| Interceptor sewers | 597,000 | 597,000 | 12,000 |
| Treatment plant | 8,624,000 | 9,758,000[a] | 323,000 |
| Effluent forcemain | 1,372,000 | 1,372,000 | 25,000 |
| Disposal/recharge facilities | 2,667,000 | 3,259,000[a] | 85,000 |
| Land | 1,088,000 | 1,088,000 | -- |
| Subtotal | 33,767,000 | 35,493,000 | 753,000 |
| Construction contingencies @ 20% | 6,753,000 | 7,099,000 | -- |
| Subtotal | 40,520,000 | 42,592,000 | -- |
| Engineering and administration @ 20% | 8,104,000 | 8,518,000 | -- |
| Subtotal | 48,624,000 | 51,110,000 | -- |
| Financing and bonding @ 23% | 11,184,000[b] | 11,184,000 | -- |
| Subtotal | 59,808,000 | 62,294,000 | -- |
| Private onlot costs (septic tank abandonment, house laterals) | 8,728,000 | 9,649,000[a] | -- |
| Contingencies @ 20% | 1,746,000 | 1,930,000 | -- |
| Subtotal, private onlot costs | 10,474,000 | 11,579,000 | -- |
| Grand total | 70,282,000 | 73,873,000 | 753,000 |
| Present worth of O&M, $ | -- | -- | 9,333,000[c] |
| Total present worth, $ | -- | 83,206,000 | |

a. Includes present worth value of increment from Stage 1 to buildout.
b. Percentage applies to Stage 1 only.
c. 30 years and 7% interest.

## RESULTS

### Areas A-M

Capital, O&M, and total present worth costs are summarized in Table 3-8. The total present worth costs are based on an interest rate of 7% and an average design life and evaluation period of 30 years; salvage value is not considered. Detailed cost calculation sheets are presented in Appendix C.

From the cost data in Table 3-8, the following observations can be made.

- In all areas, it is more costly to construct, operate, and maintain local or neighborhood collection, treatment, and disposal/recharge systems (Alternative 2) than the conventional system (Alternative 1). The costs of Alternative 2 are based on the assumption that there is available land for local treatment plant and a disposal/recharge sites. If this is not the case, then costs of Alternative 2 will be higher because of additional pipelines, pumps, and/or forcemains required to convey the wastewater to a site. Available land is discussed later in this chapter.

- In almost all areas of the community, it is less costly to implement a system of OSRs (Alternative 3) than the conventional system (Alternative 1). The savings for Alternative 3 vary from approximately $119,000 to $1,477,000 in terms of total present worth value over the next 30 years. These savings amount to less than 2% of the total project present worth value presented in Table 3-7. The exceptions are areas H and I, Martin Tract and Redfield Woods, probably because (a) of the large future growth forecasted for these areas; and (b) sewers are not proposed for some of the Martin Tract and Upland area, even though those areas are part of the Prohibition Zone. There is also an existing collection system in a mobile home development in Area H, which is not counted in the costs of the conventional system.

- In all areas of the community, it is less costly to allow existing onsite systems to operate with an OWDZ (Alternative 4) than the conventional system (Alternative 1). The cost savings are $199,000 to $2,928,000 in terms of present worth value, or less than 3.5% of the total project present worth value.

## Table 3-8. SUMMARY OF ALTERNATIVE COSTS - AREAS A-M

| Alternative | Incremental total present worth costs for alternative versus conventional project, $1,000s | |
|---|---|---|
| | Savings | Costs |
| Remove Area A - Northeast Baywood Park from conventional project and replace with: | | |
| A-2 - Local collection, treatment, disposal[a] | -- | 2,590 |
| A-3 - Onsite system enhancement[b] | -- | 257 |
| A-4 - Existing onsite systems[c] | 1,308 | -- |
| Remove Area B - North Baywood Park from conventional project and replace with: | | |
| B-2 - Local treatment collection, disposal[a] | -- | 3,176 |
| B-3 - Onsite system enhancement[b] | 210 | -- |
| Remove Area C - East Baywood Park from conventional project and replace with: | | |
| C-2 - Local treatment collection, disposal[a] | -- | 1,912 |
| C-3 - Onsite system enhancement[b] | 270 | -- |
| Remove Area D - Southeast Baywood Park from conventional project and replace with: | | |
| D-2 - Local treatment plant[a] | -- | 3,343 |
| D-3 - Onsite system enhancement[b] | 327 | -- |
| D-4 - Existing onsite systems[c] | 2,928 | -- |
| Remove Area E - West Baywood Park from conventional project and replace with: | | |
| E-2 - Local treatment plant[a] | -- | 2,837 |
| E-3 - Onsite system enhancement[b] | 1,075 | -- |
| Remove Area F - Cuesta-By-the-Sea from conventional project and replace with: | | |
| F-2 - Local treatment plant[a] | -- | 2,837 |
| F-3 - Onsite system enhancement[b] | 1,075 | -- |
| Remove Area G - Sunset Terrace from conventional project and replace with: | | |
| G-2 - Local treatment plant[a] | -- | 1,542 |
| G-3 - Onsite system enhancement[b] | 580 | -- |
| Remove Area H - Martin Tract from conventional project and replace with: | | |
| H-2 - Local treatment plant[a] | -- | 2,728 |
| H-3 - Onsite system enhancement[b] | -- | 205 |
| H-4 - Existing onsite systems[c] | 911 | -- |

## Table 3-8. SUMMARY OF ALTERNATIVE COSTS - AREAS A-M

| Alternative | Incremental total present worth costs for alternative versus conventional project, $1,000s | |
|---|---|---|
| | Savings | Costs |
| Remove Area I - Redfield Woods/Upland from conventional project and replace with: | | |
| I-2 - Local treatment plant[a] | -- | 4,865 |
| I-3 - Onsite system enhancement[b] | -- | 2,869 |
| I-4 - Existing onsite systems[c] | 3,529 | -- |
| Remove Area J - Vista de Oro from conventional project and replace with: | | |
| J-2 - Local treatment plant[a] | -- | 1,328 |
| J-3 - Onsite system enhancement[d] | 119 | -- |
| J-4 - Existing onsite systems[e] | 199 | -- |
| Remove Area K - Commercial Core from conventional project and replace with: | | |
| K-2 - Local treatment plant[a] | -- | 2,892 |
| K-3 - Onsite system enhancement[b] | 1,477 | -- |
| Remove Area L - Bayview Heights from conventional project and replace with: | | |
| L-2 - Local treatment plant[a] | -- | 1,466 |
| L-3 - Onsite system enhancement[b] | 762 | -- |
| L-4 - Existing onsite systems[c] | 1,356 | -- |
| Remove Area M - Bayridge Estates/mobile homes from conventional project and replace with: | | |
| M-2 - Local treatment plant[a] | -- | 2,872 |
| M-3 - Onsite system enhancement[d] | 1,313 | -- |
| M-4 - Existing onsite systems[e] | 1,571 | -- |

NOTE: Alternative 4 is not applicable to Areas B, C, E, F, G, and K because of shallow groundwater, flooding, and onsite system problems.

a. Average cost of the following facilities and processes (Table 3-4):
   - Gravity collection and treatment and disposal/recharge facilities similar to conventional project.
   - Gravity collection, package treatment plant, disposal/recharge.
   - STEP/STEG systems and recirculating or intermittent sand filter.

b. Based on average of 0% replacement and % replacement defined in the column "Onsite system problems" in Table 3-1.

c. Based on average of 0% new installations and % new installation defined in the column "Onsite system problems" in Table 3-1.

d. Includes continued operation of the existing community sewer system and retrofit of the existing septic tank with OSR technology.

e. Includes continued operation of the existing community sewer system septic tank, and leach field.

| Table 3-9. SUMMARY OF ALTERNATIVE COSTS - AREA Q | | |
|---|---|---|
| Alternative | Incremental total present worth costs for alternative versus conventional project, $000 | |
| | Savings | Costs |
| Remove Area Q - Combination of Areas A, D, H, I, J, L and M from conventional project and replace with:[a] | | |
| Q-2 - Local collection, treatment, disposal[b] | -- | 2,026 |
| Q-3 - Onsite system enhancement[c] | 505 | -- |
| Q-4 - Existing onsite systems[d] | 14,857 | -- |

NOTE: Based on Tables 3-2A to 3-2D, number of DUEs at Stage 1 is 3,314 and at buildout is 4,579. Average wastewater flow is 0.66 mgd at Stage 1 and 0.92 mgd at buildout, or about half the total area.

a. Average cost of the following facilities and processes in (Table 3-4):
   - Gravity collection and treatment and disposal/recharge facilities similar to conventional project.
   - Gravity collection, package treatment plant, disposal/recharge.
   - The STEP/STEG system and recirculating or intermittent sand filter are not applicable.

b. Based on average of 0% replacement and % replacement defined in the column "Onsite system problems" in Table 3-1.

c. Based on average of 0% new installations and % new installation defined in the column "Onsite system problems" in Table 3-1.

**Combining Areas - Phased Approach**

There appears to be some potential cost saving by eliminating almost any individual area from the conventional project. The potential cost savings of combined areas is evaluated by creating Area "Q", which includes Areas A, D, H, I, J, L, and M (Figure 3-7). This combination represents all areas allowing existing onsite system in Table 3-1, i.e., areas with deep groundwater. Based on Tables 3-2A to 3-2D, the number of DUEs in Area Q at Stage 1 is 3,314 and at buildout, 4,579. Average wastewater flow is 0.66 mgd at Stage 1 and 0.92 mgd at buildout, or about half the flow in the total area.

The same analysis is performed on Area Q and on Areas A to M and the results are shown in Table 3-9. From these results, Alternative 2, a local neighborhood treatment plant, is more costly than Alternative 1, but there appear to be potential cost savings in use of OSRs or use of existing onsite systems (Alternatives 3 and 4). As a result, a phased approach has been suggested. This

includes allowing OSRs and/or existing onsite systems in area Q and construction a conventional system (Alternative) 1 to serve the remainder of the community. Phase 1 would include a conventional collection system, 0.9-mgd treatment plant, disposal/recharge and establishment of an OWDZ. As summarized in Table 3-10, the capital cost for this sewered area would be $48.0 million, including contingencies, engineering, administration, bonding, and financing; the total present worth value would be $54.2 million. The capital costs for the unsewered area would be $6.2 million to $22.5 million and the total present worth value would vary from $13.4 million to $28.2 million, depending on the distribution of OSRs and existing onsite systems. The greater the number of OSRs, the higher the cost and present worth value. The phased approach could reduce initial costs by up to $19.6 million and total present worth values by as much as $15.6 million.

However, these costs do not include the cost for a second phase of a conventional facility, if required. This second phase would be for an additional average wastewater flow of 0.9 mgd and the total costs would be at least as much as the first phase, thereby adding $40 to $50 million in present worth costs to the Phase 1 costs above. The overall total present worth would be approximately $110-133 million to compared with $83 million for the conventional system in one phase.

**Table 3-10 . SUMMARY COSTS FOR PHASE 1 ONLY**

| | Capital costs, $000 | | O&M costs, $000/yr | | Total present worth, $000 | |
|---|---|---|---|---|---|---|
| | Area Q | Remainder | Area Q | Remainder | Area Q | Remainder |
| Conventional System | -- | 47,985 | -- | 498 | -- | 54,165 |
| OSR and/or existing onsite systems | 6,246 - 22,469 | -- | 515-579 | -- | 13,431 - 28,860 | -- |
| Total | 54,231 - 70,454 | | 1,013 - 1,077 | | 69,103 - 83,024 | |
| Conventional system for entire community | 73,874 | | 752 | | 83,206 | |
| Potential savings | 3,420 - 19,643 | | (261-325) | | 182 - 14,103 | |

Source: Appendix C for Area Q.

## NITRATE REDUCTIONS

As directed by the RWQCB [9], the nitrogen loading will be an important criterion in measuring the effectiveness of the alternative. Calculations of the nitrogen loading are developed to compare to the areal loadings defined conceptually in the Basin Plan [6] and incorporated into the San Lorenzo Valley Nitrate Management Plan [11]. Acceptable values for areal loading range from 10 to 40 lb/acre/yr. The upper range is provided for presently underdeveloped areas where groundwater is not already contaminated with nitrogen levels above the MCL of 10 mg/L. The lower range applies where the groundwater is already contaminated and cleanup action is needed. The San Lorenzo Valley plan was adopted by the Central Coast RWQCB with a loading of 12.4 lbs/acre/yr [11].

The nitrogen loading is estimated based on the following parameters and assumptions.

- 13 gm/day/person
- 2.5 persons/DUE [4]
- Number of DUEs from Table 3-2D
- Estimate of percent nitrogen reduction for each treatment technology based primarily on data in Appendix B and references [4,6], as follows.

    1. Conventional system: 80%
    2. Local collection and disposal: 80% in the plant and 15% of the plant effluent in the soil column (83% overall).
    3. Onsite reactors: 80% in the plant and 15% of the plant effluent in the soil column (83% overall).
    4. Anaerobic septic tank and leach fields/pit systems: 67% in the soil column

The results of this calculation are summarized in Table 3-11.

## Table 3-11. NITROGEN LOADING

| Criteria | Area Q at buildout | | | |
|---|---|---|---|---|
| | 1<br>Conventional system | 2<br>Local collection,treatment, disposal/recharge | 3<br>Enhanced onsite systems | 4<br>Existing onsite systems |
| Loading, lb/day | | | | |
| Central treatment plant and disposal/recharge | 41,100 | 24,100 | 24,100 | 24,100 |
| Local treatment plant(s) and disposal/recharge | -- | 17,000 | -- | -- |
| Onsite reactors and leach fields/pits | -- | -- | 17,000 | -- |
| Septic tanks and leach field/pits | -- | -- | -- | 32,900 |
| Total | 41,100 | 41,100 | 41,100 | 57,000 |
| Area, acres | 2,030 | 2,030 | 2,030 | 2,030 |
| Nitrogen loading, lb/acre/day | 20 | 20 | 20 | 28 |

Based on:

- 13 gm/day/person
- 2.5 persons/DUE
- Number of DUEs from Tables 3-2A to 3-2D.
- 80% nitrogen removal at conventional treatment plant, local treatment plant, and onsite reactors, and
  15% nitrogen removal in soil column from treatment plant and onsite reactor effluent (83% overall).
  67% nitrogen removal in soil column from anaerobic septic tanks and leach fields/pits.

At buildout flow, Alternatives 1, 2, and 3 provide an areal nitrogen loading of about 21 lb/acre/yr, and Alternative 4 amounts to 28 lb/acre/yr. These calculations are only approximations, but they are indicative of the improvements that can be derived by implementing Alternatives 1, 2 or 3.

In Task F, soil column denitrification for septic tank effluent was found to range from 50 to 85% [4]. Metcalf & Eddy used a community-wide average denitrification value of 67% for onsite systems in Los Osos, including those that are in shallow groundwater. Alternative 4 eliminates the shallow groundwater condition and thus provides a greater level of confidence that 67% denitrification can be consistently achieved. Nevertheless, the site-specific variability of soil column denitrification means that the nitrogen loading results for Alternative 4 are less certain than for Alternatives 1, 2, or 3, and variations in percent denitrification are likely to occur. For example, if average percent denitrification is 50% instead of 67%, the nitrogen loading is 36 lb/acre/day instead of 28 lb/acre/day.

## OTHER CRITERIA FOR EVALUATING ALTERNATIVES

In addition to total present worth costs, there are additional criteria to further evaluate the relative merits of the alternatives.

### TAC Subjective Criteria

TAC has developed a set of criteria dealing with social and economic issues important to the community. These criteria and their weights by importance, as shown in Table 3-12. Each alternative is given a score relative to each criterion, up to a maximum equal to the weight if the alternative fulfills the criterion perfectly and zero if the alternative does not fulfill the criterion. For example, if an alternative has a long history of reliable operation, it would score 12 on the "reliability - operational record" criterion; if it has a very poor track record, or no track record at all, it would score zero. If there were a mixed record of good and bad

## Table 3-12. SCORES FOR TAC SUBJECTIVE CRITERIA

| Criteria | Maximum score | 1 Conventional project [5] | 2 Local collection, treatment, disposal | 3 Enhanced onsite systems (OSR) | 4 Existing onsite systems | Comments |
|---|---|---|---|---|---|---|
| Reliability - operational record | 12.00 | 12 | 10 | 4 | 10 | OSRs have limited record of operations; others have more precedents. |
| Flexibility, adaptability, ease of operation | 5.75 | 5 | 4 | 3 | 5.75 | Conventional project and local plant operated professionally; existing onsite systems are adaptable to all types of wastewater. |
| Biomass handling | 8.75 | 4 | 2 | 8 | 8 | Limited land space at local plant. Septage from OSRs and onsite systems handled at treatment plants. |
| Biomass recovery, byproduct generation | 3.00 | 3 | 2.5 | 0.5 | 0 | Potential for compost or methane recovery for conventional project or local plant. |
| Deep aquifer recharge potential, sea water intrusion prevention | 10.50 | 9 | 7 | 4 | 4 | Conventional project designed for this. OSRs and onsite systems recharge shallow aquifer. |
| Increase/enhance potential for upper aquifer well production | 7.00 | 7 | 7 | 7 | 4 | Well setback requirements for existing onsite systems. |
| Additional production well locations | 3.25 | 3.25 | 3 | 2 | 0 | Well setback requirements for existing onsite systems. |

## Table 3-12. SCORES FOR TAC SUBJECTIVE CRITERIA

| Criteria | Maximum score | 1 Conventional project [5] | 2 Local collection, treatment, disposal | 3 Enhanced onsite systems (OSR) | 4 Existing onsite systems | Comments |
|---|---|---|---|---|---|---|
| Downgradient surfacing and liquefaction potential | 7.00 | 2 | 4 | 6 | 6 | Dispersed recharge from OSRs and onsite systems minimizes risk. |
| Seismic risks | 2.25 | 1 | 1 | 2 | 2.25 | Dispersed recharge from OSRs and onsite systems minimizes risk. |
| Parks and recreation - multiuse potential | 4.00 | 4 | 4 | 0 | 0 | Conventional and local plants create opportunities for other land uses. |
| Community economic/political/social impacts - positive | 3.50 | 3.5 | 3.5 | 1 | 0 | There would be a net community-wide benefit from sewering. |
| Community economic/political/social impacts - negative | 2.25 | 0 | 0 | 1.5 | 2.25 | There would be a net community-wide benefit from sewering. |
| Flood control, drainage enhancement | 5.50 | 4 | 4 | 0 | 0 | By removing wastewater from low areas, conventional project and local plants create greater capacity for soil to handle runoff. |

## Table 3-12. SCORES FOR TAC SUBJECTIVE CRITERIA

| Criteria | Maximum score | 1 Conventional project [5] | 2 Local collection, treatment, disposal | 3 Enhanced onsite systems (OSR) | 4 Existing onsite systems | Comments |
|---|---|---|---|---|---|---|
| Additional studies required (EIR, geotechnical, percolation) | 4.00 | 3 | 2 | 0 | 0 | Conventional project already has EIR and assessment district |
| Community acceptance - cost and location | 8.75 | 4 | 2 | 3 | 4 | Local plant sites may be difficult to find. |
| Community enhancement - environmental | 3.00 | 3 | 2.5 | 2 | 0 | All except existing systems would reduce nitrate contribution to groundwater. |
| Adaptability to new treatment standards | 6.00 | 6 | 6 | 4 | 0 | Operation of treatment plants and OSRs can be adjusted. |
| Net energy use | 3.50 | 0 | 0 | 1 | 3 | Existing system and OSRs use little energy. |
| Total | 100.00 | 73.75 | 64.50 | 49.00 | 49.25 | |

experience, the score would be in the range of 1 to 11. The scores for each alternative area shown in Table 3-12. The score for the conventional project is higher than the other three alternatives. Alternatives 3 and 4, which involve onsite systems, score lower than the others on almost all criteria. Alternatives 3 and 4 score well on biomass handling, liquefaction and seismic concerns, and downgradient surfacing potential. However, Alternatives 1 and 2, which involve central wastewater treatment instead of onsite systems, are more reliable and flexible; are better for groundwater recharge and well production; and are more adaptable to changing treatment standards.

**Land Area**

For Alternative 2, local collection, treatment, and disposal/recharge, additional sites for treatment and disposal facilities would need to be found in or near the area. While site selection is beyond the scope of this study, it is possible to identify land requirements for the facilities and vacant parcels in or near the area as candidate sites for these facilities. If insufficient area is available at a nearby, convenient location, the costs for this area are increased by an additional length of forcemain and/or interceptor sewer to reach that site.

The approximate amount of land required for facilities in Alternative 2 is shown in Table 3-13. This land requirement is assumed to be proportional to that of the conventional project based on the above-mentioned exponential relationship and includes setbacks and buffers. The known vacant land in the community is shown on Figure 3-8 and includes both undeveloped property and nonmaintained public rights-of-way [20]. While there are numerous vacant lots scattered throughout the community, only groups of adjacent lots or nonmaintained public rights-of-way totaling over ½-acre[a] are shown. The only large vacant areas are north of the Community Center, in the Martin Tract, and west of Pecho Road.

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a. This is the minimum size to be considered for a treatment and disposal system for a clustering of homes and/or businesses.

## Table 3-13. LAND AREAS REQUIRED FOR LOCAL TREATMENT AND DISPOSAL

| Area | Range of land requirements, acres[a] |
|---|---|
| A - Northeast Baywood Park | 1 - 3 |
| B - North Baywood Park | 6.5 - 8.5 |
| C - East Baywood Park | 1.5 - 3 |
| D - Southeast Baywood Park | 3.5 - 5.5 |
| E - West Baywood Park | 4 - 6 |
| F - Cuesta-by-the-Sea | 3.5 - 5.5 |
| G - Sunset Terrace | 1 - 2.5 |
| H - Martin Tract | 1.5 - 3 |
| I - Redfield Woods, Upland, Highland | 5.5 - 7.5 |
| J- Vista de Oro | 0.5 - 1 |
| K - Commercial core | 5 - 6.5 |
| L - Bayview Heights | 0.5 - 1 |
| M - Bayridge Estates, mobile homes | 3.5 - 5.5 |

a. Figures are approximate and rounded to nearest 0.5 acre. Includes area for process facilities, equipment, and setbacks and buffers.

There are few parcels in the size ranges listed in Table 3-13 in Baywood Park and the commercial core; most of these sites are located in residential areas. To find available land for local treatment and disposal facilities in Baywood Park, i.e., Areas A, B, C, D, and K, the search for sites would need to be expanded to include areas east of South Bay Blvd.

### Other Factors

The choice between a full conventional system to serve the entire community and a phased approach raises additional issues of fairness and equity and the need for additional studies. A complete discussion of these issues is beyond the scope of this report, but the following paragraphs are a few highlights.

With only a partially-sewered community, there may be a perception that some residents are not receiving the full benefit of the wastewater management system, even though onsite systems or OSRs would be inspected and monitored by an OWDZ. Questions such as "why do I have a sewer hookup and my neighbor doesn't?" would be asked. Another question would be: can property be developed even though it is not sewered?

The conventional project has a certified EIR and an assessment district has already been formed to finance design and construction; in other words, it can be implemented with a few additional studies (e.g., field tests at the Broderson site, geotechnical work, surveying, etc.) and minimal administrative obstacles and delays.

For the phased approach, the project EIR would probably need to be revised and a new assessment district formed, which could delay implementation. Other studies would also need to be done, such as defining the area to be sewered. Presumably, the chief criterion would be groundwater depth. But as discussed earlier in this chapter, groundwater contour lines are not rigid boundaries and can vary over time. Other geographical characteristics would need to be considered such as topography, streets, and land use.

An OWDZ would need to be formed. The formation process requires several months and involves studies and hearings. An important aspect of implementing an OWDZ is deciding its actual functions and establishing fees or charges for services.

# Chapter 4
# CONCLUSIONS AND RECOMMENDATIONS

## SUMMARY OF TASK G WORK

The purposes of this report are to develop and evaluate alternative wastewater management systems to deal with water quality issues and recommend the best wastewater management plan for Los Osos.

This summary section is divided into three parts: (1) approach and methodology; (2) findings and conclusions; and (3) recommendations.

### Approach and Methodology

The Task G work is a two-step procedure: (1) a preliminary screening of alternative technologies and (2) a detailed analysis of specific alternatives using technologies surviving the preliminary screening.

#### *Preliminary Screening*

1. A list of alternative technologies was prepared by BRC. The list included over 50 technologies and systems for disposal/recharge, onsite treatment, offsite treatment, collection, and sludge and septage disposal systems. Water conservation and grey water recycling were also considered.

2. For each of these technologies, data sheets are prepared with a description and analysis based on the following specific criteria developed by TAC and M&E.

    - Conformance with laws, regulations, criteria
    - Reliability
    - Flexibility
    - Precedents

- Aquifer recharge capability
- Capital and operation and maintenance costs

3. The alternative technologies are subjected to a preliminary screening based on these criteria. This result is to reduce the list of alternative technologies to a more manageable number so that subsequent analysis can focus on the most promising alternatives.

*Detailed Analysis*

4. Based on the results of the Task F Report [4], there are two general categories of wastewater management in the community: (a) areas where existing onsite systems are not allowed, i.e., only alternative collection and treatment alternatives can be considered; and (b) areas where existing onsite systems are allowed, i.e, onsite systems can be considered along with collection and treatment. The community is then divided into 13 areas, A through M, for detailed analysis of alternatives. Each area is categorized as either (a) or (b) above, based primarily on groundwater depth but including consideration of other factors such as drainage basins, flooding, land use, and onsite system problems. In addition to the 13 areas, a separate analysis is performed for an area Q which is a combination of areas A, D, H, I, J, K, L; area Q represents the portion of the community overlying deep groundwater.

5. To evaluate alternatives in each area, wastewater flows are forecasted based on unit flows developed in the Task F report [4] and projections of dwelling unit equivalents (DUEs) to buildout conditions. The projections are based on land use and dwelling unit densities from the County Planning Department [7] and appropriate factors for converting gross acres to net acres and absorption capacity to buildout. To be consistent with previous plans [2], a separate "Stage 1" forecast is performed, which is basically 2/3 of the buildout forecast. In cases where applying the 2/3 factor would result in fewer DUEs than the present, Stage 1 is based on 2/3 of the growth between current and buildout.

6. The specific alternatives include (a) a conventional collection and treatment system (as proposed in 1987 [2]); (b) two types of onsite systems; and (c) three types of local or neighborhood treatment plants.

7. The two types of onsite systems are (a) the anaerobic system, i.e., the conventional septic tank; and (b) the aerobic system or OSR, either a retrofit into an existing septic tank or a new installation if the existing tank is unsuitable. Both systems include a properly designed and installed leach field or pit. Also part of these two alternatives is the formation of an Onsite Wastewater Disposal Zone (OWDZ) pursuant to Health and Safety Code, Sections 6955 ff. The functions of this OWDZ are assumed to include

setting standards and criteria, inspection, permitting, water quality monitoring, and education.

8. The three types of local or neighborhood treatment plants are (a) a system based on the sequencing batch reactor, similar to the system proposed in [2]; (b) a package plant; and (c) a recirculating or intermittent sand filter. The first two include a conventional gravity collection system while the third includes a septic tank effluent pump or gravity collection system.

9. To evaluate alternatives, three basic factors are considered: costs, subjective socio-economic criteria, and nitrate removal. Availability of vacant land for sites and administrative/financing/bonding considerations are also discussed.

10. To compare costs of alternatives, a survey of recent sewer construction was made to determine current construction costs. Because of the general decline in construction activity in California, construction costs are lower than would be expected if historical costs were escalated by the ENR index to 1995. The reduced costs were used in developing and comparing system costs. These costs can be expected to rebound when California's economy recovers. A survey of OWDZs in California was also conducted to determine typical startup functions and costs, ongoing activities, and current costs and charges.

11. To compare whole system alternatives, capital and operation and maintenance costs must (a) include all costs associated with an alternative (see #12 below); (b) have the same bases, i.e., mid-1995; and (c) cover the same time frame (see #13 below).

12. The underlying principle in evaluating costs of alternatives is that Los Osos residents pay for all wastewater management costs, whether through assessments, monthly fees, or direct payment to private contractors for construction, repair, or maintenance. Consequently, costs include private, onlot construction and operation/maintenance, such as septic tank abandonment and plumbing, which is not necessarily paid for by the County or other public entity. If these costs are not included, then the conventional system (such as was proposed in 1987 [2]) would have a cost advantage over other systems with an onsite component paid for by a public entity. Similarly, if the cost of onsite systems were not included, the analysis would misrepresent the actual cost of onsite treatment and recharge/disposal.

13. The basic methodology of evaluating costs of alternatives in each of the 13 areas is based on using the conventional project (previously proposed in [2]) as a base case. For each area, incremental costs of the conventional project are compared with the cost of other alternatives for that area.

14. All costs are converted to present worth values based on a 30-year time frame and 7% annual interest. The 30-year period is short for pipelines but may be relatively long for some treatment plant equipment such as pumps, valves, blowers, and electrical facilities. The following assumptions and parameters are used in calculating present worth values.

    - In general, treatment plant and disposal/recharge capital costs are based on capacity at Stage 1 flows; and collection system capital costs, including pipelines and pumping stations, are based on buildout flows.

    - O&M costs are based on Stage 1 flows.

    - The next stage of the treatment plant and disposal/recharge, increasing capacity from Stage 1 to buildout flows, will occur after 12 years.

    - Buildout is assumed to be reached after 20 years. Over this 20-year period, there would be a uniform increase in the number of OSRs or onsite systems built. After 20 years (to year 30) no additional new units are built. The O&M cost over the 30-year period is an increasing gradient from year 1 to 20 and then constant to year 30.

15. The subjective criteria were developed by TAC and include socio-economic factors relating to:

    - System reliability and flexibility
    - Biomass handling, recovery, byproduct generation
    - Deep aquifer recharge potential and sea water intrusion
    - Shallow aquifer production potential and additional production well locations
    - Downgradient surfacing, liquefaction, and seismic risks
    - Parks and recreation - multi-use potential
    - Community economic/political/social impacts
    - Flood control and drainage enhancement
    - Community acceptance - cost and location
    - Community enhancement - environmental
    - Adaptability to new treatment standards
    - Net energy use

16. Nitrogen discharge to the groundwater was an important reason for the current prohibition area being formed. The ability of each alternative to minimize the release of nitrogen to the groundwater is an important comparative factor. The specific nitrogen release indicator will probably be lb/acre/day, measured at the surface or at the groundwater. Nitrogen discharge is based on the following removals (the % removals are not additive).

| | At surface | Soil column | Overall |
|---|---|---|---|
| Treatment plant | 80% | 15% (of effluent) | 83% |
| OSR | 80%[a] | 15% (of effluent) | 83% |
| Septic tanks/leach fields or pits | 0% | 67%[b] | 67% |

**Findings and Conclusions**

1. The following technologies pass the preliminary screening.

   - Disposal/recharge at the Broderson site and Los Osos Creek
   - Conventional septic tank and leach field/pit
   - Septic tank with a mound, or an intermittent or recirculating sand filter
   - Onsite reactor (OSR)
   - Sequencing batch reactor

   Other technologies that pass the preliminary screening are not considered further because they offered no particular cost or other advantage over other options. In the case of sludge or septage disposal, feasibility cannot be determined until site-specific information is available and/or a county-wide management plan is developed.

   For the each area in the community, alternatives are summarized as follows.

   1 - Conventional system (as proposed in [5])
   2 - Local/neighborhood collection, treatment, and disposal/recharge
   3 - OSRs, including an OWDZ
   4 - Existing onsite system, including an OWDZ

---

a. Assumed to be the same as a treatment plant, but there are only limited data to support this assumption.

b. Based on [4], but removals varied from 50% to 85%.

2. At buildout in the prohibition area, there will be approximately 9,250 DUEs and the average wastewater flow will be 1.85 mgd. For Stage 1, the figures are 7,230 DUEs and 1.44 mgd.

3. The revised and updated Stage 1 construction cost of Alternative 1 for the entire community is estimated to be $48.6 million. Including financing and bonding costs, the figure is $59.8 million. Including onlot private costs such as septic tank abandonment and house laterals, the total cost is $70.3 million. Including the present worth of the operation and maintenance costs, $753,000/year, over 30 years at 7% interest, the total present worth value of the project is $83.2 million.

4. For each of the 13 areas, it is more costly to construct, operate, and maintain local or neighborhood collection, treatment, and disposal/recharge systems (Alternative 2) compared to the conventional system (Alternative 1). This is also the case for the combination Area Q. The costs of Alternative 2 are based on the assumption that there is available land for local treatment plant and disposal/recharge sites. The land area needed for a local treatment plant ranges from 1 to 6 acres. The only vacant parcels of suitable size are in the Martin Tract or north of the Community Center. For most of the community, additional pipelines, pumping stations, and forcemains would be required to reach these sites. Consequently, costs of Alternative 2 are probably understated.

5. In almost all areas of the community, it is less costly to implement a system of OSRs (Alternative 3) than the conventional system (Alternative 1). The savings for Alternative 3 vary from approximately $119,000 to $1,477,000 in terms of total present worth value over the next 30 years. These savings amount to less than 2% of the total project present worth value presented in no. 3 above. The exceptions are areas H and I, Martin Tract and Redfield Woods, probably because (a) of the large future growth forecasted for these areas; and (b) sewers are not proposed for some of the Martin Tract and Upland area, even though those areas are part of the Prohibition Zone. There is also an existing collection system in a mobile home development in Area H, which is not counted in the costs of the conventional system. There are also cost savings for Alternative 3 over Alternative 1 in the combination Area Q.

6. In all areas of the community, including the combination area Q, it is less costly to allow existing onsite systems to operate with an OWDZ (Alternative 4) than the conventional system (Alternative 1). The cost savings are $199,000 to $2,928,000 in terms of present worth value, or less than 3.5% of the total project present worth value. For Area Q, the savings are 14,857,000, or 18% of the total project present worth value.

7. Based on the results of the subjective socio-economic criteria analysis, the conventional system (Alternative 1) ranks the highest, primarily because of greater reliability,

flexibility, and adaptability to changing treatment standards; and better groundwater recharge to deep aquifer.

8. Based on the previous removal percentages, a septic tank/leach field system will release about twice as much nitrogen/acre to groundwater as an treatment plant or OSR. Actual nitrogen loading depends on which of the alternatives is applied to each area. For example, if about half of the community were sewered and connected to a treatment plant or had OSRs and the other half had septic tanks and leach fields or pits, then nitrogen loading would be 28 lb/acre/day at buildout flows. If the entire community were sewered or on OSRs, then the figure would be 20 lb/acre/day. If the soil column were not considered, the figures would be 63 lb/acre/day and 24 lb/acre/day, respectively.

9. Because of the potential for cost savings by using OSRs and/or existing conventional onsite systems, a phased approach has been suggested. This includes allowing OSRs and/or existing onsite systems in area Q and construction a conventional system (Alternative) 1 to serve the remainder of the community. Phase 1 would include a conventional collection system, 0.6-mgd treatment plant, disposal/recharge and establishment of an OWDZ. The capital cost for this sewered area would be $48.0 million, including contingencies, engineering, administration, bonding, and financing; the total present worth value would be $54.2 million. The capital costs for the unsewered area would be $6.2 million to $22.5 million and the total present worth value would vary from $13.4 million to $28.2 million, depending on the distribution of OSRs and existing onsite systems. The greater the number of OSRs, the higher the cost and present worth value.

10. The phased approach could reduce initial costs by up to $19.6 million and total present worth values by as much as $15.6 million. Although this approach is technically feasible, a mixture of conventional, OSRs, and existing onsite systems, while technically feasible, could raise basic issues of fairness among Los Osos residents, e.g. why sewers and OSRs are in the same neighborhood, especially if all residents are required to pay the same assessments and fees or charges. The viability of the existing assessment district, which was based on Alternative 1 [2], would also be questionable.

11. Another critical issue for a phased approach is the fate of the onsite systems and/or OSRs in the unsewered areas. Since onsite systems remove less nitrogen than a conventional treatment system, the groundwater beneath the community would take longer to return to an acceptable nitrate concentration. For OSRs, the nitrogen removal capability has not been tested in the long-term. If continued monitoring of the groundwater shows no appreciable improvement in the nitrate concentration, a second phase of the conventional system would need to be constructed. The cost for this second phase, for an average wastewater flow of 0.9 mgd, would be at least as much as the first phase, thereby adding $40 to $50 million to the Phase 1 costs above. The overall total

present worth would be approximately $118-132 million to compared with $83 million for the conventional system in one phase.

## Recommendations

There are two choices for the community. The preferred alternative is to adopt a conventional system for most of the community. A technically feasible alternative is to adopt a conventional system for part of the community and allow the remainder to remain on onsite systems and/or install OSRs under the authority of an OWDZ.

1. **Preferred - Sewer the Entire the Community.** Adopting a conventional system for the community has the advantage of being a uniform approach that would equally benefit all residents and businesses. The technology of sewers, pumping stations, and conventional treatment is well-proven and reliable. It would be the most effective in removing nitrogen so that nitrate contribution to groundwater would be minimized. The project has a certified EIR and an assessment district has already been formed to finance design and construction; in other words, few additional studies would be required. The major disadvantage is high initial costs.

2. **Alternative - Sewer Part of the Community.** Sewering part of the community as part of a phased approach would reduce initial costs, but could increase costs in the long run if a second phase must be built. This approach would raise issues of fairness and equity, nitrogen removal, and need for additional studies. With only a partially-sewered community, there may be a perception that some residents are not receiving the full benefit of the wastewater management system, even though onsite systems or OSRs would be inspected and monitored by an OWDZ. OSRs, upon which this alternative is based, have few precedents and their ability to consistently remove nitrogen over the long term is not known. If onsite systems are retained, nitrogen removal would be reduced. The project EIR would probably need to be revised and a new assessment district formed. Other studies would need to be done, such as defining the area to be sewered and deciding the actual functions of the OWDZ.

If this approach is selected, then the following actions should also be adopted.

a. All portions of the community that contain shallow groundwater (generally less than 30 feet from the surface) or are subject to flooding problems should be served by a conventional sewer system, treatment, and disposal system (Phase 1). This includes approximately areas B, C, E, F, G, K as shown in Figure 3-1, but this area should be defined based on long-term groundwater levels. If necessary, new monitoring wells should be constructed to better define the depth of the aquifer.

b. All other areas should be formed into an OWDZ. The OWDZ should have the following responsibilities:

- Develop standards and criteria for design, operation, and maintenance of systems, including educational materials.
- Issue permits for retrofit and installation.
- Periodically inspect each onsite unit.
- Perform water quality sampling and analysis.
- Monitor all aspects of system performance, including septage pumping.
- Prepare and submit annual operating reports to the Regional Water Quality Control Board (RWQCB).

c. Working with the RWQCB, establish a groundwater monitoring system for nitrate concentrations to provide early warning for when (or if) the next phase of wastewater management improvements must be implemented.

d. Select six to ten site within the unsewered areas to establish a demonstration test for the OSR system. Both treatment performance and long-term operating and maintenance costs should be monitored. The test should be conducted over a 5-year period.

e. Implement Phase 2 when nitrates again exceed approximately 5 mg/L in the underlying groundwater. Phase 2 may consist of the extension of the conventional sewer system or the installation of OSRs, depending on the results of the demonstration program.

3. Authorize M&E to begin studies on the disposal/recharge site (Broderson) to determine its suitability.

4. Authorize M&E to begin the preliminary design based on the County's choice of recommendation 1 or 2 above.

5. If the County chooses recommendation 2, then authorize a review of the present financing plan for any limitations or difficulties derived from that choice.

# APPENDIX A
# TAC CONCEPTS

# APPENDIX A
# TAC COMMENTS

## INTRODUCTION

TAC has provided many useful comments on the draft of this report. Since submitting the draft, M&E has made many revisions and corrections, both in response to TAC input and from normal review. The following tabulation is a summary of TAC's comments and M&E responses and other major changes to the draft.

## TAC COMMENTS

| TAC comments | M&E response |
|---|---|
| 1. **Cost Comparisons** - Costs for the Proposed Project are unrealistically minimized while those for Alternatives are overstated | 1. Numerous revisions and corrections have been made to costs in Chapter 3 and Appendix C, so that all alternatives are compared on the same bases.<br><br>The full costs of the alternatives, whether paid for by individual property owners or a public entity, are included in the analysis. Specifically, costs of private onlot work such as septic tank abandonment and plumbing connections, are included. |
| 2. **Out of Pocket Costs** - There is no presentation of "out of pocket" costs (including interest on the bonds) that homeowners will pay. | 2. The cost of financing and bonding has been added to all alternatives except for 4-Use of Existing Onsite Systems.<br><br>The property owner would pay interest if he/she obtained a loan for "out-of-pocket" costs and/or assessments. However interest costs associated with such loans are not normally included in present worth analysis of wastewater projects. |
| 3. **Contract Omissions** - The report fails to fulfill the contract obligations, particularly regarding biosolids disposal, recharge of groundwater to the aquifers and locating treatment plant site closer than Turri Road. | 3. The discussion of biosolids disposal and recharge of groundwater is covered in appropriate detail in this report. While a treatment plant site closer than Turri Road would result in cost savings, detailed site evaluation for the treatment plant is not part of the scope of this report. |
| 4. **DU, DUE, Flow, Stage 1** - Serious overstatements of Dwelling Units, Equivalents and Stage 1 flows are used for calculating the cost of the wastewater treatment system. | 4. Tables 3-2A through 3-2D have been revised to reflect the use of net acres instead of gross acres. The forecasted Stage 1 buildout wastewater flows are less than in the Draft. |

| TAC comments | M&E response |
|---|---|
| 5. **Nitrogen Loading** - Although Nitrogen groundwater contamination is the primary focus of the study, insufficient attention has been paid to nitrogen loading and reduction. | 5. The primary focus of the report is on costs. Nitrogen reduction is discussed in a separate section of Chapter 3. |
| 6. **Subjective Analysis** - Very little detail and work are devoted to justifying the application of subjective criteria, which were supposed to bear equal weight with costs. | 6. An extra column containing comments on the ratings has been added to Table 3-9. |

## OTHER MAJOR CHANGES

The following major changes have been made to the draft.

1. Forecasts of wastewater have been changed to reflect net area instead of gross area.

2. Treatment plant capital and O&M costs have been adjusted to the current ENR index for Los Angeles/San Francisco.

3. The time frame for the present worth evaluation is 30 years. For the central treatment plant (Alternative 1), Stage 1 is assumed to be reached in 12 years and buildout in 20 years. For smaller local plants within each area (Alternative 2), the design is for buildout, i.e., there are no stages.

   For OSRs and onsite systems (Alternatives 3 and 4), in the first 20 years of the 30-year period, a uniformly increasing growth rate is assumed. Costs for both for Stage 1 and buildout are now included in the analysis; in the draft, only Stage 1 costs were used. All capital and O&M costs are converted to present worth values so that the comparison of alternative costs is equitable.

4. The percentage of onsite system problems in Table 3-1 has been changed to reflect the results of the sanitary survey and repair/permit data in Appendix J of the Task F report.

5. Financing and bonding at 23% of construction -- including contingencies and engineering -- have been added to costs of Alternatives 1, 2, and 3 only; they would not apply to Alternative 4 - use of existing onsite systems.

# Los Osos/Baywood Park
# Alternative Technologies Review
# TECHNICAL ADVISORY COMMITTEE

## Appendix A - Summary of Points

The Technical Advisory Committee, having examined the Task G Report by Metcalf and Eddy, finds numerous and substantial errors of fact and methodology in the report. These are so serious that the conclusions and recommendations presented in the report cannot be supported by the TAC. Major areas of divergence between the M&E report and the TAC's understanding of the facts and of proper methodology are as follows:

1. **Cost Comparisons** - Costs for the Proposed Project are unrealistically minimized, while those for Alternatives are overstated.

2. **Out of Pocket Costs** - There is no presentation of "out of pocket" costs (including interest on the bonds) that homeowners will have to pay.

3. **Contract Omissions** - The report fails to fulfill the contract obligations, particularly regarding biosolids disposal, recharge of wastewater to the aquifers and locating treatment plant site closer than Turri Road.

4. **DU, DUE, Flow, Stage 1** - Serious overstatements of Dwelling Units, Equivalents and Stage 1 flows are used for calculating the cost of the wastewater treatment system.

5. **Nitrogen Loading** - Although Nitrogen groundwater contamination is the primary focus of the study, insufficient attention has been paid to nitrogen loading and reduction.

6. **Subjective Analysis** - Very little detail and work are devoted to justifying the application of subjective criteria, which were supposed to bear equal weight with costs.

**The TAC recommends that the Board of Supervisors <u>not accept</u> this Task G report until the data and calculations are corrected, the comparative costs are adjusted, and the contract provisions are fulfilled.**

The TAC further recommends that an alternative phased approach be adopted and that an amended map of the areas involved be used for design. This proposal calls for the immediate collection and treatment of areas which are unsuitable for the continued use of onsite systems due to the occurrence of high groundwater with an allowance for expanding the system over a specified time schedule.

Once the areas which will be collected and treated during the initial phase have been designated, the balance of the area where collection/treatment has been deferred should be included in an Onsite Wastewater Disposal Zone (OWDZ). Further specific areas which lend themselves to alternative evaluation should be modified with onsite nitrate reduction technologies. After a specified time period, the County and the County Service Area 9 Advisory Group (CSA 9) should review factors such as cost, reliability, nitrate reduction and recharge effect. Upon review and analysis of all the critical factors effecting the wastewater project, the treatment plan, should be used for the implementation of a complete wastewater project.

## Preface to Task G - Appendix A

It is important for the reader of this report to understand the historical developments relative to the Los Osos/Baywood Park Alternative Technologies Review and Technical Advisory Committee (hereafter referred to as the TAC). The role and responsibility of the TAC was spelled out in a Resolution approved by the Board of Supervisors and in a County contract with the engineering firm Metcalf and Eddy. That is; "the TAC is to reflect the interests of the Los Osos/Baywood Park Community and to assure the overall objectivity of the Alternative Technologies Review as conducted by Metcalf and Eddy ("Consultant"). The TAC will assist, advise, monitor and confer with the Consultant and the County on the issues and findings, in each and every phase of work related to the Alternative Technologies Review as provided in the scope of work of Amendment No. 2 of the Metcalf and Eddy Consulting Contract for the Los Osos/Baywood Park Sewer System Project." This is quoted directly from the Board's Resolution in regard to the M&E contract.

The various members of the TAC include 8 official members representing the County Services Area 9, the Los Osos Chamber of Commerce, the Blue Ribbon Committee, and the Citizens for Affordable Waste Water Systems. In aggregate, the members of the TAC represent a wide diversity of talent and expertise covering all facets of the report dealing with Task G. The reader is encouraged to examine the page in the front of the Metcalf and Eddy report where the various TAC members are identified along with their professional affiliations.

The TAC Committee members collected and cataloged all available reports and databases regarding the water quality in the Los Osos Basin over the last forty years. The summation of these reports and data were reported in M&E's Task F Report. The San Luis Obispo County Board of Supervisors accepted the Task F Report with an attached memorandum which resolved differences in opinion between M&E and the Technical Advisory Committee. The memorandum highlighted the major problems as being related to high ground water and the density of dwellings within the prohibition zone.

A total of 90 public weekly meetings of the TAC have been held to date. The TAC has communicated by telephone conference call with Metcalf and Eddy on a weekly schedule during the Task G work phase. In addition, a member of the County Engineering staff has attended almost every meeting of the TAC.

The TAC believes that Metcalf and Eddy has misrepresented many important facts in preparing the Task G Report. System costs, system flow rates, dwelling unit totals and auxiliary considerations are some the subject areas which the TAC believes to be inaccurate which result in recommendations and conclusions by Metcalf and Eddy which are both flawed and inaccurate.

Although M&E has been preparing the Task G Report for over 18 months, the TAC has been allowed only 25 calender days in which to review and prepare comments for the Task G Report's Appendix A. During this review period, as recently as today, M&E has been sending revised cost data sheets for Appendix C, making a difficult task even harder.

The TAC has reviewed and analyzed the Task G Report with the accompanying Appendix C Cost Analysis. The conclusions reached are presented as Appendix A and include written comments with supporting figures, maps and tables. Many of the TAC's comments are based upon our original analysis and development of available data which has been over looked by Metcalf and Eddy.

The Appendix A contains these critiques along with additional points of clarification to represent the concerns of the TAC. The TAC believes that the comments of this Committee must be carefully studied and applied to the selection of Alternative Wastewater Treatment options available to the community of Los Osos. Ignoring the information in this Appendix A will lead to the selection of an inappropriate and costly wastewater treatment system.

In conclusion, the TAC strongly disagrees with the cost analysis of the M&E proposed system, the calculation of unit cost per dwelling, the rejection of the problems which were agreed upon in the Task F Report and the overall limited review of alternative wastewater treatment alternatives which were the contractual basis for this Los Osos Wastewater Study and Report on Detailed Evaluation of Alternatives.

# INTRODUCTION to APPENDIX A

The Los Osos Technical Advisory Committee (TAC) has reviewed M&E's *Los Osos Wastewater Study* report on "Detailed Evaluation Alternatives" and now advises the County Board of Supervisors that they unanimously believe M&E have failed to find the best alternative solution to the wastewater problem and have failed as well to adequately consider flooding, recharge/protection of water supply sources, alternate treatment plant sites and sludge/septage disposal, all of which was stipulated in their contract.

After almost two years of work, Metcalf and Eddy, through obvious errors, unexplained values, blatant omissions of important issues and data from Task F, has in its study endeavored to prove that a centralized treatment and disposal facility would be the least costly system and that it should be used in Los Osos, contrary to their actual charge of helping to find the ***best*** alternative system the Los Osos citizens could afford. As stated in the background on page 1-2, the cost of the proposed 1.6 million gallon—per—day project was estimated to represent a bonded assessment of over $11,500.00 per single family dwelling, causing official and citizens to search for less expensive alternatives.

This assessment, plus the abandonment and hookup, spread out in payments with interest over 30 years would cost homeowners approximately $105.00 per month. The San Francisco office of the Environmental Protection Agency wrote a letter to San Luis Obispo County asking that a true cost analysis for the proposed project be completed. The cost analysis would determine the actual percentage of residents in Los Osos/Baywood Park who might experience economic hardship. To date, San Luis Obispo County has not started or completed the cost analysis request.

The TAC would like to present more reasonable alternatives with properly documented data and costs to the Board and this will be done during the scheduled August 3, 1995 Board of Supervisors' meeting. We believe the community of Los Osos deserves the opportunity to be heard regarding the solution to the waste water disposal issue and the ensuing costs. We are convinced that "non-conventional" alternatives are available to the community which will be more affordable and better for recharging our aquifers than the system originally proposed and which will also meet the State's water quality standards.

The TAC intends to use Appendix A to document its review regarding the adequacy of Metcalf and Eddy's Task G and Appendix C report.

Appendix A

## 1. COST COMPARISONS

**Cost Evaluation.**

The purpose of Task "G" was to compare viable alternative systems or combinations of systems against the "current proposed sewerage system" developed and estimated in the Engineering Science Stage I report of 1987 [2,5] The capital costs were $ 58,000,000.

Metcalf and Eddy did not in fact make such a comparison;. Although, they recommend the use of that system with a price very close to the $58,000,000. ***They state on page 2-10 that all costs have been adjusted to Engineering News Record Construction Cost Index (ENRCCI) 7252 then proceed to use a lower value (6500) to compare the proposed value to a very limited number of alternatives; thus creating a bias of 12% in favor of the proposed project. They have under estimated the cost of the treatment plant by an additional 52%.***

They did not use the basic parameters of the Engineering Science report, so that many errors have been introduced into their cost estimates. Other errors and confusion is introduced by their methods of manipulating the data.

As shown in the calculations which follow, they have biased the costs of alternatives, especially the costs of the retention of onsite systems to a degree which is frankly ridiculous.

1. Estimated waste flow volumes have been reduced by 7% which tends to increase the apparent population density.
2. Estimated construction costs for the proposed project (alternate 1) have been reduced 10% by using the Engineering News Record Construction Cost Index (ENRCCI), but this index has not been applied to items which were not in the original contract (new alternatives).
3. Cost of the collection system, the treatment plant and the waste transport and disposal system have each been **under estimated by** M&E by **as much as 53%.**
4. O&M costs for the proposed project have been **under estimated by nearly 45%.**
5. O&M costs for retained septic systems, including the costs for operating a maintenance management district have been **over estimated by 120%.**
6. Costs of installing new septic systems have been **over estimated by nearly 140%.**
7. The estimated frequency of replacement of existing septic systems has been **over estimated by 100%** (doubled).
8. An arbitrary factor for replacing as many as **50% of existing septic systems** in each of the unsewered areas has been added to the cost of keeping any present systems.
9. The proposed system includes a Step system for Bayridge Estates, but includes none of the O&M Costs to the retained septic systems which it applies to individual homes. However when Bayridge Estates is considered part of the existing systems in alternate 4, Then all of the over estimated costs of operation, maintenance and replacement are applied not for a single system but for 149 systems.
10. **Table 3-8 The Savings for alternate 4 should be not less than $17,827,000.**

Appendix A

**Basic parameters**

The following design criteria were used in the current proposed project[ 2,5]
Dwelling Units (DU) (or DUE) [1,5]

- **Present** = Total number of Existing units within the **prohibition area** or the individual subareas (A-M) listed in this 'report
- **Stage I** = Total number of dwelling units if all vacant parcels within the Currently authorized subdivisions were built to authorized capacity. (7477 DUE)

Dwelling Units shall be considered to meet the following criteria as indicated in the cited documents

- Population = 2.5 persons per DUE
- Waste Flow = 85 g/c/d or 214g/d/ DUE (7477) = 1.6 million gal / day
- Nitrate concentration per capita per day) = 40mg/l based on the above flow rate = 12.8 g/c/d (grams [ ref. 1, pages 3-3,4 &7 ref. 2 pages III-1 & IV-9]

**To compare costs or effectiveness for alternate technologies or combinations thereof it is essential to maintain the same basis for design.**

M&E introduces a major error in calculating the waste flow calculation from their Task F report of 200 g/d/DUE rather than 214 g/d/DUE [1,2]. This causes a 7 % error in the number of dwelling units . Actual count of infill lots by TAC confirm this.

**Operation and Maintenance**

M&E lists in annual O&M costs for septic systems as $242
As noted below, for area "D" (the worst case cited by M&E) the actual rate of repair permits is about 1%/ yr.
Thus a conservative and more nearly correct annual maintenance figure would be:

| | |
|---|---|
| Annual maintenance management district fee | = $60/ yr. (includes annual insp.) |
| Average repair $990(say $1000) x .01 | = $10/yr. |
| Pumping every 5 years (determine by annual inspection) | = $40/yr. |
| Total | $110 /yr. |

Costs include replacement costs where needed.

**1. Installation Costs from M&E analysis:**

M&E estimates installation of a septic tank and leach system at $4,100 including contractor overhead and profit.They then ad 44% to this to cover contingencies and Engineering bringing the total up to $5,900. Since these would be new individual installations on bare lots they would be installed under the jurisdiction of the MM district . A permit and inspection fee would be charged at installation. Local installers will bid individual systems at $2,100 to $2,200 each. Also Septic tanks sized for multifamily units will be proportionately lower since move-in/move-out costs and permits will be approximately the same for a system sized for a fourplex as for a single family dwelling. No contingency is involved and the management and overhead is covered in the permit costs for the MM district.

2. Replacement of existing septic systems.
Table 3-1 note c reference to the Task F report figure A-2.This figure shows that from the Sanitary Survey and from the Permit and complaint data individual blocks had a higher incidence of "problems" associated with septic systems than community wide averages. This means that certain blocks showed more than their proportionate share of the problems perhaps as much as 50 % more than the average.
**This does not mean as M&E states in their cost analysis and replacement estimate that more than 50 % of the septic systems in such blocks have problems or permits for repairs.** Also the sanitary survey indicates that in every case after repairs were made the "problems" disappeared..

For an example of the distortion created by this misinterpretation of the data, examine area "D". First M&E assumes that the average of all areas will require 13 % replacement maximum.In area "D" there are a total of 20.5 blocks. Of these 7.5 have 32-45 % more than the average number of problems say 40%.
Based on appendix J in task F report, 74 permits were issued for area "D" out of a total of 590 residences. This means that 12.5% had repairs of some sort in the 12.5 years between 1980 and 1992 (1%/yr.). By no stretch of the imagination can this equate to 51% requiring replacement. Thus in this area that M&E indicates septic systems could be retained and that they show to have the highest incidence of "problems" the actual repair record is 1% per year. not 2% as used in calculation of O&M costs.
There is no basis for replacement of existing systems. Periodic replacement allowance is included in the maintenance Management District costs under O&M above.
Thus for area "D":

| | | CONSTRUCTION | | | O&M | |
|---|---|---|---|---|---|---|
| Replacement included in annual Management district fee. | | | | | | |
| Existing units | 100% | 590 included in O&M | | | $110 | = $64,900 |
| New units | -- | 292 | @2500 | $730,000 | $110 | = $32,100 |
| Total | | 882 | | $730,000 | | $97,000 |

These new units are not a part of the "sewer" contract but are individual contract bid item and contingencies are not involved. Engineering and mgt. is covered by the MM district fees and permits.
The cost of onsite systems for area "D":

| | Construction | O&M | | |
|---|---|---|---|---|
| Capital = | 730,000 | O&M = $97,000/yr. | Total PW | $1,933,000 |
| M&E | =$3,141,000 | $182,000/yr. | | $ 5,399,000 |
| alt 1 (M&E) | $53,153,000 | $671,000/yr. | | $61,479,000 |
| alt 4 (M&E) | $50,493,000 | $777,000/yr. | | $60,128,000 |
| alt 4 (TAC) | $49,953,000 | $713,000/yr. | | $58,794,000 |

## 2. OUT OF POCKET COST

A very serious omission in the M&E report is the $61,000,000 in interest costs home owners will have to pay in area "Q" if alternate.1 is built. This is the actual interest cost difference between alternate 1 (full sewer) and alternate 4 ( retaining septic systems on 42% of the dwelling units). Also ignored is the bond cost which raises the $9,120 (cash) assessment to $11,523.65 (bond), an increase of 26.4%. Most home owners in the prohibition zone in Los Osos are on a fixed income near the poverty level and did not have the $9,100 available so that they must pay interest on the larger amount of money. The checks they have to write each month to pay for the system mandated in this report could have a tremendous impact on their lives. Nowhere in this report is this considered.

After the EPA spent 3 days in December of 1994 in Los Osos reviewing the project. The San Francisco office wrote a letter to S.L.O. county asking that the true, actual cost analysis for the project be performed. This was not done

It should be an unavoidable responsibility of every person involved in choosing a system to consider the **total** cost to the homeowner for the 30 year period of paying for the system.

As an example of the distortion of the true total cost the M&E approach has generated, please examine the following different method of calculating the interest costs for alternate 1 and alternate 4 in area "Q" which contains 42 % of the DUEs in stage I.

M&E cites the $9,100 cash assessment against each homeowner and implies that this may be reduced. They provide no quantitative analysis, no calculation and no statement of the costs if the sewer were to be built today. The savings they tout as the result of the favorable ENRCCI reductions, barely cover the cost of the on-site abandonment costs ignored in the original project. The plan recommended by M&E in chapter 4 costs $57,541,000.

In the following analysis "Increase" is defined as financing costs to homeowner ignored by M&E.

**ALT 1 AREA Q, STAGE I**

M&E states there are 3314 units in area "Q" .

**1. Bond cost**($11,523.65 - $9,100) x 3314 = **(1)$7,966,856**

Payments on $11,523.65 @ 7% for 30 years = $27,605

less principle - $11,524

Interest **$16,081**

**2. Bond Interest** = 16081 x 3314 = **(2)$53,292,434**

**3. Interest on hook-up and tank removal cost ($3000)**

Assume 75% will have to use home improvement loan at 10% for 10 years.

Monthly payments =$39.65 total =$39,65 x 12 x 10 = $4,758

less principle -3,000

interest $1,758

**Increase** = 1758 x 3314 x 0.75 = **(3)$4,369,509**

**Total increase $65,629,000**

This is not a net increase since alternate 4 would still require new systems.

1241 new septic systems will be installed costing $2500 as a part of the home construction and will be covered by the mortgage assumed at 30 years @ 7%

monthly payment = $16.65

cost = $16.65 x 12 x 30 = $5,994
less principle = 2,500
Interest $3,494

4. Increase = 1241 x 3494 = **$4,361,000**

5. Increase cost of repairs of all retained septic systems (including new units).

Conservatively, repairs to 1% of all septic systems of $1,000 per year for 30 years will be required. 3314 DU x 0.01 x $1,000 x 30 yr. = $990,000 (990 repairs @ $1,000)

Assume 75% will be financed @ 10% for 10 yrs. monthly payments = $13.22.

Total = $13.22 x 12 x 10 = $1,586

Net interest cost =$1,586 - $1,000 = $586/ du

5. Increase = 990 x .75 x 586 = **$435,000**

Total increase for alternate 4 = **$4,496,000**

Total increase for alternate 1 = $65,629,000

Net increase of alternate 1 over alternate 4 = $65,629,000 - $4,496,000= **$61,133,000**

This is an interest cost difference of **$61,133,000** which the home owner can not avoid paying! This major destructive omission is probably caused by the use of the Present worth analysis with out considering ALL costs, including interest.

This interest cost analysis applies only to the alternates 1 and 4 as defined by M&E. for area Q. It does not include refinements in cost analysis and area definition proposed above by the Technical Advisory Committee (TAC).

# POINT 3 - CONTRACT OMISSIONS

Metcalf & Eddy, in Task "G", has inadequately evaluated the disposal of bio solids, recharge/protection of water supply sources, and the alternate treatment plant sites.

1. **Bio Solids** (septage/sludge) disposal must be done according to Federal Regulations. Metcalf and Eddy merely recommends more site specific studies, without either estimating or budgeting costs for proper evaluation of alternatives.

2. **Recharge/Protection of Water Supply Sources** is a major requirement of a successful alternative, both for preserving our water resources and for preventing salt water intrusion into our deep aquifers. Again, M&E in Task "G" merely recommend (Task G page 2-11) additional field testing for the Broderson and Los Osos Creek Recharge Sites, and for them to begin preliminary and final design of the project so they can confirm the suitability of the recharge sites. No estimates for costs of testing, investigating, purchasing or construction necessary for the sites are made. No provisions or estimates are made for alternative site solutions should these sites prove not to be suitable for recharge.

3. **Alternative Treatment Plant Sites** closer to the community than the Turri Road Site represent opportunities for cost savings (Task G page 2-11), and M&E notes these savings are discussed in Task G Chapter 4. However, the TAC cannot locate any information relating to cost savings in Chapter 4.

# POINT 4 Dwelling Units, Stage I, Flow Evaluation

All engineering design calculations are based on accurate data. Both M&E and the TAC realize and utilize a similar basis for the calculation of total costs. That is, the total cost is based upon the ultimate size of the total system. The size of a wastewater treatment system is normally based upon the water flow generated by the represented population. Therefore, the critical element for the cost assessment is the determination of population, both current and at "buildout."

Population at buildout is a projection of the number of dwellings which can be built under current planning ordinances and guidelines. Accurate existing dwelling/lot counts of existing subdivisions, both vacant and built upon, can be tabulated into tables which can show the present dwelling unit counts. Unsubdivided parcels with their potential dwelling units, which will ultimately become part of the Community, can be added to the existing dwelling and lots to arrive at a ultimate buildout figure. Using an agreed upon figure of 2.5 persons per dwelling (averaged) the current population can be checked against census data and projected for buildout.

The TAC has concluded that serious errors have been made as depicted in Task G Tables 3-2B,C and D and has developed TAC Tables 1, 2, 3 and 4 to summarize these errors.

TAC finds that M&E has used an incorrect method for its calculation of the dwelling unit numbers. M&E has arrived at this critical number from a Gross Acreage multiplied by Dwelling Density approach. **Table** 1 is a comparison of M&E's gross acres and TAC revised gross acres. The 205 acre reduction in the TAC column are acres removed from the qualified acreage. These 205 acres are acreage which will never be used for dwellings. These areas include: Morro Bay wet lands and marsh, the Sweet Springs Preserve, the Elfin Forrest Preserve and the Sea Pines Golf course with its approved expansion area. Exaggerated gross acreage numbers will project an increased population and hence, water flow, system size and cost.

In addition to the Gross Acreage errors, M&E has incorrectly calculated the number of dwelling units which can exist on an acre of land. M&E's use of 7 dwelling units (DU) per acre for single family residences (SFR) and 15 or 26 DU for multi family residences (MFR) is predicated on 90% lot coverage and 10% street coverage. This is an obvious error in calculation. For example, the Town of El Morro has 80 foot wide streets. Simple calculations show that only 4.88 DU's per acre are possible within the 100 year old subdivision. Similar errors can be seen on **Table** 2- ***Dwelling Unit Density @ Buildout*** for other existing subdivisions. This table points out the degree of error which would accumulate when M&E's distorted densities parameters are multiplied by exaggerated gross acreage figures.

The TAC believes that a more accurate and simplified method exists for the determination of total dwelling units by the use of the simple hand counting method. The hand counting of the available Assessors Parcel Maps, Sewer Assessment Maps, The Wallace Report, combined with the review of current land use ordinances and guidelines is a more accurate method for the determination of total dwelling units. This method can also be confirmed by driving through the neighborhoods of Los Osos. The TAC's Table 3 and 4 clearly illustrate a difference in the total number of dwelling units between M&E and the TAC. **Table 3** ***Dwelling Unit Count*** *(incremental approach)* shows three tabular columns, Existing, Stage 1 and Buildout, reflecting this approach,. Existing is a count of existing dwelling units (DU). Stage 1 is a count of all existing vacant subdivided lots within the prohibition zone. The Buildout count is the maximum allowable potential lots for all currently unsubdivided parcels. **Table 4** ***Dwelling Unit Count*** *(cumulative approach)* presents a running count which results in the total dwelling numbers for each condition listed above. **Table 5** ***Dwelling Unit Count Comparison*** illustrates the differences between the M&E "Gross Acreage x Density" and the TAC's "Dwelling Units by hand count."

The difference of **3385 DUE** *(Table 5)* Dwelling Unit Equivalents between the two methodologies should raise a red flag to the reader of this report. Serious calculation errors for system size and total cost have certainly occurred. More important to the validity of this report will be the incremental decrease in the cost per dwelling unit by the use of flawed Gross Acreage/Density data. This is caused when the total cost is divided by an erroneous dwelling unit count thereby reducing the cost per unit to an unrealistic number. Similarly the calculation of costs for the alternative onsite systems will be incrementally larger due to the erroneous addition of alternative system costs for phantom dwellings which could be never built because they do not and will never exist.

For the final analysis of designing a treatment system, Dwelling Units are adjusted for variables. For example, a single family residence (SFR) is given a Dwelling Unit Equivalent (DUE) of 1, while a mobile home is given a DUE of .5. This is because it is recognized that a mobile home has a lower wastewater flow than a single family residence because fewer people are known to reside in Mobil homes. Multifamily units, apartments, condominium and duplexes are similarly adjusted to a .75 DUE. Finally, commercial properties are adjusted to reflect the size of the lot or 1 DUE for every 10,000 square feet of lot. With this in mind, **Table 6** ***Dwelling Unit Count Adjusted to DUE*** should be compared to M&E Table 3-2D for DUE Wastewater flows.

**The DUE difference of 3385 DUE shows a tremendous differential between the work that M&E presents as fact and that which the TAC has calculated using readily available and documented data.**

The normal wastewater flow rate in millions of gallons per day (mgd) is calculated by multiplying the DUE's times a dwelling occupancy of 2.5 persons times an accepted water usage of 85 gallons per person per day thus:

## Calculations for Buildout in the Prohibition Zone

**M&E flow equals: 11089 DUE x 2.5 persons/dwelling x 85 gallons/day = 2.35 mgd**

**TAC flow equals: 7704 DUE x 2.5 persons/dwelling x 85 gallons/day = 1.67 mgd**

## Calculations for Stage I in the Prohibition Zone

**M&E flow equals: 7932 DUE x 2.5 persons/dwelling x 85 gallons/day =1.69 mgd**

**TAC flow equals: 6434 DUE x 2.5 persons/dwelling x 85 gallons/day = 1.36 mgd**

The difference in flow between the TAC and M&E calculations indicates a **41% increase in the projected flow rate for the projected Buildout project** and a **25% increase in the projected flow for the Stage I project.**

The percentages for increased flow rates should be used by the reader for the comparison of the Metcalf and Eddy calculated flow rates to the TAC's calculated flow rate based on Dwelling Equivalent Unit differences.

# Summary:

In summary, M&E's approach to calculating wastewater flow is incorrect and should be rejected as the basis for the determination of costs.

# TAC Table 1

## Gross Acres @ Buildout - Comparative Analysis of Table 3-2B

M&E Figure 3-6 map compared to TAC Figure 3-6 map Revised

Analysis by comparison of Land Use Area acreage

| Area | | | Residential | | [a] [b] | | Commerical | | Other | | Totals | | Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M&E | TAC | M&E | TAC | M&E | TAC | M&E | TAC | M&E[c] | TAC[d] | M&E[e | TAC [f] | |
| | Sub | Sub | SFR | SFR | MFR | MFR | Com | Com | | | | | |
| A | 0 | 0 | 65.0 | 55.5 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 | 65.0 | 57.0 | 8.0 |
| B | 0 | 0 | 284.0 | 269.4 | 16.0 | 12.6 | 33.0 | 21.0 | 9.0 | 8.0 | 342.0 | 311.0 | 31.0 |
| C | 0 | 0 | 78.0 | 65.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 78.0 | 65.0 | 13.0 |
| D | 0 | 0 | 96.0 | 101.0 | 17.0 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 113.0 | 111.0 | 2.0 |
| E | 0 | 0 | 114.0 | 128.5 | 16.0 | 10.5 | 0.0 | 0.0 | 9.0 | 0.0 | 139.0 | 139.0 | 0.0 |
| F | 0 | 0 | 135.0 | 151.0 | 18.0 | 0.0 | 0.0 | 0.0 | 44.0 | 0.0 | 197.0 | 151.0 | 46.0 |
| G | 0 | 0 | 94.0 | 62.5 | 9.0 | 4.0 | 0.0 | 0.0 | 18.0 | 0.0 | 121.0 | 66.5 | 54.5 |
| H | 0 | 0 | 76.0 | 75.9 | 16.0 | 0.0 | 0.0 | 24.5 | 27.0 | 16.6 | 119.0 | 120.0 | -1.0 |
| I | 0 | 0 | 317.0 | 327.0 | 8.0 | 5.3 | 0.0 | 0.0 | 19.0 | 8.7 | 344.0 | 341.0 | 3.0 |
| J | 0 | 0 | 15.0 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 17.0 | 20.0 | -3.0 |
| K | 0 | 0 | 17.0 | 40.5 | 37.0 | 39.5 | 128.0 | 82.0 | 0.0 | 0.0 | 182.0 | 162.0 | 20.0 |
| L | 46 | 26 | 106.0 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 152.0 | 126.0 | 26.0 |
| M | 0 | 0 | 125.0 | 130.0 | 0.0 | 0.0 | 0.0 | 0.0 | 11.0 | 0.0 | 136.0 | 130.0 | 6.0 |
| Total | 46 | 26 | 1522 | 1529 | 137 | 83.4 | 161 | 128 | 139 | 33.3 | 2005 | 1800 | 205.5 |

| Land Use Totals | M&E | TAC | | M&E | TAC | M&E | TAC | M&E | TAC | |
|---|---|---|---|---|---|---|---|---|---|---|
| in Acres | 1705 | 1639 | | 161 | 128 | 139 | 33.3 | 3273 | 2916 | |

[a] M&E task G Table 3-2 B Land Use at Buildout, Gross Acres from Phase Two - Basis of Design Report [5]

[b] TAC analysis of M&E "Figure A-6 Area Boundaries for Alternative Analysis" revised to buildable acreage

[c] M&E Other=Recreation, parks, open space, schools, public facilities

[d] TAC Other= Land areas used for public facilities,recreation, parks, schools. Opens space excluded

[e] Acreage from Table 3-2B

[f] Acreage from Revised TAC Gross Area Acreage Map

# TAC Table 2

## Dwelling Unit Density @ Buildout - Table 3-2C [l]

Dwelling Units Equivalents Per Acre[a,k]

| Area [j,i] | Single Family | | Multi Family | |
|---|---|---|---|---|
| | M&E | TAC [l] | M&E | TAC[h] |
| A | 7 | 4.88 | 15 | 10.5 |
| B [b] | 7 | 4.88 | 15 | 10.5 |
| C | 7 | 4.88 | 15 | - |
| D | 7 | 4.88 | 15 | 10.5 |
| E | 7 | 4.88 | 15 | 10.5 |
| F [c] | 7 | 7.62 | 15 | - |
| G [d] | 2 | 4.84 | 15 | 10.5 |
| H [e] | 4 | 0.70 | 15 | - |
| I [f] | 6 | 3.05 | 15 | 10.5 |
| J | 7 | 5.08 | - | - |
| K | 7 | 4.88 | 26 | 18.2 |
| L [g] | 1 | 0.70 | - | - |
| MM [m] | 7 | 7.05 | - | - |
| MB [n] | 7 | 4.08 | - | - |

| | |
|---|---|
| [a] | Unit densities include streets at 30% of acreage [5] |
| [b] | Area A,B,C,D,E (Town of El Morro) lots are generally 6250 sq.ft. |
| [c] | Area F (Cuesta by the Sea) lots are generally 4000 sq.ft. |
| [d] | Area G (Sunset Terrace) lots are generally 6300 sq.ft. |
| [e] | Area H (Martin Tract) lots are generally 1 acre |
| [f] | Area I (Morro Palisades and Redfield Woods) lots are 9000 sq.ft. and 5500 sq.ft |
| [g] | Area L (Bayview Heights) lots are generally one acre |
| [h] | TAC multi family units per acre = 15 x .70 |
| [i] | TAC single family density = 1 ac x .7 / lot size |
| [j] | M&E = Includes a 10% reduction for streets |
| [k] | TAC = Includes a 30% reduction for streets + lot size (sqft) |
| [l] | Potential dwellings unit equivalents for undivided parcels: |
| | Multi Family Land Use = 15 DU if propert is < 1 acre |
| | Multi Family Land Use = 26 DU if propert is > 1 acre |
| | Residential Single Family RSF = 6000 sq.ft. minimum lot size |
| | Morro Palisades (south) = 4 DU per acre |
| [m] | Area MM = Three mobil home parks |
| [n] | Area MB = Bayridge Estates subdivision |

## TAC Dwelling Unit Analysis - Actual Hand Count

Dwelling count = hand count of assessor's parcel map

Existing = Existing dwelling units

Stage 1 = Existing Dwelling Units plus Potential Dwelling Units on Existing Subdivided lots

Buildout = Existing Dwelling Units plus Potential Dwelling Units on Existing Subdivided lots plus Potential Dwelling Units on Unsubdivided Parcels [a]

## TAC Table 3

Comparative analysis to M&E Table 3-2A

### Dwelling Count for -- Existing -- Stage 1 -- Buildout Dwelling Units (DU)

Incremental Basis

| | Existing | | | | Stage 1 | | | | Buildout | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Area | SF | MF | COM | * | SF | MF | COM | * | SF | MF | COM |
| A | 233 | 13 | 0 | * | 19 | 0 | 0 | * | 0 | 0 | 0 |
| B | 1066 | 130 | 73 | * | 133 | 14 | 10 | * | 86 | 0 | 2 |
| C | 269 | 0 | 0 | * | 19 | 0 | 0 | * | 0 | 0 | 0 |
| D | 438 | 126 | 0 | * | 19 | 4 | 0 | * | 0 | 0 | 0 |
| E | 445 | 107 | 40 | * | 48 | 4 | 2 | * | 0 | 0 | 0 |
| F | 523 | 166 | 0 | * | 142 | 0 | 0 | * | 0 | 583 | 0 |
| G | 158 | 39 | 17 | * | 23 | 4 | 0 | * | 96 | 0 | 0 |
| H[b,c] | 38 | 0 | 1 | * | 14 | 0 | 0 | * | 140 | 0 | 48 |
| I[d] | 757 | 28 | 1 | * | 20 | 0 | 0 | * | 563 | 0 | 0 |
| J | 74 | 0 | 0 | * | 0 | 0 | 0 | * | 0 | 0 | 0 |
| K | 87 | 352 | 156 | * | 2 | 120 | 33 | * | 0 | 0 | 0 |
| L | 121 | 0 | 0 | * | 25 | 0 | 0 | * | 0 | 0 | 0 |
| Mm[e] | 326 | 0 | 0 | * | 0 | 0 | 0 | * | 0 | 0 | 0 |
| Mb[f] | 167 | 0 | 0 | * | 0 | 0 | 0 | * | 0 | 0 | 0 |
| Total | 4702 | 961 | 288 | * | 464 | 146 | 45 | * | 885 | 583 | 50 |
| TAC Stage Totals | | 5951 | | | | 655 | | | | 1518 | |
| M&E Stage Totals | | 4993 | | | | N.A. | | | | N.A. | |

# TAC Table 4

Cumulative Totals for -- Existing -- Stage 1 -- Buildout Dwelling Units (DU) from TAC Table 3

| | Cumulative Basis | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Existing | | | * | Stage 1 | | | * | Buildout | | | |
| Area | SF | MF | COM | * | SF | MF | COM | * | SF | MF | COM | Total |
| A | 233 | 13 | 0 | * | 252 | 13 | 0 | * | 252 | 13 | 0 | 265 |
| B | 1066 | 130 | 73 | * | 1,199 | 144 | 83 | * | 1,285 | 144 | 85 | 1,514 |
| C | 269 | 0 | 0 | * | 288 | 0 | 0 | * | 288 | 0 | 0 | 288 |
| D | 438 | 126 | 0 | * | 457 | 130 | 0 | * | 457 | 130 | 0 | 587 |
| E | 445 | 107 | 40 | * | 493 | 111 | 42 | * | 493 | 111 | 42 | 646 |
| F | 523 | 166 | 0 | * | 665 | 166 | 0 | * | 665 | 749 | 0 | 1,414 |
| G | 158 | 39 | 17 | * | 181 | 43 | 17 | * | 277 | 43 | 17 | 337 |
| H | 38 | 0 | 1 | * | 52 | 0 | 1 | * | 192 | 0 | 49 | 241 |
| I | 757 | 28 | 1 | * | 777 | 28 | 1 | * | 1,340 | 28 | 1 | 1,369 |
| J | 74 | 0 | 0 | * | 74 | 0 | 0 | * | 74 | 0 | 0 | 74 |
| K | 87 | 352 | 156 | * | 89 | 472 | 189 | * | 89 | 472 | 189 | 750 |
| L | 121 | 0 | 0 | * | 146 | 0 | 0 | * | 146 | 0 | 0 | 146 |
| Mm | 326 | 0 | 0 | * | 326 | | 0 | * | 326 | | 0 | 326 |
| Mb | 167 | 0 | 0 | * | 167 | 0 | 0 | * | 167 | 0 | 0 | 167 |
| Total | 4702 | 961 | 288 | * | 5,166 | 1,107 | 333 | * | 6,051 | 1,690 | 383 | |
| Stage Totals | | 5951 | | | | 6,606 | | | | 8,124 | | |
| | | | | | | | | | | | Total DU | 8,124 |

* TAC Stage 1 figures as shown below are based on M&E's 2/3 of buildout counts rather than actual Stage 1 Dwelling Units Equivalent Counts

# TAC Table 5

## Dwelling Unit Equivalent Count Comparison

* Column numbers are taken from other tables and may not add up due to varying criteria [a thru g]

Comparison of M&E Gross Acreage x Dwelling Unit Equivalent (DUE)
to
TAC Hand Count of Buildout DUE's from Assessment Map

| | Existing | | Stage One [c] | | Buildout | | Buildout |
|---|---|---|---|---|---|---|---|
| Area | M&E [a] | TAC [b] | M&E | TAC [g] | M&E [d] | TAC [e] | Difference [f] |
| A | 230 | 243 | 272 | 175 | 408 | 262 | 146 |
| B | 1090 | 1,237 | 1,433 | 1,003 | 2,149 | 1,504 | 646 |
| C | 248 | 269 | 326 | 192 | 489 | 288 | 201 |
| D | 460 | 533 | 555 | 370 | 832 | 555 | 278 |
| E | 472 | 565 | 624 | 412 | 935 | 618 | 317 |
| F | 607 | 648 | 731 | 733 | 1,096 | 1,099 | (3) |
| G | 193 | 204 | 189 | 218 | 284 | 326 | (42) |
| H | 47 | 81 | 327 | 161 | 491 | 241 | 250 |
| I | 674 | 779 | 1,221 | 908 | 1,831 | 1,362 | 469 |
| J | 74 | 74 | 63 | 49 | 95 | 74 | 21 |
| K | 310 | 569 | 1,039 | 492 | 1,558 | 737 | 821 |
| L | 122 | 121 | 91 | 97 | 137 | 146 | (9) |
| M | 466 | 330 | 523 | 329 | 784 | 493 | 291 |
| Total | 4993 | 5,652 | 7,396 | 5,139 | 11,089 | 7,704 | 3,385 |

M&E DUE = Gross Acreage x DU per acre x Equivalent Factor
TAC Hand Count = DU x Equivalent Factor

[a] From Table 3-2A Existing Services and Dwelling Unit Equivalents
[b] From TAC Table 3 Cumulative Dwelling Unit Count - Adjusted to Dwelling Unit Equivalents
[c] Stage 1 = M&E's 2/3 of Buildout Dwelling Figures [5]
[d] From Table 3-2D Column 1 Wastewater Flows
[e] From Table 3-2A Existing Services and Dwelling Unit Equivalents
[f] Difference between M&E and TAC counts
[g] Stage 1 DUE count is less than current DUE count due to building from 1985 thru 1988

# TAC Table 6

Cumulative Dwelling Unit Count – adjusted to DUE [g] – Comparative analysis to M&E Table 3-2D

Cumulative Basis

| | Existing | | | * | Stage I | | | * | Buildout | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area | SF | MF | COM | * | SF | MF | COM | * | SF | MF | COM | Total |
| A | 233 | 9.75 | 0 | * | 252 | 9.75 | 0 | * | 252 | 9.75 | 0 | 262 |
| B | 1066 | 97.5 | 73 | * | 1,199 | 108 | 83 | * | 1,285 | 108 | 111 | 1,504 |
| C | 269 | 0 | 0 | * | 288 | 0 | 0 | * | 288 | 0 | 0 | 288 |
| D | 438 | 94.5 | 0 | * | 457 | 97.5 | 0 | * | 457 | 97.5 | 0 | 555 |
| E | 445 | 80.25 | 40 | * | 493 | 83.25 | 42 | * | 493 | 83.25 | 42 | 618 |
| F | 523 | 124.5 | 0 | * | 665 | 124.5 | 0 | * | 665 | 434 | 0 | 1,099 |
| G | 158 | 29.25 | 17 | * | 181 | 32.25 | 17 | * | 277 | 32.25 | 17 | 326 |
| H[b] | 38 | 0 | 43 | * | 52 | 0 | 1 | * | 192 | 0 | 49 | 241 |
| I | 757 | 21 | 1 | * | 777 | 21 | 1 | * | 1,340 | 21 | 1 | 1,362 |
| J | 74 | 0 | 0 | * | 74 | 0 | 0 | * | 74 | 0 | 0 | 74 |
| K | 87 | 264 | 218 | * | 89 | 354 | 294 | * | 89 | 354 | 294 | 737 |
| L | 121 | 0 | 0 | * | 146 | 0 | 0 | * | 146 | 0 | 0 | 146 |
| Mm | 163 | 0 | 0 | * | 326 | 0 | 0 | * | 326 | 0 | 0 | 326 |
| Mb | 167 | 0 | 0 | * | 167 | 0 | 0 | * | 167 | 0 | 0 | 167 |
| Total | 4539 | 720.75 | 392 | * | 5166 | 830.25 | 438 | * | 6051 | 1139.8 | 513.5 | |
| Stage Totals | | 5651.8 | | | | 6434.3 | | | | 7704.3 | | |
| | | | | | | | | | | | Total DUE | 7,704 |

[a] Dwelling density determined by guidlines shown in Engineers Report

[b] All schools = 42 DUE

[c] Williams Bros 11 ac

[d] Commercial Nursery

[e] Mobil Home Parks (3)

[f] Bayridge Estates Subdivision

[g] DUE factors - SF = 1, MF = .75, Mobil Home = .5, Com = 1 per 10,000 sqft land

## Appendix A

POINT 5.- NITROGEN LOADING

On page 3-42 M&E writes: "In Task F, Metcalf & Eddy cited a denitrification value of 67% for the septic systems in Los Osos, not counting those that are in shallow groundwater conditions. Alternative 4 eliminates the shallow groundwater conditions, hence provides a greater level of confidence that the denitrification value of 67% can be consistently achieved."

Yet, in Table 3-11 under Alternative 4 -"Existing on-site systems", M&E shows 86,700 pounds loading, thereby allowing for NO denitrification in the soil column. Applying the 67% denitrification factor to the septic tank loading reduces the total loading for alternative 4 to 27 pounds per acre per year, very close to the 21 pounds per acre per year for the other three alternatives..

Considering the fact that the TAC in Task F maintained that the evidence from the Los Osos/Baywood Park Groundwater Nitrogen Study showed denitrification of effluent from two of the three test sites to be above 80%, then denitrification and nitrogen loading for Alternative 4, Existing onsite systems, becomes fully competitive with the other three alternatives.

# Point 6 Subjective Analysis

Under the contract with Metcalf & Eddy, there is to be an Alternative Technologies Evaluation, based on specific criteria, such as cost, technical feasibility, regulatory conformance and environmental impact. Earlier in the study process, the TAC and M&E agreed that cost would make up one-half of the criteria weight and that the other (subjective) criteria would incorporate the other one-half. However, **in the present report substantially all of the emphasis has been placed upon cost, with only fifteen lines of text and one table devoted to the subjective criteria.**

In conjunction with M&E, the TAC developed a set of criteria, which appear in Table 3-9 (starting on page 3-38). The criteria were then reviewed and weights considered appropriate were assigned to each. The weights have been adjusted so that they total to a score of 100. The TAC has no quarrel with the use of the various criteria or the weights assigned to each. The quarrel is with the values that M&E has assigned to each criterion for each alternative. On the table, the higher the value assigned, the more favorably the particular alternative is regarded as to the particular criterion.

Neither the table nor the text present any explanation for the values that have been assigned the various criteria for the Proposed Project and the Alternative Projects. Such being the case, it is extremely difficult to criticize the values assigned by M&E. It would be pointless to discuss in this appendix the various values on a case-by-case basis, but the TAC must try.

It is difficult to see why the table shows that the Proposed Project rates higher for <u>both</u> deep aquifer recharge (line 5) and for increased upper aquifer well production (line 6). Either the effluent will ultimately come to rest in the upper or lower aquifer, not in both in greater quantity than under an alternative.

The TAC does not understand the high score given the Proposed Alternative for parks and recreation (line 10). The TAC had not been informed that it was intended to use the sewage effluent disposal site as a recreational setting.

Nowhere has it been explained to the TAC how and why the Proposed Project would have positive economic/political/social impacts, as suggested on line 11.

The high score given the Proposed Project for flood control (line 13) seems questionable, since the project is not intended to provide storm drainage. Is flooding the indirect result of the same waters that are referred to as increasing the potential for upper aquifer well production? Obviously, a high score for well production cannot coexist with a high score for drainage.

The foregoing is but a modest attempt to understand M&E's intentions in regard to the subjective criteria analysis. We believe that complete justification for M&E's criteria evaluations should be provided in the report, inasmuch as this analysis was intended to be co-equal in impact with the cost analysis to which so much detail has been devoted.

# APPENDIX B
# TECHNICAL MEMORANDA ON ALTERNATIVES

# APPENDIX B - CONTENTS


**APPENDIX B1 - DISPOSAL/RECHARGE**

LANDSCAPE/AGRICULTURAL IRRIGATION . . . . . B1-1
GROUNDWATER RECHARGE . . . . . B1-4

**APPENDIX B2 - ONSITE TREATMENT**

SEPTIC TANK WITH SOIL ABSORPTION FIELD (CONVENTIONAL SYSTEM) . . . . . B2-1
SEPTIC TANK WITH SHALLOW SOIL ABSORPTION FIELD . . . . . B2-6
SEPTIC TANK WITH ZEOLITE ION EXCHANGE AND SOIL ABSORPTION FIELD . . . . . B2-11
RUCK BLACKWATER SYSTEM . . . . . B2-16
SEPTIC TANK WITH MOUND SYSTEM . . . . . B2-21
SEPTIC TANK WITH EVAPOTRANSPIRATION SYSTEM . . . . . B2-26
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# APPENDIX B1

# DISPOSAL/RECHARGE

## LANDSCAPE/AGRICULTURAL IRRIGATION

### Description

In the Los Osos area, there is one golf course and open fields at schools and that could be irrigated with treated effluent. The golf course is already proposed to be irrigated with a portion of the treated effluent from the Monarch Grove development. There are also several farms in the general area that could received the effluent. Also, areas designated "Recreation" in the current Estero Plan update could be irrigated.

The total annual demand for irrigation water at these sites is estimated to be a maximum of 0.9 to 1.2 mgd as summarized in Table B1-1. This is less than the total amount estimated to be produced in the community, 1.6 mgd. However, the actual demand is likely to be less, depending on preference of the landowner and the cost of alternative water supplies.

**Table B1-1. MAXIMUM POTENTIAL ANNUAL DEMAND FOR IRRIGATION WATER IN THE LOS OSOS AREA[a]**

| Land use | Area, acres | Average annual irrigation demand, mgd[b] |
|---|---|---|
| Landscape (school yards) | 20[c] | 0.1 |
| Areas designated "Recreation" | 35-134[d] | 0.1-0.4 |
| Agriculture | 276[e] | 0.7 |
| Total | 430 | 0.9-1.2 |

a. Excluding golf course, which is proposed to be irrigated with treated effluent from the Monarch Grove development.
b. Average of 3 ft/yr irrigation.
c. From aerial photograph.
d. [1], Table F. Represents developed and total acreage.
e. [2], Figure 11 and Table 2. Includes area generally west of Warden Creek. There may be additional agricultural acreage east of Los Osos Creek to Foothill Road.

Implementation of such a system would require treatment to the extent defined by regulations and criteria (see below) and a conveyance system from the treatment facility to the point of use. Since most of the irrigation demand would occur during the summer, storage or other disposition of the treated effluent for the rainy, winter months would be required.

In previous studies [3], irrigation with wastewater has been found not feasible, primarily because there were no significant cost savings and little interest from agricultural users. To evaluate current and future feasibility, a more detailed survey of potential users would need to be done.

## Conformance With Laws, Regulations, and Criteria

Treated wastewater effluent can be used to irrigate landscaped areas and agricultural areas under certain conditions defined by specific criteria in the California Code of Regulations. These conditions relate to the extent of treatment of the wastewater needed based on (1) type of crop or plant to be irrigated; (2) the method of irrigation; and (3) extent of public access to the irrigated site. There are three basic levels of treatment, primary, secondary, and tertiary, defined by coliform concentration and turbidity.

## Reliability

The reliability of this method of disposal depends on the reliability of the treatment and conveyance processes involved. It also depends on long-term commitments of users of the treated effluent.

## Flexibility

If treated to a tertiary level, the effluent can be used on most any crop or landscaping. There should be no difficulty if the user changes crops or there is a change in public access to the site. If treated to a primary or a secondary level, then effluent use on crops or landscaping is more limited.

## Precedents

Landscape and agricultural irrigation has been practiced worldwide for long periods of time. In California, many wastewater agencies use this method to reuse or "dispose" of wastewater. There is ample precedent for this method.

## Aquifer Recharge Capability

The plant or crop would be irrigated up to 110 to 120% its transpiration needs. Although any excess irrigation could recharge the groundwater, irrigation is not designed to directly recharge groundwater, However, since irrigation substitutes for existing groundwater use, the effect may be the same as direct recharge, i.e., reduced pumping of groundwater sustains the groundwater resource. However, the irrigation may not be in an area overlying Los Osos groundwater so that the reduced pumping should not occur with Los Osos groundwater supply. In effect, it might be an "export" of groundwater.

## Costs

The costs of a reclaimed water system depends on the specific sites to be irrigated with the treated water effluent and the location of the treatment facility. The cost would include not only collection and treatment, but conveyance to these specific sites and rainy season storage

or other disposal method. There would also be a credit for the water replaced, e.g., an existing irrigation well.

**Environmental Impacts**

There are potential health risks associated with landscape irrigation with treated effluent. The risk are minimized if the irrigation system is operated such that public contact is minimized, e.g., irrigation at night and application so that no surface runoff or ponding is allowed.

**References**


1. Estero Area Plan Update. Land Use Survey & Buildout Projections. Draft Background Report. June 1994.

2. Hydrogeology and Water Resources of the Los Osos Valley Ground-Water Basin. San Luis Obispo County California. U.S. Geological Survey. Water-Resources Investigations. Report 88-4081. Sacramento, 1988.

3. The Morro Group. Final Environmental Impact Report. County Service Area No. 9. Wastewater Treatment Facilities. Los Osos, Baywood Park, Cuesta-by-the-Sea. San Luis Obispo County, California. August 1987.

## GROUNDWATER RECHARGE

### Introduction

The purpose of this memorandum is to summarize the preliminary assessment of groundwater recharge potential for reclamation of wastewater in Los Osos/Baywood Park.

A major objective of the wastewater project is to reclaim wastewater by various means to enhance water supplies for the area. Currently, the communities rely entirely on groundwater for their domestic water supply. Previous studies have identified possible overdraft conditions in the area which would be aggravated by additional development [5,14]. The groundwater supply potentially could be enhanced by direct recharge of treated wastewater or by in-lieu recharge associated with using reclaimed wastewater as a substitute supply for landscape or agricultural irrigation.

This preliminary assessment is limited to reviewing available reports and data and conducting a reconnaissance-level site inspection of the area to gain a general familiarity of the setting. The percolation pond sites were limited to those identified previously and the assessment of those sites is based on the conditions reported by previous investigators. The potential for deep well injection has been evaluated based on the experiences of agencies in other parts of California and available geohydrologic information. This preliminary assessment also includes a review of the percolation sites and deep well injection in relation to the draft proposed regulations for groundwater recharge [4].

### Quantity of Reclaimed Water Available for Recharge

As originally proposed in 1987, the treatment facility is designed for sizing in two stages. Stage I facilities would be sized for an average dry weather flow (ADWF) of 1.6 million gallons per day (mgd) by year 2000, which is 4.91 acre-feet per day or about 1,800 acre-feet per year, and peak wet weather flow (PWWF) of 3.9 mgd (11.97 acre-feet per day). Stage II facilities for buildout would result in an increased ADWF capacity of 2.4 mgd and the increased PWWF capacity of 5.7 mgd [1,2]. The present assessment is limited to Stage I capacities.

### Groundwater Recharge Regulations

For purposes of this assessment, two primary documents are assumed to provide guidance on probable regulatory requirements for groundwater recharge. These documents are the probable waste discharge requirements specified by the RWQCB [3] and criteria established in the draft proposed regulations for groundwater recharge [4].

**Probable Waste Discharge Requirements.** The RWQCB probable requirements are based on the Basin Plan [5] and provide initial staff recommendations and would be subject to the

public review process and Board approval. The probable requirements also contain prohibitions, effluent limitations, receiving water limitations, and groundwater limitations. Four specific prohibitions are of particular interest for recharge.

1. Discharge of wastewater to water contact recreation areas of Los Osos Creek is prohibited unless a benefit to the receiving water can be realized from the discharge.

2. Discharge of wastewater to Los Osos Creek is prohibited whenever surface water continuity exists between the discharge point and Morro Bay.

3. Discharge of treated wastewater onto land areas within 100 feet of any well used for domestic supply or irrigation of food crops is prohibited.

4. Discharge of wastewater to Los Osos Creek is prohibited at any point upstream of any active site used for withdrawing creek water for domestic water supply purposes.

**Draft Regulations for Groundwater Recharge.** The California Department of Health Services has developed draft proposed regulations for groundwater recharge [2]. Formal adoption of the proposed regulations as a matter of law under Title 22 of the California Code of Regulations presently is being challenged. Consequently, it is uncertain if all or part of these draft regulations will be formally adopted. However, these draft regulations are being used by local and state agencies as guidelines in approving and regulating recharge projects on a case-by-case basis.

The draft proposed groundwater recharge regulations provide a comprehensive set of criteria to address such issues as reclaimed water quality requirements, maximum reclaimed water contribution to water supply wells, minimum depth to groundwater, minimum retention time underground, minimum horizontal separation requirements, and monitoring and compliance standards. Planned groundwater recharge projects are classified in the following project categories:

Category I - A surface spreading recharge project which uses reclaimed water that has been oxidized, filtered, disinfected, and subjected to organics removal.

Category II - A surface spreading recharge project which uses reclaimed water that has been oxidized, filtered, and disinfected.

Category III - A surface spreading recharge project which uses reclaimed water that has been oxidized and disinfected.

Category IV - A direct injection recharge project which uses reclaimed water that has been oxidized, filtered, disinfected, and subjected to organics removal.

Treatment and operational requirements for the various project categories are shown in Table B1-2.

**Table B1-2. TREATMENT AND OPERATIONAL REQUIREMENTS FOR GROUNDWATER RECHARGE PROJECTS**

| Criteria | Surface Spreading | | | Direct Injection |
|---|---|---|---|---|
| Project Category ---> | I | II | III | IV |
| Maximum reclaimed water concentration in extracted well water, percent | 50 | 20 | 20 | 50 |
| Depth to groundwater, feet at initial percolation rate of: | | | | |
| <0.2 inches/minute | 10 | 10 | 20 | n/a |
| <0.3 inches/minute | 20 | 20 | 50 | n/a |
| Underground retention time, months | 6 | 6 | 12 | 12 |
| Horizontal separation, feet | 500 | 500 | 1,000 | 2,000 |
| Level of treatment | | | | |
| Oxidation | x | x | x | x |
| Filtration | x | x | | x |
| Organics removal | x | | | x |
| Disinfection | x | x | x | x |

Source: [4].

Groundwater recharge projects using reclaimed water must comply with treatment requirements based on project category and treatment process. These requirements listed below were taken directly from the current draft regulations.

1. Oxidized Wastewater.

   Oxidized wastewater is required for all project categories. The oxidized wastewater prior to recharge shall not exceed 20 milligrams per liter (mg/l) total organic carbon (TOC), 30 mg/l suspended solids (SS), and 30 mg/l biochemical oxygen demand (BOD).

2. Filtered Wastewater.

   a. Filtered wastewater is required for project categories I, II, and IV.

   b. The turbidity of the filtered wastewater prior to recharge shall not exceed an average of 2 turbidity units.

   c. The turbidity of the filtered wastewater prior to recharge shall not exceed 5 turbidity units more than 5 percent of the time during any 24-hour period.

3. Disinfected Wastewater.

   a. Disinfected wastewater is required for all project categories.

   b. For project categories I, II, and IV, the median number of total coliform organisms in the disinfected wastewater shall not exceed 2.2 per 100 milliliters (ml). The number of total coliform organisms shall not exceed 23 per 100 ml in more than one sample within any 30-day period.

   c. For project category III, the median number of total coliform organisms in the disinfected wastewater shall not exceed 23 per 100 ml. The number of total coliform organisms shall not exceed 240 per 100 ml in more than one sample within any 30-day period.

4. Organics Removal.

   Reclaimed water used for project categories I and IV shall be subjected to organics removal. The TOC in the wastewater prior to recharge shall be reduced to the concentration specified in Table B1-3 as identified by the reclaimed water contribution to any affected domestic water supply well and by project category. The entire reclaimed water stream used for project category IV shall be subjected to organics removal.

| Table B1-3. MAXIMUM ALLOWABLE TOC AFTER ORGANICS REMOVAL | | |
|---|---|---|
| Reclaimed Water Contribution, % | Maximum TOC, mg/l | |
| | Surface Spreading (Category I) | Direct Injection (Category IV) |
| 0-20 | 20 | 5 |
| 21-25 | 16 | 4 |
| 26-30 | 12 | 3 |
| 31-35 | 10 | 3 |
| 36-45 | 8 | 2 |
| 46-50 | 6 | 2 |
| Source: [4]. | | |

There are several potential conflicts between the RWQCB probable discharge requirements [4] and the draft proposed groundwater recharge regulations [3]. These include minimum separation distance for wells and water quality limits for biochemical oxygen demand, suspended solids, turbidity, and total coliform organisms. The final discharge requirements as adopted by the RWQCB should reflect current groundwater recharge regulations.

**Overview of Local Hydrogeology and Soils**

The groundwater basin is filled with permeable, unconsolidated sediments and underlain by impermeable Franciscan basement rocks. The area is an asymmetric downfold with a westward plunge of about 3 degrees with the north limb dipping about 4 to 5 degrees and the south side dipping 20 to 25 degrees. The basin fill consists primarily of Paso Robles formation comprised of poorly consolidated sands, gravels, silts, and clays. The Paso Robles formation has been separated into the upper and lower aquifers, which constitute the significant groundwater source for the area [5,6].

West of Los Osos Creek, dune and windblown sand overlie the upper aquifer. The overlying sand also provides groundwater. East of the creek, recent alluvium consisting of clay, silt, and clayey sand overlies the lower aquifer of the Paso Robles formation. The thickness of the recent alluvium has been reported to be about 20 feet near the creek and as much as 65 feet in the eastern portion of the basin [5].

Detailed information on the hydrogeology of the area can be found in the reports listed in the references by the U.S. Geological Survey [5], The Morro Group [7,8,9] and Wiese [6].

**Identified Percolation Sites**

Several percolation sites have been identified by previous investigators. Seven of these sites were selected for evaluation in the environmental impact report (EIR) [8,9] for the treatment facilities, while several other sites previously were eliminated from further consideration. These seven primary percolation sites are shown on Figure B1-1 and listed below:

- Los Osos Creek Valley Sites (WD-1 and WD-2)
- Cemetery Mesa Sites (WD-3 and WD-4)
- Upper Los Osos Creek Site (WD-5)
- Broderson Site (WD-6)
- Los Osos Creek Channel (WD-7)

Three additional areas were identified as potential recharge sites but were rejected for various reasons. These three areas are also shown on Figure B1-1 and are generally referred to as: (1) along the east side of the community west of Los Osos Creek, (2) western Los Osos and north of Los Osos Valley Road, and (3) west of Pecho Road. These three areas were rejected in the EIR [8] for the following reasons.

- Along the east side of the community.
    - Proximity to Los Osos Creek
    - Shallow groundwater table
    - Presence of Morro Bay kangaroo rat and other rare and endangered plant species
    - Presence of significant archeological sites
    - Unlikelihood that recharged groundwater could be recovered from groundwater for municipal use.
- Western Los Osos north of Los Osos Valley Road
    - Shallow groundwater table
    - Proximity to Morro Bay - narrow cone of dispersal and possible surfacing of groundwater

- West of Pecho Road

    - Presence of Morro Bay kangaroo rat
    - Upwind from most of the community
    - Proximity to Montana de Oro State Park
    - Soil conditions - recharge upper aquifer only
    - Proximity to Morro Bay and possible surfacing of groundwater

Review of the previous studies and the site inspection appear to confirm these findings; consequently, no further review of these three areas was conducted.

Of the seven primary percolation sites listed above, all have potential for some level of recharge. A description of these sites with key considerations is provided below. A more complete description of the sites can be found in the cited references to previous investigations.

**Los Osos Creek Valley Sites (WD-1 and WD-2).** Site WD-1 is located east of Los Osos Creek and east of Eto Lake. Site WD-2 also is located east of the creek and approximately 0.4 miles south of Los Osos Valley Road (Figure B1-1). Both sites are located on nearly flat terrain. An investigation conducted by Pacific Geoscience [10] reports that the surface soils at site WD-2 are high in clay of unreported thickness, with localized sand stringers. Perched groundwater conditions are reported for this area. The depth to groundwater is reported to be 10 to 20 feet below ground surface. Similar conditions are reported at Site WD-1.

The surface soils at these sites overlie the portion of the Paso Robles formation which has been identified as the lower (deep) aquifer. Because of the high clay content, limited recharge to the Paso Robles formation could be expected. Recharge to the lower aquifer would also be limited due to the localized sand layers in the soil horizon which would convey some recharged water to Los Osos Creek. In addition, the amount of water that could be recharged and stored in the surface horizon is limited due to the shallow depth to groundwater.

Because of the above conditions, Pacific Geoscience [10] rejected both sites as inadequate for recharge of significant volumes of reclaimed wastewater. After personal inspection of the area and review of available reports, the findings by Pacific Geoscience appear to be reasonable. In addition, existing agricultural and private domestic wells are located adjacent to both sites. The status of operation, well condition, and depth to screened interval are not known for these adjacent wells. These wells are located within the minimum horizontal separation distance from recharge sites proposed in the draft groundwater recharge regulations and thus would need to be investigated further. An additional source of uncertainty is the lack of data for the thickness of clay soils at the sites.

If the thickness of the clay soils is not substantial, the soils could be removed to expose the coarse material of the lower aquifer, which is more suitable for recharge. Testing at both sites should be undertaken to determine the thickness of the soil cover. If the soil cover is not extensive, the lower aquifer material should be exposed and infiltration tests conducted to determine suitability for recharge and design of offstream recharge facilities.

**Cemetery Mesa Sites (WD-3 AND WD-4).** Site WD-3 (Figure B1-1) is located immediately east of Site WD-2, approximately 0.5 miles south of Los Osos Valley Road. The site overlies the Paso Robles formation in the southeastern portion of the groundwater basin and potentially offers an opportunity for recharge of the lower aquifer. Based on testing by Pacific Geoscience, percolation rates were not adequate to recharge the amount of treated effluent proposed. No information was presented on the type of testing performed or the results. This site was deemed inadequate by Pacific Geoscience.

Site WD-4, located northeast of the Los Osos Valley Memorial Park, has similar characteristics to Site WD-3. This site is located on the eastern edge of the groundwater basin, 0.2 miles south of Warden Lake. Site WD-4 also overlies the exposed Paso Robles formation. Based on initial inspection, Pacific Geoscience believed that Site WD-4 had the greatest potential of the two sites for recharge of the lower aquifer. As a result of field testing, however, the percolation rates at Site WD-4 were not considered adequate to recharge the expected volume of reclaimed wastewater. As with Site WD-3, no information was available as to the type of testing conducted or the results.

Based on personal inspection of both sites, it would appear that the clay loam soils overlying the lower aquifer would severely limit the recharge potential. The depth of the clay soils is not known; consequently, a determination has not been made regarding the possibility of removing the clay soils. However, as with Sites WD-1 and WD-2, testing at WD-3 and WD-4 would be appropriate to determine the depth of clay soils. In addition, both sites are located near existing private domestic and agricultural wells. Site WD-3 is located approximately 700 feet from the nearest private domestic well and 200 feet from the nearest agricultural well. Site WD-4 is located approximately 1,000 feet from the nearest private domestic and agricultural wells. Depending upon the level of treatment for the reclaimed water to be used for recharge and other site conditions, the distances to these nearby wells would not meet the minimum horizontal separation specified in the draft proposed groundwater recharge regulations. Based on the conditions reported by previous investigators and the proximity of the sites to existing wells, these sites appear to have limited recharge potential.

**Upper Los Osos Creek Site (WD-5).** The site is on a westerly, unnamed tributary of Los Osos Creek along the southern edge of the exposed lower aquifer (Figure B1-1). The Morro Group [9] reports that "optimistically" the maximum area available for percolation is limited to about three acres. Apparently, the actual area for recharge may be less than the

reported three acres. The area available would not be adequate even under very high assumed percolation rates to handle the proposed volumes of treated effluent.

The site is immediately upstream of Los Osos Creek, which provides the major portion of the natural recharge to the lower aquifer. During the wet season, Los Osos Creek is a flowing stream. Discharge of reclaimed wastewater to Site WD-5 during the wet period could be rejected because of saturated conditions and surface flows containing treated effluent could reach Morro Bay.

Site WD-5 should not be considered as a viable site for wet period disposal. The site may hold some potential for minor amounts of supplemental recharge, possibly combined with the Los Osos Creek Channel (WD-7), during dry periods.

**Broderson Site (WD-6).** This site (Figure B1-1) is located on 240 acres roughly bounded by Travis Drive on the south, Highland Drive on the north, Bay View on the east, and an extension of Doris Avenue on the west. An extension of Broderson Avenue separates the western one-third of the area from the eastern two-thirds. Since only about 40 acres would be required for the disposal ponds, the precise location within the 240 acres would be dependent upon geologic conditions and distribution of animal and plant species of concern.

Geologic conditions for the site are reported by The Morro Group [7,8,9,11], U. S. Geological Survey (USGS) [5], and Pacific Geoscience [10]. The site is generally comprised of wind-blown sand of moderate depth that overlies sandstone, siltstone, and claystone of the Paso Robles formation. Based on seismic refraction studies of the upper Paso Robles formation, The Morro Group has designated this portion of the Paso Robles formation as the upper aquifer. Depth to groundwater in this area is reported to be about 100 feet below ground surface [11]. The direction of groundwater flow for both the upper and lower aquifers underlying and in the vicinity of the site is generally in the westerly to northwesterly direction toward the bay [8].

Twenty-nine seismic refraction profiles were plotted and interpreted by The Morro Group [11] to delineate the thickness of the wind-blown sand unit. Significant and sharp velocity changes were recorded between the wind-blown sand and the Paso Robles formation. The refraction profiles indicate that the thickness of the sand unit ranges from zero to 40 feet. The greatest thickness of 25 to 40 feet is located in the western third of the site. In general, the greater the thickness of unsaturated sand, the greater the recharge capability because of the increased available storage volume.

In the area of the Broderson site, the Paso Robles formation (upper aquifer) [5,6] dips to the north about 10 to 20 degrees. This dip is consistent with correlation of a clay zone at 40 to 50 feet in Pacific Geoscience [10] boring Number 2 and one at 346 to 370 feet in the USGS [5] South Broderson well. The dip of the Paso Robles beds would facilitate infiltration of

percolating wastewater from the wind-blown sand to the upper sands of the Paso Robles formation [11].

Seven bore holes were drilled by Pacific Geoscience [10] and percolation tests were conducted at the seven sites at 10- and 25-foot depths. The percolation tests indicate a rate of 40 feet per day is reasonable for the wind-blown sand and a percolation rate of four feet per day has been assumed for the Paso Robles formation [11].

The Morro Group [11] has developed a conceptual model of the percolation ponds and groundwater system to evaluate recharge operations at this site. Because of the moderately steep ground surface slopes, the ponds have been conceived as elongated trenches parallel to the surface contours. A 1,000-foot-long trench with a bottom width of 60 feet penetrating the wind-blown sand by a thickness 20 to 25 feet is considered adequate to handle an assumed wet weather recharge of 2.0 mgd (6.14 acre-feet per day). Based on this conceptual model and the assumed percolation rates described above, The Morro Group [10] concluded that the infiltrated wastewater would flow downslope in the wind-blown sand and percolate into the Paso Robles formation (upper aquifer) within a distance of 600 feet downslope from the percolation trenches. The Morro Group [7] estimates, based upon the thickness of unsaturated material and the estimated specific yield value, that the storage capacity within 8,000 feet of the disposal ponds would be about 1,650 million gallons, as compared to an assumed annual flow to the ponds of 700 million gallons. Based upon the estimated groundwater gradients and hydraulic conductivity, the estimated rise in the water table beneath the site would be about 20 feet, thus posing no problem for pond operations and providing continuous long-term percolation rates. It should be noted that this analysis was based on limited percolation tests, and long-term tests should be conducted to verify these results.

The Morro Group [7] estimated the impacts of recharge at the Broderson site on shallow groundwater elevations downslope of the site. High and/or rising groundwater have been experienced in the past in the area of Cuesta-by-the-Sea and west of Los Osos. Based on flow calculations, The Morro Group suggests that rising water or very shallow groundwater could occur as a result of the operation of the Broderson site. Detailed analyses of the operation of the recharge ponds on the shallow groundwater are essential.

The USGS [5] conducted modeling studies assuming reasonable ranges of various assumed conditions that indicate a relatively high possibility that surface seepage might occur downslope of the Broderson Site during wet conditions. These assumed conditions that were varied for the modeling studies are hydraulic conductivity, recharge rate, and constant head boundary condition. The model results are sensitive to the hydraulic conductivity and constant head boundary assumptions which show that downslope surface seepage might occur. The USGS studies assumed one full year of recharge of 2,710 acre-feet for some of the model runs, which is significantly greater than the 1,800 acre-feet per year recharge corresponding to a 1.6 mgd design discharge. However, the USGS results raise sufficient

questions that result in uncertainty regarding the capacity of the Broderson Site to accept the entire 1.6 mgd under wet conditions without resulting in downgradient surface seepage near the bay.

The connection from the upper to lower aquifers and thus the potential to recharge the lower aquifer is uncertain. There is a differential in water level elevations between the upper and lower aquifers that would produce some downward migration of water to the lower aquifer. However, geologic cross sections reported by the USGS [5] indicate zones of significant clays within the Paso Robles formation, which would restrict flow to the lower aquifer. No estimates of potential flows to the lower aquifer were reported by previous investigators or developed as part of this assessment.

Inspection of Figure B1-1 reveals several existing wells in the vicinity of the site. The status of operation and completion information for these wells is not known. Five existing municipal supply wells are located downgradient of the site; one well adjoins the site, while four other wells are located approximately 2,500 feet from the edge of the recharge site. The adjoining well is within the minimum separation distance specified in the draft groundwater recharge regulations. Several other municipal supply wells are located north and northeasterly of the site and are beyond the minimum separation distance and appear to be upgradient from the zone of influence by recharge of reclaimed water. Figure B1-1 also shows several private domestic wells downgradient of and about 2,500 feet from the site, which is beyond the minimum separation distance. An estimate of underground retention time has been made assuming conservative aquifer characteristics [5], reported groundwater gradients [5,8], and the horizontal separation distance of 2,500 feet. These estimates show that the minimum underground retention time would be exceeded. Two remaining questions regarding the draft proposed groundwater regulations relate to the fraction of reclaimed water that would be pumped by these outlying downgradient wells and the status of the existing well that is adjoining the site. No estimates of the zone of influence of the production wells have been made to determine the fraction of reclaimed water that would be extracted.

Major environmental concerns have been identified for Site WD-6 [8] related to habitat for endangered species. The easterly two-thirds of Site WD-6 has been designated as essential habitat of the endangered Morro Bay kangaroo rat. No rats were captured west of the extension of Broderson Avenue; however, this does not preclude their presence.

A number of sensitive plant species at the site have been identified by both federal and state agencies. The Indian Knob mountain palm has been identified as an endangered plant species. Candidates for federal listing are the Morro manzanita and the Monterey spineflower. Species on the Special Plant and Watch Lists are Blochman's leafy daisy, Saint's daisy, San Luis Obispo wallflower, curly leaf monardella, and the dune almond. A 40-acre parcel in the northwestern portion of the site has the lowest relative environmental sensitivity and is recommended by The Morro Group [8] as the "environmentally superior alternative."

Based on available information developed by previous investigators, the Broderson Site has several limitations that may ultimately prove to be sufficient to reject the site as a viable recharge site. These limitations include the possibility of surface seepage downslope of the site during wet conditions, uncertain recharge to the upper and lower aquifers, proximity to existing municipal and private domestic wells, and endangered species habitat. However, this preliminary assessment reveals that, compared to all other previously identified percolation sites, the Broderson Site demonstrates the greatest potential for recharge. Further investigations beyond the scope of this assessment are required to definitively evaluate the recharge potential at this site in terms of technical capability, regulatory acceptability, and financial feasibility.

**Los Osos Creek Channel (WD-7).** Los Osos Creek Channel has been identified as a groundwater recharge site for dry weather conditions whenever surface water is not continuous between the discharge point and Morro Bay. The proposed point of discharge to Los Osos Creek is shown on Figure B1-1. The primary source of recharge to the lower aquifer is from infiltration from Los Osos Creek, mainly upstream of the Los Osos Valley Road bridge [5,8]. This reach is about one mile in length. While the major portion of the recharge is attributable to the reach of the creek above Los Osos Valley Road, Wiese [6] reports that the creek is in contact with the lower Paso Robles formation for the entire reach from where the creek enters the groundwater basin to Morro Bay. The reach below Eto Lake has been reported as a perennial stream.

The recharge potential of the channel has been evaluated by the USGS [5] and The Morro Group [8] through analyses of streamflow records. The Morro Group conducted a frequency analysis of streamflow measurements for the permanent gaging station on the creek. The frequency analysis resulted in an estimate of the number of days that the streamflow would be zero which would meet the noncontinuous flow requirement proposed by the RWQCB and recharge could potentially occur. The USGS installed temporary streamflow gaging stations and analyzed streamflow measurements from these temporary stations and the permanent gaging station to estimate seepage losses under various conditions.

The permanent streamflow gage Los Osos Creek at Los Osos Valley Road has been operated by the San Luis Obispo County Flood Control and Water Conservation District since 1976. The Morro Group [8] conducted a frequency analysis of daily streamflow records for the 1976 through 1984 period. The conclusions derived from the frequency analysis were summarized by The Morro Group [8] as:

> "Analysis of these records indicates that, even during the wettest of years, live flow at the gage peaks at about 220 days per year which would leave about 145 days per year in which recharge could be augmented even under the wettest conditions. In average years, the period during which recharge could be augmented increases to a range of about 180 to 250 days per year, and, during dry years or drought periods,

the period of potential augmentation of recharge increases to a range of 250 to 365 days per year."

On an average basis, the frequency analysis shows that no surface flow occurs at the permanent gage for about 215 days per year. This period of no surface flow generally occurs from mid-April through mid-November. The average potential recharge can be estimated by assuming the full amount of reclaimed wastewater could be recharged for the entire 215 days. The average daily amount of water proposed to be treated at the CSA 9 facility is 2.48 cubic feet per second (cfs), which is 4.91 acre-feet per day or about 1,800 acre-feet per year. Assuming seepage rates are not limiting, the average potential recharge is 1,055 acre-feet, which is about 60 percent of the total volume of reclaimed wastewater. However, the achievable recharge would be limited by the actual seepage rates.

Limited information is available regarding the seepage from Los Osos Creek. The USGS [5] conducted a seepage study during water year 1986 by measuring changes in flow in two reaches of the creek. The measurements were taken at the permanent gage at Los Osos Valley Road, and two temporary gages installed specifically for the seepage study. One of the temporary gages was installed at the entry point of the creek into Los Osos Valley, and the other temporary gage was located at the confluence with the outlet of Eto Lake (Figure B1-1). Each length of the upper and lower reaches is about one mile, resulting in a total length of two miles. The length of the reach from the Eto Lake temporary gage to Morro Bay is about 2.5 miles.

Manual discharge measurements were made every one to two weeks from March through December 1986 at the upper temporary and permanent gages. During base flow recession in the spring and summer, the measured seepage loss ranged from 0.09 to 2.77 cfs and was typically about 0.6 cfs, which results in a typical unit seepage rate of 0.6 cfs per mile. Seepage losses for the lower reach down to Eto Lake was measured only twice in May 1986. In both cases, the streamflow was less than 0.3 cfs with a seepage loss on the order of only five percent, or about 0.02 cfs (14.5 acre-feet per year). Because the reported low infiltration capacity of the lower reach, which is based on limited information, and the potential for surface flow reaching the Bay as a result of effluent spreading, the lower reach should not be considered viable without further testing and evaluation.

The average achievable recharge from the channel can be estimated by assuming the unit seepage rate of 0.6 cfs per mile, the length of channel that recharge may occur, and the average number of days of discontinuous flow from the discharge point to the bay. Until further testing is conducted on the lower reach, the effective length of channel is assumed to extend from the discharge point to about the location of the permanent gage. The length of this upper reach is one mile. Assuming recharge could occur for 215 days, the resulting estimated average achievable recharge is 256 acre-feet per year, which is significantly less than the potential recharge calculated based only on the number of days of no surface flow at the permanent gage. The estimated average achievable recharge is only 14 percent of the

total annual volume of reclaimed wastewater and 24 percent of the reclaimed wastewater produced during this 215-day period. It should be noted that the measured seepage rate of 0.6 cfs per mile for the upper reach is based on limited observations.

The use of temporary diking in the channel, similar to those used by Orange County Water District in the Santa Ana River, to increase the wetted surface area may be worth considering. However, the channel contains considerable vegetation and riparian habitat for sensitive and endangered species which could restrict access and construction activities. The USGS seepage data indicate that greater seepage rates could be achieved if the wetted surface area can be increased.

Recharge through the use of a stream channel is not specifically addressed in the proposed groundwater recharge regulations. It has been assumed for purposes of this assessment that stream channel recharge is equivalent to surface spreading under the proposed groundwater recharge regulations. In addition to the proposed groundwater recharge regulations [4] and the probable waste discharge requirements [3], several other regulations and permits may apply to stream channel recharge. These additional regulations include, but are not limited to: 1) Water Quality Control Plan, Central Coast Region, 2) California Inland Surface Waters Plan, 3) the EPA Region 9 "Guidance for Modifying Water Quality Standards and Protecting Effluent-Dependent Ecosystems," 4) State Department of Fish and Game approval, 5) Corps of Engineers approval, 6) California Coastal Commission approval, and 7) National Pollutant Discharge Elimination System (NPDES) permit. Specific applicability and requirements of these additional potentially applicable regulations have not been investigated as part of this initial assessment.

Based on available information developed by previous investigators, Los Osos Creek has several limitations that may ultimately prove to be sufficient to reject the site as a viable recharge site. These limitations include achievable volume of recharge, proximity to existing agricultural and private domestic wells, and endangered species habitat. However, this preliminary assessment reveals that Los Osos Creek provides the greatest potential of all other previously identified percolation sites to recharge the lower aquifer, which is the primary source of supply for municipal wells. Further investigations beyond the scope of this assessment are required to definitively evaluate the recharge potential at this site in terms of technical capability, regulatory acceptability, and financial feasibility.

**Deep Well Injection of Reclaimed Wastewater**

Deep well injection of reclaimed wastewater has been assessed on a cursory basis through review of available reported hydrogeologic information, experiences of agencies in other parts of California, and the proposed draft groundwater recharge regulations. It is assumed that deep well injection could be conducted for the lower Paso Robles aquifer. The location of the injection wells would depend upon several factors including proximity to existing water supply wells, allowable fraction of reclaimed water in pumped groundwater supplies,

available vertical zone of injection, and available depth to water table (unconfined conditions) or piezometric surface (confined conditions). For purposes of this assessment, the lower aquifer is assumed to be a leaky, confined aquifer with some recharge from the upper aquifer but with the primary source of the current recharge being Los Osos Creek. It is further assumed that the vertical zone of injection and available depth to piezometric surface would not limit the potential for injection. Based on the review of available hydrogeologic information and these assumptions, there are no apparent hydrogeologic considerations that would preclude the use of deep well injection in this area. The specific location and number of injection wells would have to be determined based on additional studies beyond the scope of this assessment.

The number of wells that might be required to inject the total volume of reclaimed water has been estimated for illustration purposes only. Experience in California and Texas has shown that well injection rates are approximately one-half to two-thirds of well production rates [12]. It is recommended that each injection well be equipped with pumping equipment so that redevelopment of the well can be performed on a three-month recurring interval to maintain the desired injection rate. It is assumed that the well would be operated with a service factor of two-thirds time to allow for this redevelopment and other maintenance operations.

Based on the reported pumpage and number of wells [13], the average estimated well production rate is 300 gpm. Based on the one-half to two-thirds injection factor, the estimated injection rate is 150 to 200 gpm. In order to inject the 1.6 mgd (1,800 acre-feet per year) of treated effluent, six to eight injection wells would be required. Locating these wells would require a complete inventory of existing wells and determination of which wells produce from the lower aquifer. Upon these findings, an evaluation could be made to determine possible locations of injection wells to conform to the requirements of the draft groundwater recharge regulations. The principal requirements include a minimum separation distance of 2,000 feet, a minimum underground retention time of 12 months, and a maximum reclaimed water concentration in extracted groundwater of 50 percent. Field studies and a subsequent detailed modeling study would be required to evaluate the latter two of these principal requirements.

The actual costs of well injection cannot be estimated until specific number, locations, depths, and capacity of the wells are determined. The operating costs can vary considerably and are a function of system configuration, quality of injected water, and specific maintenance procedures.

Furthermore, injection of reclaimed wastewater requires treatment to include oxidation, filtration, disinfection, and organics removal. This level of treatment may require use of reverse osmosis or a comparable process to achieve required treatment levels. Injection of tertiary treated wastewater has been successfully practiced by Orange County Water District for a seawater intrusion barrier. The reclaimed wastewater injected by Orange County Water

District is treated by reverse osmosis, which is very costly. High quality surface water is presently injected by other agencies throughout California.

From a hydrogeologic viewpoint, deep well injection has potential for recharge in the Los Osos area. However, the extent of this potential cannot been determined based on the limitations of the available information and level of this evaluation. However, the overall feasibility also depends on the level and costs of wastewater treatment required. Since a high and very costly level of treatment -- such as reverse osmosis or a comparable process -- is required, deep well injection is not be a cost-effective option. Reverse osmosis and comparable processes are discussed elsewhere in this preliminary screening.

**Summary, Conclusions, and Recommendations**

**Recharge Sites**. The evaluation of the recharge sites is summarized in Table B1-4.

Based on this preliminary assessment, all seven primary sites show some potential for groundwater recharge with reclaimed wastewater in the Los Osos area. The sites with the best potential are the Broderson Site (WD-6) and the Los Osos Creek Channel (WD-7). Four other sites, Los Osos Creek Valley (WD-1 and WD-2) and Cemetery Mesa (WD-3 and WD-4) may have potential if further testing indicates that:

- The thickness of the surficial clay soils is not substantial
- These surface soils could be economically excavated
- Recharged effluent penetrates the lower aquifer (lower Paso Robles formation)

The feasibility of the Upper Los Osos Creek site (WD-5) for dry weather recharge is limited by the small area (less than 3 acres).

Additional studies beyond the scope of this assessment are required to definitively evaluate the recharge potential of these sites in terms of technical capability, regulatory acceptability, and financial feasibility. These studies include:

- Long-term infiltration tests utilizing excavated test pits and evaluation of flow of groundwater from the overlying wind-blown sands to the underlying upper and lower Paso Robles aquifers at the Broderson Site.
- Discussions with pertinent regulatory staff to clarify probable regulatory requirements.
- Complete inventory of existing wells and determination of status of operation, production rates, use, zone of production, and other information.

- Updated and more detailed evaluation of streamflow records for permanent gage on Los Osos Creek.

- Seepage studies on Los Osos Creek for various reaches and hydrologic conditions.

- Modeling studies to evaluate operation and management of groundwater basin and specific recharge alternatives including possible surface seepage downgradient of the Broderson Site and demonstration of meeting requirements of draft proposed groundwater regulations.

- Soils tests and long-term infiltration tests at the Los Osos Creek Valley and Cemetery Mesa sites.

- Acquisition and review of the field data and report by Pacific Geoscience [10].

**Deep Well Injection.** This is not a viable option for Los Osos because of the high costs of required wastewater treatment.

## SEPTIC TANK WITH SHALLOW SOIL ABSORPTION FIELD

### Description

A septic tank followed by a shallow soil absorption field is a modification of the conventional on-site septic tank soil absorption system for the treatment and disposal of domestic wastewater. The system consists of a buried tank with an internal pump vault and a shallow sub-surface drainage system. Wastewater is collected in the septic tank where primary treatment is accomplished by gravity separation of the solids from the liquid. Solids are collected and store in the septic tank, forming sludge and scum layers. Anaerobic and facultative decomposition occurs in these layers. Even though the volume of the solid material is continually reduced by decomposition, there is a net accumulation of sludge in the tank [1]. Thus, periodic pumping of the contents of the tank is required.

Effluent is collected in the pump vault and pumped to the shallow sub-surface drainage system. The shallow sub-surface drainage system consists of a 1-inch diameter distribution pipe that is laid in a trench 10 inches below ground surface. The distribution pipe is covered by half of an 8-inch diameter pipe that has been cut in half longitudinally along its axis. This arrangement leaves an empty chamber between the distribution pipe and the surrounding larger pipe. Effluent is pumped from the septic tank through the distribution system and discharged into the open cavity where it percolates into the soil. Pollutants are removed from the effluent as it percolates through the soil by natural adsorption and biological and physical processes in the soil below the distribution system. Biological oxygen demand (BOD), suspended solids (SS), bacteria, and viruses, along with heavy metals and complex organic compounds, are absorbed by the soil under proper conditions. The size of the shallow sub-surface drainage system is determined by hydraulic loading rates, soil percolation rates and characteristics, and site size and location.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** The RWQCB typically does not set discharge requirements for individual onsite systems. However, community onsite systems (greater than five residential units) and nonresidential onsite systems may be regulated by discharge requirements. Discharge requirements are typically limits on the quality of the effluent in terms of such constituents as biochemical oxygen demand (BOD), suspended solids, settleable solids, nitrogen, various salts (sodium, chloride, sulfate, etc.), turbidity, and grease and oil.

The RWQCB has established a design criterion for nitrogen discharges from community onsite systems at 40 grams/acre/day. There is also a prohibition on nitrogen discharges from community systems exceeding 80 grams/acre/day [5].

Septic tank treatment (primary treatment) is generally capable of removing 30 to 85% of the $BOD_5$ and SS, and about 25 to 30% of the total nitrogen. Constituent concentrations 3 feet below the soil absorption system are at or below the lower limits of detectability for $BOD_5$ and SS [1]. Limited data are available on nutrient removal (nitrogen and phosphorus) from

## SEPTIC TANK WITH ZEOLITE ION EXCHANGE AND SOIL ABSORPTION FIELD

### Description

A septic tank followed by an ion exchange filter is currently being tested to reduce nitrogen concentrations in septic tank effluent in the Los Osos area. The effluent from the ion exchange filter is then disposed in a conventional or shallow soil absorption system. The entire system consists of a buried septic tank with an internal ion exchange filter and a subsurface soil absorption system. Wastewater is collected in the septic tank where primary treatment is accomplished by gravity separation of the solids from the liquid. Solids are collected and stored in the tank, forming sludge and scum layers. Anaerobic and facultative decomposition occurs in these layers. Even though the volume of the solid material is continually reduced by decomposition, there is a net accumulation of sludge in the tank [1]. Thus, periodic pumping of the contents of the tank is required.

Effluent from the septic tank flows by gravity through the ion exchange filter. The ion exchange filter exchanges ammonium ($NH_3$) from the wastewater for calcium ($Ca^{2+}$) or sodium ($Na^+$) from the filter. The ammonium ($NH_3$) is a major source of nitrogen in the wastewater and is generated from the breakdown of proteins and urea. With the elimination of ammonium ($NH_3$), the nitrification process is eliminated (i.e. conversion of ammonium ($NH_3$) to nitrate ($NO_3$)). The effluent from the ion exchange filter flows by gravity to a subsurface soil absorption system where the effluent percolates into the soil. Additional pollutants are removed from the effluent by natural adsorption and biological processes in the soil zone adjacent the field. Biological oxygen demand ($BOD_5$), suspended solids (SS), bacteria, and viruses, along with heavy metals and complex organic compounds, are absorbed by the soil under proper conditions.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** The RWQCB typically does not set discharge requirements for individual onsite systems. However, community onsite systems (greater than five residential units) and nonresidential onsite systems may be regulated by discharge requirements. Discharge requirements are typically limits on the quality of the effluent in terms of such constituents as biochemical oxygen demand (BOD), suspended solids, settleable solids, nitrogen, various salts (sodium, chloride, sulfate, etc.), turbidity, and grease and oil.

The RWQCB has established a design criterion for nitrogen discharges from community onsite systems at 40 grams/acre/day. There is also a prohibition on nitrogen discharges from community systems exceeding 80 grams/acre/day [6].

Septic tank treatment (primary treatment) is generally capable of 30 to 85% removal of $BOD_5$ and SS, with only 25 to 30% removal of total nitrogen.

The ion exchange filter absorbs ammonium ($NH_4^+$) thus preventing the nitrification process from occurring (i.e. conversion of ammonium ($NH_4^+$) to nitrate ($NO_3^-$)). No long term data are available on the nitrogen removal efficiencies from an ion exchange filter, but recent

studies indicate a wide range of removal efficiencies. Removal of nitrogen depends on a number of factors including wastewater retention time in the exchange filter and regeneration of ion exchange filter media. Little removal of $BOD_5$ and SS occurs through the ion exchange filter.

The soil absorption system reduces the concentrations of $BOD_5$ and SS to their lower limits of detectability [1].

**Reclamation Criteria.** Not applicable.

**Technical Aspects**

**Reliability.** No long term data are available on the performance of the septic tank followed by ion exchange filter systems for the removal of nitrogen from domestic wastewater. Recent testing on three systems in the Los Osos area by the RWQCB has demonstrated that nitrogen removal efficiencies vary from 90% to below 20% for the limited sampling that was performed [2]. The ion exchange system has no moving parts or electrical components. Periodic monitoring of ion exchange effluent is required monthly to determine when regeneration of media is necessary. Pumping of accumulated solids from the septic tank is required once every 5 to 10 years.

**Flexibility.** No data are available on the performance of the zeolite ion exchange systems for the treatment of wastewater from several homes or commercial/institutional users. Peak flowrates could present problems for the filter and some equalization would be need to ensure proper residence times are achieved.

**Precedents.** The use of the zeolite ion exchange system to treat wastewater from individual households is preliminary at this time. The Los Osos area is one of the first areas to test such systems. Two systems have been operating in Los Osos since August 1993. Based on preliminary results, it appears that the units are too small to be effective for extended periods of time.

**Aquifer Recharge Capability.** Percolation of septic tank effluent through the soil absorption system will recharge the underlying aquifer.

## Costs

Costs for a typical septic tank, zeolite ion exchange filter and soil absorption system for a three bedroom home are as follows:

Capital Costs:

| | |
|---|---|
| Inspection and design | $ 750[c] |
| Permit | $ 150 |
| Sewer, septic tank and soil absorption system | $3,300 |
| Ion exchange filter unit | $2,300 |
| Sub-total | $6,500 |

Annual Operation and Maintenance Cost:

| | | |
|---|---|---|
| Pumping septage from tank (every 5 to 10 years) | $ 33/year | (Range $15 to $50) |
| Recharge of ion exchange material | $300/year | |
| Total | $333/year | (Range $315 to $350) |

Costs based on [3].

Present Worth Costs:

Present worth factor, interest rate 8⅜%, 20 years, (P/A) = 9.5595.

PW cost = Capital Cost + (P/A)x(Annual O&M Cost)
= $6,500 + 9.5595 x $333/year
= $9,700

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c. Average cost of services required by a septic tank maintenance district or comparable agency. Includes work such as percolation testing, site evaluation, design drawings and specifications, construction inspection, and right-of-way or easement acquisition.

## References


1. Metcalf & Eddy, Inc., Wastewater Engineering: Treatment, Disposal, and Reuse 3rd Edition, McGraw-Hill, Inc., New York, New York. 1991.

2. Personal conversations with Howard Kolb, California Regional Water Quality Control Board, Central Coast Region and Shannon Capitain, student intern. 1994.

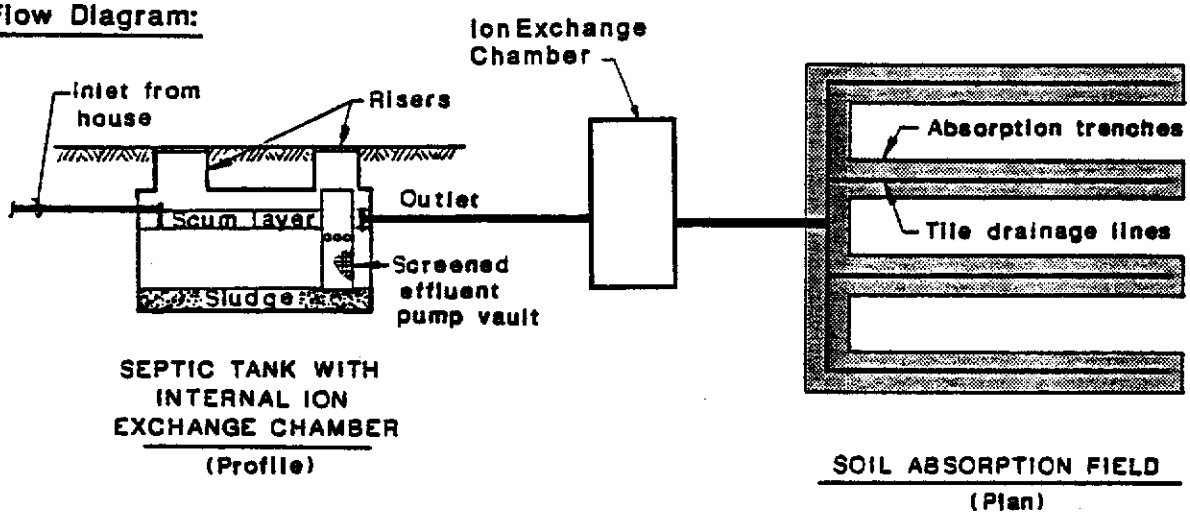
3. U.S. Environmental Protection Agency. Innovative and Alternative Technology Assessment Manual., Environmental Research Information Center. EPA 430/78-009. February 1980.

4. Tchobanoglous, G. and E.D. Schroeder, Water Quality, Addison-Wesley Publishing Company, Reading, Massachusetts. 1985.

5. U.S. Environmental Protection Agency. On-site Wastewater Treatment and Disposal Systems., Environmental Research Information Center. EPA 625/1-80-012. October 1980.

6. California Regional Water Quality Control Board. Central Coast Region. Water Quality Control Plan. 1989.

**Flow Diagram:**




SEPTIC TANK WITH INTERNAL ION EXCHANGE CHAMBER
(Profile)

SOIL ABSORPTION FIELD
(Plan)

| | |
|---|---|
| Los Osos Wastewater Study | Figure B2-3 |
| SEPTIC TANK WITH ION EXCHANGE AND SOIL ADSORPTION FIELD | |
| M&E Metcalf & Eddy | Date: May 1995 |

## RUCK BLACKWATER SYSTEM

### Description

The conventional Ruck System is based on the principle that the household wastes are separated into blackwater (toilet wastes) and greywater (sink, shower, laundry, etc.). Both the blackwater and greywater are treated by primary separation in separate septic tanks. About 80% of the generated household nitrogen is in the blackwater [1]. The blackwater septic tank effluent is sent through a sand filter. The sand filter is comprised of In-Drains® that increases the biomat layer at the top of the filter and increase the surface area within the filter while keeping the filter aerobic. As the blackwater septic tank effluent passes through the top layer of the sand filter, most of the $BOD_5$ is taken up by the increased biomat layer, leaving the remaining filter for the nitrification process (conversion of ammonia $NH_3$ to nitrate $NO_3^-$). The nitrate ($NO_3^-$) rich effluent from the sand filter is mixed with the greywater in the greywater septic tank. The greywater supplies the carbon needed for the denitrification process (conversion of nitrate $NO_3^-$ to elemental nitrogen $N_2$ gas). The effluent from the greywater septic tank is then sent to a soil absorption field for disposal. Because of the reduced $BOD_5$ loading the soil absorption field can be as much as four times smaller than a conventional soil absorption field, assuming the assimilative capacity of the lot is adequate.

To retrofit an existing on-site treatment system without separating the wastewater from the house, simple modifications are made to the system. The effluent from the conventional septic tank (both blackwater and greywater) is sent through a larger sand filter. This is to ensure $BOD_5$ removal and nitrification (conversion of ammonium $NH_4^-$ to nitrate $NO_3^-$). Soap is mixed with the effluent from the sand filter in a mixing chamber. The soap adds the carbon source to the water so the denitrification process can occur. The effluent from the mixing chamber is then sent to a soil absorption system.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** The RWQCB typically does not set discharge requirements for individual onsite systems. However, community onsite systems (greater than five residential units) and nonresidential onsite systems may be regulated by discharge requirements. Discharge requirements are typically limits on the quality of the effluent in terms of such constituents as biochemical oxygen demand (BOD), suspended solids, settleable solids, nitrogen, various salts (sodium, chloride, sulfate, etc.), turbidity, and grease and oil.

The RWQCB has established a design criterion for nitrogen discharges from community onsite systems at 40 grams/acre/day. There is also a prohibition on nitrogen discharges from community systems exceeding 80 grams/acre/day [6].

The Ruck System removes biological oxygen demand ($BOD_5$), suspended solids (SS), bacteria, nitrogen, phosphorus and color, by gravity separation (septic tank), filtration and biological uptake (Ruck sand filter) and absorption (soil absorption). Removal efficiencies of $BOD_5$, SS, and phosphorus range between 60 to 85% and 40 to 95% for nitrogen removal,

depending on the design. The bacteria count is reduced to extremely low levels. $BOD_5$ and SS concentrations have been reduced to or below 10 mg/L.

**Reclamation Criteria.** Not applicable.

**Technical Aspects**

**Reliability.** The Ruck System requires a similar maintenance schedule that is needed for a conventional septic system. Septic tank pumping would be required every 5 to 10 years along with routine monitoring and weekly addition of soap to the soap pump. The Ruck sand filter is designed to operate without service for up to 25 years.

**Flexibility.** Ruck Systems have been installed for domestic wastes from homes, condominiums, schools, restaurants, motels, truck weighing stations and light industrial applications. The Ruck System is a biological wastewater treatment system. The Ruck System is also suitable for milk and food processing wastes where balanced nutrients are available for bacterial synthesis. Ruck systems can be clustered to serve more than one home.

**Precedents.** There have been over 205 Ruck System units installed in the United States since its introduction in 1977. The majority of the installations are for residential homes and condominiums in the Northeast United States. A few commercial applications have also been installed in New Jersey and Rhode Island. Seven Ruck System installations are in the state of California, (1) a CHP inspection facility in Truckee, CA; (2) an industrial facility in Castroville, CA; and 5 installations for Cal Trans.

**Aquifer Recharge Capacity.** Percolation of septic tank effluent through the soil absorption system will recharge the underlying aquifer.

**Costs**

Costs for a Ruck System and soil absorption system for a three bedroom home:

Capital Cost:

| | |
|---|---|
| Inspection and design | $850[d] |
| Permit | $150 |
| Ruck Sand Filter | $9,200 |
| Septic tank and soil absorption system | $3,500 |
| Total | $13,700 |

d. Average cost of services required by a septic tank maintenance district or comparable agency. Includes work such as percolation testing, site evaluation, design drawings and specifications, construction inspection, and right-of-way or easement acquisition.

Annual Operation and Maintenance Cost:

| | | |
|---|---|---|
| Septage pumping (every 5 to 10 years) | $33/year | (Range $15 to $50) |
| Soap and soap pump O&M | $ 8/year | |
| Total | $ 41/year | (Range $23 to $58) |

Costs based on [4], Fact Sheet 7.1.6 and RSC Ruck System-Consultants.

Present Worth Costs:

Present worth factor, interest rate 8⅜%, 20 years, (P/A) = 9.5595.

PW cost = Capital Cost + (P/A)x(Annual O&M Cost)
= $13,700 + 9.5595 x $ 41/year
= $14,100

**Other Factors**

**Land Area Requirements.** A 300 square foot area would be required for the filter, excluding the septic tank, soil absorption system, and setbacks.

**Environmental Impacts.** In Los Osos/Baywood Park, onsite systems in low-lying areas are subject to flooding, which may render the RUCK system ineffective for the duration of the flooding.

**References**


1. Ingham, A.T., Residential Greywater Management in California, State of California, State Water Resources Control Board, Division of Planning and Research. January 1980.

2. U.S. Environmental Protection Agency. On-site Wastewater Treatment and Disposal Systems., Environmental Research Information Center. EPA 625/1-80-012. October 1980.

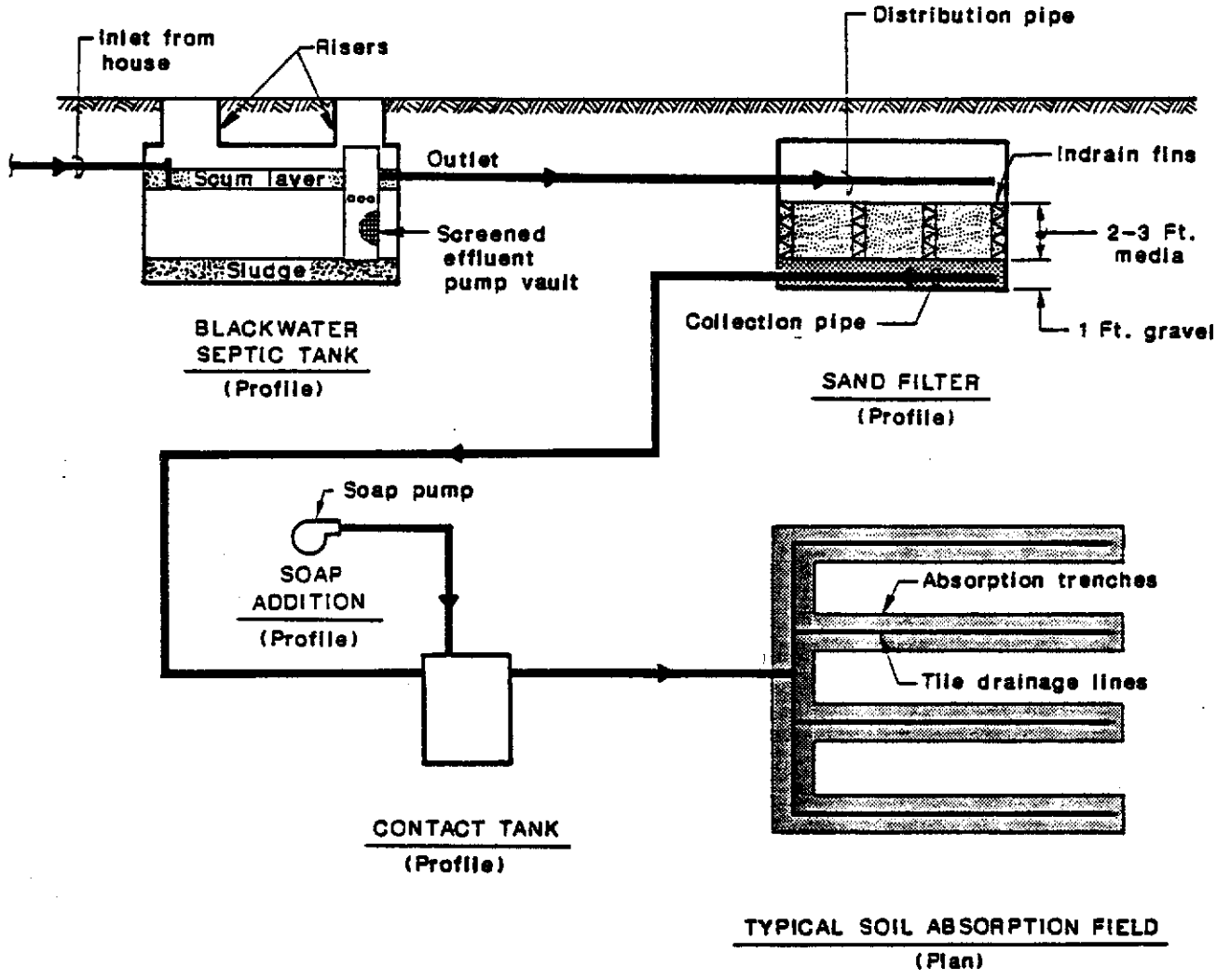
3. Metcalf & Eddy, Inc., Wastewater Engineering: Treatment, Disposal, and Reuse 3rd Edition, McGraw-Hill, Inc., New York, New York. 1991.

4. U.S. Environmental Protection Agency. Innovative and Alternative Technology Assessment Manual., Environmental Research Information Center. EPA 430/78-009. February 1980.

5. Tchobanoglous, G. and E.D. Schroeder, Water Quality, Addison-Wesley Publishing Company, Reading, Massachusetts. 1985.

6. California Regional Water Quality Control Board. Central Coast Region. Water Quality Control Plan. 1989.

Flow Diagram:




| | |
|---|---|
| Los Osos Wastewater Study | Figure B2-4 |
| RUCK BLACKWATER SYSTEM | |
| Metcalf & Eddy | Date: May 1995 |

## SEPTIC TANK WITH MOUND SYSTEM

### Description

Septic tank followed by a mound system is best used where problem soil conditions preclude the use of the conventional on-site treatment system. A mound system may also be used in areas with shallow groundwater to increase distance from the disposal point to the water table. The system consists of a buried septic tank with an internal pump vault and the mound, a soil absorption system, that is elevated above the natural soil surface [1]. The septic tank provides primary treatment of the wastewater by gravity separation of the solids from the liquid. Solids are collected and stored in the tank forming sludge and scum layers where anaerobic and facultative decomposition occurs. Even though the volume of the solid material is continually reduced by the anaerobic and facultative decomposition, there is a net accumulation of sludge in the tank [2]. Thus, periodic pumping of the contents of the septic tank is required.

Effluent from the septic tank is pumped to the pressure distribution system used to dose the mound. The mound consists of a fill material (usually sand), a distribution network, a cap and top soil to cover the mound with vegetation. A pressure distribution network is used to dose the effluent uniformly throughout the mound. The effluent infiltrates the mound fill material and the unsaturated zone of the natural soil underlying the mound. Pollutants are removed from the effluent by natural adsorption and biological and physical processes as the effluent passes through the mound and into the natural soil [1]. Biological oxygen demand ($BOD_5$), suspended solids (SS), bacteria, and viruses, and complex organic compounds, are absorbed by the mound fill material under proper conditions. The size of the mound is determined by the percolation rates of the fill material and hydraulic loading rates.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** The RWQCB typically does not set discharge requirements for individual onsite systems. However, community onsite systems (greater than five residential units) and nonresidential onsite systems may be regulated by discharge requirements. Discharge requirements are typically limits on the quality of the effluent in terms of such constituents as biochemical oxygen demand (BOD), suspended solids, settleable solids, nitrogen, various salts (sodium, chloride, sulfate, etc.), turbidity, and grease and oil.

The RWQCB has established a design criterion for nitrogen discharges from community onsite systems at 40 grams/acre/day. There is also a prohibition on nitrogen discharges from community systems exceeding 80 grams/acre/day [5].

Septic tank treatment (primary treatment) is generally capable of removing 30 to 85% of the $BOD_5$ and SS, and about 25 to 30% of the total nitrogen. Constituent concentrations for $BOD_5$ and SS below the mound, are at or below the lower limits of detectability [2]. The mound system essentially operates as an intermittent sand filter [2]. Under these operating conditions, nitrification occurs (conversion of ammonia $NH_3$ to nitrate $NO_3$) during aerobic

conditions and denitrification occurs (conversion of nitrate $NO_3$ to nitrogen $N_2$ gas) during anaerobic conditions. Routinely, up to a 45% reduction in total nitrogen is achieved [2].

**Reclamation Criteria.** Not applicable.

**Technical Aspects**

**Reliability.** Properly designed, constructed, and operated septic tank mound systems have demonstrated to be an efficient and economical alternative for difficult soil conditions. The mound system requires periodic maintenance of the distribution pumping system, as well as routine pumping of the accumulated solids in the septic tank every 5 to 10 years. If properly designed the constructed mound should operate satisfactorily with little or no regular maintenance [1].

**Flexibility.** Modifications to the mound system to handle larger flows from a cluster of homes would require larger absorption areas, which could be accomplished by using a series of mounds. But, for community-sized flows, many regulatory agencies no longer approve the use the mound systems because of the high rate of failure [2].

**Precedents.** Septic tank mound systems have proven to be successful alternatives for difficult soil conditions. They have been in use for more than 25 years [3].

**Aquifer Recharge Capability.** Percolation of septic tank effluent through the mound will recharge the underlying aquifer.

**Costs**

Costs for a typical septic tank with a mound system (based on ENR 7252) for a three bedroom home are as follows:

Capital Costs:

| | | |
|---|---|---|
| Inspection and design | | $ 750[e] |
| Permit | | $ 150 |
| Sewer, septic tank with screened effluent pump, vault and pump | | $ 2,200 |
| Mound system | | $ 5,000 |
| | Total | $ 8,100 |

e. Average cost of services required by a septic tank maintenance district or comparable agency. Includes work such as percolation testing, site evaluation, design drawings and specifications, construction inspection, and right-of-way or easement acquisition.

Annual Operation and Maintenance Cost:

| | | | |
|---|---|---|---|
| Pumping | | $ 78/year | (Range $52 to $130) |
| Septage pumping (every 5 to 10 years) | | $ 33/year | |
| | Total | $111/year | (Range $91 to $169) |

Cost based on [3], Fact Sheet 7.1.7.

Present Worth Costs:

Present worth factor, interest rate 8⅜%, 20 years, (P/A) = 9.5595.

PW cost = Capital Cost + (P/A)x(Annual O&M Cost)
= $8,100 + 9.5595 x $111/year
= $9,200

For comparison purposes, this cost includes a new, replacement septic tank and leach field or pit plus the additional process. This cost could be reduced if the existing septic tank and/or leach field or leach pit can be used without replacement.

**Other Factors**

**Land Requirement.** Based on guidelines in federal and state publications [1,5], the land area required for a mound system can range from 1,500 to 3,000 sq ft, depending on soil conditions, slope, and wastewater hydraulic loading. This area is based on a 3:1 sideslope for the mound and excludes the septic tank and required setbacks. The areas may be smaller if the sideslopes are steeper or the mound is enclosed in a brick or masonry structure.

**Environmental Impacts.** In Los Osos/Baywood Park, onsite systems in low-lying areas are subject to flooding, which may render the mound system ineffective for the duration of the flooding.

## References


1. U.S. Environmental Protection Agency. On-site Wastewater Treatment and Disposal Systems., Environmental Research Information Center. EPA 625/1-80-012. October 1980.

2. Metcalf & Eddy, Inc., Wastewater Engineering: Treatment, Disposal, and Reuse 3rd Edition, McGraw-Hill, Inc., New York, New York. 1991.

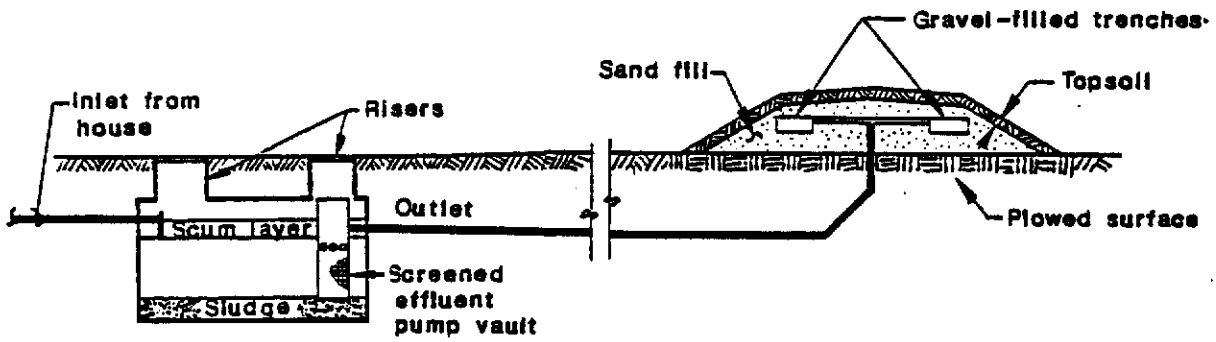
3. U.S. Environmental Protection Agency. Innovative and Alternative Technology Assessment Manual., Environmental Research Information Center. EPA 430/78-009. February 1980.

4. Tchobanoglous, G. and E.D. Schroeder, Water Quality, Addison-Wesley Publishing Company, Reading, Massachusetts. 1985.

5. State Water Resources Control Board. Guidelines for Mound Systems. January 1980.

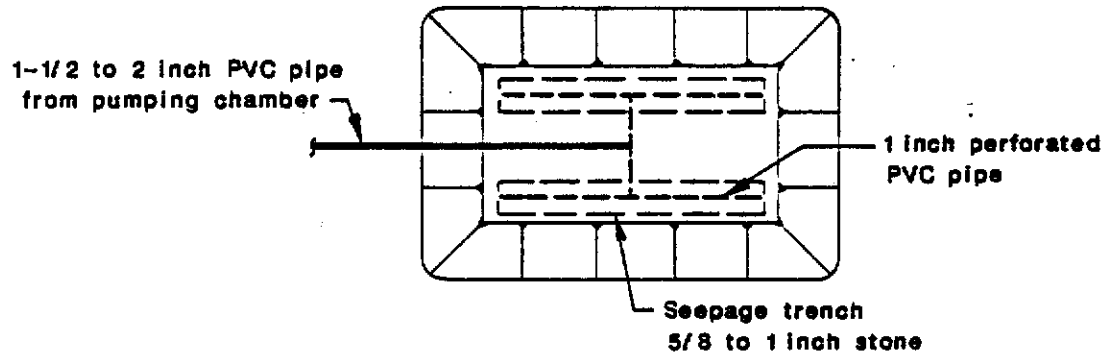
6. California Regional Water Quality Control Board. Central Coast Region. Water Quality Control Plan. 1989.

## Flow Diagram:




SEPTIC TANK
(Profile)

MOUND
(Profile)




MOUND
(Plan)

| Los Osos Wastewater Study | Figure B2-5 |
|---|---|
| SEPTIC TANK WITH MOUND SYSTEM | |
| M&E Metcalf & Eddy | Date: May 1995 |

## SEPTIC TANK WITH EVAPOTRANSPIRATION SYSTEM

### Description

Septic tank followed by an evapotranspiration system is used where problem soil conditions preclude the use of the traditional on-site treatment system of a septic tank followed by a soil absorption field Alternative No. 1). The evapotranspiration system consists of a buried septic tank, a sand evapotranspiration bed with an impermeable liner and a distribution network. The septic tank provides primary treatment of the wastewater by gravity separation of the solids from the liquid. Solids are collected and stored in the tank forming sludge and scum layers where anaerobic and facultative decomposition occurs. Even though the volume of the solid material is continually reduced by anaerobic and facultative decomposition, there is a net accumulation of sludge in the tank [1]. Thus, periodic pumping of the contents of the tank is required.

Effluent from the septic tank is discharged by gravity or pumped, to the evapotranspiration bed. The evapotranspiration system disposes of wastewater to the atmosphere so no percolation of the wastewater to the groundwater is allowed [2]. The evapotranspiration bed functions by raising the wastewater to the upper portion of the bed by capillary action in the sand, then evaporates it to the atmosphere. In addition, vegetation transports water from the root zone to leaves, where it is transpired to the atmosphere. Pollutants are removed from the effluent by evaporation and transpiration. Evapotranspiration beds performance is affected by climate, hydraulic loading rates, sand capillary rise characteristics, depth of free water surface in the bed, cover soil, vegetation and salt accumulation.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** The RWQCB typically does not set discharge requirements for individual onsite systems. However, community onsite systems (greater than five residential units) and nonresidential onsite systems may be regulated by discharge requirements. Discharge requirements are typically limits on the quality of the effluent in terms of such constituents as biochemical oxygen demand (BOD), suspended solids, settleable solids, nitrogen, various salts (sodium, chloride, sulfate, etc.), turbidity, and grease and oil.

The RWQCB has established a design criterion for nitrogen discharges from community onsite systems at 40 grams/acre/day. There is also a prohibition on nitrogen discharges from community systems exceeding 80 grams/acre/day [6].

Septic tank effluent (primary treatment) is generally capable of removing 30 to 85% of the $BOD_5$ and SS, and about 25 to 30% of the total nitrogen. Constituent removal percentages from the evapotranspiration bed are unknown. However, due to impermeable liner, nitrates or other constituents will not migrate to the groundwater.

**Reclamation Criteria.** Not applicable.

## Technical Aspects

**Reliability.** Properly designed, constructed and operated evapotranspiration systems is an effective means of domestic wastewater disposal [3]. The system has no moving parts and requires very little routine maintenance. Routine operation and maintenance consists of typical yard maintenance activities and periodic pumping of accumulated solids in the septic tank every 5 to 10 years.

**Flexibility.** Evapotranspiration systems could be applicable to serve several homes or commercial/institutional users, but the large area requirements may limit their practicality [4]. The septic tank system may require compartmentalization to handle special problems generated by the users.

**Precedents.** There are estimated to be 4,000 to 5,000 year round evapotranspiration systems in operation in the United States, particularly in the semi-arid regions of the Southwest [3].

**Aquifer Recharge Capability.** Percolation of the septic tank effluent will not recharge the underlying aquifer, due to the impermeable liner used in the design of evapotranspiration systems.

## Costs

An evapotranspiration systems in the Los Osos area with an annual net evaporative rate of 0.05 gal/sq ft/day [5] and a 200 gpd household discharge would require a 2 ft deep bed with an area approximately 5,000 $ft^2$. Costs for a typical septic tank with an evapotranspiration bed (based on ENR 7252) are as follows:

Capital Costs:

| | | |
|---|---|---|
| Inspection and design | | $ 800[f] |
| Permit | | $ 150 |
| Sewer, septic tank with screened effluent pumping vault and pump | | $ 2,200 |
| Evapotranspiration system | | $11,200 |
| | Total | $14,350 |

f. Average cost of services required by a septic tank maintenance district or comparable agency. Includes work such as percolation testing, site evaluation, design drawings and specifications, construction inspection, and right-of-way or easement acquisition.

Annual Operation and Maintenance Cost:

| | | |
|---|---|---|
| Pumping | $ 78 | |
| Septage pumping (every 5 to 10 years) | $ 33/year | (Range $13 to $52) |
| Total | $111 | |

Costs based on [3], Fact Sheet 7.1.5.

Present Worth Costs:

Present worth factor, interest rate 8⅜%, 20 years, (P/A) = 9.5595.

PW cost = Capital Cost + (P/A)x(Annual Cost)
= $14,350 + 9.5595 x $111/year
= $15,400

For comparison purposes, this cost includes a new, replacement septic tank and leach field or pit plus the additional process. This cost could be reduced if the existing septic tank and/or leach field or leach pit can be used without replacement.

**Other Factors**

**Land Requirement.** A 5,000 sq. ft. land requirement is needed for the evapotranspiration system, excluding the septic tank and required setback.

**Environmental Impacts.** In Los Osos/Baywood Park, onsite systems in low-lying areas are subject to flooding, which may render the evapotranspiration system ineffective for the duration of the flooding.

**References**


1. Metcalf & Eddy, Inc., Wastewater Engineering: Treatment, Disposal, and Reuse 3rd Edition, McGraw-Hill, Inc., New York, New York. 1991.

2. Tchobanoglous, George and E.D. Schroeder, Water Quality, Addison-Wesley Publishing Company, Reading, Massachusetts. 1985.

3. U.S. Environmental Protection Agency. Innovative and Alternative Technology Assessment Manual., Environmental Research Information Center. EPA 430/78-009. February 1980.

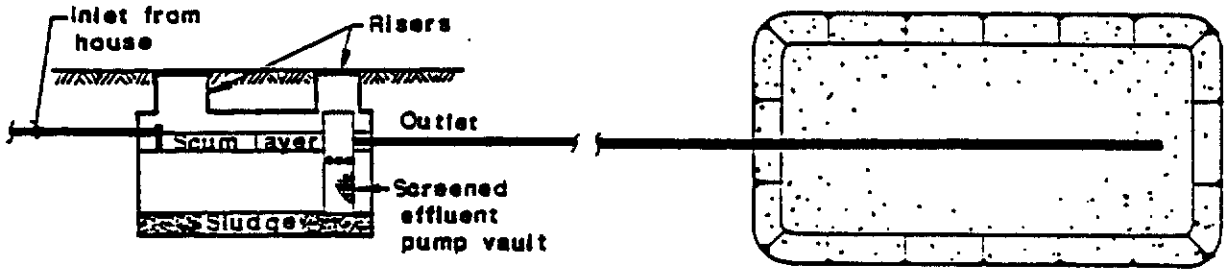
4. U.S. Environmental Protection Agency. On-site Wastewater Treatment and Disposal Systems., Environmental Research Information Center. EPA 625/1-80-012. October 1980.

5. Pettygrove, G.S. and T. Asano (eds.). Irrigation with Reclaimed Municipal Wastewater - A Guidance Manual. Calif. State Water Resources Control Board. Report No. 84-1 wr. July 1984.

6. California Regional Water Quality Control Board. Central Coast Region. Water Quality Control Plan. 1989.

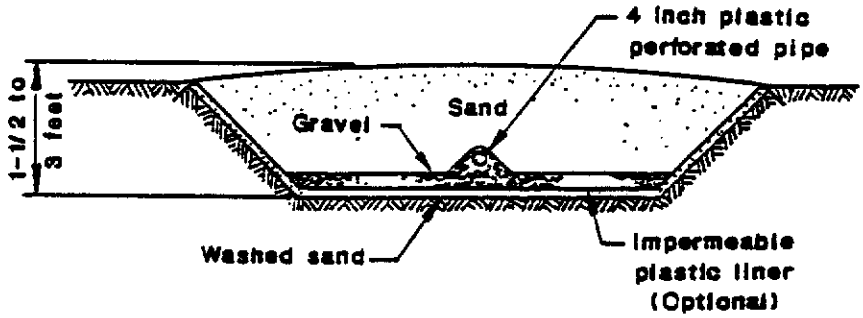
## ALTERNATIVE No. 6: SEPTIC TANK WITH EVAPOTRANSPIRATION BED

**Flow Diagram:**




SEPTIC TANK
(Profile)

EVAPOTRANSPIRATION BED
(Plan)




TYPICAL EVAPOTRANSPIRATION BED
(Cross Section)

| | |
|---|---|
| Los Osos Wastewater Study | Figure B2-6 |
| SEPTIC TANK WITH EVAPOTRANSPIRATION BED | |
| Metcalf & Eddy | Date: July 1995 |

## SEPTIC TANK WITH CONSTRUCTED WETLANDS SYSTEM

### Description

Septic tank followed by a constructed wetlands followed by a soil absorption system is as alternative to the traditional on-site treatment system of a septic tank followed by a soil absorption system (Alternative No.1). Wastewater is collected in the septic tank where primary treatment is accomplished by gravity separation of the solids from the liquid. Solids are collected and stored in the tank, forming sludge and scum layers. Anaerobic and facultative decomposition occurs in these layers. Even though the volume of the solid material is continually reduced by decomposition, there is a net accumulation of sludge in the tank [1]. Thus, periodic pumping of the contents of the tank is required.

Effluent is discharged from the septic tank, usually by gravity, to the constructed wetlands. The constructed wetlands is an engineered, marsh-like area designed, constructed and operated to treat wastewater by simulating the physical, chemical, and biological processes that occur in natural ecosystems [2]. The absorption/filtration potential of the roots and stems of the aquatic plants and the ion exchange/absorption capacity of the wetlands sediment contribute to the effectiveness of wetland treatment systems [3]. Constructed wetlands performance is affected by climate factors, because the metabolic activity of the bacteria is reduced. The size of the constructed wetlands is determined on the basis of the organic and hydraulic loading rates.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** The RWQCB typically does not set discharge requirements for individual onsite systems. However, community onsite systems (greater than five residential units) and nonresidential onsite systems may be regulated by discharge requirements. Discharge requirements are typically limits on the quality of the effluent in terms of such constituents as biochemical oxygen demand (BOD), suspended solids, settleable solids, nitrogen, various salts (sodium, chloride, sulfate, etc.), turbidity, and grease and oil.

The RWQCB has established a design criterion for nitrogen discharges from community onsite systems at 40 grams/acre/day. There is also a prohibition on nitrogen discharges from community systems exceeding 80 grams/acre/day [6].

Septic tank effluent (primary treatment) is generally capable of removing 30 to 85% the of $BOD_5$ and SS, and about 25 to 30% of the total nitrogen. The constructed wetlands is capable of producing effluent concentrations of $BOD_5$, SS, and total nitrogen as low as 10, 10, and 5 mg/L, respectively [3]. A total nitrogen removal of 90% is possible with a septic tank followed by a constructed wetlands systems.

**Reclamation Criteria.** Not applicable.

## Technical Aspects

**Reliability.** Properly designed, constructed and operated wetlands systems is an effective means of domestic wastewater disposal. The system has no moving parts but requires some operation and maintenance. The owner is required to maintain and observe the system to preclude or minimize problems. Items to monitor include system water level, berms or retaining walls and vegetation. Routine operation and maintenance consists of typical horticultural maintenance activities and periodic pumping of accumulated septic tank solids every 3 to 5 years.

**Flexibility.** Constructed wetlands could be applicable to small systems, such as schools, camps and even individual homes [1].

**Precedents:** Constructed wetlands are considered to be a relatively new technology and is considered to be an alternative technology to a traditional septic tank system. Most onsite wetlands are located in Kentucky, Alabama, and Louisiana. Most applications of constructed wetlands are because of septic system failures or unsuitable locations for the traditional systems. Nitrogen removal criteria are generally not applied to the current systems [4].

**Aquifer Recharge Capability.** Percolation of the constructed wetlands effluent will recharge the underlying aquifer.

## Costs

Costs for a typical constructed wetlands system for a three bedroom home are as follows:

Capital Cost:

| | |
|---|---|
| Inspection and design | $ 750[g] |
| Permit | $ 150 |
| Sewer, septic tank and screened effluent vault and soil absorption system | $ 3,500 |
| Constructed wetlands system | $ 6,100 |
| Total | $10,500 |

Annual Operation and Maintenance Cost:

| | | |
|---|---|---|
| Pumping septage from tank (every 5 to 10 years) | $33/year | (Range $15 to $50) |
| O & M cost for wetland | $10/year | |
| Total | $43/year | |

Annual operation and maintenance costs based on [5], Fact Sheet 7.1.6.

Present Worth Costs:

Present worth factor, interest rate 8⅜%, 20 years, (P/A) = 9.5595.

PW cost = Capital Cost + (P/A)x(Annual O&M Cost)
= $10,500 + 9.5595 x $ 43/year
= $10,900

For comparison purposes, this cost includes a new, replacement septic tank and leach field or pit plus the additional process. This cost could be reduced if the existing septic tank and/or leach field or leach pit can be used without replacement.

---

g. Average cost of services required by a septic tank maintenance district or comparable agency. Includes work such as percolation testing, site evaluation, design drawings and specifications, construction inspection, and right-of-way or easement acquisition.

## Other Factors

**Land Area Requirements.** An area of 250 to 300 square feet would be required for the wetlands, in addition to the area for the septic tank and soil absorption field.

**Environmental Impacts.** A constructed wetland could be a health and safety hazard because untreated wastewater and marshy soil are accessible to residents, especially children and especially if the wetland is on an individual lot. This hazard may be mitigated by a fence surrounding the wetland.

## References


1. Metcalf & Eddy, Inc., Wastewater Engineering: Treatment, Disposal, and Reuse 3rd Edition, McGraw-Hill, Inc., New York, New York. 1991.

2. Tennessee Valley Authority Resource Group Water Management. General Design, Construction, and Operation Guidelines: Constructed Wetlands Wastewater Treatment Systems for Small Users Including Individual Residences Second Edition., Chattanooga, Tennessee. TVA/WM--93/10. May 1993.

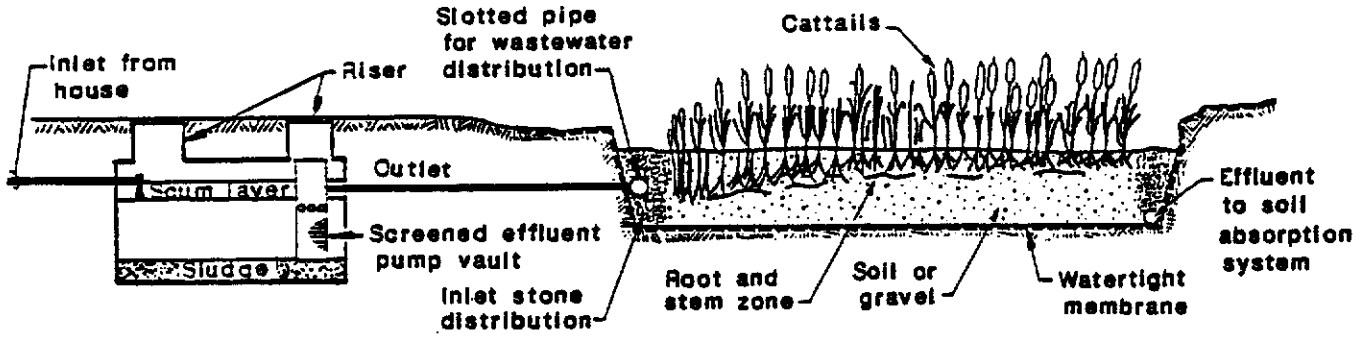
3. Tchobanoglous, George and E.D. Schroeder, Water Quality, Addison-Wesley Publishing Company, Reading, Massachusetts. 1985.

4. U.S. Environmental Protection Agency. Subsurface Flow Constructed Wetlands for Wastewater Treatment: A Technology Assessment. EPA 832-R-93-008. Office of Water (WH547). July 1993.

5. U.S. Environmental Protection Agency. Innovative and Alternative Technology Assessment Manual. Environmental Research Information Center. EPA 430/9-78-009. February 1980.

6. California Regional Water Quality Control Board. Central Coast Region. Water Quality Control Plan. 1989.

Flow Diagram:




SEPTIC TANK
(Profile)

WETLANDS
(Cross section)

| Los Osos Wastewater Study | Figure B2-7 |
|---|---|
| SEPTIC TANK WITH CONSTRUCTED WETLANDS SYSTEM | |
| M&E Metcalf & Eddy | Date: May 1995 |

## SEPTIC TANK WITH RECIRCULATING SAND FILTER AND SOIL ABSORPTION FIELD

**Description.** Septic tank followed by a recirculating sand filter is essentially the same as an intermittent sand filter system. The major difference is a portion of the filter effluent is mixed with the septic tank effluent and is recirculated through the filter. The filter media is larger in size and the loading rate is greater than an intermittent sand filter.

The recirculating sand filter system consists of a buried septic tank with an internal screened vault, a separate pump basin, and a sand filter bed. The recirculating filter consists of 2 to 3 ft of sand or pea gravel with a surface distribution system and 0.5 ft of gravel enclosing the underdrain system to collect the filter effluent. Wastewater is collected in the septic tank where primary treatment is accomplished by gravity separation of the solids from the liquid. Solids are collected and stored in the tank forming sludge and scum layers where anaerobic and facultative decomposition occurs. Although the volume of the solid material is continually reduced by the anaerobic and facultative decomposition, there is a net accumulation of sludge in the tank [1]. Thus, periodic pumping of the contents of the tank is required.

Effluent from the septic tank is usually discharged by gravity to the pump basin. The septic tank effluent is mixed with filter effluent and the combined effluent is pumped to the filter. Pollutants are removed by a combination of physical, chemical and biological transformations as the combined effluent passes through the filter.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** The RWQCB typically does not set discharge requirements for individual onsite systems. However, community onsite systems (greater than five residential units) and nonresidential onsite systems may be regulated by discharge requirements. Discharge requirements are typically limits on the quality of the effluent in terms of such constituents as biochemical oxygen demand (BOD), suspended solids, settleable solids, nitrogen, various salts (sodium, chloride, sulfate, etc.), turbidity, and grease and oil.

The RWQCB has established a design criterion for nitrogen discharges from community onsite systems at 40 grams/acre/day. There is also a prohibition on nitrogen discharges from community systems exceeding 80 grams/acre/day [6].

Primary treatment (septic tank effluent) is generally capable of removing 30 to 85% of the $BOD_5$ and SS, and about 25 to 30% of the total nitrogen. Recirculating sand filter systems produce a high quality effluent with respect to $BOD_5$ and SS. Generally, over 90% removal of $BOD_5$ and SS is possible, reducing the effluent concentration to less than 10 mg/L.

Total nitrogen removal could range from 29 to 82%, with the highest removal achieved if the effluent from the filter is recycled back to the septic tank. Nitrogen removal in recirculating filters for a typical domestic wastewater can be expected to range from 45 to 55% [2]. Additional denitrification may occur in the soil column.

**Reclamation Criteria.** Not applicable.

**Technical Aspects**

**Reliability.** Properly designed, constructed, and operated recirculating sand filters will produce effluent of very high quality. Routine operation and maintenance consists of checking the dosing chamber and filter bed quarterly. Periodic maintenance to the filter bed include raking or replacing sand or pea gravel if incrustation should occur or if the filter bed becomes clogged. Periodic pumping of accumulated solids in the septic tank is required every 5 to 10 years.

**Flexibility.** Recirculating sand filter systems have been applied to both individual homes and small communities up to 0.2 Mgal/d [5].

**Precedents.** Many recirculating sand filters are used throughout the United States to treat wastewater for individual homes, small commercial and institutional developments, as well for small communities.

**Aquifer Recharge Capability.** Percolation of the recirculating sand filter effluent will recharge the underlying aquifer.

**Costs**

Costs for a typical recirculating sand filters are based on ENR 7252:

Capital Costs

| | |
|---|---|
| Inspection and design | $ 850[h] |
| Permit | $ 150 |
| Sewer, septic tank with screened effluent pump vault and pump, and soil absorption system | $3,500 |
| Recirculating sand filter | $4,600 |
| Total | $9,100 |

h. Average cost of services required by a septic tank maintenance district or comparable agency. Includes work such as percolation testing, site evaluation, design drawings and specifications, construction inspection, and right-of-way or easement acquisition.

Annual Operation and Maintenance Cost:

| | | |
|---|---|---|
| Septage pumping (every 5 to 10 years) | $ 33/year | (Range $15 to $50) |
| Pump chamber and filter maintenance | $200/year | |
| Energy Costs (pump) 50 to 250 kWh/yr @ $0.08/kWh | $ 12/year | (Range $4 to $20) |
| Total | $245/year | (Range $279 to $470) |

Costs based on [4], Fact Sheet 7.1.8.

Present Worth Costs:

Present worth factor, interest rate 8⅜%, 20 years, (P/A) = 9.5595.

PW cost = Capital Cost + (P/A)x(Annual O&M Cost)
= $9,100 + 9.5595 x $ 245/year
= $11,400

For comparison purposes, this cost includes a new, replacement septic tank and leach field or pit plus the additional process. This cost could be reduced if the existing septic tank and/or leach field or leach pit can be used without replacement.

**Other Factors**

**Land Requirement.** System requires 100 sq ft for the filter and recirculating pumps, in addition to the septic tank and soil absorption field.

**Environmental Impacts.** In Los Osos/Baywood Park, onsite systems in low-lying areas are subject to flooding, which may render this system ineffective for the duration of the flooding.

**References**


1. Metcalf & Eddy, Inc., Wastewater Engineering: Treatment, Disposal, and Reuse 3rd Edition, McGraw-Hill, Inc., New York, New York. 1991.

2. Nolte and Associates, Inc., Literature Review of Recirculating and Intermittent sand Filter Operation and Performance, Prepared for the California Regional Water Quality Control Board, Central Valley Region, Redding, California. June 1992.

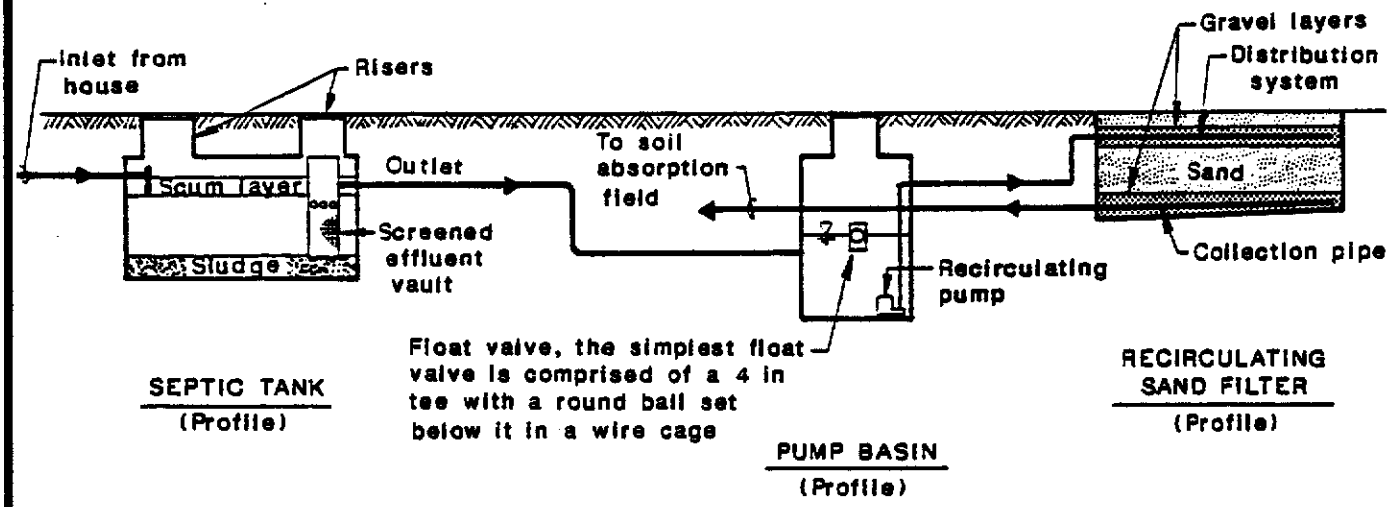
3. U.S. Environmental Protection Agency. On-site Wastewater Treatment and Disposal Systems., Environmental Research Information Center. EPA 625/1-80-012. October 1980.

4. U.S. Environmental Protection Agency. Innovative and Alternative Technology Assessment Manual., Environmental Research Information Center. EPA 430/78-009. February 1980.

5. Tchobanoglous, G. and E.D. Schroeder, Water Quality, Addison-Wesley Publishing Company, Reading, Massachusetts. 1985.

6. California Regional Water Quality Control Board. Central Coast Region. Water Quality Control Plan. 1989.

Flow Diagram:




| | |
|---|---|
| Los Osos Wastewater Study | Figure B2-8 |
| SEPTIC TANK WITH RECIRCULATING SAND FILTER AND SOIL ADSORPTION FIELD | |
| M&E Metcalf & Eddy | Date: May 1995 |

## SEPTIC TANK WITH INTERMITTENT SAND FILTER, RECYCLE, AND SOIL ABSORPTION FIELD

### Description

Septic tank followed by an intermittent sand filter with effluent recycle, for nitrogen control, followed by a soil absorption system is an alternative to the conventional on-site treatment system comprised of a septic tank followed by a soil absorption system. Wastewater is collected in the septic tank where primary treatment is accomplished by gravity separation of the solids from the liquid. Solids are collected and stored in the tank, forming sludge and scum layers. Anaerobic and facultative decomposition occurs in these layers. Even though the volume of the solid material is continually reduced by decomposition, there is a net accumulation of sludge in the tank [2]. Because there is a net accumulation, periodic pumping of the contents of the septic tank is required. Effluent from the septic tank is pumped to the filter.

The intermittent sand filter is comprised of 2 to 3 ft of sand with a surface distribution system and an underdrain system to collect the filter effluent. The intermittent sand filter is used principally to further treat the septic tank effluent and to convert the ammonia in the effluent to nitrate. The filter is dosed with septic tank effluent from 12 to 48 times per day.

Effluent from the intermittent sand filter is returned to the septic tank where the nitrate is denitrified to nitrogen gas under anoxic conditions. The organic matter in the wastewater is used as the carbon source for the denitrification reaction. Pollutants are removed in the intermittent sand filter by physical forces and by chemical and biological transformations. The intermittent sand filter is sized using a hydraulic loading rate from 1 to 3 gal/ft$^2$·d.

### Conformance with Laws, Regulations, Criteria

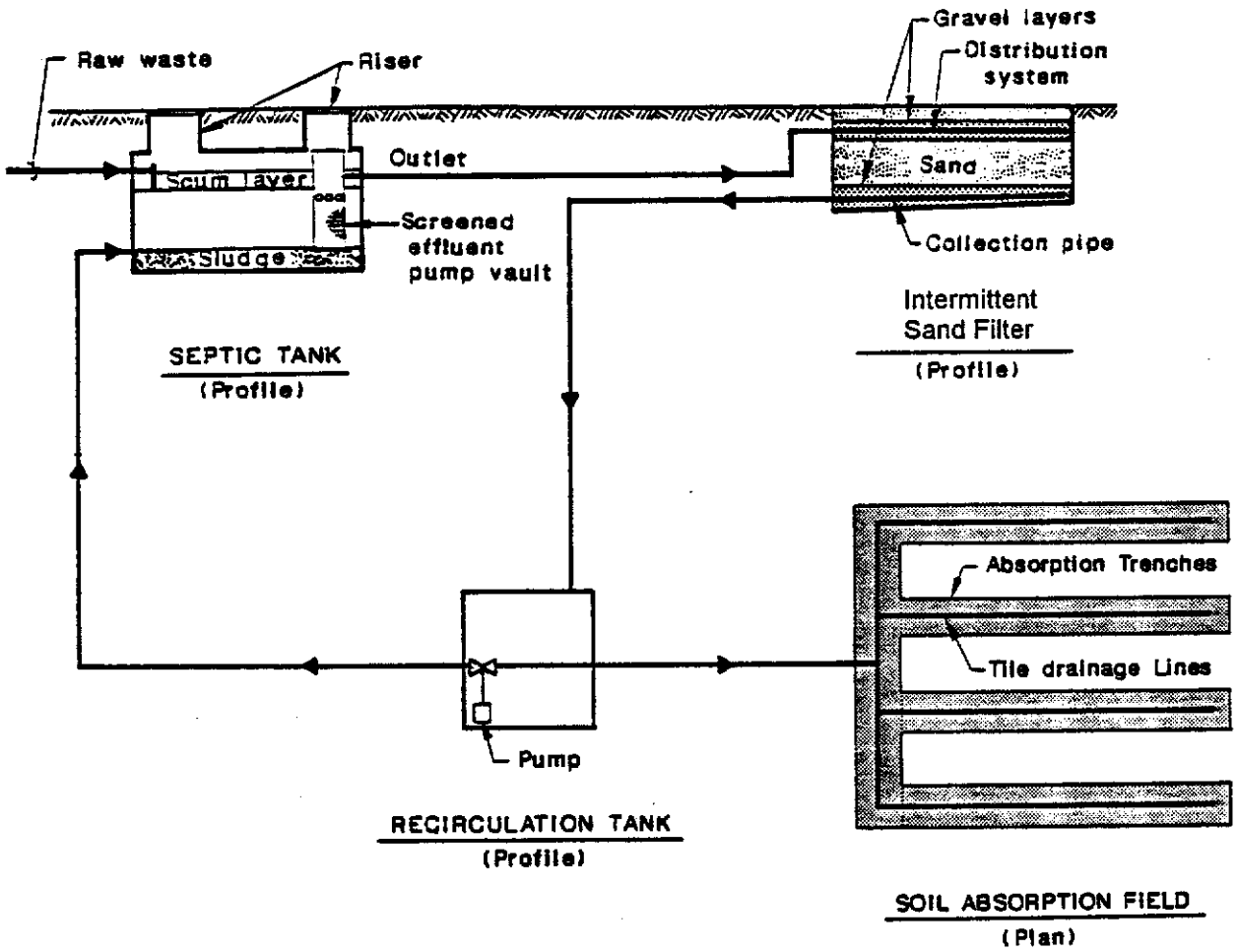
**RWQCB Discharge Requirements.** The RWQCB typically does not set discharge requirements for individual onsite systems. However, community onsite systems (greater than five residential units) and nonresidential onsite systems may be regulated by discharge requirements. Discharge requirements are typically limits on the quality of the effluent in terms of such constituents as biochemical oxygen demand (BOD), suspended solids, settleable solids, nitrogen, various salts (sodium, chloride, sulfate, etc.), turbidity, and grease and oil.

The RWQCB has established a design criterion for nitrogen discharges from community onsite systems at 40 grams/acre/day. There is also a prohibition on nitrate discharges from community systems exceeding 80 grams/acre/day [5].

Primary treatment (septic tank effluent) is generally capable of removing 30 to 85% of the $BOD_5$ and SS, and about 25 to 30% of the total nitrogen. Intermittent sand filters produce a high quality effluent with respect to $BOD_5$ and SS. Generally, over 90% removal of $BOD_5$ and SS is possible, reducing the effluent concentration to less than 10 mg/L. Typically nitrogen is transformed almost completely to nitrate (nitrification) [1]. Partial denitrification (40 to 50%) (transformation of nitrate to nitrogen gas) occurs in properly operated filters [2].

5. California Regional Water Quality Control Board. Central Coast Region. Water Quality Control Plan. 1989.

Flow Diagram:




| Los Osos Wastewater Study | Figure B2-9 |
|---|---|
| SEPTIC TANK FOLLOWED BY INTERMITTENT SAND FILTER WITH EFFLUENT RECIRCULATION FOR INTERNAL DENITRIFICATION | |
| M&E Metcalf & Eddy | Date: May 1995 |

## SEPTIC TANK WITH INTERMITTENT SAND FILTER AND SOIL ABSORPTION FIELD

**Description.** A septic tank with an internal screened pump vault, followed by an intermittent sand filter and a soil absorption system is used as an alternative to the traditional on-site treatment system comprised of a septic tank followed by a soil absorption system. The intermittent sand filter system, consisting of a buried septic tank and a sand filter bed, is used principally to further treat the septic tank effluent. Wastewater is collected in the septic tank where primary treatment is accomplished by gravity separation of the solids from the liquid. Solids are collected and stored in the tank, forming sludge and scum layers. Anaerobic and facultative decomposition occurs in these layers and although the volume of the solid material is continually reduced by this decomposition, there is a net accumulation of sludge in the tank [1]. Thus, periodic pumping of the contents of the tank is required.

Effluent from the septic tank is pumped to the intermittent sand filter. The filter bed consists of 2 to 3 feet of sand with a surface distribution system and a gravel underdrain system to collect the filter effluent.The intermittent sand filter typically is dosed 12 to 48 times per day. By reducing the amount of wastewater applied to the filter with each dose, the treatment efficiency of the filter is enhanced. The intermittent sand filter removes pollutants by physical, chemical and biological transformations. The intermittent sand filter is sized using a hydraulic loading rate of 1 to 3 gal/sq ft/day.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** The RWQCB typically does not set discharge requirements for individual onsite systems. However, community onsite systems (greater than five residential units) and nonresidential onsite systems may be regulated by discharge requirements. Discharge requirements are typically limits on the quality of the effluent in terms of such constituents as biochemical oxygen demand (BOD), suspended solids, settleable solids, nitrogen, various salts (sodium, chloride, sulfate, etc.), turbidity, and grease and oil.

The RWQCB has established a design criterion for nitrogen discharges from community onsite systems at 40 grams/acre/day. There is also a prohibition on nitrate discharges from community systems exceeding 80 grams/acre/day [6].

Primary treatment (septic tank effluent) is generally capable of removing 30 to 85% of the $BOD_5$ and SS, and about 25 to 30% of the total nitrogen. Intermittent sand filters produce a high quality effluent with respect to $BOD_5$ and SS. Generally, over 90% removal of $BOD_5$ and SS is possible, reducing the effluent concentration to less than 10 mg/L. Providing the aerobic conditions within the filter, nitrogen is transformed almost completely by the nitrification process nitrate (conversion of ammonium $NH_4^+$ to nitrate $NO_3^-$) [2]. The denitrification process (conversion of nitrate $NO_3^-$ to nitrogen $N_2$ gas) occurs simultaneously in micro pockets within the filter. Routinely, up to a 45% reduction in total nitrogen is achieved [1] with an intermittent sand filter. Additional denitrification may occur in the soil column.

**Reclamation Criteria.** Not applicable.

**Technical Aspects**

**Reliability.** Properly designed, constructed, and operated intermittent sand filters will produce effluent of very high quality for domestic wastewater [2]. Routine operation and maintenance consists of periodic maintenance of the pump system used to dose the filter, routine maintenance to the filter bed if the bed becomes clogged and periodic pumping of accumulated solids in the septic tank.

**Flexibility.** Intermittent sand filters systems can be used to serve individual homes or small commercial/institutional users.

**Precedents.** More than 10,000 intermittent sand filters are in use throughout the United States to treat wastewater from individual homes as well as small commercial and institutional developments.

**Aquifer Recharge Capability.** Percolation of the intermittent sand filter effluent will recharge the underlying aquifer.

**Costs**

Costs for a typical intermittent sand filters, based on ENR 7252:

Capital Costs:

| | |
|---|---|
| Inspection and design | $ 850[j] |
| Permit | $ 150 |
| Sewer, septic tank and screened effluent vault, and soil absorption system | $3,500 |
| Intermittent sand filter | $4,300 |
| Total | $8,800 |

j. Average cost of services required by a septic tank maintenance district or comparable agency. Includes work such as percolation testing, site evaluation, design drawings and specifications, construction inspection, and right-of-way or easement acquisition.

Annual Operation and Maintenance Cost:

| | | |
|---|---|---|
| Septage pumping (every 5 to 10 years) | $ 33/year | (Range $15 to $50) |
| Pump chamber and filter restoration | $100/year | |
| Energy Costs (pump) 50 to 250 kWh/yr @ $0.08/kWh | $ 12/year | (Range $4 to $20) |
| Total | $145/year | (Range $279 to $470) |

Costs based on [3], Fact Sheet 7.1.8.

Present Worth Costs:

Present worth factor, interest rate 8⅜%, 20 years, (P/A) = 9.5595.

PW cost = Capital Cost + (P/A)x(Annual O&M Cost)
= $8,800 + 9.5595 x $ 145/year
= $10,200

For comparison purposes, this cost includes a new, replacement septic tank and leach field or pit plus the additional process. This cost could be reduced if the existing septic tank and/or leach field or leach pit can be used without replacement.

**Other Factors**

**Land Requirement.** System requires 100 sq ft for the filter, in addition to the septic tank and soil absorption field.

**Environmental Impacts.** In Los Osos/Baywood Park, onsite systems in low-lying areas are subject to flooding, which may render this system ineffective for the duration of the flooding.

**References**


1. Metcalf & Eddy, Inc., Wastewater Engineering: Treatment, Disposal, and Reuse 3rd Edition, McGraw-Hill, Inc., New York, New York. 1991.

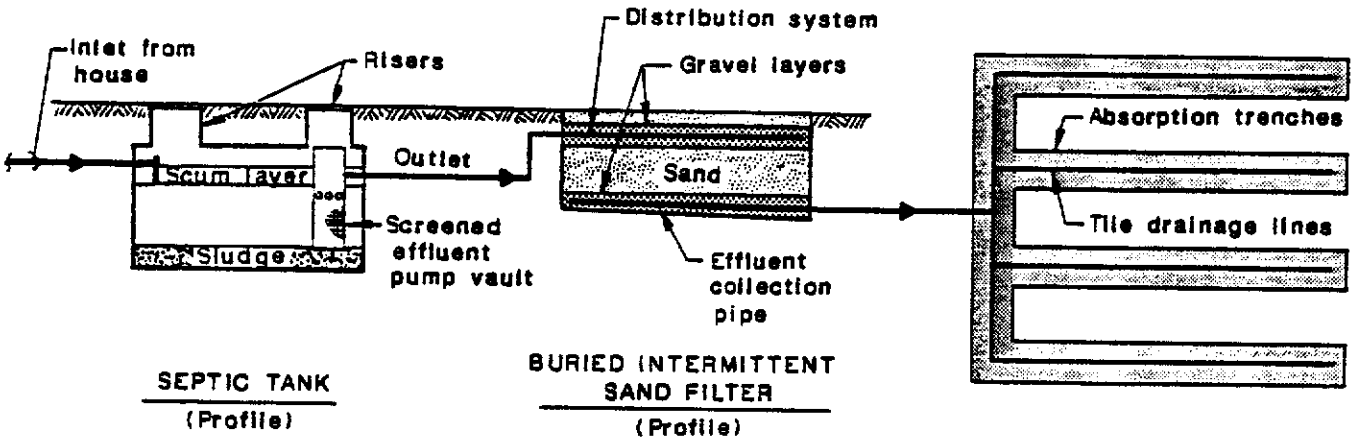
2. U.S. Environmental Protection Agency. On-site Wastewater Treatment and Disposal Systems., Environmental Research Information Center. EPA 625/1-80-012. October 1980.

3. U.S. Environmental Protection Agency. Innovative and Alternative Technology Assessment Manual., Environmental Research Information Center. EPA 430/78-009. February 1980.

4. Tchobanoglous, G. and E.D. Schroeder, Water Quality, Addison-Wesley Publishing Company, Reading, Massachusetts. 1985.

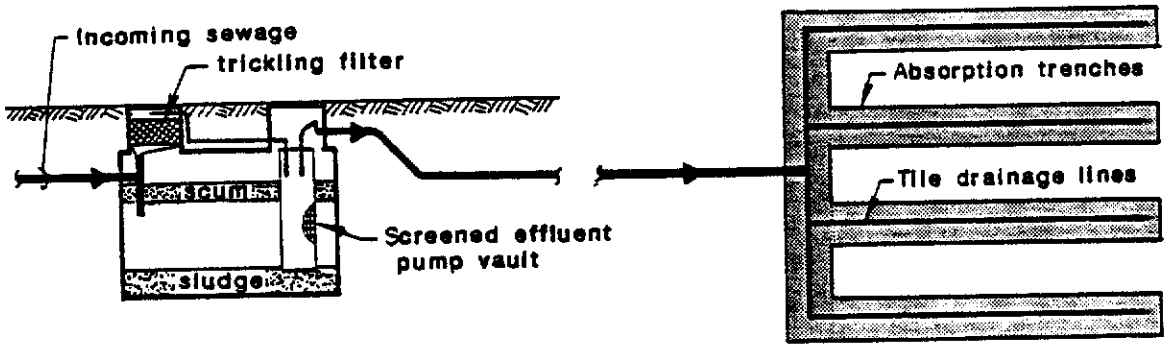
5. California Regional Water Quality Control Board. Central Coast Region. Water Quality Control Plan. 1989.

Flow Diagram:




| | |
|---|---|
| Los Osos Wastewater Study | Figure B2-10 |
| SEPTIC TANK WITH INTERMITTANT SAND FILTER AND SOIL ADSORPTION FIELD | |
| Metcalf & Eddy | Date: May 1995 |

Flow Diagram:




SEPTIC TANK WITH INTERNAL RECIRCULATION
(Profile)

SOIL ABSORPTION FIELD
(Plan)

| | |
|---|---|
| Los Osos Wastewater Study | Figure B2-11 |
| SEPTIC TANK WITH INTERNAL NITRIFICATION/DENITRIFICATION AND SOIL ADSORPTION FIELD | |
| M&E Metcalf & Eddy | Date: May 1995 |

## ONSITE REACTOR

### Description

This proprietary unit is basically a refinement of an extended aeration activated sludge system that incorporates elements of the sequencing batch reactor (SBR) technology. It is similar to an SBR in that there is multiple phase treatment: aeration/nitrification, settling/clarification/denitrification, and decant. However, the process can be operated continuously instead of batches, i.e., influent can continue to fill the reaction chamber while the above processes occur.

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** The process is capable of tertiary BOD, SS, and nitrogen removal. Nitrogen removals of up to 90% have been accomplished.

### Technical Aspects

**Reliability/Flexibility/Precedents.** There are only a few dozen such installations, mostly in Hawaii and Mexico and mostly for commercial wastewater such as restaurants and country clubs. The system has recently been certified to be installed in subdivisions in Nevada based on testing of three samples conducted by the Nevada Bureau of Water Pollution Control. The National Sanitation Foundation has also conducted 15 weeks of testing for certification under its Standard 40. However, little long-term data on performance are available.

**Aquifer Recharge Capability.** Not Applicable.

### Costs

The costs of a new installation for an individual lot and for a clustered system are based on manufacturer and M&E estimates. The manufacturer claims that the equipment can be installed in an existing septic tank, but has never done this.

| Table B2-1. PRESENT WORTH ANALYSIS - CONTINUOUS FEED CYCLIC REACTOR | | |
|---|---|---|
| | Individual lot | Clustered (50,000 gpd) |
| 1. Construction, $ | 6,000-7,400 | -- |
| 1a. 20% contingency, $ | 1,200-1,500 | -- |
| 1b. Subtotal, $ | 7,200-8,900 | 400,000[b] |
| 1c. 20% engineering, $ | 1,400-1,800 | 80,000 |
| 2. Total capital, $ | 8,600-10,000 | 480,000 |
| 3. Operation and maintenance, $/yr | 250 | 24,000 |
| 4. Present worth of O&M, $[c] | 2,400 | 229,000 |
| 5. Total present worth, $[d] | 11,000-13,100 | 709,000 |

a. Includes excavation, backfill, installation, and soil absorption system. First figure is for retrofit into an existing septic tank; second figure is for a new installation.
b. Actual cost of system plus installation and site work.
c. 8⅜% for 20 years.
d. Sum of rows 2 and 4.

## GREYWATER SEPTIC TANK WITH SOIL ABSORPTION FIELD AND WATERLESS TOILETS

### Description

Wastewater generated in the household is separated into greywater and toilets wastes. Greywater is comprised of all waters generated in the household that do not contain toilet wastes including: water used for bathing, personal hygiene, laundry, dish washing, drinking, cooking and miscellaneous cleaning. Greywater accounts for about 60% of the wastewater generated by the average household in California [1]. Greywater contains about 67% of the $BOD_5$ and phosphorus and 33% of the suspended solids, and only 20% of the nitrogen found in combined wastewater (greywater and blackwater) [1]. A typical greywater treatment system consists of a buried septic tank with an internal screened vault, where the water is collected and scum, grease, and settleable solids are removed by gravity separation, and a soil absorption field. Effluent is discharged, usually by gravity, to a soil absorption system for disposal.

The remaining 40% of the wastewater is called blackwater and consists of water used for toilet flushing. Two types of waterless toilets, incinerator and composting are considered. Both types eliminate the blackwater contribution from the household wastewater.

The incinerator toilet operates by incinerating human organic wastes. Wastes are deposited into a combustion chamber and are incinerated upon a signal [4]. The process can be fueled by gas, fuel oil or electricity (electric operated incinerated toilets are considered in this study since gas and fuel-oil-operated incinerator toilets require more frequent maintenance). An ash residue is generated which must be empties at least twice weekly, depending on the toilet usage. The incinerator toilet reduces the volume of human waste by 99% (approximately 1 tablespoon of clean ash is generated [6]) which can be deposited into the household garbage.

The composting toilet operates by collecting and retaining the human wastes in the composter where, along with carbon-rich bulking agents, aerobic bacteria decompose the waste into water vapor, carbon dioxide, and a stable end-product. The composting process can reduce the volume of the human wastes by 95%. Composted properly, the toilet wastes decompose to a nuisance free, humus-like material that can be used as a soil conditioner in agricultural or horticultural applications [3].

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** For an incinerator or compost toilet, there is no discharge. Greywater treatment is accomplished by gravity separation of the solids and liquid. Pollutants are removed from the septic tank effluent by natural absorption and biological processes in the soil absorption system. Biological oxygen demand ($BOD_5$), suspended solids(SS), bacteria, viruses, heavy metals and complex organic compounds are absorbed by the soil underlying the absorption zone. The total nitrogen load to the greywater septic tank is reduced by 40 to 90% by the separation of toilet wastes from greywater [4]. Total nitrogen load to the greywater septic tank ranges from 4 to 60 mg/L [2,4]. No data

Annual Operation and Maintenance Cost

| | | |
|---|---|---|
| Plastic liners for toilets | $300/year | |
| Septage pumping (every 8 to 10 years) | $ 15/year | (Range $15 to $50) |
| Energy | $ 234/year | (Based on 8 kWh/day @ $0.08/kWh) |
| Total | $549/year | |

Annual Operation and Maintenance Costs based on [4] Fact Sheet 7.2.2 and Clivus Multrum, Inc. Use lower end of range for septage pumping due to the reduced solids accumulation in the greywater septic tank. Likewise, use the lower end of the range for the energy costs due to only a small ventilation fan is required for the composting toilet.

Present Worth Costs

Present worth factor, interest rate 8⅜%, 20 years, (P/A) = 9.5595.

PW cost = Capital Cost + (P/A)x(Annual Cost)
= $10,800 + 9.5595 x $549/year
= $16,000

**Other Factors**. Potential environmental impacts include odors and health hazards from incomplete decomposition of improperly maintained compost toilets. For incinerator toilets, potential problems include odors and fire or explosion. Also for incinerator toilets, the energy cost is much higher than any other onsite alternative. In Los Osos/Baywood Park, onsite systems in low-lying areas are subject to flooding, which may render the grey water system ineffective for the duration of the flooding.

## References


1. Ingham, A.T., Resident Greywater Management in California, State of California, State Water Resources Control Board, Division of Planning and Research. January 1980.

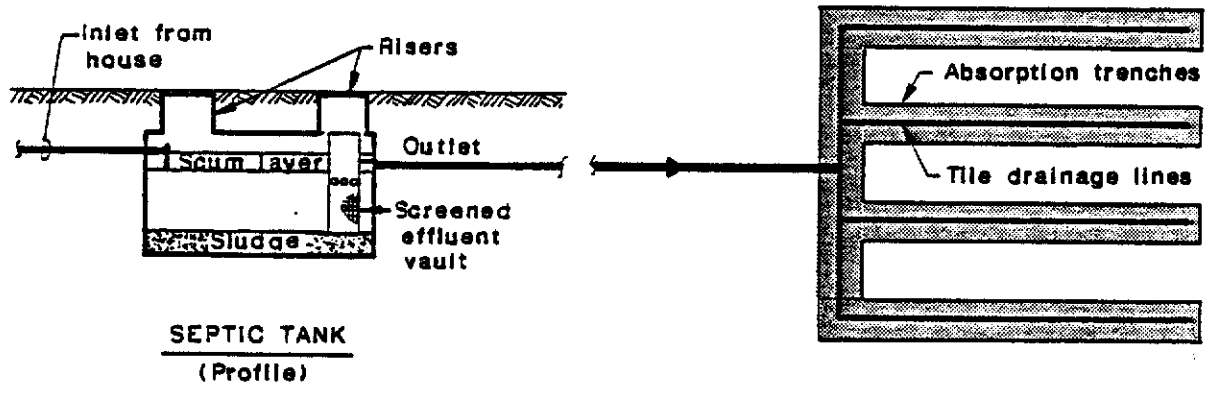
2. U.S. Environmental Protection Agency. On-site Wastewater Treatment and Disposal Systems., Environmental Research Information Center. EPA 625/1-80-012. October 1980.

3. Metcalf & Eddy, Inc., Wastewater Engineering: Treatment, Disposal, and Reuse 3rd Edition, McGraw-Hill, Inc., New York, New York. 1991.

4. U.S. Environmental Protection Agency. Innovative and Alternative Technology Assessment Manual., Environmental Research Information Center. EPA 430/78-009. February 1980.

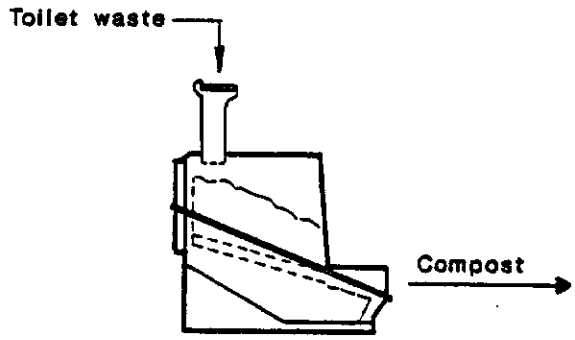
5. Tchobanoglous, G. and E.D. Schroeder, Water Quality, Addison-Wesley Publishing Company, Reading, Massachusetts. 1985.

## Flow Diagram:




SEPTIC TANK
(Profile)

TYPICAL SOIL ABSORPTION FIELD
(Profile)




COMPOSTING TANK
(Profile)

| | |
|---|---|
| Los Osos Wastewater Study | Figure B-2-12 |
| GREYWATER SEPTIC TANK WITH SOIL ADSORPTION FIELD AND COMPOSTING TOILET | |
| M&E Metcalf & Eddy | Date: July 1995 |

# APPENDIX B3

## OFFSITE TREATMENT
## (NEIGHBORHOOD OR CLUSTERED)

## OFFSITE TREATMENT (NEIGHBORHOOD OR CLUSTERED) DESIGN CRITERIA

For comparison purposes, the design criteria for offsite systems are based on previous faility plans [Engineering Science. Phase Two - Basis of Design Report. CSA No. 9. February 1987] as summarized below.

Flow (Stage 1)

| | |
|---|---|
| Average daily | 1.6 mgd |
| Peak dry weather | 3.2 mgd |
| Peak wet weather | 3.9 mgd |

Untreated wastewater characteristics

| | |
|---|---|
| Biochemical oxygen demand (BOD) | 220 mg/L |
| Suspended solids (SS) | 220 mg/L |
| Ammonia nitrogen | 40 mg/L |

## SEQUENCING BATCH REACTOR (SBR)

### Description

The SBR is an activated-sludge type process operated in a batch mode instead of continuously. SBR is a secondary treatment process designed to remove biochemical oxygen demand (BOD) and suspended solids (SS) from incoming wastewaters. Nitrification and denitrification are also possible with proper design and modifications to operating parameters. Preliminary treatment such as screening, comminution and/or grit removal normally precede the process.

Aeration, sedimentation, nitrification/denitrification, and decant processes occur in the same basin, typically with five steps.

1. Fill basin
2. Aerate to achieve biological organic stabilization and nitrification
3. Settle to allow anoxic conditions to develop and denitrification to occur
4. Decant of liquid portion to subsequent process
5. Withdraw settled solids

At least two basins in parallel are used so that treatment can be continuous, i.e. while one basin is filling or in aeration, incoming flow can be diverted to another basin. A typical cycle lasts 4 to 12 hours and must be determined empirically.

The SBR was the secondary treatment process recommended in previous facilities plans for Los Osos [1,2]. The process is typically proceeded by preliminary treatment such as screening and grit removal, but primary sedimentation is not generally required.

### Conformance with Laws, Regulation, Criteria

**RWQCB Discharge Requirements.** The SBR generally is capable of over 90% removal of BOD and SS. If properly designed and operated, discharge requirements for BOD and SS should be met consistently. Nitrogen removal is typically 75% ±, based on limited data, since most existing SBR plants are not designed for nitrogen removal.

**Reclamation Criteria.** The SBR can be part of an overall treatment train designed to conform to these criteria. However, additional processes for coagulation, filtration, and disinfection will be required to meet specific bacteriological and turbidity limits.

### Technical Aspects [3,4,5,6]

**Reliability.** The SBR process can be automated and generally requires little day-to-day operator attention. But proper operation requires skilled and experienced operators and

regular inspection and maintenance of equipment. The process will need adjustments in cycle times to optimize performance as wastewater characteristics change. The decant system (step 4 above) is critical because the clarity of the liquid portion will affect efficiency of downstream processes, especially disinfection.

**Flexibility.** The SBR is well-suited to small, primarily domestic wastewater flows. Operation can be adjusted to wide flow variations and quality changes.

**Precedents.** The SBR is not as widespread as conventional activated sludge systems or other biological secondary treatment systems, e.g. There are fewer than 100 applications in the United States, mostly in small communities with wastewater flows <2 mgd.

**Aquifer Recharge Capability.** Not applicable.

**Costs**

The construction cost of the SBR itself has been estimated in previous facility plans [1,2]. This figure has been updated using vendor and manufacturer quotes. Capital, operation and maintenance, and present worth costs are summarized in Table B3-1, and will be used as the basis of comparison with other alternative secondary treatment processes.

**Table B3-1. PRESENT WORTH ANALYSIS - SBR**

| | |
|---|---|
| 1. Construction, $ | 2,000,000 |
| 1a. 20% contingency, $ | 400,000 |
| 1b. Subtotal, $ | 2,400,000 |
| 1c. 20% contractor overhead and profit, | 480,000 |
| 2. Total capital, $ | 2,880,000 |
| 3. Operation and maintenance, $/yr | 54,000 |
| 4. Present worth of O&M, $[a] | 516,000 |
| 5. Total present worth, $[b] | 3,396,000 |

a. 8⅜% for 20 years.
b. Sum of rows 2 and 4.

**Other Factors** [3,4,5,6]

The SBR is a relatively new type of biological wastewater treatment system. As such, improvements continue to be made as users and manuafacturers gain more experience with operations. Land requirements are minimal, typically less that one acre for a plant to serve Los Osos, excluding area for other treatment processes. Solids to be processed and disposed from a SBR unit include sludge; grit and screenings from preliminary treatment also need to be handled. Odors are seldom an issue, but can be a generated during the filling or aeration step if the wastewater is already septic upon entering the plant.

**References**


1. Engineering-Science. Phase One - Sewerage Planning Study. CSA No. 9 - Los Osos, Baywood Park, Cuesta-By-The-Sea. Prepared for County Engineering Department. San Luis Obispo County. May 1986.

2. Engineering-Science. Phase Two - Basis of Design Report. CSA No. 9 - Los Osos, Baywood Park, Cuesta-By-The-Sea Sewerage Project. Prepared for County Engineering Department. San Luis Obispo County. February 1987.

3. Summary Report. Sequencing Batch Reactors. US Environmental Protection Agency. Center for Environmental Research Information. Cincinnati, OH. EPA/625/8-86/011. October 1986.

4. Sequencing Batch Reactors For Nitrification and Nutrient Removal. US Environmental Protection Agency. Office of Water. Washington, D.C. EPA 832-R-92-002. September 1992.

5. Summary Report. Small Community Water and Wastewater Treatment. US Environmental Protection Agency. Office of Research and Development. Washington, D.C. EPA/625/R-92/010. September 1992.

6. Wastewater Treatment/Disposal for Small Communities. US Environmental Protection Agency. Office of Research and Development. Washington, D.C. EPA/625/R-92/005. September 1992.

## INTEGRATED PONDING SYSTEMS

### Description

The integrated pond system consists of a series of ponds that are used for settleable solids removal, biological oxidation, nitrogen removal, and sludge stabilization. A schematic diagram is shown in Figure B3-1. Degritted wastewater is initially introduced into a fermentation zone that is intensely anoxic. This zone, designed to retain all settleable solids indefinitely, stabilizes the solids through digestion (methane fermentation). About 60 percent of the incoming BOD is removed as well as nearly all of the suspended solids and some nitrogen. Any nitrate in the incoming wastewater is converted to nitrogen gas that is discharged to the atmosphere.

Effluent from the fermentation step passes into a high rate aeration pond where mechanical aeration is provided for oxidation of residual BOD and for odor control. Effluent from a subsequent pond is also recycled to the aeration pond to assure presence of acclimated bacteria for the treatment of wastewater. In the aeration pond, residual ammonia is converted to nitrate.

From the aeration pond, the aerated solids pass into a second fermentation pit for the removal and stabilization of settleable solids. Further denitrification of the wastewater also occurs in this pit.

Following the second fermentation pit, effluent passes into a third fermentation pit, two aerobic oxidation ponds, and a maturation pond for further stabilization of the wastewater. Additional BOD and nitrogen removal occurs as well as partial disinfection. Algae are present in the aerobic and maturation ponds and the final effluent requires further treatment by dissolved air flotation and/or filtration to achieve suspended solids concentration below 10 mg/L. Disinfection by chlorination is also required to meet permit requirements.

An alternative integrated pond system design uses oxidation ponds in lieu of an aerated pond but approximately 40 percent more land area is required.

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** Effluent from the pond system followed by dissolved air flotation, and disinfection should meet proposed RWQCB requirements for BOD, SS, Nitrogen removals can be as high as 90%.

**Reclamation Criteria.** The integrated pond system can fit into an overall treatment train designed to meet reclamation criteria. Additional processes need to be added for coagulation, filtration, and disinfection to meet regulation for reclamation.

## Technical Aspects

**Reliability.** Aerated ponds systems of various types have been used in many small communities in California and the United States. They are easy to operate and do not generally require highly skilled operating personnel. One of the principal problems with pond systems relate to algae growth, especially during the warm summer months. Algae blooms cause an increase in suspended solids; removal of algae by special systems such as dissolved air flotation may be required. Dissolved air flotation systems require much more attention than the ponds in order to assure that proper suspended solids removals are attained.

**Flexibility.** Flexibility in operating an integrated pond system is limited to adjusting the aeration rate and effluent recycle. Because the ponds system has a long retention time and significant buffering capability, variation in wastewater characteristics should be easily assimilated. Pond systems require large areas of land and therefore they are not easy to expand unless additional land is purchased and reserved for expansion.

**Precedents.** Integrated pond systems have been developed by Dr. William Oswald and installations in Hollister and St. Helena, California are cited in a report to the County of San Luis Obispo [1]. The St. Helena facility treats winery wastewater that is very difficult to treat. Results as reported by Dr. Oswald have been successful.

**Aquifer Recharge Capability.** Not Applicable.

## Costs

The estimated capital, operation and maintenance, and present worth costs are summarized in Table B3-2.

## Other Factors

Land area requirements = 34 acres for initial design and about 46 acres for ultimate buildout; these areas include buildings, roads and setbacks.

## Advantages

- The pond system is simple and relatively easy to operate.
- Design can accommodate nitrification and denitrification.

| Table B3-2. PRESENT WORTH ANALYSIS -- INTEGRATED PONDING SYSTEMS | |
|---|---|
| 1. Construction, $ | 3,477,000 |
| 1a. 20% Contingency, $ | 695,000 |
| 1b. Subtotal, $ | 4,172,000 |
| 1c. 20% engineering services, $ | 834,000 |
| 2. Total capital, $ | 5,066.000 |
| 3. Operation and maintenance cost, $/yr | 130,000 |
| 4. Present worth of O&M (x9.55), $[a] | 1,245,000 |
| 5. Land cost (34 acres at 22,000), $ | 748,000 |
| 6. Total Present Worth, $[b] | 7,059,000 |

a. 8 3/8% for 20 years.
b. Sum of rows 2, 4, and 5.

**Disadvantages**

- Ponds systems a require larger land area.
- Pond system is difficult to expand unless additional land is required and reserved for expansion.
- Addition of dissolved air flotation for algae systems increases operating complexity and cost. Chemical dosages will have to be carefully controlled to ensure adequate suspended solids removal is maintained.
- Information on year-round nitrogen removal performance is not readily available.

**References**

1. Swanson Oswald Associates: Los Osos/Baywood Park, Questa By The Sea, (CSA No. 9) Alternative Technology for Wastewater Treatment, Report to County of San Luis Obispo, February 25, 1992.

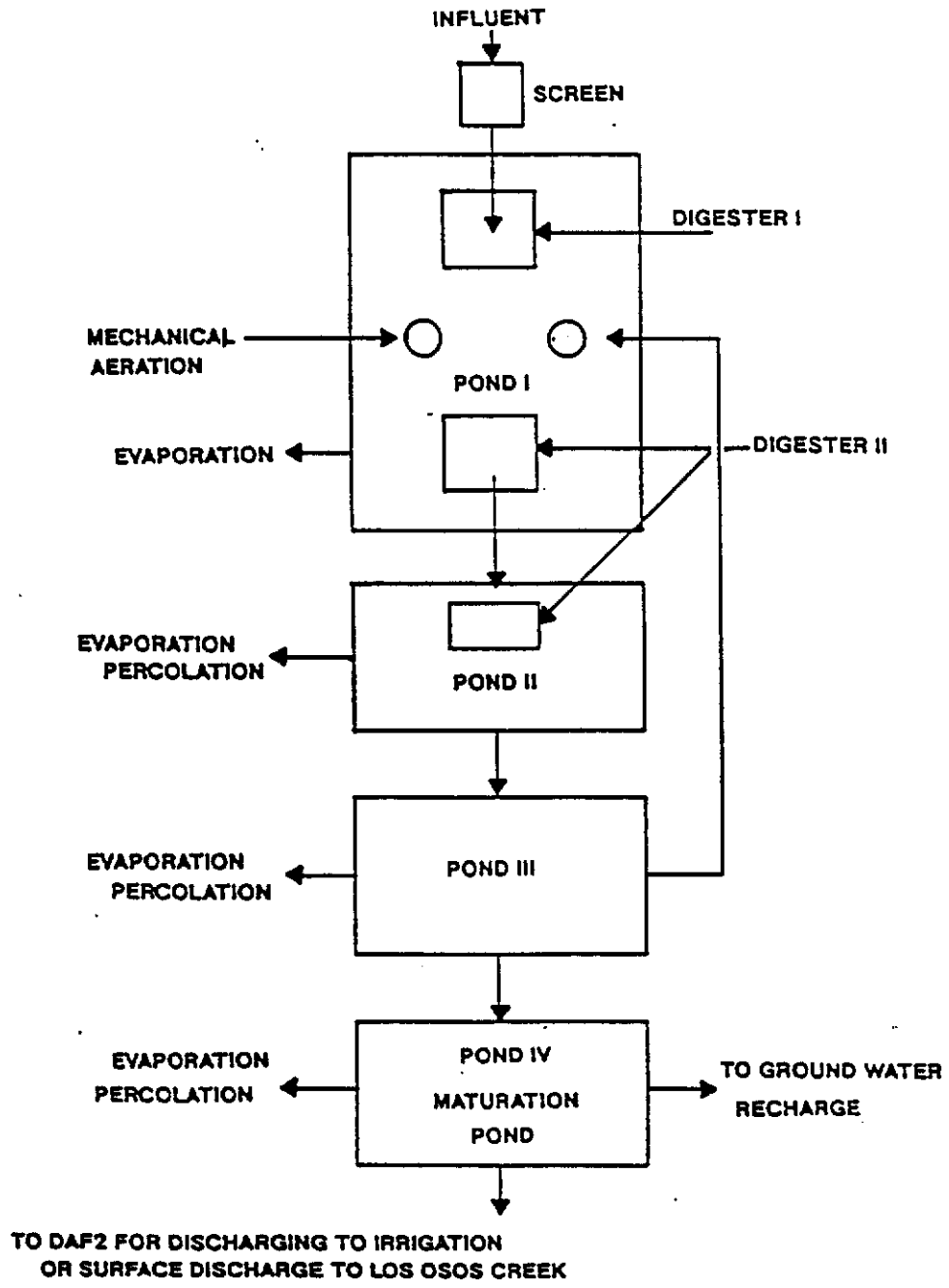



**FIGURE B3-1**

**SCHEMATIC DIAGRAM OF AN INTEGRATED POND SYSTEM**

## CONSTRUCTED WETLANDS

### Description

Constructed wetlands are designed to treat primary, pond, or secondary effluent using emergent plants such as reeds, bulrush and cattails. The flow path can be either subsurface or free water surface (FWS). The free water surface wetland, more widely used for larger than 1 mgd flows, will be considered for either septic tank effluent or aerated pond effluent at Los Osos. BOD is removed by the establishment of attached biological growth on the plant stems and roots. Suspended solids are removed by entrapment in the vegetation and by sedimentation. Nitrogen removal is accomplished by nitrification-denitrification with a minor amount of plant uptake.

The constructed wetland for Los Osos would be a shallow (1 ft depth), emergent, free water surface wetland. To achieve 90 percent nitrogen removal with a minimum expected water temperature of 15°C will require a detention time of 10 days. The area required would be 50 acres.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements**. Constructed wetlands are capable of achieving 90 percent removal of BOD and SS [1, 2]. Nitrogen removal requires long detention times, depending on the water temperature [3,4]. The 5 mg/L total nitrogen concentration can be achieved using constructed wetlands.

**Reclamation Criteria**. Constructed wetlands can be a part of an overall treatment system to conform to the reuse criteria for recharge. Additional treatment is required including coagulation, filtration, and disinfection.

### Technical Aspects

**Reliability**. Constructed wetlands are simple to operate and can tolerate variations in wastewater flows and strength. Periodic harvesting (on a 3 to 5 year basis) is generally needed to maintain consistent hydraulic pathways through the vegetation.

**Flexibility**. Constructed wetlands consist of multiple parallel cells with long narrow flow paths. Cells can be added to provide more area for additional flows. A number of decentralized wetlands will work as well as one 50 acre wetland.

**Precedents**. Some of the 200 constructed wetlands in the U.S. are required to meet BOD and SS limits only. Others have been implemented to remove nitrogen. The wetlands in operation have generally been designed to meet BOD and SS limits with ammonia standards as low as 2 mg/L. Total nitrogen standards are limited to a handful of systems.

**Aquifer Recharge Capability.**

Percolation of constructed wetland can be used to recharge groundwater.

**Costs**

Capital costs and O&M costs are presented in Table B3-3. Costs replace the SBR and the sludge handling costs. If septic tank effluent is received, deduct $600,000 for the aerated lagoon (primary treatment equivalent). Sludge will be removed from the basins every 5 years and the O&M costs reflect the cost for sludge handling.

**Other Factors**

Land requirements are 50 acres for the constructed wetlands.

Table B3-3. CONSTRUCTED WETLANDS - PRESENT WORTH ANALYSIS

| | |
|---|---|
| 1. Construction, $ | 4,300,000 |
| 1a. 20% contingency, $ | 860,000 |
| 1b. Subtotal, $ | 5,160,000 |
| 1c. 20% engineering services $ | 1,032,000 |
| 2. Total Capital, $ | 6,192,000 |
| 3. O&M, $/year | 30,000 |
| 4. P.W. of O&M (x9.5595), $[a] | 287,000 |
| 5. Land cost (60 acres @ 15,000), $ | 900,000 |
| 6. Total present worth, $[b] | $7,092,000 |

a. 8 3/8% for 20 years.
b. Sum of rows 2, 4, and 5.

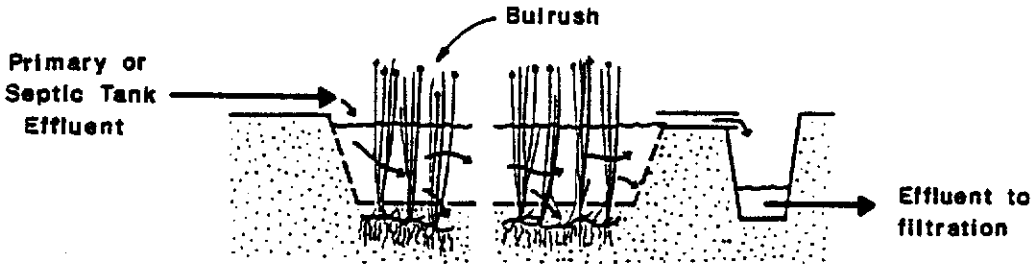
## References


1. Water Pollution Control Federation. *Natural Systems for Wastewater Treatment. Manual of Practice FD-16.* 1990.

2. Reed, S.C. E.J. Middlebrooks, and R.W. Crites. *Natural Systems for Waste Management and Treatment.* McGraw-Hill Book Company. New York, NY, 1988.

3. Hammer, D.A. and R.L. Knight. *Designing Constructed Wetlands for Nitrogen Removal. In: Proceedings, Wetland Systems in Water Pollution Control.* University of New South Wales, Sydney, Australia. 1992.

4. Reed, S.C., R.W. Crites, and E.J. Middlebrooks. *Natural Systems for Waste Management and Treatment.* Second edition. McGraw-Hill Book Company New York, NY. 1994 (in press).




| | |
|---|---|
| Los Osos Wastewater Study | Figure B3-2 |
| CONSTRUCTED WETLANDS SYSTEM | |
| Metcalf & Eddy | Date: May 1995 |

## TRICKLING FILTER WITH DENITRIFICATION

### Description

A trickling filter or bio-filter is an attached growth biological process in which microorganisms responsible for treatment (slime layer) are attached to a surface (filter media) that is exposed periodically to wastewater. The filter media usually consists of either rock or a variety of plastic packing materials. Conventional trickling filters are typically between 5-10 feet tall and use a rock medium. Developed more recently, bio-filters range in height from 15-30 feet and are filled with a high porosity plastic medium[1]. For the purposes of this study and based on the characteristics of the wastewater influent, plastic media has been chosen as the media of choice. Plastic media is more effective than rock media because of its higher surface area-to-volume ratio and its reduction of such problems as minimal void area and the potential for biomass plugging. Trickling filters are constructed with an underdrain system for collecting the treated wastewater and any biological solids that have become detached from the media[2].

Denitrification can be accomplished using denitrification filters. Denitrification filters (granular media filters or deep bed filter denitrification) have been used successfully in the U.S. since the 1970s. In current practice, denitrification filters follow nitrification and serve the dual functions of filtration and denitrification. They rely on heterotrophic microorganisms that grow on and between the coarse media in deep bed filters. Any carbon source suitable for denitrification with any other denitrification process is also suitable for denitrification filters. Typically, methanol, at a dosage of 3 mg/l per mg/l of $NO_3$-N is used.

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** The proposed treatment system integrated with additional processes upstream and downstream (i.e. coagulation, filtration, and disinfection) is capable of reducing BOD, and TSS to 5 mg/l. Typical nitrogen removal is as high as 80%.

**Reclamation Criteria.** Trickling filters can be integrated into an overall treatment train designed to meet reclamation criteria. Additional processes need to be added for coagulation, filtration, and disinfection to meet the specific regulations.

### Technical Aspects

**Reliability.** Due to its nominal amount of moving parts, minimal instrumentation (or no instrumentation), the trickling filter operates with very low maintenance.

**Flexibility.** Trickling filters are capable of attenuating the peaks from surges of BOD loading through the treatment plant.

**Precedents.** Trickling filters have been used to provide biological wastewater treatment for nearly 100 years. In the past 10 years a number of dual purpose trickling filters have been successfully designed and operated to simultaneously remove BOD and to nitrify.

**Aquifer Recharge Capability.** Not Applicable.

**Costs**

The estimated capital, operation and maintenance, and present worth costs are summarized in Table B3-4.

Table B3-4. PRESENT WORTH ANALYSIS

| | |
|---|---|
| 1. Construction, $ | 2,500,000 |
| 1a. 20% Contingency, $ | 500,00 |
| 1b. Subtotal, $ | 3,000,000 |
| 1c. 20% Engineering Services, $ | 600,00 |
| 2. Total Capital, $ | 3,600,000 |
| 3. O&M, $/yr | 7,000 |
| 4. Present Worth O&M (x 9.55), $[a] | 68,000 |
| 5. Total Present Worth, $[b] | 3,668,000 |

a. 8-3/8% for 20 years.
b. Sum of rows 2 and 4.

**Advantages**

- Low operating costs.
- Trickling filters are able to tolerate shock loads in small plants.
- Trickling filters have minimum requirement for skilled technical supervision.
- Denitrification filters can provide dual functions of filtration and denitrification.

## Disadvantages

- Vulnerable to climatic changes because of the mechanism of exposing wastewater droplets to large quantities of air at ambient temperature.
- Cannot meet requirements of effluent standards without additional processing.
- Process performance is less reliable in satisfying secondary treatment requirements consistently.

## References


[1] Department of Civil and Environmental Engineering, University of California, Davis, *The Cost of Wastewater Reclamation in California*, 1992.

[2] Metcalf & Eddy, Inc.: *Wastewater Engineering: Treatment, Disposal, and Reuse*, Third Edition, McGraw-Hill, 1991.

[3] Water Environment Federation, *Design of Municipal Wastewater Treatment Plants, WEF Manual of Practice No. 8*, 1992.

[4] Misco Pacific Quotation from Munters Corporation dated February 24, 1994.

## ROTATING BIOLOGICAL CONTACTORS

### Description

A rotating biological contactor (RBC) consists of a series of closely spaced circular disks of high density plastic media mounted on a horizontal shaft. The disks are partially submerged in wastewater and are rotated slowly through it. Biological growths become attached to the surfaces of the disks and eventually form a biomass layer over the entire wetted surface area of the disks. The rotation of the disks alternately contacts the biomass with the organic material in the wastewater and then with the atmosphere for adsorption of oxygen. The disk rotation effects oxygen transfer and maintains the biomass in aerobic condition. A typical RBC schematic is shown in Figure B3-3.

In most RBC installations, the shaft mounted disks are arranged in series of stages and the organic loading changes from one stage to the next as the wastewater is treated. To account for the higher organic loading at the entrance to the RBCs, more shafts can be used in the initial stages, tapering to fewer shafts in the following stages. As alternative, step feeding can be used wherein the wastewater is introduced at more than one stage.

Both mechanical and air drive methods can be used for RBCs. Mechanical drive systems consist of a motor, speed reducer, and V-belt or roller chain components. Some manufacturers offer air drives. An air drive assembly has deep plastic cups attached to the perimeter of the media, and an air header located beneath the media. Forced release of the air into the cups creates a buoyant force that causes the shaft to turn. Air-drive RBCs can provide additional oxygen to the biomass.

For nitrogen removal, a two-stage system is required. In the first stage, BOD reduction and nitrification occurs. In the second stage, denitrification occurs through the use of submerged discs in an anoxic environment. For odor control, RBCs are provided with fiberglass covers.

RBC installations commonly use primary clarifiers ahead of the RBC units. Final clarifiers are also required for final removal of biological solids.

A schematic diagram for the facilities required for an RBC system for Los Osos is shown in Figure B3-4. For the purposes of preparing a comparative cost estimate, an aerobic digester is used for sludge stabilization. After stabilization, sludge is discharged to the sludge dewatering facilities.

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** An RBC is capable of over 90% removal of BOD and suspended solids. When designed for nitrogen removal, nitrogen removal of up to 80% may

be achieved if totally submerged RBCs are used for denitrification. However, there are not many totally submerged RBCs in operation in the U.S.

**Reclamation Criteria.** The RBC can be integrated into an overall treatment train designed to meet reclamation criteria. Additional processes need to be added for coagulation, filtration, and disinfection to meet the specific regulations.

### Technical Aspects

**Reliability.** High organic loadings can cause the initial stages to become overloaded resulting in odors, and in extreme cases, structural failure of the shafts and media. Because the RBC process has had a history or operating problems, it has fallen out of favor with design engineers and operators. Limited operating data are available to evaluate its operating performance for denitrification.

**Flexibility.** RBC plants can be designed to meet BOD and suspended solids effluent requirements for secondary treatment but the characteristics of the incoming wastewater must be carefully evaluated. If the influent loads are greatly underestimated, septicity can develop in the initial stages resulting in odors and poor performance.

**Precedents.** Rotating biological contactors can be used for secondary treatment, and they can be operated in the seasonal or continuous nitrification and denitrification modes. In the U.S. and Canada, 70% of the RBC systems have been used for secondary treatment for carbonaceous BOD (CBOD) removal only, 25% for CBOD and nitrification, and 5% for nitrification only. Totally submerged RBCs are manufactured for denitrification. Most plants installed are in the range of 1 to 10 mgd in capacity.

**Aquifer Recharge Capability.** Not Applicable.

### Costs

The estimated costs for an RBC based on providing two primary clarifiers, 12-RBCs, two final clarifiers and one aerobic digester are summarized in Table B3-5.

| Table B3-5. PRESENT WORTH ANALYSIS - ROTATING BIOLOGICAL CONTACTORS [5,6] | |
|---|---|
| 1. Construction, $ | 3,840,000 |
| 1a. 20% Contingency, $ | 768,000 |
| 1b. Subtotal, $ | 4,608,000 |
| 1c. 20% engineering services | 922,000 |
| 2. Total capital, $ | 5,530,000 |
| 3. Operation and maintenance cost, $/yr | 79,600 |
| 4. Present worth of O&M, $ (x9.55)[a] | 760,000 |
| 5. Total present worth, $[b] | 6,290,000.00 |
| a. 8-3/8% for 20 years.<br>b. Sum of rows 2 and 4. | |

**Advantages**

- Process uses relatively low amounts of electric energy.
- When properly designed, process is simple and relatively easy to operate.
- Process design can accommodate nitrification and denitrification.
- RBCs are compact and do not take up much space.
- RBC units can be expanded relatively easily.

**Disadvantages**

- Present worth is more than 50 percent higher than other alternatives.
- Design requires careful wastewater characterization, medial selection, and process staging, and method of wastewater feed.
- Organic overloading may cause excessive biological buildup on the media and may cause structural damage to the shafts and media, and excessive odors.

- Sludge from RBCs is not stabilized therefore a separate sludge stabilization process such as anaerobic or aerobic digestion is required.

- RBCs have to be covered and provided with ventilation and odor control equipment to minimize potential odor problems.

- Good operator skills are required.

**References**


1. Metcalf & Eddy, Inc.: Wastewater Engineering: Treatment, Disposal, and Reuse, McGraw-Hill, 1991.

2. Water Environment Federation: Design of Municipal Wastewater Treatment Plants, Vol. 1, WEF Manual of Practice, Nov. 8, 1991.

3. Brenner, R.C. Heidman, J.A. Opatken, E.J., and Petrasek, A.C.: Design Information on Rotating Biological Contactors, U.S. Environmental Protection Agency, EPA/600/2-84-106, June 1984.

4. Water Pollution Control Federation: O & M of Trickling Filters, RBCs and Related Processes, Manual of Practice OM-10, 1988.

5. Envirex, Inc.: SBC Process Design Outline dated February 2, 1994.

6. U.S. Environmental Protection Agency. Estimating Sludge Management Costs, EPA/625/6-85/010, October 1985.

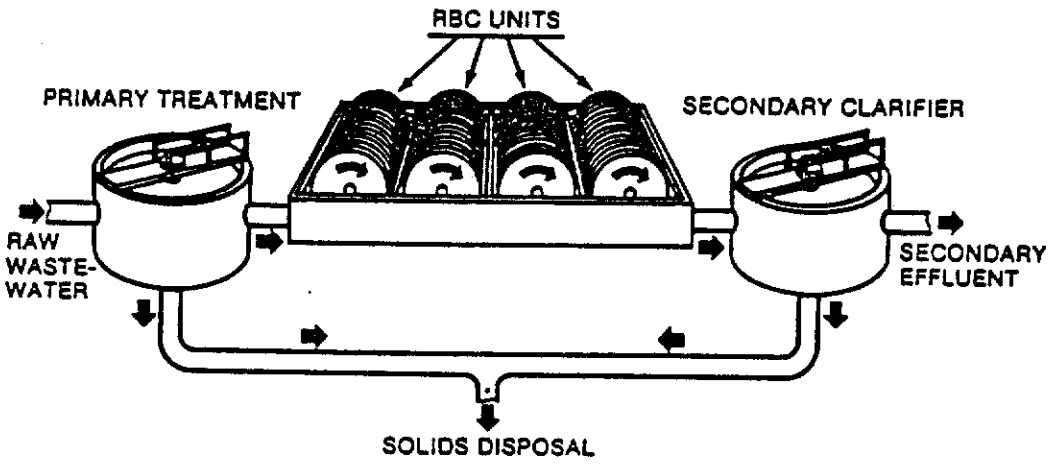



**FIGURE B3-3**

**TYPICAL RBC PLANT SCHEMATIC**

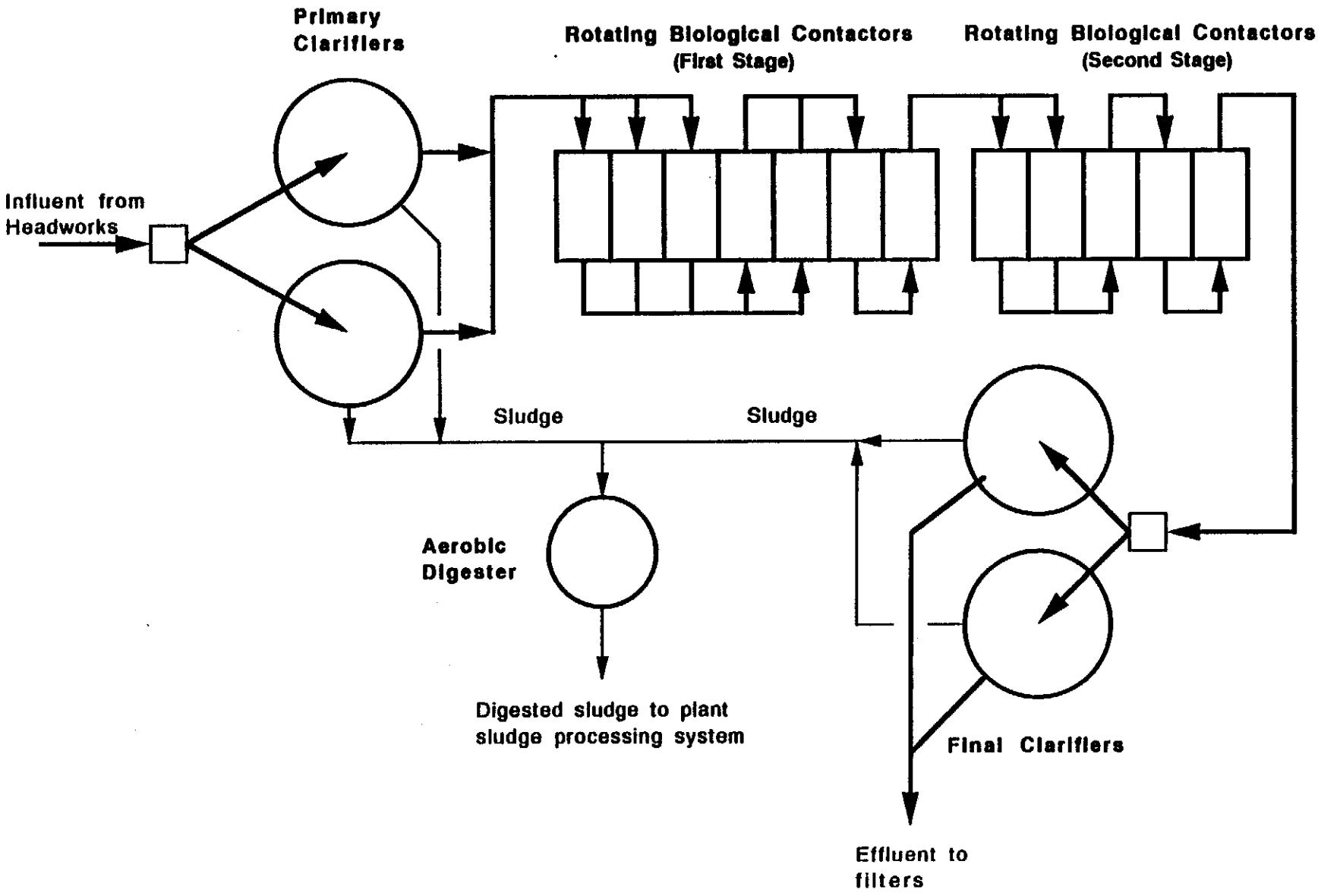



**FIGURE B3-4**

**SCHEMATIC FLOW DIAGRAM OF RBC SYSTEM**

## ACTIVATED SLUDGE

### Description

Activated sludge (A/S) is a continuous flow biological treatment process in which the wastewater is stabilized in a continuously aerated suspension of microorganisms. The stabilization occurs when these micro organisms are "activated" by the organic matter in wastewater and the aeration as oxygen supply. There are numerous variations of the process, mostly the manner in which the air (oxygen) is added to the wastewater. The process is normally preceded by preliminary treatment such as screening, comminution, grit removal, and primary sedimentation and followed by secondary sedimentation. A/S is typically used in small, package plants.

### Conformance with Laws, Regulation, Criteria

**RWQCB Discharge Requirements.** A/S generally is capable of over 90% removal of BOD and SS. If properly designed and operated, the higher discharge requirements for BOD and SS should be met consistently. Without additional treatment processes, the more stringent BOD and SS limits may not be met consistently. The process can also be designed for nitrification, but additional processes may be required to meet the proposed total nitrogen limit.

**Reclamation Criteria.** A/S can be part of an overall treatment train designed to conform to these criteria. However, additional processes for coagulation, filtration, and disinfection will be required to meet specific bacteriological and turbidity limits.

### Technical Aspects [1,2]

**Reliability.** A/S process operation generally produces consistent effluent quality but requires skilled and experienced operators and regular inspection and maintenance of equipment.

**Flexibility.** A/S can be adapted to any type of municipal wastewater. From an operation view, the process is sensitive to variations in flow or influent quality. The extent of nitrification is dependent on temperature and is best above 55° F.

**Precedents.** A/S is among the most widespread types of biological secondary treatment systems. It is in use in thousands of treatment plants nationwide.

**Aquifer Recharge Capability.** Not applicable.

**Costs**

The present worth costs of the A/S system are shown in Table B3-6.

| Table B3-6. PRESENT WORTH ANALYSIS - ACTIVATED SLUDGE | |
|---|---|
| 1. Construction, $ | 2,800,000 |
| 1a. 20% contingency, $ | 560,000 |
| 1b. Subtotal, $ | 3,360,000 |
| 1c. 20% engineering, $ | 672,000 |
| 2. Total capital, $ | 4,032,000 |
| 3. Operation and maintenance, $/yr | 40,000 |
| 4. Present worth of O&M, $[a] | 382,000 |
| 5. Total present worth, $[b] | 4,414,000 |

a. 8⅜% for 20 years.
b. Sum of rows 2 and 4.

**References**

1. Innovative and Alternative Technology Assessment Manual. US Environmental Protection Agency. Office of Research and Development. Cincinnati, OH. 430/9-78-009. February 1980.

2. Metcalf & Eddy. Wastewater Engineering. Treatment, Disposal, and Reuse. Third Edition. New York, McGraw-Hill, 1991.

3. Metcalf & Eddy cost data.

4. Engineering-Science. Phase Two - Basis of Design Report. CSA No. 9 - Los Osos, Baywood Park, Cuesta-By-The-Sea Sewerage Project. Prepared for County Engineering Department. San Luis Obispo County. February 1987.

5. Summary Report. Sequencing Batch Reactors. US Environmental Protection Agency. Center for Environmental Research Information. Cincinnati, OH. EPA/625/8-86/011. October 1986.

## OXIDATION DITCH

### Description

The oxidation ditch is an activated sludge biological treatment process, commonly operated in the extended aeration mode. Typical oxidation ditches consists of a ring-or oval-shaped channel or a multi-channel configuration that is equipped with mechanical aeration devices. Oxidation ditch plants typically include coarse screening, grit removal, one or more closed loop channels, secondary clarification, and disinfection (see Figure B3-5). Primary sedimentation tanks are seldom used.

Wastewater entering the ditch is mixed with return activated sludge from a secondary clarifier and aerated. The mixtures circulates through the channels at a velocity of about 0.8 to 1.2 ft/s. Oxidation ditches typically are designed for hydraulic detention times greater than 10 hrs (24 hrs is the average) and long solids retention times (10 to 50 days) [6]. Oxidation ditches can also be designed to achieve nitrification and denitrification , and phosphorus removal. Because of the long solids retention times, separate sludge digestion may not be necessary to stabilize the sludge further before dewatering and disposal.

Mechanical aeration devices used with oxidation ditches may consists of horizontal shaft disk or brush type aerators, surface or draft tube turbine aerators, or jet aerators.

Separate secondary sedimentation tanks are used for most applications; some applications use interchannel clarifiers to save space [1,7].

Depending on the type of installation selected, either one large unit sized to handle the entire flow or two oxidation ditches sized for 50 percent of the design flow can be provided. Two clarifiers are recommended for redundancy and reliability. For the purpose of preparing a cost estimate, the proprietary "Orbal" process manufactured by Envirex is used. The Orbal system uses one structure with three concentric channels equipped with disc aerators (see Figure B3-6). Any one of the channels can be dewatered for maintenance and at least 50 percent of the volume and two-thirds of the connected horsepower remains. Speed and submergence of the disc aerators can be changed to meet the aeration requirements.

## Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** An oxidation ditch is capable of over 90% removal of BOD and suspended solids. When designed for nitrogen removal, up to 90% reduction can be achieved.

**Reclamation Criteria.** The oxidation ditch can be integrated into an overall treatment train designed to meet reclamation criteria. Additional processes need to be added for coagulation, filtration, and disinfection to meet the specific regulations.

## Technical Aspects

**Reliability.** A 1978 performance study by EPA of 29 oxidation ditch plants indicated the average annual removal of BOD ranged from 87 to 99 percent and for suspended solids, 82 to 98 percent. An effluent of 20 mg/L BOD and 20 mg/L suspended solids was achieved 85 to 90 percent of the time and a 30/30 effluent was achieved 95 percent of the time. [5]. The process is also relatively simple and easy to operate.

**Flexibility.** Because the oxidation ditch is designed for a long hydraulic residence time, it is highly resistant to loading changes without affecting effluent quality. It is particularly well suited to small to medium size plants; most oxidation ditch plants are in the range of $<1$ to 10 mgd in capacity. The process is difficult to expand as additional separate aeration and sedimentation units will be required to be built.

**Precedents.** Oxidation ditches are widely used in the United States for flowrates in the range cited above. Over 1,800 plants are reported to use the oxidation ditch process [6].

**Aquifer Recharge Capability.** Not Applicable.

## Costs

| Table B3-7. PRESENT WORTH ANALYSIS - OXIDATION DITCH [8] | |
|---|---|
| 1. Construction, $[a] | $2,500,000 |
| 1a. 20% Contingency, $ | 500,000 |
| 1b. Subtotal, $ | 3,000,000 |
| 1c. 20% engineering srvices, $ | 600,000 |
| 2. Total capital, $ | 3,600,000 |
| 3. Operation and maintenance cost, $/yr | 43,400 |
| 4. Present worth of O&M, $ (x9.55)[b] | $414,000 |
| 5. Total present worth, $[c] | $4,014,000 |
| a. Based on the Orbal Disc Aeration Process by Envirex.<br>b. 8-3/8% for 20 years.<br>c. Sum of rows 2 and 4. | |

## Advantages

- High process reliability; process absorbs shock loadings easily without upset.
- Channel flow pattern prevents short-circuiting.
- Process is simple and relatively easy to operate.
- Operation can be adjusted to accommodate nitrification and denitrification, and phosphorus removal.
- Maintenance of disc aerator drives can be accomplished dewatering the tanks.
- Low biosolids production.

- Long solids retention time stabilizes the biosolids and eliminates the need for separate sludge digestion facilities.

**Disadvantages**

- Fine screening and grit removal is needed to prevent aeration fouling and grit deposits.
- Good operator skills are required.
- Some oxidation ditch process modifications are proprietary and licenses fees may be required for their use.
- Plant is not readily expandable.

**References**


1. Metcalf & Eddy, Inc.; Wastewater Engineering: Treatment, Disposal, and Reuse, McGraw-Hill, 1991.
2. Water Environment Federation: Design of Municipal Wastewater Treatment Plants, Vol.1, WEF Manual of Practice, Nov. 8, 1991.
3. "Modified Ditch Products Under Spec Effluents with Ease", WATER/Engineering & Management, Sept. 1986, pp 26-28.
4. U.S. Environmental Protection Agency: Manual: Wastewater Treatment/Disposal for Small Communities, pp 94-97, EPA/625/R-92/005, September 1992.
5. U.S. Environmental Protection Agency: A Comparison of Oxidation Ditch Plants to Competing Processes for Secondary and Advanced Treatment of Municipal Wastes, EPA/600/2-78-051, 1978.
6. U.S. Environmental Protection Agency: Evaluation of Oxidation Ditches for Nutrient Removal, EPA/832/R-92/003, September 1992.
7. Arcemont, A.: "Wastewater Process Lives Up to Early Promise", WATER/Engineering & Management, pp 28-29, October 1993.
8. Misco Pacific Quotation from Envirex Inc., dated January 29, 1994.

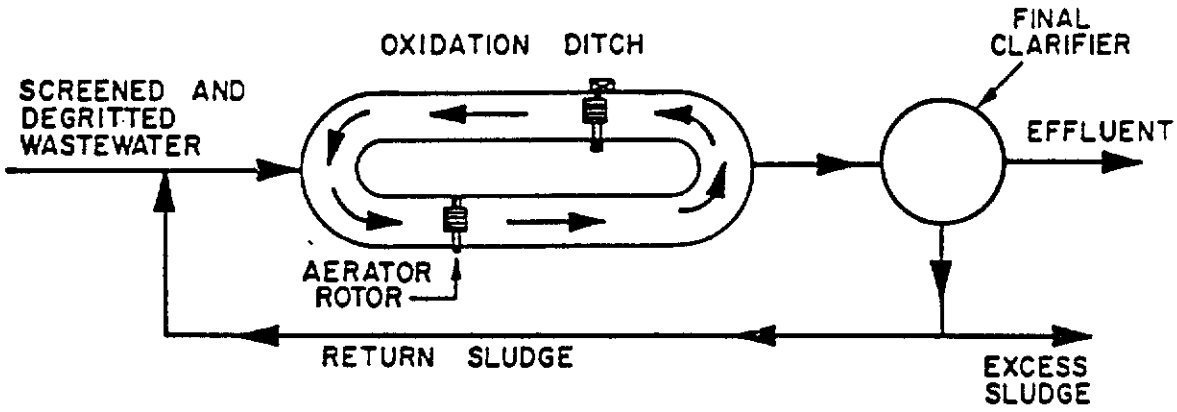



**FIGURE B3-5**

**TYPICAL OXIDATION DITCH SCHEMATIC**

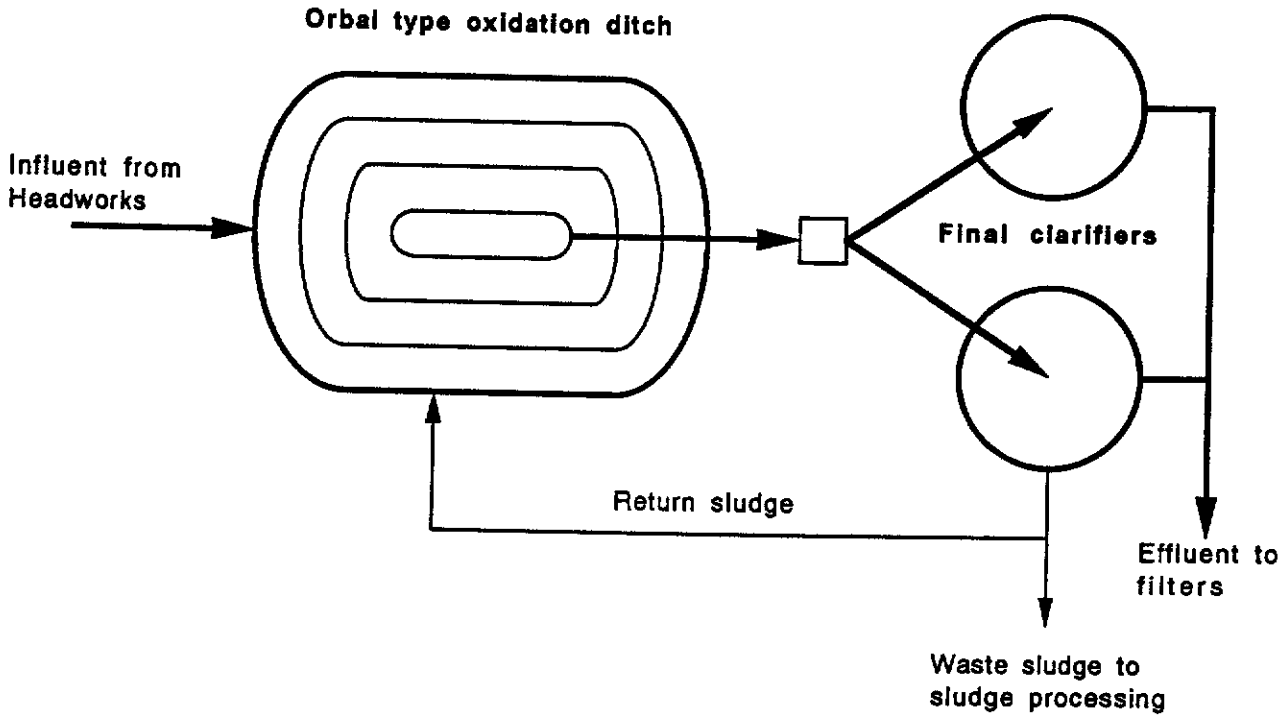



FIGURE B3-6

FLOW DIAGRAM FOR OXIDATION DITCH ALTERNATIVE

## AQUATIC PLANT SYSTEM - DUCKWEED

### Description

The duckweed system proposed by Lemna Corporation consists of a combination of aerated lagoons, submerged nitrification, and quiescent duckweed ponds for secondary polishing and denitrification. The system would replace the SBR and requires a headworks prior to the system, and the filtration and disinfection systems after it.

The system is shown schematically in the following figure. The wastewater treatment facility will consist of the construction of parallel modules each treating 0.8 mgd and each consisting of two ponds. The first pond of each module has a surface area of 2.6 acres and an operating depth of 12 feet. This first pond is divided into three cells using hydraulic baffles and is aerated. The aerated cells have a combined detention time of 10 days.

After the aeration ponds the flow passes into the submerged nitrification reactors. Aeration and the submerged media will allow biological nitrification of the ammonia.

The second pond of each module has a surface area of 5 acres and an operating depth of 12 feet. This pond is covered entirely with a matrix of Lemna floating barriers used to hold the floating duckweek plants in place. The plant mat and barrier grid creates a quiescent environment conducive to settling and denitrification. The total detention time is 20 days. The final step is a slow sand filter (1 acre in size) for final polishing.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** The Lemna System is capable of removing 90 percent of the BOD and SS [1,2]. Nitrogen removal ranges from 50 to 90 percent depending on the use of the nitrification units.

**Reclamation Criteria.** The Lemna system can be part of an overall treatment train designed to conform to these criteria. Additional treatment including coagulation, flocculation, filtration and disinfection are required.

### Technical Aspects

**Reliability.** The aerated lagoon - Lemna system requires little day-to-day operator attention. Periodic harvesting of the duckweed plants is required to maintain system efficiency. Harvesting is expected to be needed 6 to 8 times per year.

**Flexibility.** With two parallel cells, one cell can be taken out of service during the summer for short periods for maintenance or sludge removal (once in 10 years). Variations in flow and strength can be easily accommodated because of the ability to vary the pond depth and

the long detention time. The system is readily expandable with an additional 0.8 mgd module.

**Precedents.** There are about 40 operating duckweed systems in the U.S., most of them installed by Lemna Corporation. There are six systems with low (<5 mg/L) ammonia standards, however, one of the systems has a 5 mg/L total nitrogen limit.

**Aquifer Recharge Capability.** Not applicable.

**Costs**

Capital costs are presented in Table B3-8 along with O&M costs and total present worth costs. These costs replace the SBR in the current estimate. In addition, the current capital cost for sludge handling would be eliminated to account for the greatly reduced sludge production. Sludge handling is assumed to occur once in 10 years and the cost has been included in the O&M costs.

Table B3-8. AQUATIC PLANT SYSTEM - DUCKWEED PRESENT WORTH ANALYSIS

| | |
|---|---|
| 1. Construction, $ | 3,300,000 |
| 1a. 20% contingency, $ | 660,000 |
| 1b. Subtotal, $ | 3,960,000 |
| 1c. 20% engineering services, $ | 792,000 |
| 2. Total Capital, $ | 4,752,000 |
| 3. O&M, $/year | 92,000 |
| 4. Land cost (35 acres at $22,000/acre), $ | 770,000 |
| 5. P.W. of O&M (x9.5595), $[a] | 879,000 |
| 5. Total present worth, $[b] | 6,401,000 |

a. 8-3/8% for 20 years.
b. Sum of rows 2, 4, and 5.

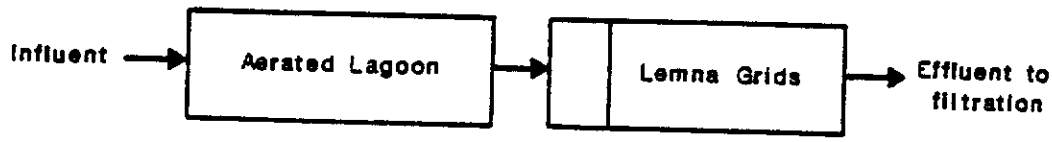
## Other Factors

Land area needed for the duckweed system would be approximately 35 acres, including setbacks.

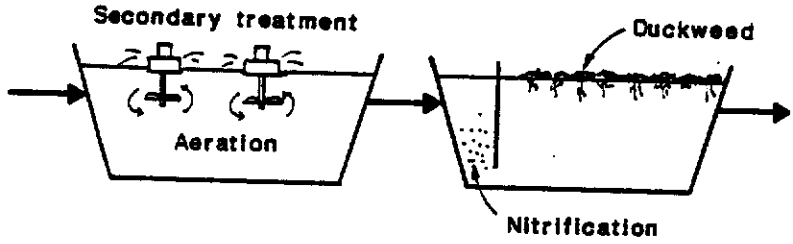
## References


1. Water Pollution Control Federation. Natural Systems for Wastewater Treatment. Manual of Practice FD-16. 1990.

2. Reed, S.C., E.J. Middlebrooks, and R.W. Crites. Natural Systems for Waste Management and Treatment. McGraw-Hill Book, New York, N.Y. 1988.




PLAN




PROFILE

| | |
|---|---|
| Los Osos Wastewater Study | Figure B3-7 |
| LEMNA AQUATIC PLANT SYSTEM | |
| M&E Metcalf & Eddy | Date: May 1995 |

## WATER HYACINTH AQUATIC PLANT SYSTEM

### Description

Aquatic plant systems using floating water hyacinths have been used to achieve secondary treatment, to polish oxidation pond effluent and to achieve tertiary treatment [1]. Basins that are 3 to 4 ft deep are covered with water hyacinths. Primary effluent passes through the basins and is treated biologically by attached growth bacteria on the plant roots and by suspended growth bacteria. Based on the San Diego pilot plant experience [2], the basins should be aerated. A schematic of a water hyacinth system is presented in the following figure.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements**. Based on performance in Florida [1,3] and San Diego, water hyacinth systems can meet a BOD/SS limit of 10 mg/L. Meeting any nitrogen discharge requirement, however, may not be possible. Nitrogen removal was not emphasized in San Diego, however, experience at Roseville demonstrated significant capability for nitrification [1].

**Reclamation Criteria.** Water hyacinth systems can be a part of an overall treatment system to conform to the reuse criteria for recharge. Additional treatment is required, including coagulation, filtration and disinfection.

### Technical Aspects

**Reliability**. Water hyacinth systems produce a reliably high quality effluent. Frequent harvesting (3 to 4 times per year) produce the best nitrogen removal in Florida. The sensitivity of water hyacinths to cold weather and predators has limited their use to consistently temperate climates.

**Flexibility**. Water hyacinth systems can be constructed in modules to allow harvesting, sludge removal and response to varying flowrates. the systems are readily expandable and are suitable to decentralized situations.

**Precedents**. There are limited positive precedents for water hyacinth systems. Most of the Florida systems have been abandoned.

**Aquifer Recharge Capability**. Not applicable.

## Costs

**Capital Costs.** The estimated capital, operation and maintenance, and present worth costs are shown in Table B3-9.

| Table B3-9. WATER HYACINTHS - PRESENT WORTH ANALYSIS | |
|---|---|
| 1. Construction, $ | 5,200,000 |
| 1a. 20% contingency, $ | 1,040,000 |
| 1b. Subtotal, $ | 6,240,000 |
| 1c. 20% engineering services | 1,248,000 |
| 2. Total Capital, $ | 7,488,000 |
| 3. O&M, $/year | 80,000 |
| 4. P.W. of O&M (x9.5595)[a] | 765,000 |
| 5. Land cost (25 acres at $27,000), $ | 675,000 |
| 5. Total present worth, $[b] | 8,928,000 |

a. 8-3/8% for 20 years.
b. Sum of rows 2, 4, and 5.

**Operation and Maintenance Cost.** Operation and maintenance costs are estimated to be $80,000/year.

## Other Factors

**Land Requirements.** The land area needed for a 1.6 mgd water hyacinth system is 25 acres, including setbacks and roads.

## Conclusion

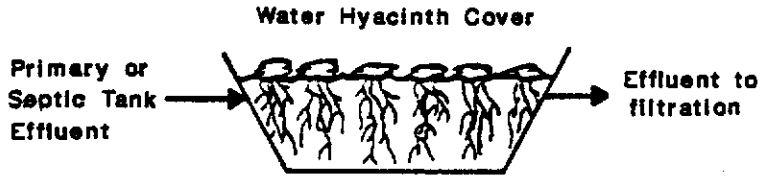
The fatal flaw for the water hyacinth system is the lack of precedent to meet the 5 mg/L total nitrogen limit.

## References


1. Water Pollution Control Federation Natural Systems for Wastewater Treatment. Manual of Practice FD-16, 1990.

2. Tchobanoglous, G. *et al. Evolution and Performance of City of San Diego Pilot Scale Aquatic Wastewater System Using Water Hyacinths*. Research Journal WPCF. 61:1625, 1989.

3. Reed, S.C., E.J. Middlebrooks, and R.W. Crites. *Natural Systems for Waste Management and Treatment*. McGraw - Hill Book Co. New York, N.Y., 1988.




AQUACULTURE BASIN

| | |
|---|---|
| Los Osos Wastewater Study | Figure B3-8 |
| WATER HYACINTH AQUATIC PLANT SYSTEM | |
| M&E Metcalf & Eddy | Date: May 1995 |

## HIGH EFFICIENCY DISTILLATION

### Description

High efficiency distillation is a tertiary treatment process which is similar to reverse osmosis in that dissolved salts are separated from a solution. Feed water enters a heat exchanger, where it is heated by outgoing distillage and wastewater. The feed water is then degassified and fed into an evaporator/condenser core. The core consists of stacked thin metal plates separated by gaskets, which form channels that direct the liquid and vapor flow. Feed water enters the evaporator sections, where it is boiled. The steam produced exits through gasket openings, and the mist is removed by baffles. The steam is drawn into a compressor where it is pressurized, and then it condenses and drips down as pure water. The purified water exits the chamber through a manifold.

The boiler is heated by heating elements during start-up, but during regular operation the boiler is heated with its own steam, which significantly reduces operating costs.

High efficiency distillation can be added to a treatment scheme for effluent polishing prior to groundwater recharge.

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirement.** The high efficiency distillation unit would only be required if the TOC limit for reinjection into the groundwater is required to be less than 10 mg/L As currently designed, the SBR, in conjunction with the filters and flocculation process, will produce effluent with 10 mg/L of BOD and TSS, and 5 mg/l of nitrogen. Theoretically, 10 mg/L of BOD corresponds to 10 mg/l of TOC, since the ratio of $BOD_5$/TOC for typical untreated domestic waste is approximately 1.0 [1].

**Reclamation Criteria.** If more stringent requirements are passed for the TOC limit required for groundwater recharge by CCR Title 22, a high efficiency distillation system could be used to bring the TOC down to 1 ppm (which is approximately 1 mg/l).

### Technical Aspects

**Reliability/Flexibility/Precedents.** Maintenance of the system is expected to be minimal since, unlike reverse osmosis, there is no membrane to replace. The metal plates are constructed of 316L SS or titanium for very corrosive applications, and will not need replacing over the course of the system's lifetime.

The distiller is capable of handling variations in flow and feed concentration successfully. In general, the focus of the system is on reducing total dissolved solids (TDS), not on

specifically reducing TOC, although at such low feed concentrations (BOD of 10 mg/l) significant TOC reduction is simultaneously achieved.

Historically, most appliations have been in the water bottling industry, where a high quality or distilled water product is necessary. There are only a few installations for wastewater effluent polishing.

**Aquifer Recharge Capability.** Because the distiller achieves such a high level of purity, the effluent could be reinjected into the aquifer.

## Costs

The estimated capital, operation and maintenance, and present worth costs are summarized in Table B3-10.

**Table B3-10. PRESENT WORTH ANALYSIS[a]**

| | |
|---|---|
| 1. Construction | 7,061,000 |
| 1a. 20% contingency, $ | 1,412,000 |
| 1b. Subtotal, $ | 8,473,000 |
| 1b. 20% engineering, $ | 1,694,000 |
| 2. Total capital, $ | 10,167,000 |
| 3. O&M, $/yr | 414,000 |
| 4. Present worth of O&M, $[b] | 3,953,700 |
| 5. Total Present worth, $[c] | 14,121,300 |

a. Includes the cost of an activated sludge system; excludes cost of a brine concentrator.
b. 8 ⅜% for 20 years.
c. Sum of rows 2 and 4.

## Other Factors

**Land Area.** To treat 1.6 MGD approximately 30 distillation units are required. Each unit has a footprint of 96" x 66" x 96". Units are put together in groups of 10, and a group of ten covers an approximate area of 65 ft x 35 ft. 30 units can be expected to cover 7500

square feet. Concentrating the brine would require an additional 15 units, and would require an approximately 330 square feet.

**Brine Disposal.** The waste generated by this process (called brine), which contains the removed salts, requires some type of disposal. Ocean disposal is common because sea water naturally contains high salt concentrations, therefore there are no environmental impacts associated with the discharge of the brine. Another alternative is to concentrate the brine by using a secondary distillation unit to process the brine produced from the first distillation unit. By using a compressor with very high pressure the salt can be extracted from the brine so that 98% of the feed water to the primary distillation unit can be recovered. This method of brine disposal results in higher operating costs, but all that remains for disposal is a small amount of salts in slurry form, which can be fed to the sludge handling processes of the plant.

## References

1. Metcalf & Eddy, Inc.: Wastewater Engineering; Treatment, Disposal, and Reuse, Third Edition, McGraw-Hill, 1991.

## REVERSE OSMOSIS/MEMBRANE FILTERS

### Description

Reverse osmosis is a process in which water is separated from dissolved salts in solution by filtering through a semipermeable membrane at a pressure greater than the osmotic pressure caused by the dissolved salts in the wastewater. The membranes used act as filters with pores as small as 0.001 microns. Reverse osmosis systems consist of a membrane, a membrane support, a containment vessel, and high pressure pumps[1]. There are different kinds of membranes and the choice of one kind depends on the constituents anticipated in the water to be treated [2]. The waste or brine stream generated by the reverse osmosis requires some type of disposal (sometimes discharge into an ocean).

Reverse osmosis represents a common unit process designed to remove salts; however, it is also effective in removing total organic compounds (TOC). For the purposes of this study, reverse osmosis has been considered as a treatment option for the removal of TOCs from the wastewater effluent prior to groundwater recharge.

Reverse osmosis can be added to a treatment scheme for effluent polishing before groundwater recharge. It has been noted in full-scale reverse osmosis units that the process is effective in removing the majority of dissolved non-volatile organic materials and low molecular weight trace organic compounds as measured by TOC analytical tests, producing an effluent with a TOC concentration less than 1 mg/l[3].

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** The reverse osmosis unit would only be necessary if the TOC limit for reinjection into the groundwater is required to be less than 10 mg/l. As currently designed, the SBR, in conjunction with the filters and flocculation process will produce an effluent with 10 mg/l of BOD and TSS, and 5 mg/l of nitrogen. Theoretically, 10 mg/l of $BOD_5$ corresponds to 10 mg/l of TOC. For typical untreated domestic wastes the $BOD_5$/TOC ratio varies from 1.0 to 1.6 [1]. Nitrogen removals are typically 80-95%.

**Reclamation Criteria.** If more stringent requirements are passed for the TOC limit prior to groundwater recharge by CCR Title 22, a reverse osmosis system could be used to bring the TOC level down to an acceptable level (near 1 mg/l).

### Technical Aspects

**Reliability/Flexibility/Precedents.** Although not widespread, reverse osmosis has been and is being used in systems that treat municipal wastewater[2]. A large scale application at the Orange County Water District's Water Factory 21 is utilizing reverse osmosis to treat 5 MGD of secondary effluent for subsequent reinjection into the groundwater table to resist

saltwater intrusion. However, the application focus is on reducing total dissolved solids (TDS), not specifically TOC.

Fouling of the membrane is the main maintenance and operational concern of the reverse osmosis system. Minimizing the loss of production capacity of the system due to fouling depends on the pretreatment, the operating parameters, and the membrane chosen[2].

Costs

The estimated capital, operation and maintenance, and present worth costs are summarized in Table B3-11.

**Table B3-11. PRESENT WORTH ANALYSIS, REVERSE OSMOSIS [3][a]**

| | |
|---|---|
| 1. Construction, $ | 7,640,000 |
| 1a. 20% Contingency, $ | 1,528,000 |
| 1b. Subtotal, $ | 9,168,000 |
| 1c. 20 % engineering services , $ | 1,834,000 |
| 2. Total Capital, $ | 11,002,000 |
| 3. O&M, $/yr | 334,000 |
| 4. Present Worth O&M, $ (x 9.55) | 3,189,000 |
| 5. Total Present Worth, $ | 14,192,000 |

a. Includes the cost of an activated sludge system.
b. 8⅜% for 20 years.
c. Sum of rows 2 and 4.

**Advantages**

- Capable of removing dissolved organics that are less selectively removed by other demineralization processes.
- Capability of lowering the TDS content to very low levels.
- Although dependent on the characteristics of the carbon molecules, reverse osmosis is capable of lowering the TOC content to low levels (near 1.0 mg/l).

## Disadvantages

- Higher operational costs than other hydraulically operated processes because of the usage of high pressure pumps.
- High capital costs.
- Influent water to system must be of "high quality" (filtered) to prevent fouling of the reverse osmosis membranes.
- Limited operating experience for treatment of domestic wastewater.
- Problem of concentrated brine disposal.

## References


1. Metcalf & Eddy, Inc.: Wastewater Engineering: Treatment, Disposal, and Reuse, Third Edition, McGraw-Hill, 1991.

2. UOP Fluid Systems, Membrane Separation Experience in Municipal Wastewater Reuse, 1988.

3. Department of Civil and Environmental Engineering, University of California, Davis, The Cost of Wastewater Reclamation in California, 1992.

## BREAKPOINT CHLORINATION

### Description

Chlorination has many applications for the treatment of wastewater, among which include disinfection, control of odors and septicity, reduction of BOD, and removal of ammonia nitrogen from treatment plant effluents. For the purposes of this study, the application of breakpoint chlorination has been investigated for the removal of ammonia nitrogen from the future Los Osos treatment plant effluent. Breakpoint chlorination involves the addition of chlorine to wastewater to oxidize the ammonia nitrogen in solution to nitrogen gas and other stable compounds.

The most common chlorine compounds used in wastewater treatment plants for breakpoint chlorination are chlorine gas ($Cl_2$) and sodium hypochlorite (NaOCl). Breakpoint chlorination is dependent on the pH, temperature, contact time, and the ratio of chlorine to ammonia.

The breakpoint chlorination process can be used for the removal of ammonia nitrogen from treatment plant effluents, either alone or in combination with other processes. To avoid large chlorine dosages required when used alone, breakpoint chlorination can be used following biological nitrification to achieve low levels of ammonia in the effluent. To optimize the performance of this process and to minimize equipment and facility costs, flow equalization is usually required. Also, because of the potential toxicity problems that may develop if chlorinated compounds are discharged to the environment, it is usually necessary to dechlorinate the effluent [1].

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** Breakpoint chlorination is capable of 80 to 95% removal of total nitrogen entering the breakpoint chlorination unit (% removal depends on the fraction of influent nitrogen for which breakpoint chlorination is effective and on the other processes included in the treatment plant). However, the addition of chlorine raises the TDS in the effluent and may produce high chlorine residuals that are toxic to aquatic organisms.

### Technical Aspects

**Reliability/Flexibility/Precedents.** In a survey of advanced wastewater treatment facilities, only eight out of over 1,200 unit operations or processes used breakpoint chlorination. The reasons for the limited use of this process are cost, inconsistent performance, and operating and maintenance problems [1].

**Aquifer Recharge Capability.** Not Applicable.

## Costs

The cost of breakpoint chlorination as a denitrification method would be in addition to other secondary treatment processes that produced nitrified effluent such as conventional activated sludge. Also included is the cost of flow equalization, a dechlorination system, and (if required) additional processes to remove increased TDS from the effluent.

| Table B3-12. PRESENT WORTH ANALYSIS - BREAKPOINT CHLORINATION | |
|---|---|
| 1. Construction, $[a] | 3,611,000 |
| 1a. 20% contingency, $ | 722,000 |
| 1b. Subtotal, $ | 4,333,000 |
| 1c. 20% engineering, $ | 867,000 |
| 2. Total capital, $ | 5,200,000 |
| 3. Operation and maintenance, $/yr | 540,000 |
| 4. Present worth of O&M, $[b] | 5,157,000 |
| 5. Total present worth, $[c] | 10,357,000 |

a. Includes activated sludge (separate memorandum) and dechlorination. Excludes processes to reduce TDS.
b. 8⅜% for 20 years.
c. Sum of rows 2 and 4.

## Advantages

- With proper control, all ammonia nitrogen in wastewater can be oxidized.
- Process can be used following other nitrogen removal processes for fine-tuning of nitrogen removal.
- Concurrent effluent disinfection.
- Limited space requirement.
- Not sensitive to toxic substances and temperature.
- Adaptable to existing facilities.

## Disadvantages

- May produce high chlorine residuals that are toxic to aquatic organisms.
- Wastewater contains a variety of chlorine demanding substances which increase cost of treatment.
- Process is sensitive to pH, which affects dosage requirements.
- High operating cost due to chemical requirements.
- Trihalomethane formation may impact quality of water supplies.
- Addition of chlorine raises effluent TDS.
- Process may not be able to meet total nitrogen standards.
- Requires careful control of pH to avoid formation of nitrogen trichloride gas.
- Requires highly skilled operators.

## References

1. Metcalf & Eddy, Inc.: *Wastewater Engineering: Treatment, Disposal, and Reuse*, Third Edition, McGraw-Hill, 1991.

## ION EXCHANGE

### Description

Ion exchange is a unit process by which ions of a given species are displaced from an insoluble exchange material by ions of a different species in solution. The exchange material consists of a solid phase of naturally occurring minerals or a synthetic resin having a mobile ion attached to an immobile functional acid or base group. Ion exchange may be operated in either a batch or continuous mode. In a batch process, the resin is stirred with the wastewater to be treated in a reactor until the reaction is complete. The spent resin is removed by settling and subsequently is regenerated and reused. In a continuous process, the exchange material is placed in a bed or a packed column, and the water to be treated is passed through it [1].

Ion exchange can be used for the reduction of total dissolved solids (TDS) and for the removal of nitrogen. For the purposes of this study, the application of ion exchange has been investigated for the removal of nitrogen from the future Los Osos treatment plant effluent.

For nitrogen control, the ion typically removed from the waste stream is ammonium, $NH_4^+$. The ion that the ammonium displaces depends on the type of solution used to regenerate the bed. (Regeneration is the process of removing the accumulated $NH_4^+$ from the ion exchange media so that the media can be reused.) Both natural and synthetic resins are available, although synthetic resins are more widely used for their durability. High concentrations of influent suspended solids can plug the ion exchange beds, causing high headlosses and inefficient operation. Resin binding can be caused by residual organics found in biological treatment effluents; therefore, some form of chemical treatment and clarification is required before the ion exchange process takes place[2].

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** Ion exchange is capable of 70 to 90% removal of total nitrogen entering the ion exchange unit. Percent removal depends on the fraction of influent nitrogen for which the ion exchange is effective, on the other processes included in the treatment plant, and on the form the nitrogen is in when entering the unit.

### Technical Aspects

**Reliability/Flexibility/Precedents.** In a survey of advanced wastewater treatment facilities, only one out of over 1,200 unit operations or processes used ion exchange for the removal of nitrogen. The reasons for the limited use of this process are cost, inconsistent performance, and operating and maintenance problems. In addition, ion exchange has had limited

application because of the extensive pretreatment required, the concerns about the life of the ion exchange media, and the complex regeneration system required [2].

**Aquifer Recharge Capability.** Not Applicable.

**Costs**

The cost of ion exchange as a denitrification method would be in addition to other secondary treatment processes that produced nitrified effluent such as conventional activated sludge. Also included is the cost of an effuent filter.

**Table B3-13. PRESENT WORTH ANALYSIS - ION EXCHANGE**

| | |
|---|---|
| 1. Construction, $[a] | 6,170,000 |
| 1a. 20% contingency, $ | 1,234,000 |
| 1b. Subtotal, $ | 7,404,000 |
| 1c. 20% engineering, $ | 1,481,000 |
| 2. Total capital, $ | 8,885,000 |
| 3. Operation and maintenance, $/yr | 319,000 |
| 4. Present worth of O&M, $[b] | 3,047,000 |
| 5. Total present worth, $[c] | 11,932,000 |

a. Includes activated sludge (separate memorandum) and effluent filtration.
b. 8⅜% for 20 years.
c. Sum of rows 2 and 4.

**Advantages**

- Can be used where climatic conditions inhibit biological nitrification and where stringent effluent standards are required.
- Produces a relatively low TDS effluent.
- Produces a reclaimable product (aqueous ammonia).

- Process may be able to meet total nitrogen standards.
- Ease of product quality control.
- No process waste containing ammonia for which ultimate disposal must be provided.

**Disadvantages**

- Organic matter in effluent from biological treatment can cause resin binding.
- Pretreatment by filtration is usually required to prevent the buildup of excessive headloss due to suspended solids accumulation.
- High concentrations of other cations will reduce ammonia removal capability.
- Regeneration recovery may require the addition of another unit process (e.g. gas stripping).
- High capital and operating costs.
- Regeneration products must be disposed of.
- Requires highly skilled operators.
- Pretreatment of influent may be required to increase effectiveness on nitrogen removal (i.e. nitrification).

**References**

1. Metcalf & Eddy, Inc.: Wastewater Engineering: Treatment, Disposal, and Reuse, Second Edition, McGraw-Hill, 1979.

2. Metcalf & Eddy, Inc.: Wastewater Engineering: Treatment, Disposal, and Reuse, Third Edition, McGraw-Hill, 1991.

## BIOLOGICAL NUTRIENT REMOVAL

### General Description

Biological nutrient removal (BNR) is a two-step process that involves nitrification in an aerobic environment followed by denitrification in an anoxic environment. Ammonia nitrogen is converted to nitrite nitrogen and then to nitrate nitrogen during nitrification, and then nitrate nitrogen is converted to nitrogen gas in denitrification. A significant amount of nitrogen is also removed with the waste activated sludge (WAS). The N content of WAS volatile solids is approximately 10%. The denitrifying organisms are primarily facultative heterotrophs that reduce nitrate in the absence of molecular oxygen or other oxygen sources. A source of carbon is required for the denitrification step, either an external source such as methanol or acetate, or an internal source such as recycling the carbonaceous BOD in the nitrified effluent back to an anoxic reactor at the head of the flow scheme, diverting a portion of the raw influent, or using the endogenous carbon present in cell mass as the degradable carbon source. The reactions are affected by specific environmental conditions including pH, wastewater temperature, and dissolved oxygen concentration [1].

Two types of BNR processes may be used: suspended growth or attached growth processes. Examples of suspended growth processes include the *Wuhrmann Process, Ludzack-Ettinger Process, Modified Ludzack-Ettinger Process, Bardenpho™ Process, Sequencing Batch Reactors, Oxidation Ditch Processes, Phased Isolation Ditches (Bio-denitro™), and Alternating Aeration.* Examples of attached growth processes for separate stage nitrification include *Trickling Filters, and Rotating Biological Contactors (RBCs),* and for separate stage denitrification include *Denitrification Filters, Fluidized Bed Denitrification, and Submerged Rotating Biological Contactors (SRBCs)* [2]. Schematics of these processes are attached.

Combined systems, also known as Integrated Fixed Film Activated Sludge (IFAS), include Ringlace or Captor media. For purposes of this study, only those alternatives that are applicable for small plants are considered: Bardenpho™ Process, Sequencing Batch Reactors[a], Oxidation Ditch Processes[a], Alternating Aeration systems, Trickling Filters[a], and Rotating Biological Contactors (RBCs)[a]. The attached growth processes for separate stage denitrification need to be used in conjunction with a nitrification process. A discussion of these are included with the trickling filter evaluation.

---

[a]Considered by others. See separate evaluation/write-up.

## Bardenpho™ Process

### Description

The Bardenpho™ system is a proprietary process which consists of a series of four anoxic and aerobic zones with recycling of mixed liquor from the first aerobic zone to the first anoxic zone at a rate as high as four to six times the influent flow rate. Complete denitrification cannot be attained with a preaeration anoxic zones since part of the aerobic stage effluent is not recycled through the anoxic zone. The second anoxic zone provides for additional denitrification using nitrate produced in the aerobic stage as the electron acceptor and endogenous organic carbon as the electron donor. The Bardenpho™ process can achieve effluent concentrations of total nitrogen as low as 2 to 4 mg/l as long as the ratio of oxidizable nitrogen to carbon in the influent is less than 0.08 [1].

### Conformance with Laws, Regulation, Criteria

The Bardenpho™ system can be designed for up to 90% nitrogen removal. Typical nitrogen removals are 80 to 95%.

### Reclamation Criteria

Additional processes may need to be added to meet reclamation criteria, such as coagulation, filtration, and disinfection.

### Technical Aspects

Each stage of the process is accomplished in a separate region or tank. If phosphorus needs to be removed in the future, a fifth stage may be added to form a system that removes both nitrogen and phosphorus. EIMCO holds a patent on this process, which means that there is a licensing fee associated with its use.

### Reliability

The Bardenpho™ process is highly reliable because each of the nitrification/denitrification stages is handled in an independent, controllable environment. The recycle can be adjusted according to actual operating performance to adjust the quality of the final effluent. There is not a high degree of operator involvement required for the proper operation of this system.

### Flexibility

The system can be adjusted slightly by altering recycle rates from the aerobic tanks back to the anoxic tanks. However, once the tanks are designed and built, there is not much that can be done to add flow or maintain higher detention times without also including a flow

equalization tank. With the addition of a fifth reaction tank, the system can be designed and operated to remove both nitrogen and phosphorus.

## Precedents

The patent for the Bardenpho™ system was originally issued in 1976 [1]. Although no exact numbers of installations are available, the Bardenpho™ system and modifications thereof are widely used throughout the U.S. A partial list of installations is included with the attached literature. The simplicity of the system along with the fact that the vendor creates and supports the sizing for the tanks and equipment makes this an attractive package-type plant.

## Aquifer Recharge Capability

Effluent from the Bardenpho™ system is nitrified and denitrified to meet the tentative discharge requirements.

## Costs

**Table B3-14. PRESENT WORTH ANALYSIS - BARDENPHO™**

| | |
|---|---|
| 1. Construction, $ | 1,800,000 |
| 1a. 20% Contingency, $ | 360,000 |
| 1b. Subtotal, $ | 2,160,000 |
| 1c. 20 % engineering services | 532,000 |
| 2. Total Capital, $ | 2,692,000 |
| 3. Operation and maintenance, $ | 85,500 |
| 4. Present worth of O&M, $[a] | 816,000 |
| 5. Total present worth[b] | 3,508,000 |

a. 8 3/8% for 20 years.
b. Sum of rows 2 and 4.

### Other Factors

The nitrification zone is actually an oxidation ditch which is resistant to shock loads. Depending on the alkalinity of the wastewater, pH adjustment may be necessary to optimize nitrification rates. Design should account for possibility of bulking sludge.

## Alternating Aeration Process

### Description

An alternating aeration system consists of a reaction vessel in which the source of air is alternately turned on and off to create aerobic and anoxic zones within the tank for nitrification and denitrification, respectively. Typically, timers are used for the blowers to control the quantity and cycling of air. Supplemental sources of carbon are needed to properly denitrify in the anoxic zone, which, typically, is accomplished with the addition of methanol or influent wastewater.

### Conformance with Laws, Regulation, Criteria

All of the alternating aeration systems can be designed for up to 90% nitrogen removal. Typical nitrogen removals are 70 to 95%.

### Reclamation Criteria

Additional processes may need to be added to meet reclamation criteria, such as coagulation, filtration, and disinfection.

### Technical Aspects

These systems can be designed as a single, dual, or triple sludge system. With a single sludge alternating aeration system, each stage of the process is accomplished in the same tank. Careful consideration must be given to the range of influent characteristics to ensure proper tankage to meet the discharge requirements. With a dual sludge system, each stage is separated and designed with its own secondary clarifier. While this provides greater operational control and the ability to optimize the rates of nitrification and denitrification, it requires double the tankage, equipment, and power to operate. A triple sludge system has separate tanks and clarifiers for carbon oxidation, nitrification, and denitrification. The high cost of triple the tankage and associated equipment has made this type of system very seldom used. For purposes of this evaluation, a single sludge system will be analyzed.

## Reliability

An alternating aeration system is a reliable nitrogen removal system because each of the nitrification/denitrification stages is handled in an independent, controlled environment. The levels of performance can be adjusted by adjusting the timing of the aeration device. This type of system does not require a high degree of operator skill to properly operate and maintain.

## Flexibility

The system can be adjusted slightly by altering the timing of the aeration phases. Because all of the stages are accomplished in one tank, there is little flexibility in internal recycle rates or in accommodating expanding flows. However, once the proper operational settings are determined to achieve the desired levels of treatment, there should be little need for process adjustments.

## Precedents

Dual and triple sludge systems were in vogue in the early 1970s in the United States but have since been replaced by other biological nutrient removal alternative processes. Currently, there is a trend back to the single sludge alternating aeration system, particularly for small plants with small staffs and limited space. The simplicity of the system along with the fact that the process is easily operated and maintained makes this an attractive alternative for the treatment plant. Overall, there is limited experience with alternating aeration processes with much of it being in the New England area.

## Costs

| Table B3-15. PRESENT WORTH ANALYSIS - ALTERNATING AERATION | |
|---|---|
| 1. Construction, $ | 2,000,000 |
| 1a. 20% Contingency, $ | 400,000 |
| 1b. Subtotal, $ | 2,400,000 |
| 1c. 20 % engineering services | 480,000 |
| 2. Total Capital, $ | 2,808,000 |
| 3. Operation and maintenance, $ | 81,700 |
| 4. Present worth of O&M, $[a] | 780,000 |

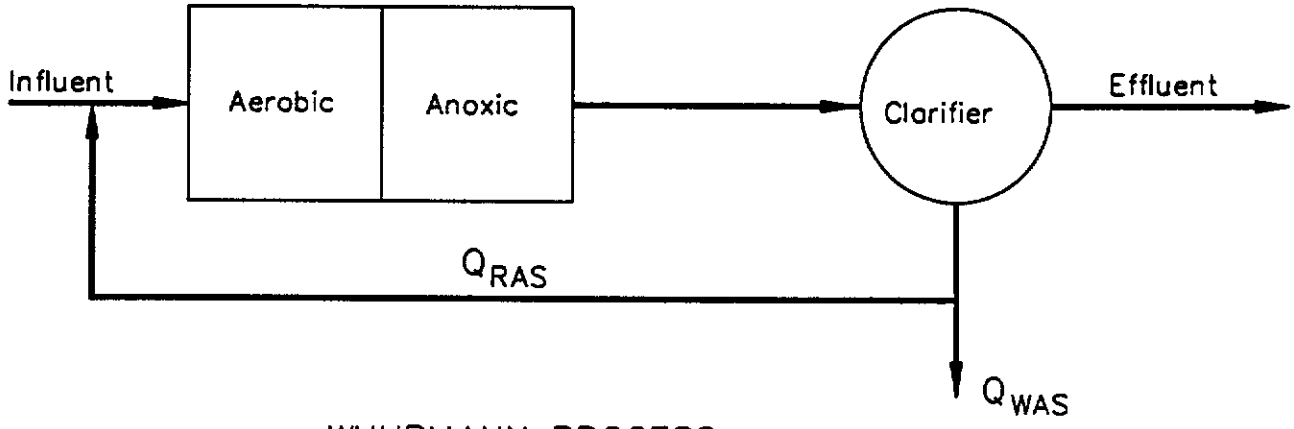
| Table B3-15. PRESENT WORTH ANALYSIS - ALTERNATING AERATION | |
|---|---|
| 1. Construction, $ | 2,000,000 |
| 5. Total present worth[b] | 3,588,500 |

a. 83/8% for 20 years.
b. Sum of rows 2 and 4.

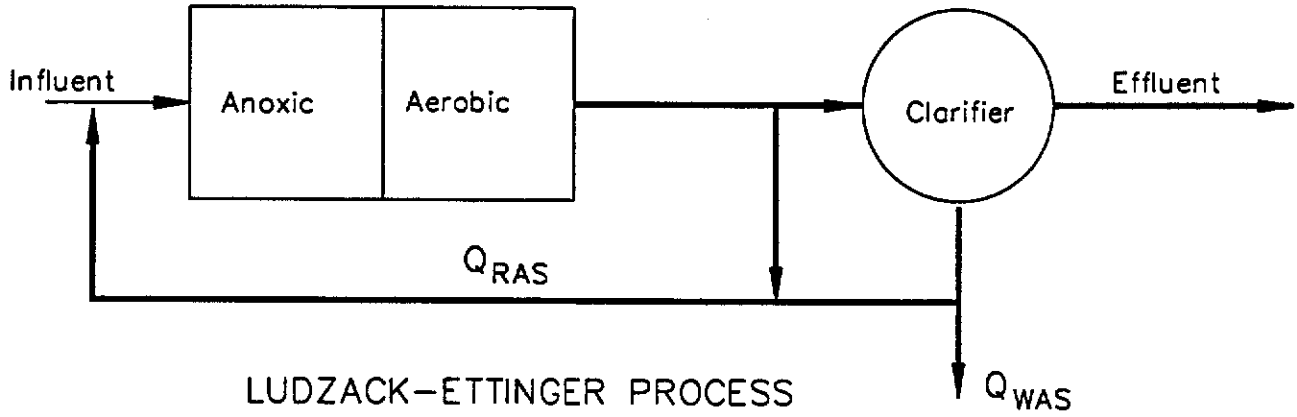
## References


1. Water Environment Federation, Design of Municipal Wastewater Treatment Plants, WEF Manual of Practice No. 8, 1992.

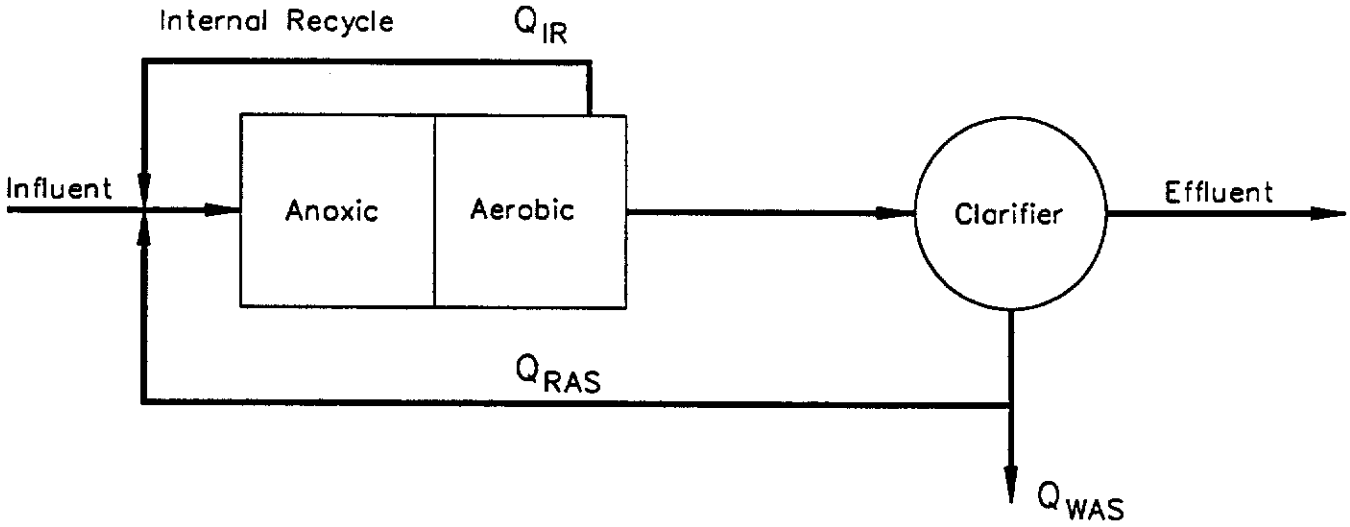
2. Metcalf & Eddy, Wastewaste Engineering, Third Edition, 1991




WUHRMANN PROCESS

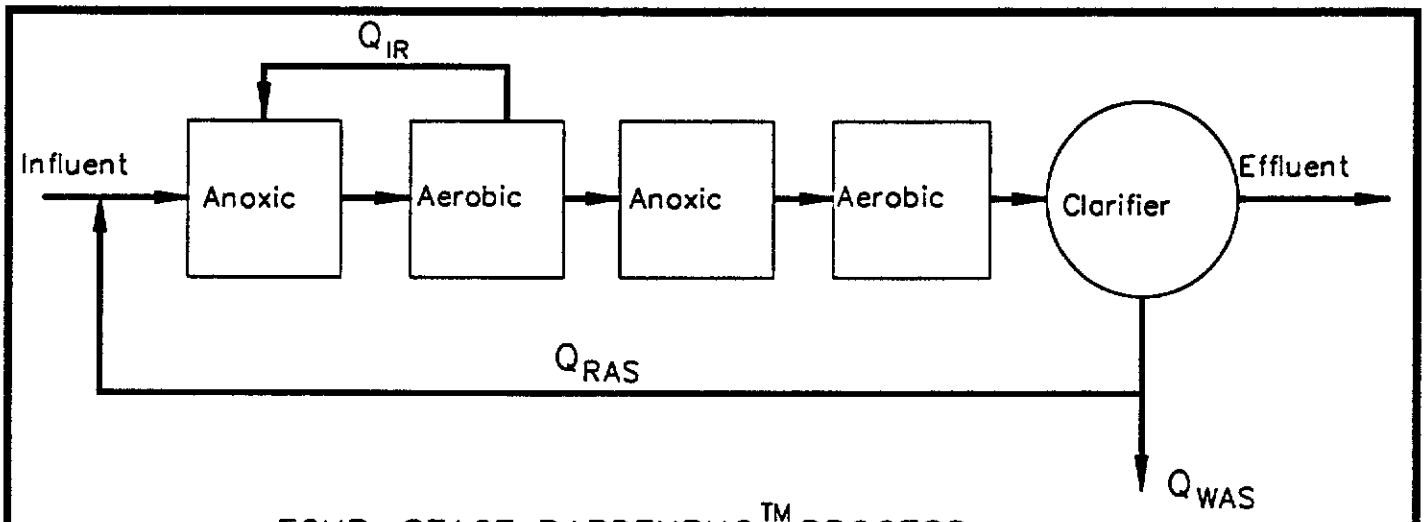



LUDZACK–ETTINGER PROCESS

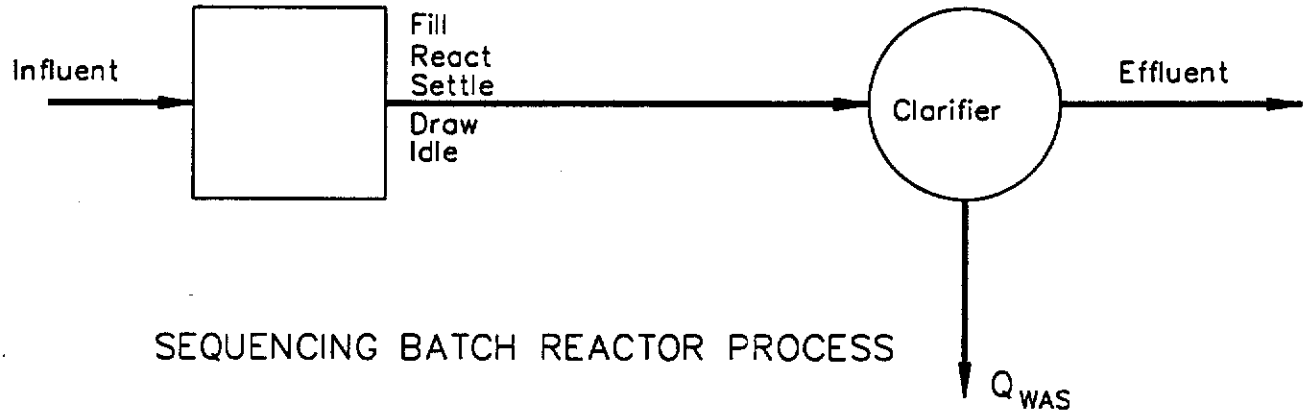



MODIFIED LUDZACK–ETTINGER PROCESS

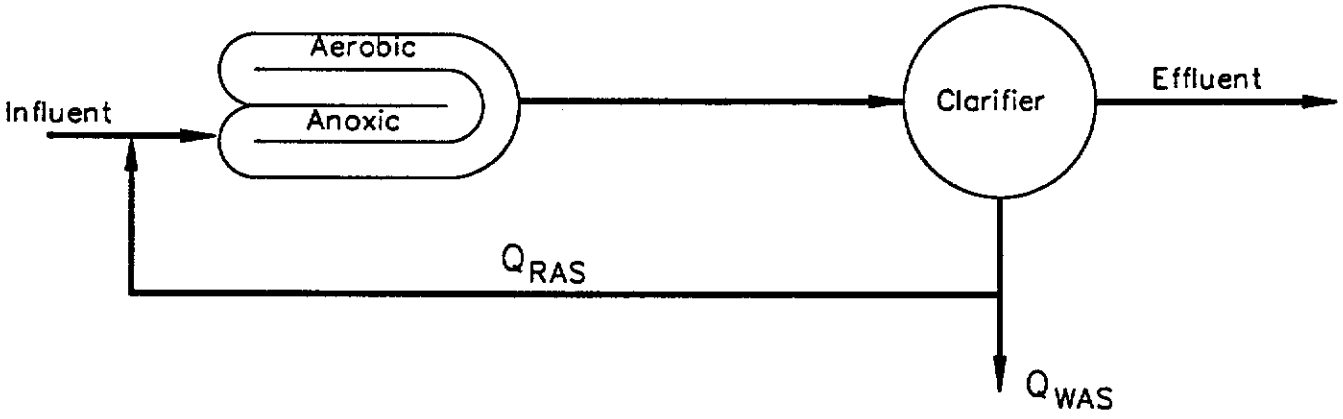
| | |
|---|---|
| Los Osos Alternatives Study | Figure B3-9 |
| BNR ALTERNATIVES | |
| Metcalf & Eddy | Date: February 1994 |




FOUR-STAGE BARDENPHO™ PROCESS

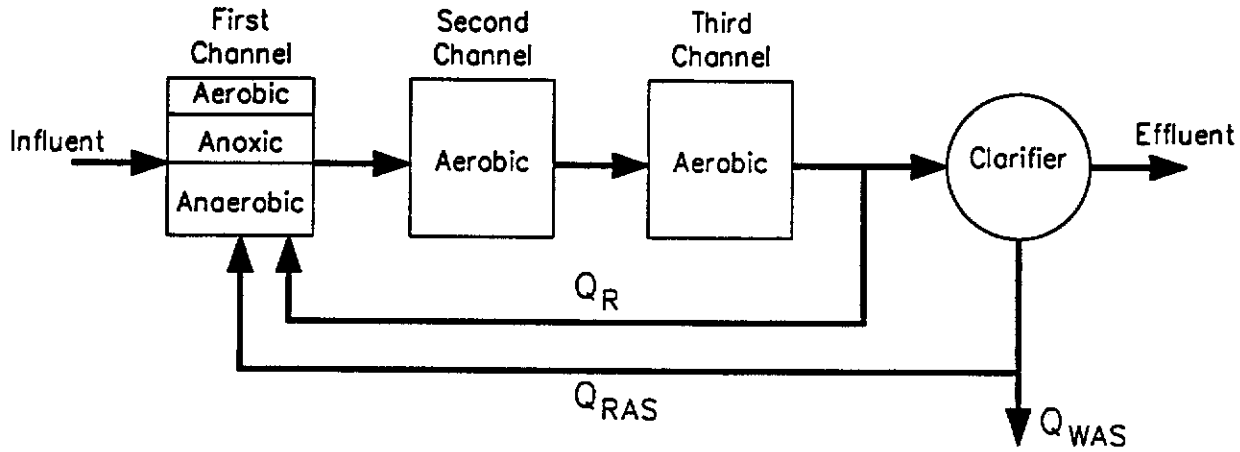


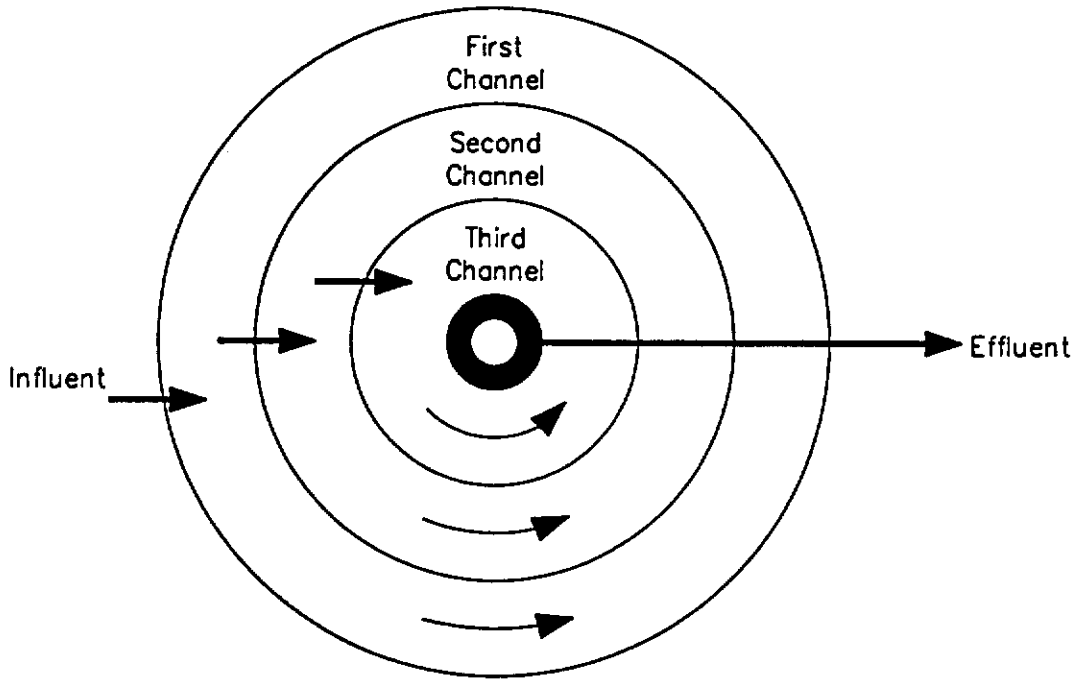

SEQUENCING BATCH REACTOR PROCESS



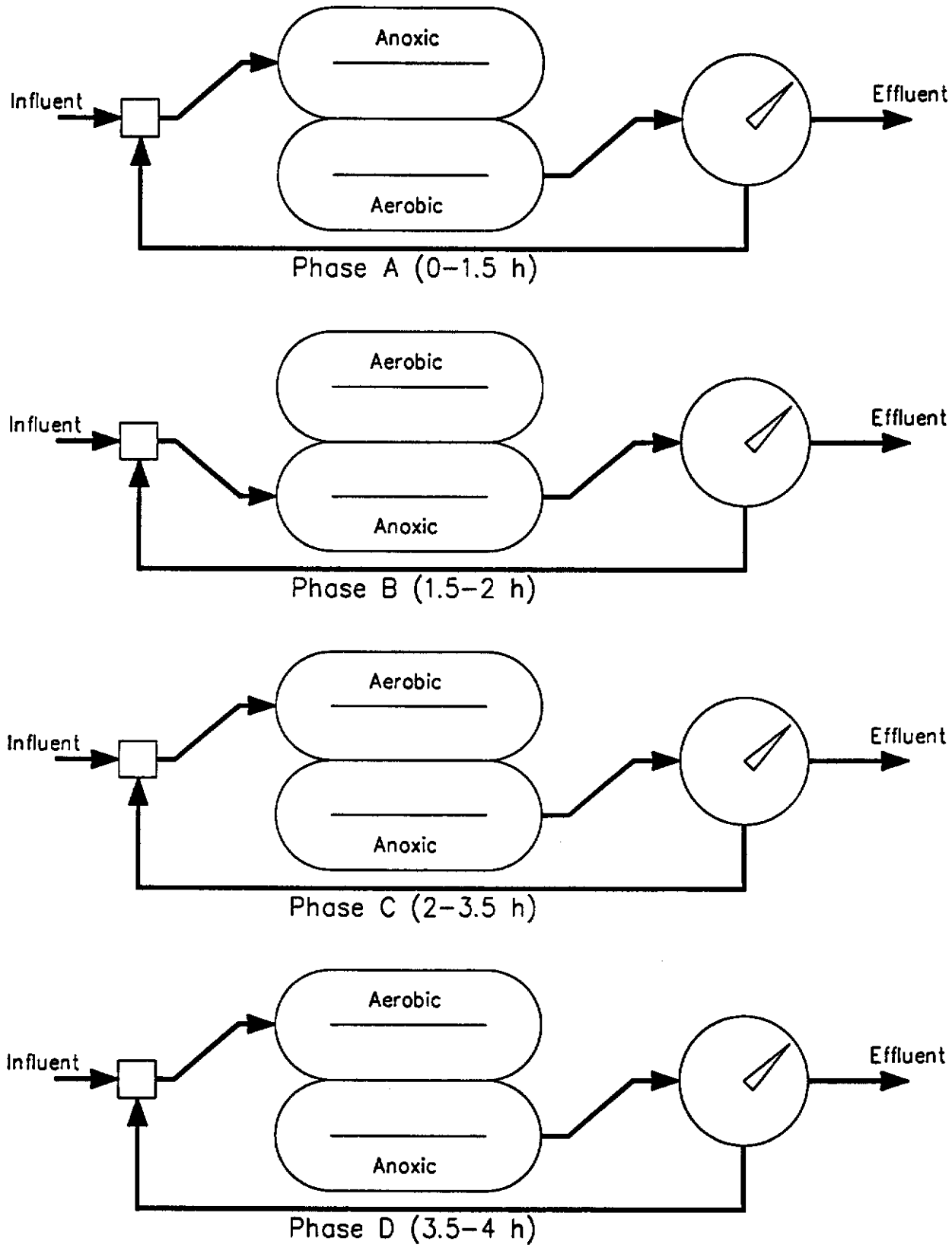

OXIDATION DITCH PROCESSES

| | |
|---|---|
| Los Osos Alternatives Study | Figure B3-10 |
| BNR ALTERNATIVES | |
| Metcalf & Eddy | Date: February 1994 |

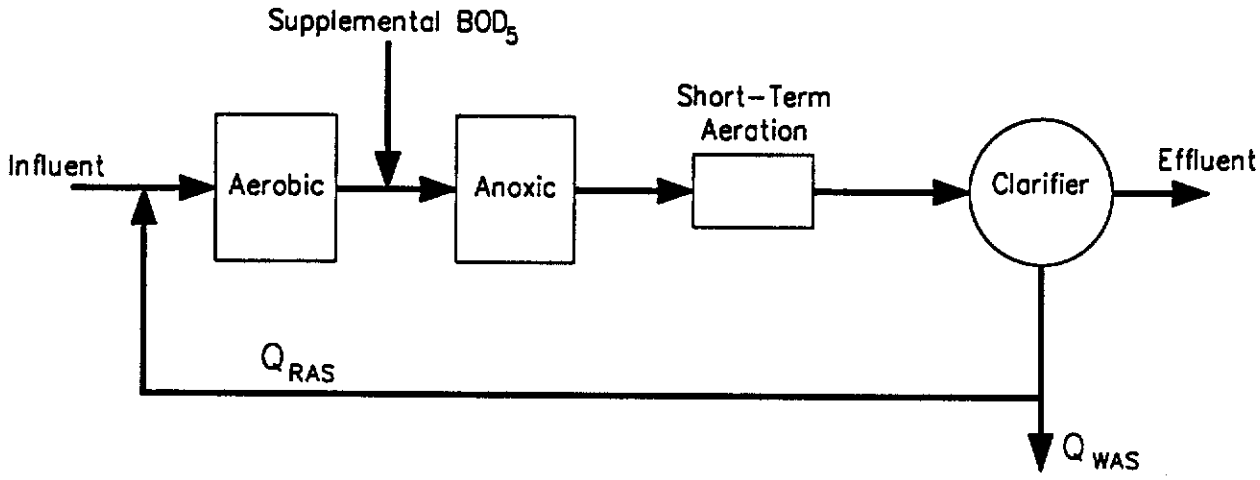


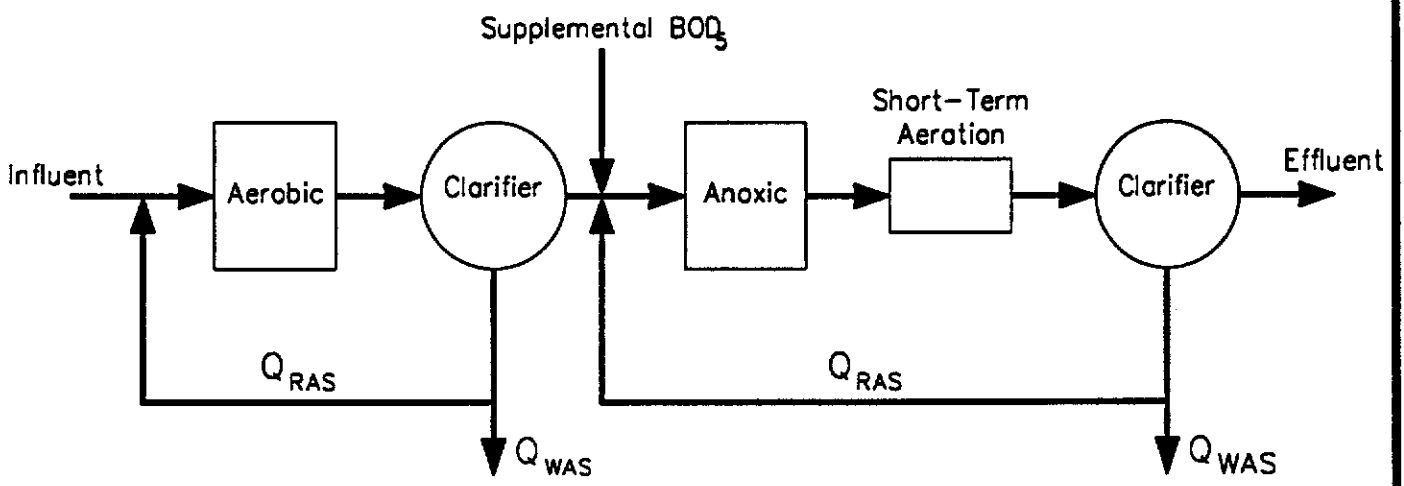

| Los Osos Alternatives Study | Figure |
|---|---|
| ORBAL SIMPRE ISOLATION DITCH PROCESS | B3-11 |
| M&E Metcalf & Eddy | Date: February 1994 |



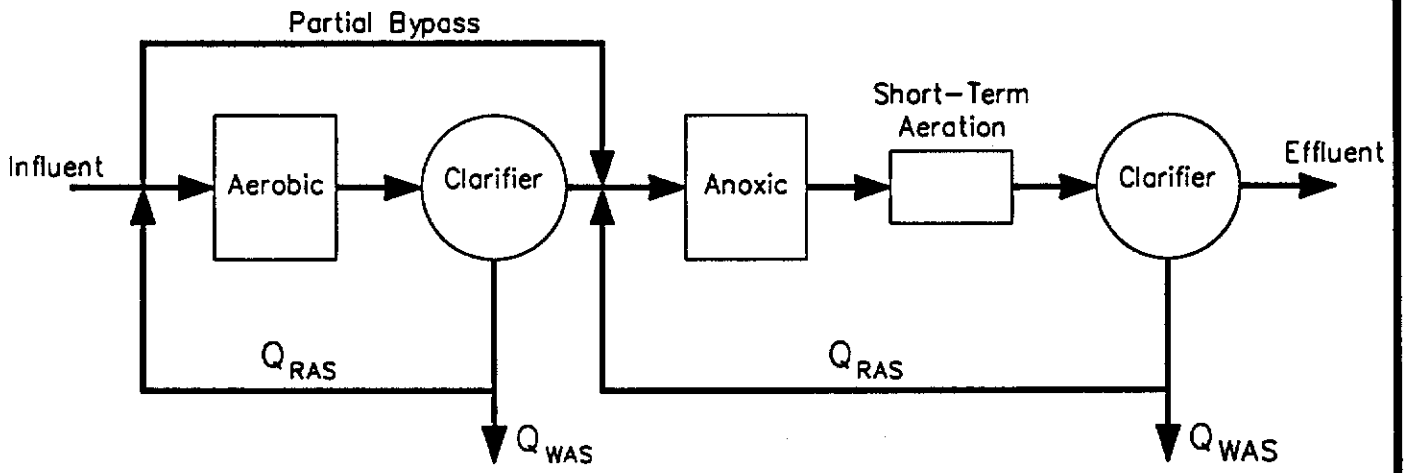

| Los Osos Alternatives Study | Figure |
|---|---|
| BIO–DENITRO DE–DITCH PHASED ISOLATION DITCH PROCESS | B3-12 |
| Metcalf & Eddy | Date: February 1994 |



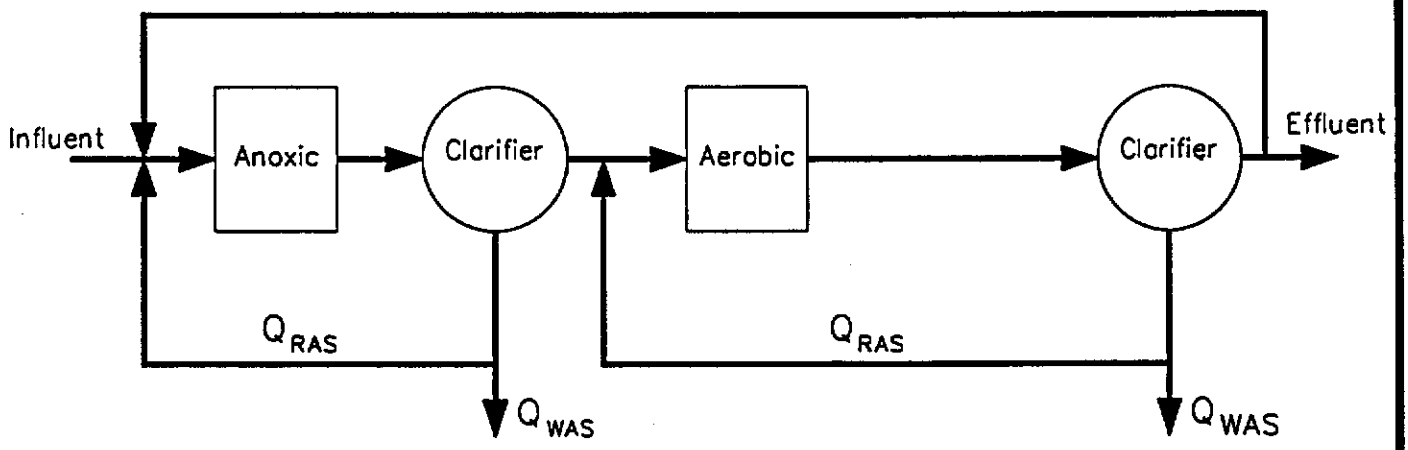

| Los Osos Alternatives Study | Figure B3-13 |
|---|---|
| SINGLE SLUDGE PROCESSES | |
| M&E Metcalf & Eddy | Date: February 1994 |




(a)

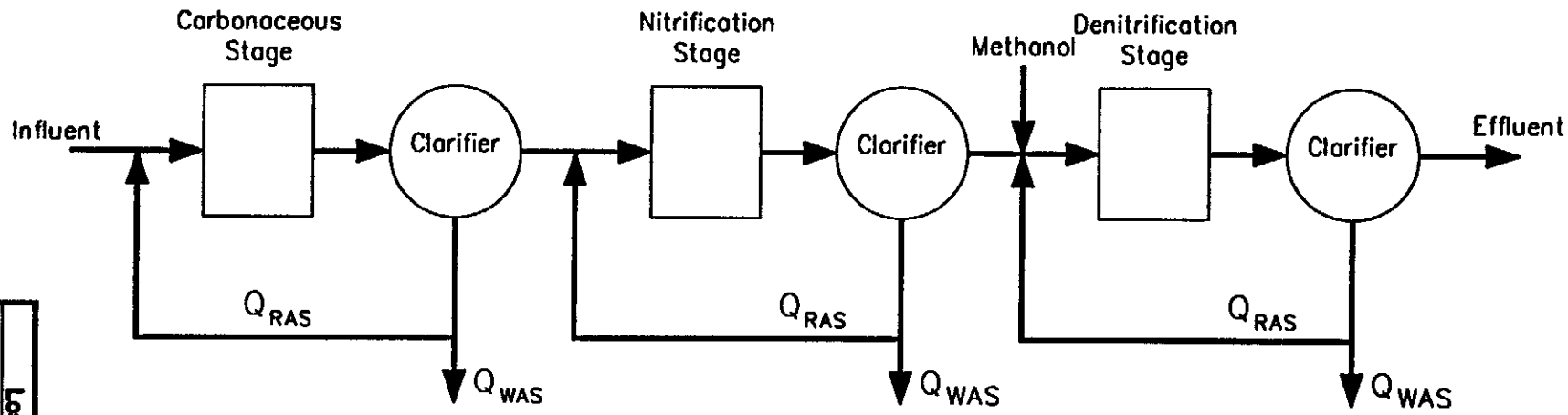



(b)




(c)

| Los Osos Alternatives Study | Figure |
|---|---|
| DUAL SLUDGE PROCESSES | B3-14 |
| Metcalf & Eddy | Date: February 1994 |




Metcalf & Eddy

TRIPLE SLUDGE PROCESS

Los Osos Alternatives Study

Date: February 1994

Figure B3-15

## BIOLOGICAL NITROGEN REMOVAL - BIOSTYR

### Description

Biostyr is an aerated biofilter which consists of upflow filtration through a submerged and floating fine granular media of plastic particles. The upflow filter systems is a secondary treatment process and is particularly efficient for nitrogen removal. Air is injected into the filter media, separating an aerated stage from the final filter zone. This allows the filter to simultaneously nitrify and denitrify in one unit. The Biostyr system is also capable of eliminating carbon pollution, suspended solids, and bacteria, which attach to the synthetic media which acts as a filter. Counter-current flushing rinses the filtration zone, and the sludge is removed by gravity from the bottom of the chamber. A residence time of 1 to 2 hours for secondary purification is usually required. Preliminary treatment such as screening and grit removal normally precede the process.

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** The Biostyr system is capable of reducing $BOD_5$ and TSS to 10 mg/l, and achieving 5 mg/l for both can be done with the addition of methanol. Nitrogen removal is typically 90-95%

**Reclamation Criteria.** The Biostyr system can be integrated into an overall treatment train designed to meet reclamation criteria. Additional processes will need to be added for coagulation, filtration, and disinfection to meet the specific regulations.

### Technical Aspects

**Reliability.** The Biostyr system eliminates the need for separate washwater and washing pumps because the head of the water above the filter is sufficient to wash the filter. Access to the nozzles is fairly easy and there is no requirement to empty the media. But Biostyr is a new technology, and proper operation will require skilled operators and regular inspection and maintenance of equipment.

**Flexibility.** The unit is capable of handling flow variations between 0.1 MGD and 3 MGD. This system is only suitable for domestic wastewater.

**Precedents.** Biostyr was developed in 1990. While filtration is fairly common, upflow filtration was not developed until 1987. Most of the Biostyr systems have been installed in France and other parts of Europe. No systems are currently operating in the United States.

**Aquifer Recharge Capability.** Not Applicable

## Costs

| Table B3-16. PRESENT WORTH ANALYSIS - BIOSTYR | |
|---|---|
| 1. Construction, $ | 2,691,000 |
| 1a. 20% contingency, $ | 538,200 |
| 1b. Subtotal, $ | 3,229,200 |
| 1c. 20% engineering, $ | 645,840 |
| 2. Total capital, $ | 3,875,000 |
| 3. O&M, $/yr | 62,400 |
| 4. Present worth of O&M, $[a] | 595,920 |
| 5. Total Present worth, $[b] | 4,470,960 |

a. 8 ⅜ % for 20 years.
b. Sum of rows 2 and 4.

## Other Factors

The Biostyr is very compact, requiring an approximate area of 1500 square feet. Odor and emissions will be minimized since the surrounding air will only be in contact with oxygen saturated treated water. The stripping of volatiles in the effluent is avoided with this system. In addition, the dirty washwater remains in a closed space without exposure to the atmosphere. Solids to be processed and disposed of will need to be digested. The backwash water can be recycled back to the primary unit to minimize water usage.

## References

1. Rogalla et al, (1993): High Rate Aerated Biolfilters for Plant Upgrading, "Upgrading of Wastewater Treatment Plant" Conference, Berlin.

## COUNTER-CURRENT AERATION SYSTEM

### Description

The counter-current aeration systems is a proprietary process that is a modification of the activated sludge process. Patent rights for the process are held by the Schreiber Corporation. The system employs air diffusers mounted at the bottom of a revolving bridge in a circular aeration tank (see Figure B3-16). The revolving bridge is centrally fixed in a aeration tank at a pivot point and is supported by a rubber tire assembly at the tank periphery. The bridge travels at a peripheral speed of 2.8 to 3.5 ft/s and completes one tank revolution in about 2 minutes. Sections of the air diffuser assembly can be removed from the tank without dewatering the tank contents.

As a result of the circling motion of the bridge, which is moving at a rate faster than the tank contents, fine bubbles are dispersed in a sweeping pattern behind the traveling bridge. Membrane diffusers are used to create the fine bubbles. Because the bubbles are discharged in a sweeping pattern, the contact time of the bubbles with the wastewater is increased as compared to conventional diffused air systems. The additional contact time improves the oxygen transfer efficiency.

Similar to the oxidation ditch process, the counter current aeration systems does not require primary clarifiers. The secondary clarifiers, are equipped with skimmers for scum removal. Screening and grit removal is required, however, ahead of the aeration tank.

Separate secondary sedimentation tanks are used for most applications. For smaller installations, the secondary clarifier is incorporated in the center as a circular tank. For Los Osos, a separate secondary clarifier is required (see Figure B3-16). A feature of the Schreiber secondary clarifier design is that the scraper and skimming equipment can be hoisted above the liquid level for inspection and maintenance. The tank contents do not have to be drained for maintenance. This features allows a single clarifier to be used instead of two; other designs require the tank contents to be drained for inspection and maintenance of the equipment.

Similar to the oxidation ditch, the solids retention time in a counter current aeration system typically ranges from 20 to 30 days. Because the sludge is well stabilized, separate sludge digestion facilities are not required.

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** The counter-current aeration is capable of over 90% removal of BOD and suspended solids. When designed for nitrogen removal, over 90% removal of nitrogen can be achieved. Typical nitrogen removals are 70 to 95%.

**Reclamation Criteria.** The counter-current system can be integrated into an overall treatment train designed to meet reclamation criteria. Additional processes need to be added for coagulation, filtration, and disinfection to meet the specific regulations.

## Technical Aspects

**Reliability.** An EPA-sponsored study surveyed four wastewater treatment plants using the counter-current aeration process. The plants ranged in size from 0.65 to 7.0 mgd. Effluent quality observations reported that average effluent BOD ranged from 1.6 to 10.8 mg/L and suspended solids ranged from 1.0 to 26.8 mg/L. For the largest plant, nearly 30 percent of the observations exceeded 30 mg/L. Poor performance for this plant was attributed to organic shock loadings and leaking air mains, although repairt of the air mains did not fully eliminate the solids problem [1].

**Flexibility.** Because the counter-current aeration system is designed for a long hydraulic resident time, it is highly resistant to loading changes without affecting effluent quality. It is particularly well suited to small to medium size plants. The system can also be programmed through its process control for the removal of nitrogen and phosphorus. The process is difficult to expand as additional separate aeration and sedimentation units will be required to be built.

**Precedents.** Most plants installed are in the range of 0.5 to 10 mgd in capacity but one 17 mgd plant has been reported [2]. Typically this aeration system has been installed in extended aeration applications with low organic loadings and a hydraulic detention time of 24 hours [1].

**Aquifer Recharge Capability.** Not Applicable.

## Costs

The estimated capital cost for a counter-current aeration system (based on manufacturer's information), operation and maintenance cost, and present worth costs are summarized in Table B3-17.

| Table B3-17. PRESENT WORTH ANALYSIS - COUNTER-CURRENT AERATION SYSTEM [3,4] | |
|---|---|
| 1. Construction, $ | 2,700,000 |
| 1a. 20% Contingency, $ | 540,000 |
| 1b. Subtotal, $ | 3,240,000 |
| 1c. 15% contractor overhead and profit | 948,000 |
| 2. Total capital, $ | 3,888,000 |
| 3. Operation and maintenance cost, $/yr | 41,500 |
| 4. Present worth of O&M, $ (x9.55) | 396,000 |
| 5. Total Present Worth, $ | 4,284,000 |
| a. 8 3/8% for 20 years.<br>b. Sum of rows 2 and 4. | |

**Advantages**

- Process is simple and relatively easy to operate.
- Design can be modified to accommodate nitrification and denitrification, and phosphorus removal.
- Higher oxygen transfer efficiencies are claimed as compared to conventional diffused air aeration systems.
- Low biosolids production.
- Long solids retention time stabilizes the biosolids and eliminates the need for separate sludge digestion facilities.
- The ability to remove the diffusers from the aeration tank and the sludge scrapers and skimmers from the clarifier without dewatering the tanks permits single units to be used.

**Disadvantages**

- Fine screening is needed to prevent fouling with rags.
- Good operator skills are required.
- Frequent maintenance of the center drive seals and bridge gear boxes has been reported at existing installations [1].
- Diffuser fouling may reduce plant treatment capacity.
- Process is proprietary and limits competitive bidding. Equipment price may include a royalty payment.
- Significant down-time of aeration unit for maintenance will affect plant performance.
- Plant is not readily expandable.

**References**


1. U.S. Environmental Protection Agency: Project Summary: Post Construction Performance of Schreiber Counter-Current Aeration Facilities, EPA/600/S2-87-089, January 1988.

2. "Jackson Has the Plant to See in Tennessee", Water Lines (a publication of the Schreiber Corporation), Issue 3, February 1992.

3. Schreiber Corporation: Preliminary Basis for Design, January 1994.

4. Telefax, Bill Needham & Company, Equipment pricing information for Los Osos, January 31, 1994.

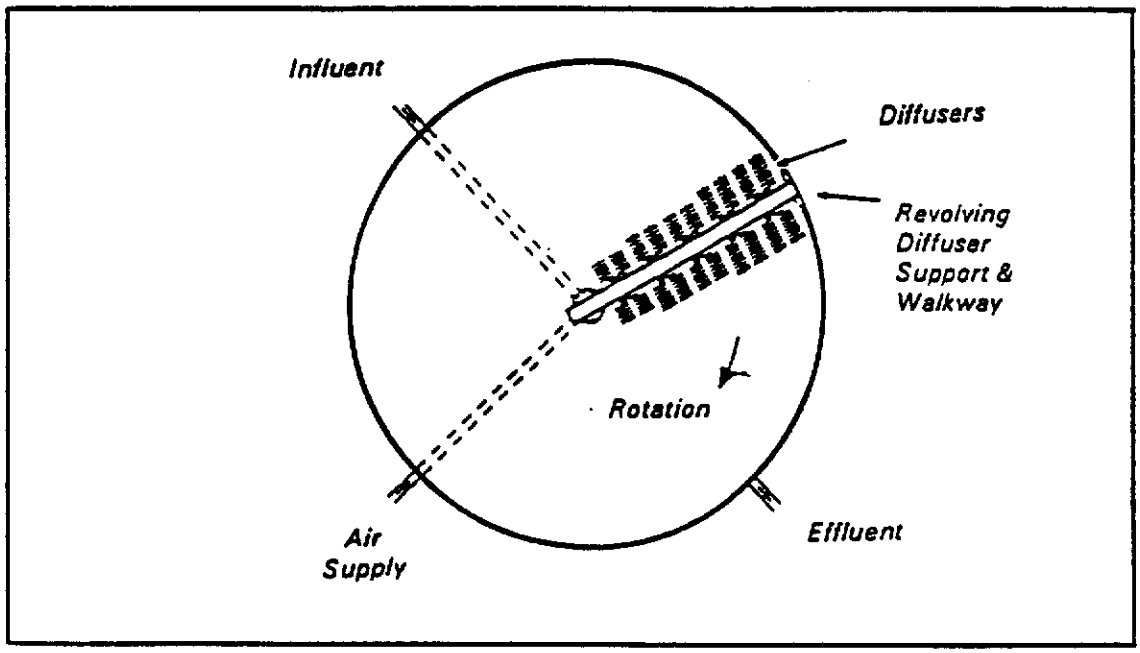



**FIGURE B3-16**

**TYPICAL COUNTER CURRENT AERATION SCHEMATIC**

## DUAL-POWER, MULTIPLE CELL AERATED POND SYSTEM

### Description

The dual-power, multiple cell (DPMC) aerated pond system consists of a series of ponds that are used for settleable solids removal, biological oxidation, nitrification, and sludge stabilization. A schematic diagram is shown in Figure B3-17. Screened wastewater is initially introduced into a completely mixed, high rate aeration pond where mechanical aeration is provided for oxidation of BOD. The first cell is followed by a series of three ponds, each aerated at a power level that permits the settleable fraction of a suspended solids to settle while maintaining aerobic conditions in the upper pond layer. Solids that settle form deposits; over time the biodegradable material in the sludge decomposes. Solids must be removed from the ponds when the sludge accumulation becomes excessive. The total hydraulic retention time in the four ponds is about 7 days at the average design flowrate.

Sludge removal is accomplished at intervals depending on the level of accumulation in the ponds. Removal is usually accomplished by a small dredging barge. Sludge may be disposed of on land as it is well stabilized.

Effluent from the pond system is well nitrified, but little denitrification occurs because of the relatively short retention time in the ponds and no anoxic zone is provided as in the integrated pond system. Consequently, a packed bed reactor with a methanol feed system is required for denitrification. In addition, the ponds are susceptible to algae growth during the warmer sunnier months thereby increasing the effluent suspended solids. Dissolved air flotation for algae removal is also necessary before denitrification and filtration.

### Conformance with Laws, Regulations, and Criteria

**RWQCB Discharge Requirements.** Effluent from a DPMC aerated pond system normally contains less than 30 mg/L BOD and suspended solids, and is nitrified. During summer months, algae growths may increase the suspended solids significantly. To meet discharge criteria, dissolved air flotation for algae removal and deep beds reactors for denitrification are provided. Disinfection by chlorination is also required to meet permit requirements.

**Reclamation Criteria.** The DPMC aerated pond system can be integrated into an overall treatment train designed to meet reclamation criteria. Coagulation and filtration also has to be provided to meet reclamation disinfection criteria.

### Technical Aspects

**Reliability.** Aerated ponds system have been used in many small communities in California and the United States. They are easy to operate and generally provide effluent of consistent quality. One of the principal problems with pond systems relate to algae growth especially

during summer months. Algae blooms cause an increase in suspended solids; removal of algae by special systems such as dissolved air flotation may be required.

**Flexibility.** Depending on the piping arrangements, a DPMC aerated pond system provides greater operating flexibility than other types of ponds systems. Alternative flow patterns and aerator locations can be used depending on changes in wastewater characteristics. Pond systems require large land areas and therefore are not easy to expand.

**Precedents.** Although the technical aspects of a DPMC aerated pond system is not unique, there are only a few installations of this type in the United States. The concept was developed by Dr. Linville Rich, a noted environmental engineering professor [1]. Results published from operating pond systems indicate a DPMC pond system is capable of high removals of BOD and suspended solids but no data are published for pond systems requiring nitrogen removal. If a DPMC system were used for Los Osos, it most likely would be the first of its type in California.

**Aquifer Recharge Capability.** Not Applicable.

### Costs

The estimated capital, operation and maintenance, and present worth costs are summarized in Table B3-18.

### Other Factors

Land area requirements = 12 acres, including setbacks and roads.

### Advantages

- The pond system itself is simple and relatively easy to operate.
- Compared to other types of aerated pond systems, power requirements are lower.

| Table B3-18. PRESENT WORTH ANALYSIS<br>DUAL POWER, MULTIPLE CELL POND SYSTEM | |
|---|---|
| 1. Construction, $ | 3,600,000 |
| 1a. 20% Contingency, $ | 720,000 |
| 1b. Subtotal, $ | 4,320,000 |
| 1c. 20% engineering services | 864,000 |
| 2. Total capital, $ | 5,184,000 |
| 3. Operation and maintenance cost, $/yr | 103,600 |
| 4. Present worth of O&M, $ (x9.55)[a] | 989,000 |
| 5. Total Present Worth, $[b] | 6,173,000 |
| a. 8⅜ % for 20 years.<br>b. Sum of rows 2 and 4. | |

**Disadvantages**

- Because of the need for algae and nitrogen removal, the process complexity and cost increase significantly.
- Ponds systems require larger land area than other types of systems.
- Pond systems are more difficult to expand unless additional land is purchased and reserved for future ponds.
- Present worth costs are significantly higher than those for other treatment alternatives.

**References**

1. Rich, L.G.: A Low-Cost Secondary Treatment Alternative, Water/Engineering & Management, pp 27-28, February 1982.

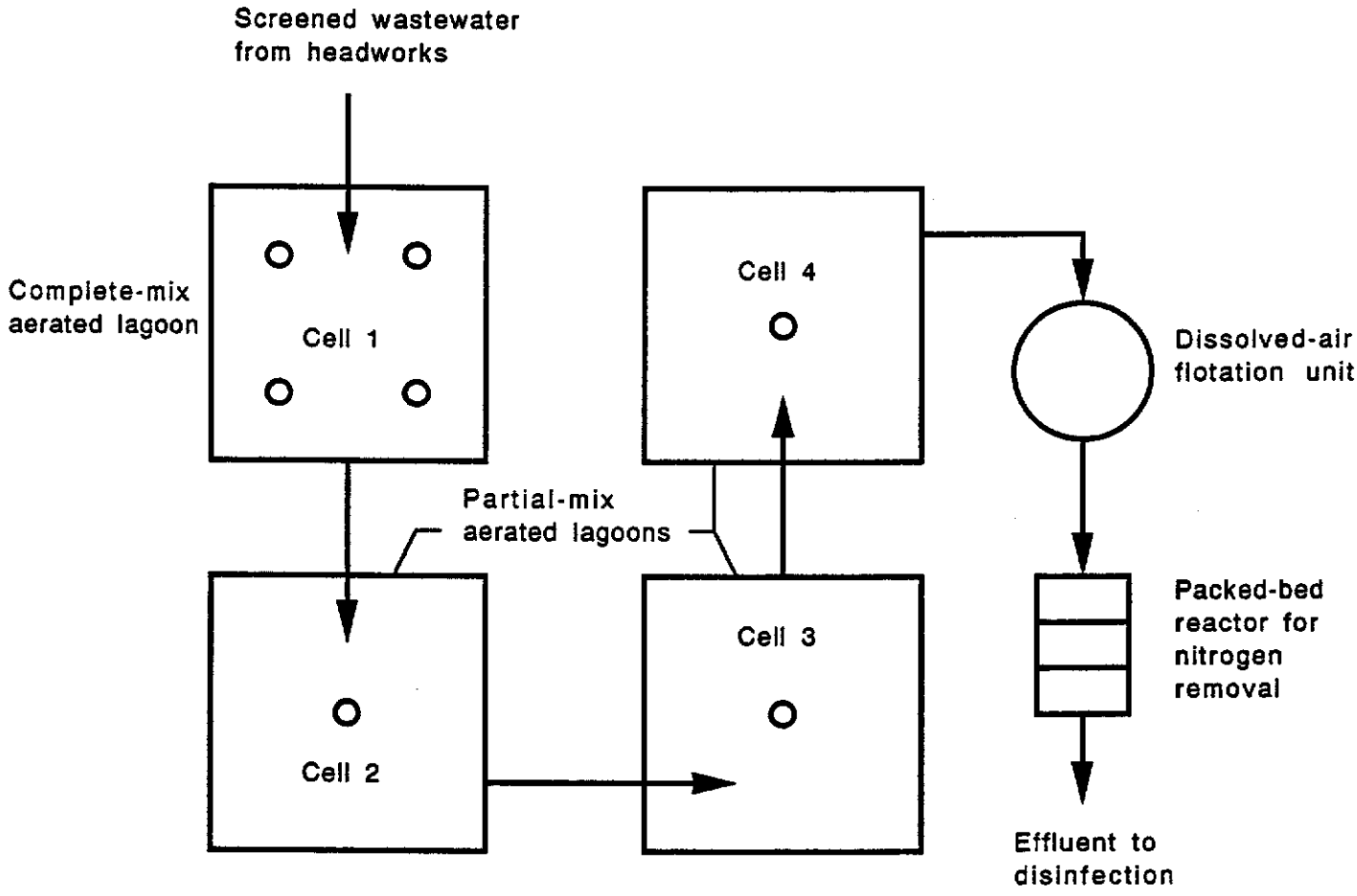



**FIGURE B3-17**

**FLOW DIAGRAM FOR DUAL-POWER, MULTIPLE CELL AERATED POND SYSTEM**

## RAPID INFILATATION (RI)

### Description

Rapid infiltration treatment is the use of permeable soils for biological, physical, and chemical treatment of wastewater. Primary of secondary effluent is treated as if it infiltrates the soil surface and percolates through the soil matrix. Extensive removal of BOD, suspended solids, phosphorus, bacteria and viruses occurs during treatment [1].

Primary or secondary effluent is surface applied in shallow spreading basins. Well-drained permeable soils are required.

### Conformance with Laws, Regulations, Criteria

**RWQCB Discharge Requirements.** Rapid infiltration is capable of removing 40 to 90% of the applied nitrogen. Removal is accomplished by nitrification and subsequent dentrification in the soil profile. Significant nitrogen removal requires intermittent application, moderate hydraulic loading rates (50 to 100 ft/yr) and a BOD:N ratio of 3:1 or more [2,3]. With primary effluent, rates below 100 ft/yr and optimum hydraulic loading cycles, 70 to 90% nitrogen removal can be achieved [3,4]. For secondary effluent (with BOD:N ratios less than 3:1) the nitrogen removal can be expected to be 40 to 50% [5,6].

**Reclamation Criteria.** Rapid infiltration can be part of an overall treatment train to conform to criteria for groundwater recharge. Septic tank effluent can be used directly for rapid infiltration treatment and recharge at decentralized, cluster locations.

### Technical Aspects

**Reliability.** Rapid infiltration requires minimal operator attention to produce reliable performance. Intermittent cycling of wetting and drying will maintain the infiltration rate and will facilitate nitrification/dentrification. Periodic scarification of basins is needed to break up solids accumulation.

**Flexibility.** Improved treatment for nitrogen removal can be obtained by increasing the detention time is the soil decreasing infiltration rates) and by increasing the BOD:N ratio by adding more carbon to the soil or the applied wastewater.

**Precedents.** There are over 300 operating rapid infiltration systems in the U.S. with the oldest dating back 100 years [2]. Most RI systems discharge through the subsurface into a nearby surface water body. This indirect surface discharge is generally encouraged by

regulatory agencies, because a high nitrogen removal requirement can usually be avoided [2]. Some RI systems, such as at Whittier Narrows in Los Angeles County, recharge potable aquifers [2].

**Aquifer Recharge Capacity.** Rapid infiltration is the most common form of groundwater recharge.

## Costs and Land Requirements

Costs and land requirements for rapid infiltration are the same as for groundwater recharge.

## References


1. U.S. Environmental Protection Agency. Process Design Manual for Land Treatment of Municipal Wastewater. EPA 625/1-81-013, Center for Environmental Research Information. Cincinnati, Ohio 1981.

2. Reed, S.C., E.J. Middlebrooks, and R.W. Crites. Natural Systems for Waste Management and Treatment. McGraw-Hill Book Co., NewYork, NY 1988.

3. Crites, R.W. Nitrogen Removal in Rapid Infiltration Systems. Journal Environmental Engineering Division, ASCE, 111(6):865-873, December 1985.

4. Bouwer, H. and R.C. Rice. Renovation of Wastewater at the 23rd Avenue Rapid Infiltration Project. Journal WPCF, 56(1):76-83 January 1984.

5. Reed, S.C. and R.W. Crites. Handbook on Land Treatment Systems for Industrial and municipal Wastes. Noyes Data. Park Ridge, N.J. 1984.

6. WPCF. Nutrient Control, MOP No. FD-7. 1983.

# APPENDIX B4

# COLLECTION

## GRAVITY COLLECTION SYSTEM

### Description

Using criteria in [1], the gravity wastewater collection system consists of minimum 8-inch diameter PVC pipes, maximum 350 feet spacing between manholes, and is designed for a minimum scouring velocity of 2.5 feet per second (fps). The large elevation differences in the study area allow gravity flow for much of the area. Several portions of the system require small lift stations (for localized low-lying areas) which pump short distances into an adjacent gravity collection subarea. Several larger pumping stations and force mains are required to convey collected wastewater to the proposed treatment plant facility site.

Not all of the lots can be served by gravity. The system as laid out includes isolated areas of streets with grinder pumps on-lot and pressure sewers in the street. These pumps into an adjacent gravity sewer.

Laterals from each lot will be from a cleanout at the property line to the main in the street. The homeowner will be responsible for connecting to the cleanout at their property line. Existing septic tanks and drain field will be abandoned.

### Conformance with Laws, Regulation Criteria

The gravity collection system is designed to conform to all known laws, regulations and local criteria.

### Reclamation Criteria

Not applicable.

### Technical Aspects

The gravity collection system is the simplest system to operate, requiring regular maintenance only to flush out the pipes. The manholes serve as isolation valves in the system, thereby eliminating the need for potentially high maintenance division valves (required for pressurized/pumped collection systems). The lift stations and pump stations in the gravity system will require regular maintenance for operation of pumps, valves, and controls.

Provisions for new electric service will be required for each of the proposed lift station and pumping station sites. Several miscellaneous individual sites will require new power for the proposed grinder pump systems.

Trouble-shooting the system for problems is simple with a gravity system. Flow diversions can be accomplished easily with temporary pumping from one manhole to another, allowing a section of gravity main to be isolated. Cleaning "pigs" can be used to clear pipe clogs. Redundancy in the lift stations and pump stations will provide stand-by pumps for period requiring pump maintenance or repairs.

**Reliability**

With several main pumping stations, the main area of concern for reliability is a power failure. The pump station wet wells will be sized to allow for 2 - 4 hours of storage in the event of a power outage. Beyond that, emergency generators will be provided to ensure that there are not overflows or backups into the system.

**Flexibility**

A gravity collection system is flexible in terms of accommodating a range of flows. As more connections are made, the velocity is increased and the head loss increases, but gravity sewers are not designed to flow full. Therefore, there is excess capacity available for increased flows to be conveyed. Once the existing system pipe is installed, however, the pipe invert cannot be easily changed. If future areas of service require additional reaches of pipe, the elevation of the new services will control how they are connected. It is often common that later-developed services will require pumps to "get into" the gravity main. This restriction leads to a conclusion that the gravity system can be expanded but it is not easily accomplished.

**Precedents**

Most of the systems in the United States, particularly those dating back to the turn of the century, are based on gravity flow. In fact, the Romans were the first to experiment with large conduits for transporting wastewater. The knowledge required to operate a gravity flow is nothing beyond basic physical science, and given the number of systems in place and operating for close to a 100 years, there are more precedents for a gravity system than for any other type of collection system.

**Aquifer Recharge Capability**

Not applicable.

**Costs**

The quantities used to calculate the costs presented in Table B4-re based on [1]. O&M costs are based on the connected horsepower as summarized in [1]. Other maintenance time was added to account for general system maintenance.

No costs were assigned for land acquisition. However, in reality, land will be needed for the 3 lift stations and the 3 pump stations and miscellaneous easements for pipelines, grinder pumps, and force mains.

| Table 1. PRESENT WORTH ANALYSIS - GRAVITY | |
|---|---|
| 1. Construction, $[a] | 30,585,000 |
| 1a. 20% Contingency, $ | 6,117,000 |
| 1b. Subtotal | 36,702,000 |
| 1c. 20% engineering services | 7,340,000 |
| 2. Total Capital, $ | 44,042,000 |
| 3. Operation and maintenance, $ | 327,000 |
| 4. Present worth of O&M, $[a] | 3,124,000 |
| 5. Total present worth[b] | 47,166,000 |
| a. Includes private on-lot costs for septic tank abandonment and house laterals.<br>b. 8⅜% for 20 years.<br>c. Sum of rows 2 and 4. | |

## Other Factors

Approximate land area requirements are: 1 lot for each lift station (total, 3 lots) and 1 to 2 lots for each pumping station (total, 6 lots max). This amounts to approximately 3 acres total.

## Advantages

- Minimum mechanical equipment
- Familiarity with gravity sewers - many precedents

## Disadvantages

- Infiltration and inflow
- Maintenance

## References

1. Phase Two - Basis of Design Report. (SA No. 9 - Los Osos, Baywood Park, Cuesta - By - The - Sea Sewerage Project. Engineering Services, February 1987.

## SEPTIC TANK EFFLUENT PUMP/SEPTIC TANK EFFLUENT GRAVITY (STEP/STEG) COLLECTION SYSTEM

### Description

The STEP/STEG wastewater collection system consists of 2 to 8-inch diameter PVC pipes to achieve a design velocity of 5 feet per second (fps) or less. The concept of a cluster STEP system is to provide each residence with a septic tank. From the residence, septic tank effluent flows by gravity to a cluster effluent pump station which can generally serve ten homes. The solids are left in the tank and the effluent is pumped via low pressure, small diameter sewers to the treatment plant.

The large elevation differences in the study area will allow gravity flow for much of the area. Naturally sloping areas will still be pumped in this alternative, but the power requirements are greatly reduced and the cluster system is enhanced. A typical 1/2-hp effluent pump can handle a maximum of approximately 200 feet of total dynamic head. The cluster STEP system will not require additional small lift stations as is required in the gravity alternative. No additional pumping stations will be required.

Gravity laterals from a tank on each lot will be connected to the small diameter main in the street which is then connected to the cluster pump station. Unlike the common STEP system, the homeowner does not have to supply power to the tank since it does not contain a pump. The homeowner will be responsible for providing a water-tight connection to the septic tank. Existing septic tanks that are not water-tight will be abandoned and new tanks placed.

### Conformance with Laws, Regulation, Criteria

The cluster STEP collection system is designed to conform to all known laws, regulations and local criteria.

### Reclamation Criteria

Not applicable.

### Technical Aspects

The cluster STEP collection system is designed to provide a duplex effluent pumping unit at each cluster pump station. System operation and maintenance will be required for the pumps and for the pressure sewers. Isolation valves are required in the system, to allow troubleshooting for leaks in the piping network or for emergencies. The cluster pump station consists of a PVC pump basin with duplex 1/2-hp submersible effluent pumps. The pump basin inlet is equipped with an automatic valve that will close in the event of a power outage.

of systems in operation, ranging from 1 to 1,100 or more pumping units connected per system. The cluster STEP system is relatively new but uses accepted technology to remove the homeowner from being involved with the maintenance of the system.

### Aquifer Recharge Capability

Not applicable.

### Costs

The quantities used to calculate the costs presented in Table B4-2 are based on pipeline quantities and treatment plant location in [1]. O&M costs are based on the revised connected horsepower. Other maintenance time was added to account for general system maintenance.

No costs were assigned for land acquisition. However, in reality, land will be needed for the miscellaneous easements for pipelines, cluster pump stations, and pressure mains.

**Table B4-2. PRESENT WORTH ANALYSIS - STEP/STEG**

| | |
|---|---|
| 1. Construction, $ | 29,423,000 |
| 1a. 20% Contingency, $ | 5,117,000 |
| 1b. Subtotal | 34,540,000 |
| 1c. 20% Engineering services | 6,908,000 |
| 2. Total Capital, $ | 41,448,000 |
| 3. Operation and maintenance, $ 1 yr | 608,000 |
| 4. Present worth of O&M, $[b] | 5,807,000 |
| 5. Total present worth[c] | 47,255,000 |

a. IncludeS abandonment of existing septic tank.
b. 83/8% for 20 years.
c. Sum of rows 2, 4, and 6.

## VACUUM COLLECTION SYSTEM

### Description

The concept of a vacuum system is to convey wastewater by using a vacuum as the driving force. A vacuum sewer system consists of three major components: the valve pit package; vacuum service lines, branch lines and mains; and the vacuum collection station. Raw wastewater flows from the home usually by gravity to a valve pit package located in the yard, a public right-of-way, or in the roadway. When approximately 10 gallons of wastewater flows into the sump basin, a pneumatic signal is sent to the controller mounted on the top of the interface valve which opens the valve by vacuum. When the 10 gallons of wastewater is drawn into the vacuum lines, the interface valve closes. Wastewater is drawn to the collection tank by the vacuum pumps at a velocity of 15 to 18 feet per second (fps). As the tank fills, sensing rods in the tank activate the wastewater pumps which in turn pump the wastewater to an interceptor to the treatment plant.

Vacuum lines and mains are laid in narrow trenches at minimum cover in a saw-tooth profile for grade and upgrade transport and following grade for downgrade transport. A 0.2% slope is normally maintained between lifts. Maximum static lift and friction loss is 13 feet measured from the valve pit package to the collection station. Service lines are typically 3-inch diameter PVC gasketed or solvent-weld pipe. Branch lines and vacuum mains can be from 4- to 10-inch diameter PVC (Schedule 40 or SDR 21) pipe.

### Conformance with Laws, Regulation, Criteria

The vacuum collection system is designed to conform to all known laws, regulations and local criteria.

### Reclamation Criteria

Not applicable.

### Technical Aspects

The vacuum collection system is designed to collect wastewater from a maximum of four residences to each valve pit, and then through a series of vacuum lines and mains, collect at a centralized vacuum collection station. Wastewater pumps would then convey the collected wastewater to the interceptor to the treatment plant. Because the maximum lift a vacuum collection station can achieve is 13 feet per vacuum main, it is not feasible to layout the Los Osos service area with one centralized collection station. Rather, three localized collection stations are proposed that would each pump to a common interceptor to the treatment plant. Much of the system can flow by gravity to the collection stations.

## GRINDER PUMP COLLECTION SYSTEM

### Description

Using criteria set in [1], the grinder pump wastewater collection system consists of minimum 2-inch diameter PVC pipes and ranging up to 8-inch diameter to achieve a design minimum scouring velocity of 2.5 feet per second (fps). The concept of a grinder pumping system is to provide each residence with a grinder pumping station that replaces the existing septic tank. The system evaluated for this study is based on the use of Environment One pumps, which are positive displacement-type grinder pumps. This type of grinder pump is much better suited for a collection system than conventional centrifugal pumps because of the hydraulic head variations inherent in a pumped collection system.

From the residence, wastewater flows by gravity to the grinder pump station. The solids are ground into a slurry and pumped via low pressure, small diameter sewers to the treatment plant. The pressure sewers range in size from 2-inch to 8-inch diameter. The large elevation differences in the study area allow gravity flow for much of the area. Naturally sloping areas will still be pumped in this alternative, but the power requirements are greatly reduced. A typical 1/2-hp grinder pump can handle a maximum of approximately 90 feet of static head and up to 140 feet of total dynamic head.

The topography of the study area is such that the small portions of the system that require small lift stations for localized low-lying areas in the gravity alternative will not require the lift stations in the grinder pump alternative. One large conveyance pumping station and force main is required to convey collected wastewater to the proposed treatment plant facility site.

The system as laid out in [1] includes one connection to a community sewer. By combining these features, and even using traditional gravity sewers in subareas of the system, it is possible to eliminate many individual grinder pumps. The system as compared here, however, provides either a simplex or duplex grinder pumping station at each lot or pair of lots.

Laterals from each lot will be from the proposed simplex or duplex unit to the small diameter main in the street. The homeowner will be responsible for connecting to the grinder pumping station unit. Existing septic tanks and drain fields will be abandoned.

### Conformance with Laws, Regulation, Criteria

The grinder pump collection system is designed to conform to all known laws, regulations and local criteria.

## Reclamation Criteria

Not applicable.

## Technical Aspects

The grinder pump collection system is designed to provide either a simplex or duplex pumping unit on each lot or pair of lots. System operation and maintenance will be required for the pumps and for the pressure sewers. Isolation valves are required in the system, to allow troubleshooting for clogs or leaks in the piping network. The grinder pump station consists of a 30-gallon cannister with a submersible 1/3- or 1/2-hp submersible grinder pump within. A baffle/screen is used to protect the pump intake from large solids. The pump is equipped with an internal thermistor to automatically shutoff if the pump gets overheated. This situation is commonly allowed in a grinder system, to cycle the pump until the system head is such that the new plug of sewage can be pumped into the main.

The large conveyance pump station will require regular maintenance for operation of pumps, valves, and controls.

Provisions for new electric service will be required for each of the proposed grinder pump station and pumping station sites. This amounts to almost every lot within the service area.

Trouble-shooting the system for problems with a grinder pump system often involves isolating one or more reaches of pipe. The remainder of the system will continue to operate by closing isolation valves to re-route the flow. If an individual grinder requires maintenance or repair, the community maintenance staff should have spares on hand to allow a temporary replacement to keep the house on line while maintenance or repairs are performed. Redundancy in the conveyance pump station will provide stand-by pumps for periods requiring pump maintenance or repairs.

## Reliability

The main area of concern for a grinder pump system reliability is a power failure. The conveyance pump station wet well will be sized to allow for 2 - 4 hours of storage in the event of a power outage. Beyond that, emergency generators will be provided to ensure that there are no overflows or backups into the system. After power comes back on, all of the individual grinders will likely try to start pumping at once. The hydraulics of this situation are such that some pumps will not have sufficient head to overcome that in the main and will have to wait until the peak dissipates somewhat before pumping. These levels will be set for automatic operation with manual overrides. However, a properly designed system should have sufficient pipe sizes and connected horsepower to resume normal operation within a few hours. Reliability can be enhanced with a program to inform residents about limitations of a

grinder pump system and what precautions should be used in owning and maintaining a grinder pump.

**Flexibility**

A grinder pump collection system is flexible in terms of accommodating future connections. As more connections are made, the velocity is increased and the head loss increases, which creates a situation where it will take longer for individual pumps to empty the canister. As additional reaches of the system are added to serve new areas, the hydraulic characteristics of the system will need to be reviewed. A grinder pump system is therefore considered relatively easy to expand.

**Precedents**

Grinder pump systems have been used in the United States since the 1970s, primarily for recreational lake communities, small rural, communities, trailer parks, apartments and condo complexes, and isolated pockets (low-lying areas) within cities. Currently there are hundreds of systems in operation, ranging from 10 to 800 or more pumping units connected per system.

**Aquifer Recharge Capability**

Not applicable.

**Costs**

The quantities used to calculate the costs presented in Table B4-4 are based on [1]. O&M costs are based on the connected horsepower in [1]. Other maintenance time was added to account for general system maintenance.

No costs were assigned for land acquisition. However, in reality, land will be needed for the main conveyance pump station and miscellaneous easements for pipelines, grinder pumps, and force mains.

The grinder pump system with the treatment plant located as in [1] is more expensive than a gravity system in overall present worth costs. The actual construction cost is slightly lower than the gravity system.

| Table B4-4. PRESENT WORTH ANALYSIS - GRINDER | |
|---|---|
| 1. Construction, $[a] | 30,699,000 |
| 1a. 20% Contingency, $ | 6,140,000 |
| 1b. Subtotal | 36,839,000 |
| 1c. 20% Engineering services | 7,368,000 |
| 2. Total Capital, $ | 44,207,000 |
| 3. Operation and maintenance, $/yr | 744,000 |
| 4. Present worth of O&M, $[b] | 7,105,000 |
| 5. Total present worth[c] | 51,312,000 |

a. Includes abandonment of existing septic tank.
b 8 3/8 % for 20 years.
c Sum of rows 2, 4, and 6.

**Other Factors**

Approximate land area requirements are 1 to 2 lots for the main conveyance pump station which amounts to approximately 1 acre total.

**Advantages**

- Small diameter plastic pipe
- Narrow and shallow trenches
- Minimum equipment and labor
- Reduction of infiltration and inflow

**Disadvantages**

- Mechanical Equipment - large number of pumps
- Power outages
- Power costs
- Operating problems
- Easements

## References


1. Phase Two - Basis of Design Report. CSA No. 9 - Los Osos, Baywood Park, Cuesta-By-The-Sea Sewerage Project. Engineering-Science. February 1987.

2. Environment One literature.

## TRENCHLESS CONSTRUCTION

### Description

Trenchless technologies have been developed to eliminate the need for traditional open-cut trenches, thereby improving the safety to construction personnel and minimizing disruption to existing communities and commercial establishments. These technologies are also applied to projects with environmentally sensitive areas or difficult crossings such as under busy roads or airport work.

The concept of microtunneling is to use a single point of entry, a shaft no larger than a 3 to 5 foot diameter manhole, and launch a microtunneling machine which typically consists of a cutting head (mole, rock crusher, or auger head), a slurry system (to add water at the cutting head to make for easier drilling), and the conduit attached to and trailing behind the cutting head. There are great variations in the size and corresponding range of these systems. One must define the subsurface character very carefully before deciding to use this technology, and determining which size machine is appropriate for the job.

### Conformance with Laws, Regulation, Criteria

There are no formal laws, regulations, and criteria that specifically address trenchless technologies. The criteria for trench safety (OSHA regulations) are all easily met with trenchless technologies.

### Reclamation Criteria

Not applicable.

### Technical Aspects

Trenchless technologies, which include techniques for installing new conduit and for rehabilitating existing pipelines, have a wide range of applicability and performance. For this project, it is only relevant to discuss technologies for new construction. This type of system may be divided into several categories of technologies: horizontal directional drilling, microtunneling, and pipe jacking.

- Horizontal directional drilling (HDD) is a technique for pipe and cable installation that uses a guided horizontal drilling method for creating an arc profile, and is generally used for long distances.

- Microtunneling is a small tunnelling system that is remotely monitored and steered, and is generally defined for pipes 36 inches in diameter and less.

- Pipe jacking is a technique for installing pipes through the ground in a previously excavated hole using hydraulic jacks from an entry pit, and is normally used for pipes greater than 36 inches in diameter.

Other parameters that distinguish between trenchless technologies include whether the system is steerable. For pipes and cables greater than 6 inches in diameter, steerable systems are normally used -- either a directional fluid jet cutting tool or microtunneling. For smaller than 6-inch diameter conduits, one can use either steerable or non-steerable systems. Steerable systems include directional fluid jet cutting, guided impact moling, and a directional rod pusher (good for compressible, rock-free soils).

Non-steerable technologies include thrust boring, impact moling, auger boring, rod pushing, and a wet/slurry boring. Nonsteerable systems may be used where the grade of the pipe is not critical and where cost is a factor. These are low cost techniques typically used for small diameter utilities where the exact grade is not critical. Auger borings are typically used for crossings, should be applied for soils that are rock-free and compactible, and can be used with pipes ranging in diameter from 4 to 60 inches and for distances from 60 to 400 feet. Impact moling is used for soft, rock-free soil, the setup is critical, and can be used with pipes ranging from 2 to 6 inches in diameter and for runs less than 60 feet. Thrust boring and rod pushers need a pit to launch from, used with plastic or steel pipe, and are applicable for pipes from 2 to 6 inches in diameter and runs up to 300 feet. Wet/slurry borings require large amounts of water (20-30 gpm), and are used for pipes from 2 to 12 inches in diameter and for runs up to 100 feet. Hole collapse is a concern for this type of technology.

For critical grade applications, auger boring may be used. This technique has an accuracy of approximately 6 inches in both planes (horizontal and vertical) achieved by using levels along the length of the pipe, and is typically used for road crossings. Microtunneling is applicable for a gravity sewer installation because it provides lines laid to close line and grade tolerances, allows long drives between manholes, pipes may be laid deeper than other utilities, and works in ground conditions that can be difficult and with high water tables. Jacking techniques also allows installation of lines to close line and level tolerances, works in all types of ground conditions, works below the water table, reduces the potential for damage to adjacent structures and utilities, installs conduits rapidly and safely, and there is no major cost penalty for greater depths of installation.

There are three types of guided boring systems that allow for differing lengths of installations.

- The mini directional drilling method is powered for line installations and crossings up to 400 feet long.

- The midi directional drilling method is used under rivers, in environmentally sensitive areas and roadways, and has a typical range of 400 to 900 feet.

- Horizontal directional drilling is used under rivers, highways, and runways, and has a typical range of over 900 feet.

Table B4-5 is a summary of the available trenchless methods for new installations.

**Table B4-5. COMPARISON OF TRENCHLESS TECHNIQUES**

| Technique/System | Typical Applications | Type of Conduit Installed | Typical Ranges | |
|---|---|---|---|---|
| | | | Drive Span, ft | Diameter, in. |
| Augering | Typically, crossing techniques for installations of casings used for distribution mains | Steel casing | 60 - 400 | 4 - 60 |
| Thrust Boring & Rod Pushers | Line installations for utility mains and services (gas, electric, telecommunications) | Plastic, steel | 100 | 2 - 6 |
| Impact Moling | Line installations for utility mains and services | Plastic, steel | 60 | 2 - 6 |
| Impact Ramming | Crossings for installation of casings | Steel casing | 60 - 100 | 2 - 48 |
| Fluid Jet Cutting | Installation of pressure mains and services, and electric cables | Plastic, steel | 60 - 450 | 2 - 10 |
| Wet/Slurry Boring | Line installation for utility mains and services | Plastic, steel | 60 - 100 | 2 - 12 |
| Rotary/Directional Drilling | Long crossing installations | Plastic, steel | 200 - 5000 | 2 - 60 |
| Pipe Jacking | Crossings for sewers and pressure lines | Reinforced concrete, steel, ductile iron | 100 - 3000 | over 36 |
| Microtunneling | Sewer installations and connections | Concrete, FRP, clay | 100 - 500 | 6 - 36 |

Source: [1].

### Reliability

To date, the trenchless techniques have proven to be very reliable. With the proper setup and standard safety precautions, the trenchless methods can accomplish the same task as traditional open-cut technology in less time, more cost-effectively, and with more accuracy with certain systems. With a skilled operator, the methods are considered very reliable.

### Flexibility

Trenchless techniques are typically more flexible than a traditional open-cut trenching operation. If unforeseen subsurface obstructions develop, the trenchless system can be adjusted readily to avoid the obstruction whereas with a traditional trencher, considerable effort would be required to change the course of the machine.

### Precedents

Trenchless methods are taking a long time to gain acceptance in the U.S. The methods and technologies have been used in Europe and Japan for several decades and are readily accepted alternatives to the standard way of installing utilities. In the U.S., most of the projects using trenchless techniques have been on the East Coast and in Texas.

### Aquifer Recharge Capability

Not applicable.

### Costs

Typically, the unit cost for installing a utility line with trenchless techniques is greater than traditional open-cut methods (Table B4-6). However, considering the overall impacts to the job, including disruption of community and safety issues (which cannot be assigned a dollar value easily), the approximate cost for trenchless installation techniques is comparable.

| Table B4-6. COST COMPARISON | | | |
|---|---|---|---|
| | Trenchless, Microtunneling | Trenchless, Directional Fluid Boring | Open-Cut |
| 1. Construction, $[a]/lf | 200.00 | 30.00 | 50.00 |
| 1a. 20% Contingency, $ | 40.00 | 6.00 | 10.00 |
| 1b. 15% Contractor overhead and profit, $ | 30.00 | 4.50 | 7.50 |
| 2. Total Capital, $ | 270.00 | 40.50 | 67.50 |
| a. Assuming 8-in dia. pipe, sandy soils and high water table. | | | |

**Other Factors**

The use of trenchless techniques for installing the collection system will depend on the type of system chosen. If the system is a pressure system, utilizing small diameter pipeline, it will depend on the contractor and his willingness and familiarity with the various applicable methods. Because this system will involve installing new pipe in almost every street, it will be cost-effective to install small diameter mains using trenchless methods because of the time savings involved. However, if a gravity system or an alternative system is chosen that involves critical grades for the pipes, larger diameters, or greater depths, it will not be cost-effective to use trenchless methods throughout. For critical roadway crossings or busy commercial areas, it is worth considering.

**Reference**

1. Kramer, S.R., W.J. McDonald, J.C. Thomson. Introduction to Trenchless Technology.

# APPENDIX B5

# SLUDGE AND SEPTAGE DISPOSAL

# LAND APPLICATION OF BIOSOLIDS

## Description

Biosolids generated in secondary biological treatment are land applied to agricultural or silvicultural land at agronomic rates, based on crop nitrogen needs. Liquid or dewatered biosolids are applied by spraying, injection or surface spreading. Biosolids provide nutrients and organic matter to the soil profile.

## Conformance with Laws, Regulations, Criteria

Land application has been regulated by the U. S. EPA under 40 CFR 257 (1979) and currently under 40 CFR 503. Biosolids must be low in trace metals, stabilized and have its pathogen content reduced.

Loading rates are based on crop nitrogen needs and the availability of nitrogen in the biosolids. The RWQCB sets requirements for application limitations and setbacks from wells and property lines.

## Technical Aspects

**Reliability**. The land spreading operation is quite reliable and can be continued indefinitely providing the metal content remains low [1]. Spreading can be accomplished with commercially available spreaders or can be contracted to local farmers.

**Flexibility**. Land application is seasonal and is well adapted to use with drying beds, where dried solids can be stored until cropland is available. Land application of biosolids can be accomplished on agency-owned lands or on private farm land.

**Precedents**. Municipalities in every part of the country are using land application successfully and have been doing so for many decades [1]. Currently about 25 percent of the nation's biosolids are land applied.

**Aquifer Recharge Capability**. Not applicable.

## Costs

Costs depend on the loading rate, haul distance, land price [2], and site development. For the SBR the biosolids production is 310 tons dry solids per year. At a loading rate of 5 tons/acre the land needed is 62 acres. Costs range from $60 to $200 per ton of dry solids [3].

## References


1. U. S. Environmental Protection Agency. Use and Disposal of Municipal Wastewater Sludge. EPA 625/10-84-003. September 1984.

2. U. S. Environmental Protection Agency. Innovative and Alternative Technology Assessment Manual. CERI. EPA 430/78-009. February 1980.

3. Water Pollution Control Federation. Beneficial Use of Wastewater Solids. Manual of Practice FD-15. 1989.

## DEDICATED LANDFILL

### Description

Disposal of sludge or septage can be accomplished by landfilling or landspreading. The process requires a suitable site and application equipment. The application method may be by spreading on the land, spay irrigation, or subsurface injection. Onsite storage is also required for stockpiling during inclement weather.

There is currently no landfill or site in San Luis Obispo County that accepts wastewater sludge or septage. Sludge is kept on the site of wastewater treatment plants and septage is hauled to the Santa Maria wastewater treatment plant. For sludge and septage generated in Los Osos, a new site would need to be found.

### Conformance With Laws, Regulations, and Criteria

The recently-adopted federal regulations (40 CFR 503) govern disposal of sludge and septage. The regulations have five major parts.

A - General provisions, including applicablility, deadlines, and definitions.

B - Land application, including requirements for pollutant limits, management practices, operational standards, monitoring, and recordkeeping for distribution, marketing, agricultural application, and nonagricultural application (e.g., reclamation of disturbed land).

C - Surface disposal, including requirements for pollutant limits, management practices, operational standards, monitoring, and recordkeeping for dedicated sludge/septage landfills (monofills).

D - Pathogen and vector attraction reduction, including standards for Class A and B sludges and 11 approved processes for pathogen reduction.

E - Incineration, including requirements for pollutant limits, management practices, operational standards, monitoring, and recordkeeping.

### Technical Aspects

**Reliability and Precedent.** Landfilling is among the most common sludge/septage disposal methods available. It requires very little equipment (other than hauler trucks and/or spreading vehicles) and minimal operator attention.

**Flexibility.** Landfilling can accommodate virtually any type of sludge and septage within the Part 503 regulations.

**Aquifer Recharge Capability.** Not applicable.

**Costs**

Costs depend on the application rate, haul distance, site acquisition and development. The costs will probably be similar to agricultural land application ($60 to $150/dry ton of solids).

## COMPOSTING

### Description

Biosolids composting is the controlled thermophilic decomposition of organic matter carried out under aerobic conditions to a relatively stable humus-like material. Although composting does not render biosolids totally inert, the process reduces the pathogenic organisms in the biosolids such that the product can be handled without risk and offensive odors.

Compost is particularly beneficial as a soil conditioner, since it has been stabilized and will decompose slowly, remaining effective over a long period. Compost is less effective as a fertilizer, since the composting process results in a significant amount of nitrogen reduction and therefore only a small amount nitrogen is available to crops and plants.

Biosolids composting is broadly categorized into confined and unconfined processes. Unconfined processes include windrow composting and aerated static pile systems. Due to its large area requirements and potential for odor, particularly during turning, windrow composting is rarely used for biosolids. The aerated static pile is the most common unconfined process. The confined or in-vessel composting system is of three types: horizontal, vertical and agitated bed systems. Of these, the agitated bed system has been the technology of choice for recent project as it is relatively less complex than the horizontal and vertical systems.

### Conformance with Laws, Regulations, and Criteria

In 1993, the U.S. Environmental Protection Agency published comprehensive regulations for composting as 40 CFR part 503 whichi specify limits on cadmium, lead, nickel, zinc, copper and PCB's (polychlorinated biphenyls). Several state and local agencies also have statutory responsibilities with regard to the production and distribution of biosolids compost. These include the State Department of Health Services, State Water Resources Control Board, California Integrated Waste Management Board, and the State Air Resources Board.

### Technical Aspects

According to the Phase 2-Basis of Design Report prepared by Engineering Science, the average daily production of sludge is projected to be about 20,400 gallons per day, which corresponds to about 8.8 dry tons per day. The composting techniques available for evaluation are the aerated static pile system in the unconfined process category and the horizontal agitated bed composting system in the confined process category.

In the unconfined process category aerated static pile composting is chosen over windrow composting due to superior odor control, greater inactivation of pathogenic organisms and use of less land area. The aerated static pile system consists of mixing the sludge with a

bulking agent, such as wood chips, construction of a composting pile, aerated composting, screening of the composted mixture, curing and storage. The system is normally not enclosed though a roof is desirable atleast over the mixing area to protect the mix from precipitation. The advantages of a static pile system include (1) lower capital cost, depending on the degree of enclosure (2) flexibility to accommodate variety and changes of sludge and bulking agent quality and quantity and (3) ability to easily handle increases in sludge production. Disadvantages are (1) lower process stability as there is no agitation of pile contents during composting (2) less ability to adjust moisture in composting a mass after initial mix and (3) significant potential for odor release.

In the confined process category, the horizontal agitated bed system is the technology of choice. The system employs a configuration of single or multiple open concrete bays housed in a totally enclosed building fed at one end with a mixture of sludge and bulking agent (such as wood chips). The bays have an automatic agitator which runs on rails on top of the bay walls. The agitator mixes, agitates and moves the material 12-14 feet down the bay every day, thus creating space for a new load. At the end of a predetermined retention period the material will have traversed the bay length to the discharge end of the bays where the compost is removed and stored. Vendors which supply this system include International Process System (IPS) and Longwood Manufacturing Corporation (LMC). Some of the advantages of the agitated bed system include (1) sludge and bulking agents is mixed during composting (2) greater process stability due to agitation and temperature control during composting (3) ability to accommodate a variety of bulking agents including yard waste. Disadvantages include (1) air handling and scrubbing capability for odor and moisture control and (2) maintenance as the system is mechanized.

A careful evaluation based on cost land area requirement, technical complexity and operational ease among other factors, will need to be made to select the most appropriate system for Los Osos. Furthermore, considering sludge from other treatment plants may result in economics of scale for all sludge in the county

**Reliability.** The aerated static pile technique is more labor intensive than the agitated bed system which can be automated which requires less operator attention. The latter, however, requires skilled and experienced operator for operation, inspection and maintenance.

**Flexibility.** The aerated static pile system is well suited to small quantities of wastewater sludge and variations can be easily accommodated provided there is sufficient land area. The agitated bed system will be designed with reasonable spare capacity to handle fluctuations in sludge production. Increase beyond system capacity, will require additional concrete bays which translates to increase capital costs.

**Costs.** In general capital costs and maintenance cost for in-vessel processes tend to be higher than aerated static pile systems. In an effort to keep capital cost low, in-vessel systems are generally designed with shorter retention times as compared with a typical 21-

day retention time for an aerated static pile facility. The construction costs of a 1-ton per day in-vessel system, based on estimates from previous facilities is approximately $2,000,000 - $3,000,000 compared to an estimated capital cost of $2,000,000 for an equivalent aerated static pile system. The annual operation and maintenance cost for a 1-ton per day system is approximately $400,000 - $500,000, compared to $300,000 for an equivalent aerated static pile system.

## SEPTAGE DISPOSAL AT OTHER WASTEWATER TREATMENT PLANTS

### Description

Currently, no wastewater treatment plant in San Luis Obispo County accepts septage. The only available site is at the Santa Maria plant.

Most wastewater treatment plants can handle minor volumes of septage. But for large volumes, plants must be designed to specifically handle septage because of its its high concentration of BOD and suspended solids. Typical septage is 40 times more concentrated than municipal wastewater. Consequently, septage is typically handled at a treatment plant separately from the main stream of influent. Pumper trucks transfer their loads to a holdling tank upstream the plant headworks. The septage can then be pumped to the treatment plant at controlled rates based on the plant capacity and capability.

### Conformance with Laws, Regulations, Criteria

Septage treatment at wastewater treatment plants is regulated by the plant's discharge requirements issued by the RWQCB.

### Technical Aspects

**Reliability.** Treatment is as reliable as the overall plant's reliability. Because of the concentrated nature of septage, there is the potential for plant upsets and other operating problems.

**Flexibility.** N/A

**Precedents.** N/A

### Costs

The costs are included in the fee that pumpers charge to residents and businesses. The current charges in the Los Osos area is from $150 to $200.

### Other

Septage treatment at existing wastewater treatment plants does centralizes treatment of all wastewater at one point, so that operations are more easily controlled. When operated properly, there is minimal environmental impact (compared with land disposal). Because of the nature of septage, there is the potential for odors.

The treatment plant at Santa Maria is an approximately 100 mile round trip and to an adjacent county (Santa Barbara). Los Osos residents and San Luis Obispo County have no control or authority over operation at the Santa Maria plant and are subject to its charges and operating rules.

# APPENDIX B6

# OTHER

## WATER CONSERVATION

### Description

Water conservation is a series of measures designed to reduce water consumption so that wastewater flows to onsite systems or sewers are reduced. The measures apply to indoor water use only, i.e., the fraction that would typically enter the onsite system or sewer. Typically, these measures include:

- Requiring low flow toilets, shower flow restrictors, and other plumbing devices to be installed or retrofitted to directly reduce water use by household appliances and fixtures.

- Distributing educational materials to encourage wiser and more efficient of water, such as shorter showers, leak repair, etc.

- Implementing financial incentives such as rebates for installing water-saving devices/fixtures or rate structures that penalize high water use.

Outdoor water use such as irrigation, car washing, or recreation is not included in this list, since such water use generally does not reach the onsite system or sewer. Gray water recycling is discussed separately.

The basic idea as far as wastewater management is concerned is to reduce indoor water use sufficiently so that wastewater collection, treatment, and disposal processes and facilities can be downsized and be less costly.

### Conformance with Laws, Regulation, Criteria

**RWQCB Discharge Requirements.** These requirements are not generally applicable. Water conservation measures reduce overall hydraulic load on the sewer, but the total BOD, SS, and nitrogen loads remain the same. Consequently, the concentrations of these constituents in domestic wastewater may be increased.

**Reclamation Criteria.** Not applicable.

### Technical Aspects

**Reliability.** Most water conservation efforts are aimed at voluntarily reducing all domestic and commercial/industrial water use. Mandatory measures may be put into effect if severe drought conditions occur. For the most part, these measures have been successful, especially for water agencies for which most supply is derived from surface sources. Agencies having ground water as a major (if not sole) source, such measures have not been as compelling

since groundwater supplies do not significantly vary year-to-year as do surface water reservoirs which are dependent on runoff from rainfall.

Historical analysis of water demands show that before 1976 most water agencies experienced steadily increased per capita demands. During the 1976-77 drought, there was greatly reduced per capita demand -- in some agencies, 50% less. In general, most of this reduction comes from outdoor water use, such as landscape irrigation and car washing. Once the drought is proclaimed over, however, water use increased to generally follow the historical trends, although not as high as pre-drought levels.

In Los Osos, historical unit water consumption (gallons/service) is shown in Figure B6-1 for each water agency/organization: CSA 9, Cal Cities and SET 9. From the peak use in 1988, consumption per connection has decreased 15 to 20%. Future development in Los Osos will probably have reduced per capita indoor water use because of State and locally mandated devices and fixtures such as low-flush toilets and low glow showerhead. CSA 9 is also considering a retrofit program for such devices and fixtures. The key issue is the risk of undersizing sewers or other facilities based on reduced per capita water use in the future.

**Flexibility.** Not applicable.

**Precedents.** Water conservation efforts have been underway in California since the drought of 1976-77. As a result of that drought, numerous specific measures have been successfully implemented in virtually every water supply agency in California.

**Aquifer Recharge Capability.** Not applicable.

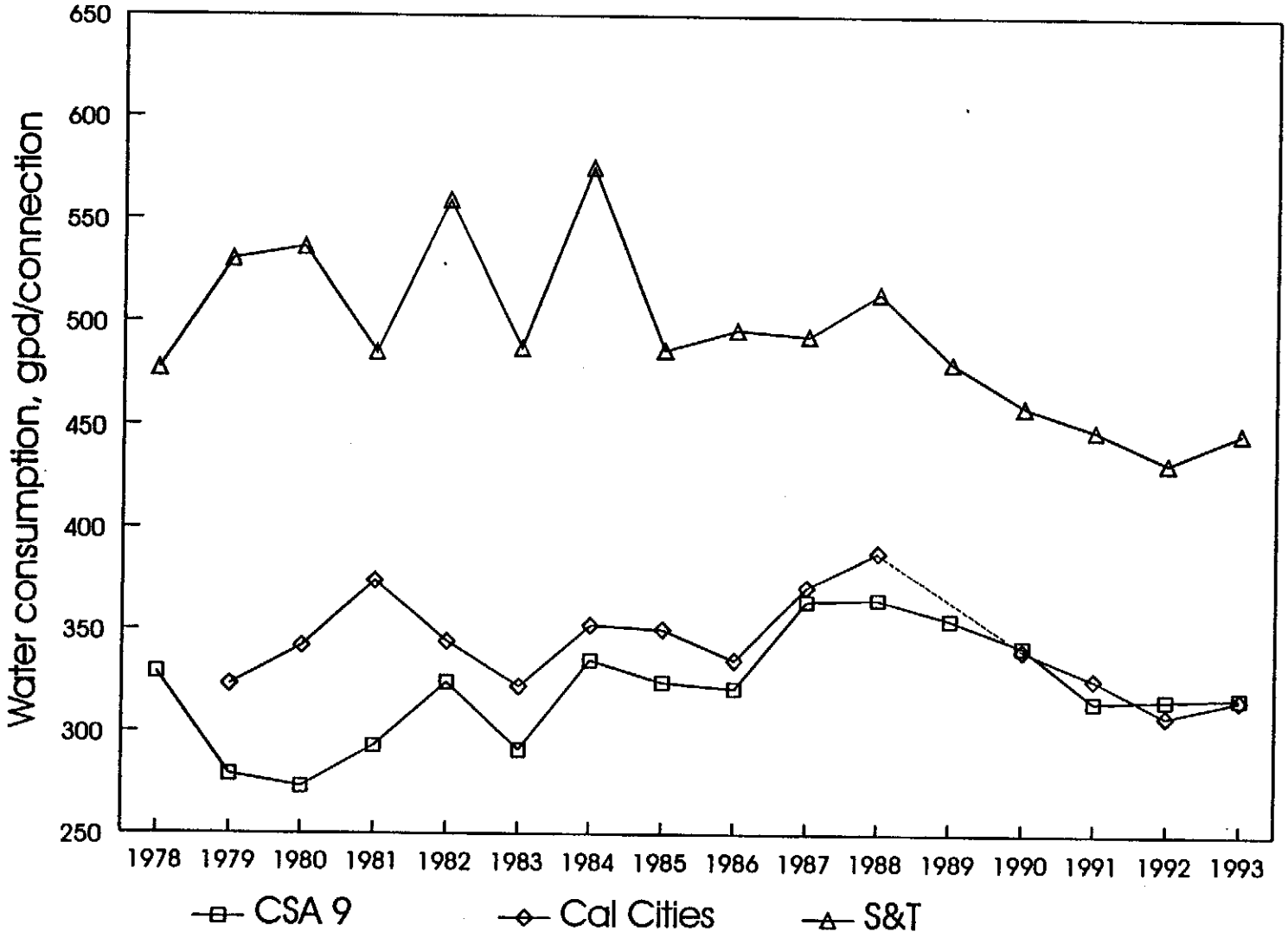
**Costs**

The cost implications of a water conservation program are reduced wastewater conveyance, treatment, and disposal costs.

- Conveyance. There would be reduced pipeline sizes as a results of reduced flows. For a gravity sewer, to decrease by one pipe size, e.g., 8-in. to 6-in., would require indoor water flows to be reduced by 40 to 50%. For a pressure sewer or force main, similar reductions would be necessary to reduce pipe size. Energy costs for pumping would also be lowered accordingly. However, it is not likely that such high reductions in indoor water use could occur, unless there were significant year - round grey water recycling (see separate memo). The historic water use reductions in Figure B6-1 are not large enough to significantly affect costs of a conveyance system.

- Treatment and disposal. The reduced hydraulic loading on treatment processes could result in a smaller facility with lowered capital and operating costs. However,

the solids loading, including nitrogen, would be unchanged, so that cost savings are not likely to be significant.




| | |
|---|---|
| Los Osos Wastewater Study | Figure B6-1 |
| Unit Water Consumption | |
| M&E Metcalf & Eddy | Date: May 1995 |

## GREYWATER RECYCLING

### Description

Wastewater generated in the household is separated into greywater and toilets wastes. Greywater is comprised of all waters generated in the household that do not contain toilet wastes including: water used for bathing, personal hygiene, laundry, dish washing, drinking, cooking and miscellaneous cleaning. Greywater accounts for about 60% of the wastewater generated by the average household in California [1]. The remaining 40% of the wastewater is called blackwater and consists of water used for toilet flushing. Greywater contains about 67% of the $BOD_5$ and phosphorus and 33% of the suspended solids, and only 20% of the nitrogen found in combined wastewater (greywater and blackwater) [1]. Traditionally, treatment facilities have been the primary source of water disposal for single- and multi-family residential buildings and complexes. However, as long-term water shortages increase, and water conservation becomes more of a national issue, various onsite water treatment and recycling technologies are being more actively explored, such as greywater recycling [2].

Greywater has many uses in the U.S. among which include application for landscape irrigation, toilet flushing, and as supply water for ornamental ponds and make-up water for cooling towers used in many central air-conditioning systems. A significant amount of water in a typical home (25% to 40%) can be re-used for landscape irrigation which would meet a substantial portion of irrigation needs required for trees, shrubs, and lawns. In addition, when greywater is used for landscape irrigation, it is further purified by the biological activity in the topsoil. Soil microorganisms break down organic matter while plants take up nutrients [3].

Greywater recycling systems consist of the following major elements: storage tank(s); piping; filters; pump; and distribution system. Greywater is collected inside a water tank (the tank does not store water and therefore keeps it from becoming septic). A filter inside the tank removes suspended solids (i.e. hair and lint). A pump, also located inside the tank is used to discharge the water to an irrigation system. Drip irrigation or a mini-leachfield system are possible subsurface irrigation alternatives for greywater discharge.

### Conformance with Laws, Regulations, Criteria

According to the Department of Water Resources (DWR), greywater recycling systems for subsurface landscape irrigation is currently allowed only for single-family dwellings. Regulations on this can be found Appendix J of the California Plumbing Code in Title 24, Part 5, California Administrative Code. According to these regulations no permit for any greywater recycling system will be issued until a plot plan with appropriate data, satisfactory to the Administrative Authority, has been submitted and approved. Permits will not be issued when there is insufficient lot area or inappropriate soil conditions for adequate absorption of the greywater.

Restrictions on the greywater recycling system include not allowing any connection to potable water systems and any surfacing of greywater. Regulations and standards for multi-family dwellings will be approved in 1995.

The greywater recycling system does not address the treatment of blackwater. With the implementation of this system the amount of wastewater generated from a typical household would be significantly reduced (approximately 60%) and thereby reduce onsite or offsite treatment costs.

## Technical Aspects

**Reliability.** When properly installed, operated, and maintained, greywater recycling systems can recycle much of the household water that otherwise would flow into a sanitary sewer or septic system for treatment [3]. Filter clogging is a potential problem in greywater recycling systems if proper maintenance in not given. Filters should be replaced every two to four months depending on the contents of the re-used water.

**Flexibility.** Kitchen water (comprises part of the greywater in a typical home) cannot be legally re-used do to high organic concentrations and the possibility of pathogens associated with food cleaning and preparation [2].

**Precedents.** Greywater used for landscape irrigation has been approved in many states including California.

**Aquifer Recharge Capacity.** Naturally renews groundwater supply.

## Costs

The estimated capital, operation and maintenance, and present worth costs are summarized in Table B6-1.

| Table B6-1. PRESENT WORTH ANALYSIS - GREYWATER RECYCLING SYSTEM [2] | |
|---|---|
| 1. Installation, $[a] | 2,000 |
| 1a. 20% Contingency, $ | 600 |
| 1b. Subtotal, $ | 2,600 |
| 1c. 20% engineering services | 500 |
| 2. Total Capital, $ | 3,100 |
| 3. O&M, $/yr | 560 |
| 4. Present Worth of O&M[b] | 5,300 |
| 5. Total Present Worth, $[c] | 8,400 |

a. Does not include toilet or kitchen waste disposal system.
b. 20 years at 8-3/8%.
c. Sum of rows 2 and 4.

## Other Factors

### Advantages

- Results in significant water savings.
- Helps reduce peak water demand.
- Conserves municipal water supplies.
- Reduces municipal sewage treatment costs.
- Low maintenance.
- Future solution to addressing stringent environmental regulations for water use and disposal.
- The County of San Luis Obispo has modified its plumbing codes to make greywater recycling a viable option.
- Lessens drought vulnerability.
- Subsurface use prevents evaporation and the possibility of human contamination.

**Disadvantages**

- Requires retrofitting of existing plumbing.
- Health and safety risks associated with the use of onsite greywater recycling are relatively unknown.
- Excess sodium levels from detergents and soaps can interfere in the soil's ability to absorb water and can directly damage plants.
- Rain or excessive irrigation can saturate the soil above the distribution system and cause greywater to pool on the surface.

**References**


1. Ingham, A.T., Resident Greywater Management in California, State of California, State Water Resources Control Board, Division of Planning and Research. January 1980.

2. ReWater Systems, Palo Alto, CA. May 1994.

3. National Association of Plumbing-Heating-Cooling Contractors, Assessment of On-Site Graywater and Combined Wastewater Treatment and Recycling Systems, Falls Church, VA. August 3, 1992.

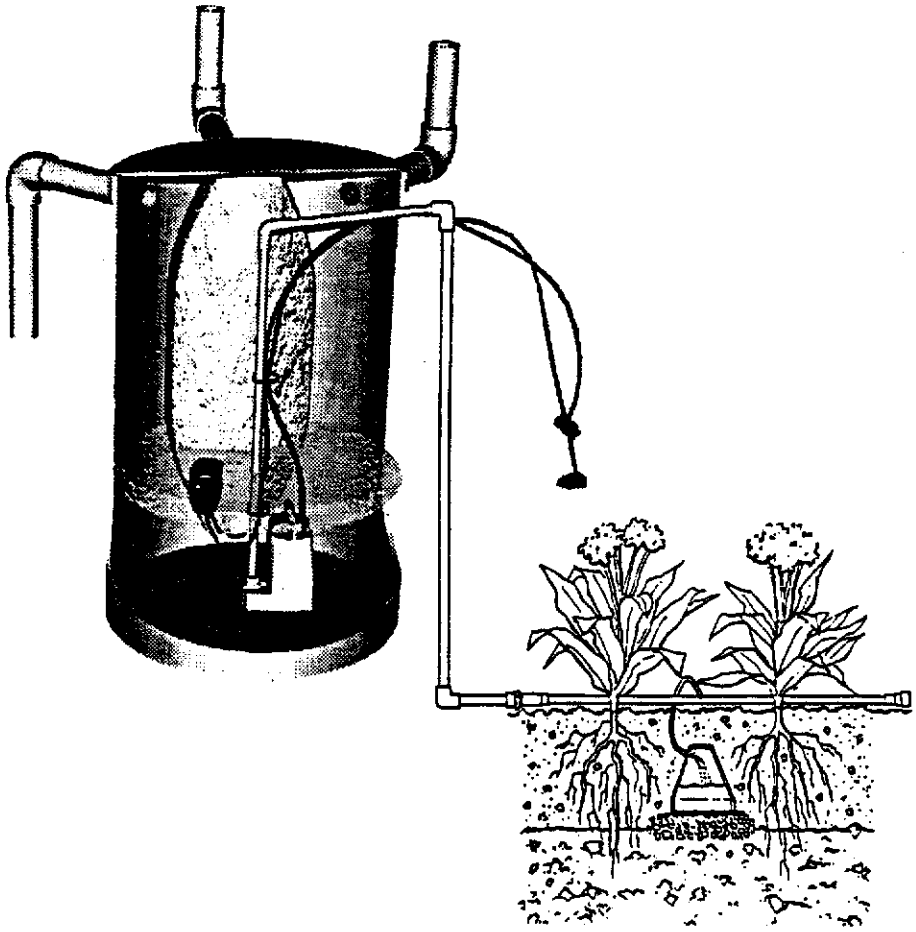


**FIGURE B6-2**

**Greywater Recycling System/Mini-Leachfield Irrigation**

(Figure adapted from ReWater Systems)

# APPENDIX C
# COST WORKSHEETS

# APPENDIX C
# COST WORKSHEETS

These are spreadsheet files, one for each area A through M and Q. For each area, the spreadsheets are set up as follows.

| Sheet | Page | Contents |
|---|---|---|
| A | 1 | Summary of incremental costs and total costs.<br><br>References. |
| B | 1 | Wastewater flow estimates for current, stage 1 and buildout.<br><br>Construction and O&M costs for "common facilities", i.e., the 1.6 mgd treatment plant, lift/pumping stations, forcemains, interceptors, disposal/recharge. |
| B | 2 | Construction and O&M costs for Alternative 1, based on the conventional project quantities [2], updated unit costs, and a portion of the common facilities attributed to the flow in the area. |
| B | 3 | Construction and O&M costs for Alternative 1 using STEP/STEG or grinder pump systems instead of the conventional project, which is primarily gravity sewers.<br><br>These costs are not used in the report text because the overall present worth value in Chapter 2 is not significantly different than the conventional project. Further detailed estimates for the area resulted in the same non-significant cost difference. |
| B | 4 | Notes. |
| C | 1 | Construction and O&M costs for Alternative 2, based on the conventional [2] project quantities, updated unit costs, and estimates for new, local treatment facilities. |
| | 2 | Construction and O&M costs for Alternative 2 with a STEP/STEG system and a local sand filter treatment plant.<br><br>The costs for grinder pump system are not used in the report text because the overall present worth value in Chapter 2 is not significantly different than the conventional project. Further detailed estimates for the area resulted in the same non-significant cost difference. |
| D | 1 | Construction and O&M costs for Alternative 3 - Enhanced Onsite Systems (onsite reactors). |
| E | 1 | Construction and O&M costs for Alternative 4 - Existing Onsite Systems.[a] |

a. Not applicable to Areas B, C, E, F, G, K because of shallow groundwater (Table 3-1).

| Summary, Area A – Northeast Baywood Park – Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| A–1 Conventional (Sheet B) | $2,433,000 | -- | -- | $22,000 | -- | -- | $2,706,000 | -- | -- |
| A–2 Pkg plant } (Sheet | $6,298,000 | -- | -- | $77,000 | -- | -- | $7,253,000 | -- | -- |
| A–2 – alternate } C) | $3,781,000 | -- | -- | $37,000 | -- | -- | $4,240,000 | -- | -- |
| A–2 – sand filter} | -- | $3,551,000 | -- | -- | $68,000 | -- | -- | $4,395,000 | -- |
| A–3 Onsite: min.} (Sheet | $1,986,000 | | | $75,000 | | | $2,917,000 | | |
| A–3 Onsite: max} D) | $2,078,000 | | | $75,000 | | | $3,009,000 | | |
| A–4 Nothing: min.} (Sheet | $374,000 | | | $74,000 | | | $1,292,000 | | |
| A–4 Nothing: max} E) | $587,000 | | | $74,000 | | | $1,505,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area A – Northeast Baywood Park – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| A–1 Conventional (Sheet B) | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| A–2 Pkg plant } (Sheet | $77,739,000 | -- | -- | $807,000 | -- | -- | $87,753,000 | -- | -- |
| A–2 – alternate } C) | $75,222,000 | -- | -- | $767,000 | | -- | $84,740,000 | -- | -- |
| A–2 – sand filter} | -- | $3,551,000 | -- | -- | $68,000 | -- | -- | $4,395,000 | -- |
| A–3 Onsite: min.} (Sheet | $73,427,000 | | | $805,000 | | | $83,416,000 | | |
| A–3 Onsite: max} D) | $73,519,000 | | | $805,000 | | | $83,508,000 | | |
| A–4 Nothing: min.} (Sheet | $71,815,000 | | | $804,000 | | | $81,792,000 | | |
| A–4 Nothing: max} E) | $72,028,000 | | | $804,000 | | | $82,005,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES

1. Draft Background Report. Estero Area Plan Update. San Luis Obispo County Planning Department. June 1994. Appendix A – Land Use Survey.

2. Phase Two – Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

LOS OSOS WASTEWATER STUDY Sheet B
Detailed evaluation of alternatives
Cost Estimate

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area A – Northeast Baywood Park

### A–1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 230 | -- | -- | -- | -- | -- | 230 | 0 | 0 |
| No. DUE [a] | 230 | 303 | 340 | | 0 | 0 | 230 | 303 | 340 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | 200 | 200 | 200 |
| Total flow, gpd | 46,000 | 60,600 | 67,945 | | 0 | 0 | 46,000 | 60,600 | 67,945 |
| Peak factor | 4.0 | 4.0 | 4.0 | | 2.0 | 2.0 | 4.0 | 4.0 | 4.0 |
| Peak flow, gpd | 184,000 | 242,400 | 271,780 | | 0 | 0 | 184,000 | 242,400 | 271,780 |

| Costs for common facilities | | | | Const. [c] | | | | O&M [d] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | $179,288 | | | | | | | | $5,630 /yr [j] |
| | LS–2 | $185,265 | | | | | | | | $6,655 /yr [j] |
| | LS–3 | $173,312 | | | | | | | | $5,889 /yr [j] |
| Pump stations | PS–1 | $717,153 | | | | | | | | $25,797 /yr [j] |
| | PS–2 | $418,339 | | | | | | | | $13,201 /yr [j] |
| Bayridge Estates community STEP | | $59,763 | | | | | | | | $3,964 /yr [j] |
| Forcemains [c] | | | | | | | | | | |
| FM–1 | 6 in. | 580 | ft @ | $30 | = | $17,400 | @ | $0.75 [h] | = | $435 /yr |
| FM–2 | 6 in. | 1,900 | ft @ | $30 | = | $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| FM–3 | 6 in. | 200 | ft @ | $30 | = | $6,000 | @ | $0.75 [h] | = | $150 /yr |
| I–1 | 15 in. | 3,700 | ft @ | $39 | = | $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| I–2 | 12 in. | 100 | ft @ | $34 | = | $3,400 | @ | $1.00 [i] | = | $100 /yr |
| I–12 | 18 in. | 1,600 | ft @ | $49 | = | $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| I–3 | 21 in. | 6,400 | ft @ | $58 | = | $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | $1,314,781 | | | | | | | | $73,462 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | Second stage of plant present worth [i] | | | | | | |
| 21 in., 7,200 ft @ | $58 | $417,600 | | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | $8,623,888 | | | | | | | | $323,000 /yr |
| Headworks | | $428,858 | | -- | | | | | | |
| Secondary treatment | | $2,006,834 [l] | | $445,529 | | | | | | |
| Tertiary treatment | | $1,199,977 | | $266,402 | | | | | | |
| Biosolids handling | | $1,676,943 | | $372,291 | | | | | | |
| Effluent pumping station | | $225,425 | | $50,046 | | | | | | |
| Ancillary facilities | | $3,085,851 | | -- | | | | | | |
| Land | | $468,638 | 9 | ac @ | $52,071 /ac | | | | | |
| Effluent forcemain | | | | | | | | | | |
| 16 in., 24,500 ft @ | $56 | $1,372,000 | | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | $2,666,615 | | $592,004 | | | | | | $85,000 /yr |
| Land | | $619,777 | 20 | ac @ | $30,989 /ac | | | | | |

588106

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area A – Northeast Baywood Park**

**A–1 Conventional project**

**Cost for Alternative A–1 Buildout**

| | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 –in. | 8,450 | ft @ | $27 | = | $228,150 | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 | = | $0 | | | | |
| Manholes | 30 | @ | $1,750 | = | $52,500 | | | | |
| Pressure sewer | | | | | | | | | |
| 2 –in. | 1,020 | ft @ | $19 | = | $19,380 | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | |
| 6 –in. | 200 | ft @ | $30 | = | $6,000 | | | | |
| STEP systems [n] | 28 | @ | $2,000 | = | $56,000 | [includes house lateral] | @ | $140 [p] = | $3,920 /yr |
| Total | 9,670 | ft | | | | 9,670 | ft @ | $0.75 = | $7,253 /yr |
| Y–connection and street lateral | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | |
| { | 12,120 | ft [k] @ | $21 | = | $254,520 | | | | |
| Future | 1,469 | ft [k] @ | $10 | = | $14,690 [l] | | | | |
| Common facilities – incremental (avoidable) costs [f,o] | | | | | | | | | |
| FM –1 | | (portion = | 0.0% | | $0 | (portion = | 0.0% | | $0 /yr |
| FM –2 | | (portion = | 0.0% | | $0 | (portion = | 0.0% | | $0 /yr |
| FM –3 | | (portion = | 19.1% | | $1,147 | (portion = | 11.4% | | $17 /yr |
| I–1 | | (portion = | 0.0% | | $0 | (portion = | 0.0% | | $0 /yr |
| I–2 | | (portion = | 0.0% | | $0 | (portion = | 0.0% | | $0 /yr |
| I–12 | | (portion = | 0.0% | | $0 | (portion = | 0.0% | | $0 /yr |
| I–3 | | (portion = | 0.0% | | $0 | (portion = | 0.0% | | $0 /yr |
| LS –1 | | (portion = | 0.0% | | $0 | (portion = | 0.0% | | $0 /yr |
| LS –2 | | (portion = | 0.0% | | $0 | (portion = | 0.0% | | $0 /yr |
| LS –3 | | (portion = | 16.6% | | $28,811 | (portion = | 26.1% | | $1,539 /yr |
| PS –1 | | (portion = | 0.0% | | $0 | (portion = | 0.0% | | $0 /yr |
| PS –2 | | (portion = | 0.0% | | $0 | (portion = | 0.0% | | $0 /yr |
| Bayridge Estates STEP | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% | | $0 /yr |
| Main pumping station (PS –3) | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% | | $0 /yr |
| Interceptor to treatment plant | | (portion = | 1.5% ) | | $8,295 | (portion = | 0.9% | | $62 /yr |
| Treatment plant | | | | | | (portion = | 2.1% | | $6,933 /yr |
| Headworks | | (portion = | 3.4% ) | | $14,632 | | | | |
| Secondary treatment | | (portion = | 2.1% ) | | $52,635 | | | | |
| Tertiary treatment | | (portion = | 2.1% ) | | $31,473 | | | | |
| Biosolids handling | | (portion = | 3.4% ) | | $69,918 | | | | |
| Effluent pumping station | | (portion = | 3.4% ) | | $9,399 | | | | |
| Ancillary facilities | | (portion = | 2.6% ) | | $79,307 | | | | |
| Land | | (portion = | 2.9% ) | | $13,363 | | | | |
| Effluent force main | | (portion = | 1.3% ) | | $17,745 | (portion = | 0.9% | | $212 /yr |
| Disposal/recharge | | (portion = | 3.0% ) | | $97,494 | (portion = | 2.9% | | $2,424 /yr |
| Land | | (portion = | 2.9% ) | | $17,673 | | | | |
| Total | | | | | $1,071,133 | | | | $22,359 /yr |
| Total including contingency @ | | 20% | | | $1,285,360 | | | | |
| Total including engineering, administration @ | | | 20% | | $1,542,432 | | | | |
| Total, including financing and bonding @ | | | 23% | | $1,897,191 | | | | |
| On–lot costs | | | | | | | | | |
| Septic tank abandonment | | 230 | ea @ [e] | $1,000 = | $230,000 | | | | |
| House lateral | | | | | | | | | |
| 4 –in. { | 60 | ft ea. | | | | | | | |
| { | 12,120 | ft [k] @ | $15 | = | $181,800 | | | | |
| Future | 4,904 | ft [k] @ | $7 | = | $34,325 [l] | | | | |
| Total on–lot costs | | | | | $446,125 | | | | |
| Total, including contingency @ | 20% | | | | $535,350 | | | | |
| GRAND TOTAL | | | | | $2,432,541 | | | | |

## Area A – Northeast Baywood Park

### A–1 Conventional project

**Adjustment for STEP/STEG** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. [m] | 9,470 | ft @ | $19 [k] | = | $179,930 | | | | | |
| 3 –in. [m] | 0 | ft @ | $21 [k] | = | $0 | | | | | |
| 4 –in. [m] | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | 200 | ft @ | $30 [k] | = | $6,000 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 9,670 | ft | | | | 9,670 | ft @ | $0.50 | = | $4,835 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 230 | ea [k] @ | $2,000 | = | $460,000 [Including house lateral] | | @ | $140 [p] | = | $32,200 /yr |
| Lateral 2 –in. | 12,120 | ft @ | $19 | = | $230,280 Street | | | | | |
| Future tank/pump | 110 | ea @ | $1,000 | = | $110,000 [l] | | @ | $100 [p,l] | = | $11,000 /yr |
| Future lateral | 1,469 | ft @ | $9 | = | $13,221 [l] | | | | | |
| Septic tank abandonment | | | | | $230,000 | | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($56,351) | | | | | ($1,871) /yr |
| Revised subtotal, STEP/STEG | | | | | $1,173,081 | | | | | $46,164 /yr |
| Less conventional facilities (sewers, laterals) | | | | | ($1,077,365) | | | | | ($11,173) /yr |
| Adjusted total, STEP/STEG | | | | | $1,166,849 | | | | | $57,351 /yr |
| Total including contingency @ | 20% | | | | $1,400,219 | | | | | |
| Total including engineering, administration @ | | 20% | | | $1,680,262 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $2,066,723 | | | | | |

**Adjustment for grinder pumps** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 9,470 | ft @ | $19 [k] | = | $179,930 | | | | | |
| 3 –in. | 0 | ft @ | $21 [k] | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 9,470 | ft | | | | 9,470 | ft @ | $0.50 | = | $4,735 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 230 | ea [k] @ | $2,500 | = | $575,000 [Including house lateral] | | @ | $110 [q] | = | $25,300 /yr |
| Lateral 2 –in. | 12,120 | ft @ | $19 | = | $230,280 [Street] | | | | | |
| Future tank/pump | 110 | ea @ | $1,000 | = | $110,000 [l] | | @ | $75 [q,l] | = | $8,250 /yr |
| Future lateral | 1,469 | ft @ | $9 | = | $13,221 [l] | | | | | |
| Septic tank abandonment | | | | | $230,000 | | | | | |
| Revised subtotal, grinder | | | | | $1,338,431 | | | | | $38,285 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | ($1,077,365) | | | | | ($11,173)/yr |
| Adjusted total, grinder | | | | | $1,332,199 | | | | | $49,472 /yr |
| Total including contingency @ | 20% | | | | $1,598,639 | | | | | |
| Total including engineering, administration @ | | 20% | | | $1,918,367 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $2,359,592 | | | | | |

## Area A – Northeast Baywood Park

### A–1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .
d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.6 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.
h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in. gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawings [2].
o. Flow portions:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 0.0% |
| FM –3 | 45.4% |
| I–1 | 0.0% |
| I–2 | 0.0% |
| I–12 | 0.0% |
| I–3 | 0.0% |
| LS –1 | 0.0% |
| LS –2 | 0.0% |
| LS –3 | 45.4% |
| PS –1 | 0.0% |
| PS –2 | 0.0% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS–3) | 0.0% |
| Force main to treatment plant | 4.2% |
| Treatment plant | 4.2% |
| Headworks | 4.2% |
| Secondary treatment | 4.2% |
| Tertiary treatment | 4.2% |
| Biosolids handling | 4.2% |
| Effluent pumping station | 4.2% |
| Ancillary facilities | 4.2% |
| Land | |
| Effluent force main | 4.2% |
| Disposal/recharge | 4.2% |
| Land | 4.2% |

p. Based on: 2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh; 50 ft average TDH; $200 septage pumping every 5 years.
q. Based on: 2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh; 50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area A – Northeast Baywood Park

### A–2 Local collection, treatment, and dispose/recharge

Cost for Alternative A–2 Buildout – same as A–1 unless noted

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 –in. | 8,450 | ft @ | $27 | = | $228,150 | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 30 | @ | $1,500 | = | $45,000 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 –in. | 1,020 | ft @ | $19 | = | $19,380 | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | |
| STEP systems | 28 | @ | $2,000 | = | $56,000 | @ $140 | = | $3,920 /yr | |
| Total | 8,450 | ft | | | | @ $0.75 | = | $6,338 /yr | |
| Y–connection; street lateral | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | |
| { | 12,120 | ft [f] @ | $21 | = | $254,520 | | | | |
| Future | 1,469 | ft [f] @ | $10 | = | $14,690 [g] | | | | |
| Treatment plant | 0.06795 | mgd (buildout) | | | $1,877,094 [a] | | | $66,561 /yr [b] | |
| Disposal/recharge (buildout) | | | | | $405,948 [b] | | | | |
| Land (buildout) | 4 | ac @ | $88,205 | | $352,819 [b] | | | | |
| Alternative treatment plant: @ | $6.71 | /gal, | $455,737 [c] | | | $27,000 /yr [d] | | | |
| Total | | | | | $3,253,801 | | | $78,819 /yr | |
| Total including contingency @ | | 20% | | | $3,904,321 | | | | |
| Total including engineering, administration @ | | | 20% | | $4,685,186 | | | | |
| Total, including financing and bonding @ | | | 23% | | $5,762,778 | | | | |
| Revised total with alternative treatment plant | | | | | $1,832,244 | | | $37,258 /yr | |
| Total including contingency @ | | 20% | | | $2,198,693 | | | | |
| Total including engineering, administration @ | | | 20% | | $2,638,432 | | | | |
| Total, including financing and bonding @ | | | 23% | | $3,245,271 | | | | |
| On–lot costs | | | | | | | | | |
| Septic tank abandonment | 230 | ea @ | $1,000 | = | $230,000 | | | | |
| Lateral | | | | | | | | | |
| 4 –in. { | 60 | ft ea. | | | | | | | |
| { | 12,120 | ft [f] @ | $15 | = | $181,800 | | | | |
| Future | 4,904 | ft [f] @ | $7 | = | $34,325 [g] | | | | |
| Total on–lot costs | | | | | $446,125 | | | | |
| Total, including contingency @ | 20% | | | | $535,350 | | | | |
| GRAND TOTAL | | | | | $6,298,128 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $3,780,621 | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area A – Northeast Baywood Park**

**A–2 Local collection, treatment, and dispose/recharge**

**Adjustment for STEP/STEG – same as A–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 8,450 | ft @ | $19 | = | $160,550 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 8,450 | ft | | | | 8,450 | ft @ | $0.50 | = | $4,225 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 230 | ea @ | $2,000 | = | $460,000 | [including house lateral] | @ | $140 | = | $32,200 /yr |
| Lateral 2 –in. | 12,120 | ft @ | $19 | = | $230,280 | Street | | | | |
| Future tank/pump | 110 | ea @ | $1,000 | = | $110,000 [g] | | @ | $100 [g] | = | $11,000 /yr |
| Future lateral | 1,469 | ft @ | $9 | = | $13,221 [g] | | | | | |
| Septic tank abandonment | | | | | $230,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $840,780 | | | | | $20,218 /yr |
| Revised subtotal, STEP/STEG | | | | | $2,044,831 | | | | | $67,643 /yr |
| Less conventional plant + land (not disposal) | | | | | ($2,229,913) | | | | | ($66,561)/yr |
| Less conventional facilities | | | | | ($1,063,865) | | | | | ($10,258)/yr |
| Adjusted total, STEP/STEG | | | | | $2,004,655 | | | | | $67,643 /yr |
| Total including contingency @ | 20% | | | | $2,405,586 | | | | | |
| Total including engineering, administration @ | | 20% | | | $2,886,704 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $3,550,645 | | | | | |

**Adjustment for grinder pumps – same as A–1 unless noted.** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 8,450 | ft @ | $19 | = | $160,550 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 8,450 | ft | | | | 8,450 | ft @ | $0.50 | = | $4,225 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 230 | ea @ | $2,500 | = | $575,000 | [including house lateral] | @ | $110 | = | $25,300 /yr |
| Lateral 2 –in. | 12,120 | ft @ | $19 | = | $230,280 | [Street] | | | | |
| Future tank/pump | 110 | ea @ | $1,000 | = | $110,000 [g] | | @ | $75 [g] | = | $8,250 /yr |
| Future lateral | 1,469 | ft @ | $9 | = | $13,221 [g] | | | | | |
| Septic tank abandonment | | | | | $230,000 | | | | | |
| Revised subtotal, grinder | | | | | $1,319,051 | | | | | $37,775 /yr |
| Less conventional facilities | | | | | ($1,063,865) | | | | | ($10,258)/yr |
| Adjusted total, grinder | | | | | $3,508,787 | | | | | |
| Total including contingency @ | 20% | | | | $4,210,545 | | | | | |
| Total including engineering, administration @ | | 20% | | | $5,052,654 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $6,214,764 | | | | | $27,518 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   10 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g. Based on present worth of future installations over a 20–year period at 7%. For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area A – Northeast Baywood Park**

**A–3 Enhance/upgrade existing onsite systems**

**Cost for Alternative A–3 Buildout – same as A–1 unless noted**

| | | | | Construction | | | O&M | | |
|---|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | | |
| | % of existing units | | | | | | | | |
| Retrofit | 100% | 230 units @ | $3,000 [a] | = | $690,000 | @ | $247 [b] | = | $56,879 |
| New | 0% | 0 units @ | $4,400 [a] | = | $0 | @ | $247 [b] | = | $0 |
| New to buildout | -- | 110 units [f] @ | $3,920 [a] | = | $431,176 [d] | @ | $169 [b,e] | = | $18,589 |
| Total | | | | | $1,121,176 | | | | $75,468 |
| Total including contingency @ | | 20% | | | $1,345,412 | | | | |
| Total including engineering, administration @ | | | 20% | | $1,614,494 | | | | |
| Total, including financing and bonding @ | | | 23% | | $1,985,828 | | | | |
| **Maximum** | | | | | | | | | |
| | % of existing units | | | | | | | | |
| Retrofit | 84% | 193 units @ | $3,000 [a] | = | $579,000 | @ | $247 [b] | = | $47,729 |
| New [c] | 16% | 37 units @ | $4,400 [a] | = | $162,800 | @ | $247 [b] | = | $9,150 |
| New to buildout | -- | 110 units [f] @ | $3,920 [a] | = | $431,176 [d] | @ | $169 [b,e] | = | $18,589 |
| | | | | | | | | | $75,468 |
| Total | | | | | $1,172,976 | | | | |
| Total including contingency @ | | 20% | | | $1,407,572 | | | | |
| Total including engineering, administration @ | | | 20% | | $1,689,086 | | | | |
| Total, including financing and bonding @ | | | 23% | | $2,077,576 | | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)
b. Based on:
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
c. Table 3–1.
d. Present worth over first 20 years @ 7%.
e. Average cost over 30 –year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area A – Northeast Baywood Park**

**A–4 Retain existing onsite systems**

**Cost for Alternative A–4 Buildout – same as A–1 unless noted**

| | | | Construction | | | | | O&M | |
|---|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | | |
| | % of existing units | | | | | | | | |
| Replacement | 0% | 0 units @ | $4,100 | [a] | = | $0 | @ | $242 [b] | $0 |
| No replacement | 100% | 230 units @ | $90 | [a] | = | $20,700 | @ | $242 [b] | $55,660 |
| New to buildout | -- | 110 units [f] @ | $2,172 | [a] | = | $238,895 [d] | @ | $165 [b,e] | $18,190 |
| Total | | | | | | $259,595 | | | $73,850 |
| Total including contingency @ | | 20% | | | | $311,514 | | | |
| Total including engineering, administration @ | | | 20% | | | $373,817 | | | |
| Total, including financing and bonding @ | | | 0% | | | $373,817 | | | |
| **Maximum** | | | | | | | | | |
| Replacement [c] | 16% | 37 units @ | $4,100 | [a] | = | $151,700 | @ | $242 [b] | $8,954 |
| No replacement | 84% | 193 units @ | $90 | [a] | = | $17,370 | @ | $242 [b] | $46,706 |
| New to buildout | -- | 110 units [f] @ | $2,172 | [a] | = | $238,895 [d] | @ | $165 [b,e] | $18,190 |
| Total | | | | | | $407,965 | | | $73,850 |
| Total including contingency @ | | 20% | | | | $489,558 | | | |
| Total including engineering, administration @ | | | 20% | | | $587,470 | | | |
| Total, including financing and bonding @ | | | 0% | | | $587,470 | | | |

a. Based on complete replacement of septic tank and leach field or pit (Appendix D).
For no replacement, based on initial inspection only (Appendix D).
b. Based on:
4 hr/yr @ $30 /hr (one inspection/year; administration)
2.0% of capital cost
$200 pumping every 5 years.
c. Table 3–1.
d. Present worth over first 20 years @ 7% .
e. Average cost over 30 –year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

| Summary, Area B – North Baywood Park – Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| B–1 Conventional (Sheet B) | $13,281,000 | -- | -- | $119,000 | -- | -- | $14,758,000 | -- | -- |
| B–2 Pkg plant } (Sheet | $16,749,000 | -- | -- | $207,000 | -- | -- | $19,318,000 | -- | -- |
| B–2 – alternate } C) | $13,455,000 | -- | -- | $149,000 | -- | -- | $15,304,000 | -- | -- |
| B–2 – sand filter} | -- | $15,853,000 | -- | -- | $268,000 | -- | -- | $19,179,000 | -- |
| B–3 Onsite: min.} (Sheet | $9,721,000 | | | $365,000 | | | $14,250,000 | | |
| B–3 Onsite: max} D) | $10,317,000 | | | $365,000 | | | $14,846,000 | | |
| B–4 Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| B–4 Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area B – North Baywood Park – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| B–1 Conventional (Sheet B) | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| B–2 Pkg plant } (Sheet | $77,342,000 | -- | -- | $840,000 | -- | -- | $87,766,000 | -- | -- |
| B–2 – alternate } C) | $74,048,000 | -- | -- | $782,000 | | -- | $83,752,000 | -- | -- |
| B–2 – sand filter} | -- | $15,853,000 | -- | -- | $268,000 | -- | -- | $19,179,000 | -- |
| B–3 Onsite: min.} (Sheet | $70,314,000 | | | $998,000 | | | $82,698,000 | | |
| B–3 Onsite: max} D) | $70,910,000 | | | $998,000 | | | $83,294,000 | | |
| B–4 Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| B–4 Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES

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2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

## Area B – North Baywood Park

### B–1 Conventional project

Assumptions/parameters

Wastewater flow

| | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 1,090 | -- | -- | -- | -- | -- | 1,090 | 0 | 0 |
| No. DUE [a] | 1,090 | 1,194 | 1,791 | | 0 | 0 | 1,090 | 1,194 | 1,791 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 218,000 | 238,800 | 358,200 | | 0 | 0 | 218,000 | 238,800 | 358,200 |
| Peak factor | 3.0 | 3.0 | 3.0 | | 2.0 | 2.0 | 3.0 | 3.0 | 3.0 |
| Peak flow, gpd | 654,000 | 716,400 | 1,074,600 | | 0 | 0 | 654,000 | 716,400 | 1,074,600 |

Costs for common facilities

| | | | | Const. [c] | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | | $179,288 | | | | | | | $5,146 /yr [j] |
| | LS–2 | | | $185,265 | | | | | | | $5,265 /yr [j] |
| | LS–3 | | | $173,312 | | | | | | | $5,026 /yr [j] |
| Pump stations | PS–1 | | | $717,153 | | | | | | | $15,903 /yr [j] |
| | PS–2 | | | $418,339 | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | | $59,763 | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM–1 | 6 in. | | 580 | ft @ | $30 | = $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | | 1,900 | ft @ | $30 | = $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | | 200 | ft @ | $30 | = $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | | 3,700 | ft @ | $39 | = $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | | 100 | ft @ | $34 | = $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | | 1,600 | ft @ | $49 | = $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | | 6,400 | ft @ | $58 | = $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | | | $1,314,781 | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | | | | | | | |
| 21 in., 7,200 ft @ | | | $58 | $417,600 | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | | $8,623,888 | | | | | | | $323,000 /yr |
| Headworks | | | | $428,858 | | | | | | | |
| Secondary treatment | | | | $2,006,834 | | | | | | | |
| Tertiary treatment | | | | $1,199,977 | | | | | | | |
| Biosolids handling | | | | $1,676,943 | | | | | | | |
| Effluent pumping station | | | | $225,425 | | | | | | | |
| Ancillary facilities | | | | $3,085,851 | | | | | | | |
| Land | | | | $468,638 | 9 | ac @ | $52,071 /ac | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in., 24,500 ft @ | | | $56 | $1,372,000 | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | | $2,666,615 | | | | | | | $85,000 /yr |
| Land | | | | $619,777 | 20 | ac @ | $30,989 /ac | | | | |

Second stage of plant present worth [i]

| |
|---|
| -- |
| $445,529 |
| $266,402 |
| $372,291 |
| $50,046 |
| -- |
| $592,004 |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area B – North Baywood Park

### B–2 Local collection, treatment, and dispose/recharge at site in Area A

**Adjustment for STEP/STEG – same as B–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 36,220 | ft @ | $19 | = | $688,180 | | | | | |
| 3 –in. | 1,640 | ft @ | $21 | = | $34,440 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 37,860 | ft | | | | 37,860 | ft @ | $0.50 | = | $18,930 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 1,090 | ea @ | $2,000 | = | $2,180,000 | [including house lateral] | @ | $140 | = | $152,600 /yr |
| Lateral 2 –in. | 47,760 | ft @ | $19 | = | $907,440 | Street | | | | |
| Future tank/pump | 566 | ea @ | $1,000 | = | $566,000 | [g] | @ | $100 [g] | = | $56,600 /yr |
| Future lateral | 18,480 | ft @ | $9 | = | $166,320 | [g] | | | | |
| Septic tank abandonment | | | | | $1,090,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $4,089,545 | | | | | $39,425 /yr |
| Revised subtotal, STEP/STEG | | | | | $9,721,925 | | | | | $267,555 /yr |
| Less conventional plant + land (not disposal) | | | | | ($3,777,952) | | | | | ($152,829)/yr |
| Less conventional facilities | | | | | ($5,046,800) | | | | | ($53,925)/yr |
| Adjusted total, STEP/STEG | | | | | $8,950,521 | | | | | $267,555 /yr |
| Total including contingency @ | 20% | | | | $10,740,625 | | | | | |
| Total including engineering, administration @ | | 20% | | | $12,888,750 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $15,853,162 | | | | | |

**Adjustment for grinder pumps – same as B–1 unless noted.**

**NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 36,220 | ft @ | $19 | = | $688,180 | | | | | |
| 3 –in. | 1,640 | ft @ | $21 | = | $34,440 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 37,860 | ft | | | | 37,860 | ft @ | $0.50 | = | $18,930 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 1,090 | ea @ | $2,500 | = | $2,725,000 | [including house lateral] | @ | $110 | = | $119,900 /yr |
| Lateral 2 –in. | 47,760 | ft @ | $19 | = | $907,440 | [Street] | | | | |
| Future tank/pump | 566 | ea @ | $1,000 | = | $566,000 | [g] | @ | $75 [g] | = | $42,450 /yr |
| Future lateral | 18,480 | ft @ | $9 | = | $166,320 | [g] | | | | |
| Septic tank abandonment | | | | | $1,090,000 | | | | | |
| Revised subtotal, grinder | | | | | $6,177,380 | | | | | $181,280 /yr |
| Less conventional facilities | | | | | ($5,046,800) | | | | | ($53,925)/yr |
| Adjusted total, grinder | | | | | $9,183,927 | | | | | |
| Total including contingency @ | 20% | | | | $11,020,712 | | | | | |
| Total including engineering, administration @ | | 20% | | | $13,224,855 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $16,266,571 | | | | | $127,355 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   37 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g Based on present worth of future installations over a 20–year period at 7%.
   For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area B – North Baywood Park

### B-3 Enhance/upgrade existing onsite systems

Cost for Alternative B-3 Buildout – same as B-1 unless noted

| | | | Construction | | | O&M | | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 100% | 1090 units @ | $3,000 [a] = | $3,270,000 | | @ | $247 [b] = | $269,557 |
| New | 0% | 0 units @ | $4,400 [a] = | $0 | | @ | $247 [b] = | $0 |
| New to buildout | -- | 566 units [f] @ | $3,920 [a] = | $2,218,598 | [d] | @ | $169 [b,e] = | $95,647 |
| Total | | | | $5,488,598 | | | | $365,204 |
| Total including contingency @ | | 20% | | $6,586,318 | | | | |
| Total including engineering, administration @ | | | 20% | $7,903,582 | | | | |
| Total, including financing and bonding @ | | | 23% | $9,721,406 | | | | |
| **Maximum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 78% | 850 units @ | $3,000 [a] = | $2,550,000 | | @ | $247 [b] = | $210,205 |
| New [c] | 22% | 240 units @ | $4,400 [a] = | $1,056,000 | | @ | $247 [b] = | $59,352 |
| New to buildout | -- | 566 units @ | $3,920 [a] = | $2,218,598 | | @ | $169 [b,e] = | $95,647 |
| | | | | | | | | $365,204 |
| Total | | | | $5,824,598 | | | | |
| Total including contingency @ | | 20% | | $6,989,518 | | | | |
| Total including engineering, administration @ | | | 20% | $8,387,422 | | | | |
| Total, including financing and bonding @ | | | 23% | $10,316,529 | | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)
b. Based on:
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
c. Table 3-1
d. Present worth over first 20 years @ 7%.
e. Average cost over 30 -year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

**Summary Area C – East Baywood Park – Incremental Cost**

| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| C–1 Conventional (Sheet B) | $3,507,000 | -- | -- | $29,000 | -- | -- | $3,867,000 | -- | -- |
| C–2 Pkg plant } (Sheet | $6,709,000 | -- | -- | $83,000 | -- | -- | $7,739,000 | -- | -- |
| C–2 – alternate } C) | $4,089,000 | -- | -- | $41,000 | -- | -- | $4,598,000 | -- | -- |
| C–2 – sand filter} | -- | $4,045,000 | -- | -- | $77,000 | -- | -- | $5,000,000 | -- |
| C–3 Onsite: min.} (Sheet | $2,429,000 | | | $88,000 | | | $3,521,000 | | |
| C–3 Onsite: max} D) | $2,582,000 | | | $88,000 | | | $3,674,000 | | |
| C–4 Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| C–4 Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

**Summary Area C – East Baywood Park – Total Costs**

| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| C–1 Conventional (Sheet B) | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| C–2 Pkg plant } (Sheet | $77,076,000 | -- | -- | $806,000 | -- | -- | $87,078,000 | -- | -- |
| C–2 – alternate } C) | $74,456,000 | -- | -- | $764,000 | | -- | $83,937,000 | -- | -- |
| C–2 – sand filter} | -- | $4,045,000 | -- | -- | $77,000 | -- | -- | $5,000,000 | -- |
| C–3 Onsite: min.} (Sheet | $72,796,000 | | | $811,000 | | | $82,860,000 | | |
| C–3 Onsite: max} D) | $72,949,000 | | | $811,000 | | | $83,013,000 | | |
| C–4 Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| C–4 Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES

1. Draft Background Report. Estero Area Plan Update. San Luis Obispo County Planning Department. June 1994. Appendix A – Land Use Survey.

2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

Area C – East Baywood Park

C–1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 248 | -- | -- | -- | -- | -- | 248 | 0 | 0 |
| No. DUE [a] | 248 | 272 | 408 | | 0 | 0 | 248 | 272 | 408 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 49,600 | 54,400 | 81,600 | | 0 | 0 | 49,600 | 54,400 | 81,600 |
| Peak factor | 4.0 | 4.0 | 4.0 | | 2.0 | 2.0 | 4.0 | 4.0 | 4.0 |
| Peak flow, gpd | 198,400 | 217,600 | 326,400 | | 0 | 0 | 198,400 | 217,600 | 326,400 |

| Costs for common facilities | | | Const. [c] | | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | $179,288 | | | | | | | | $5,146 /yr [j] |
| | LS–2 | | $185,265 | | | | | | | | $5,265 /yr [j] |
| | LS–3 | | $173,312 | | | | | | | | $5,026 /yr [j] |
| Pump stations | PS–1 | | $717,153 | | | | | | | | $15,903 /yr [j] |
| | PS–2 | | $418,339 | | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | $59,763 | | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM–1 | 6 in. | 580 | ft @ | $30 | = | $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | 1,900 | ft @ | $30 | = | $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | 200 | ft @ | $30 | = | $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | 3,700 | ft @ | $39 | = | $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | 100 | ft @ | $34 | = | $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | 1,600 | ft @ | $49 | = | $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | 6,400 | ft @ | $58 | = | $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | | $1,314,781 | | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | Second stage of plant present worth [l] | | | | | | |
| 21 in., 7,200 ft @ | | | $58 $417,600 | | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | $8,823,888 | | | | | | | | $323,000 /yr |
| Headworks | | | $426,858 | | -- | | | | | | |
| Secondary treatment | | | $2,006,834 | | $445,529 | | | | | | |
| Tertiary treatment | | | $1,199,977 | | $266,402 | | | | | | |
| Biosolids handling | | | $1,676,943 | | $372,291 | | | | | | |
| Effluent pumping station | | | $225,425 | | $50,046 | | | | | | |
| Ancillary facilities | | | $3,085,851 | | -- | | | | | | |
| Land | | | $468,836 | 9 | ac @ | $52,071 /ac | | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in., 24,500 ft @ | | | $58 $1,372,000 | | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | $2,866,815 | | $592,004 | | | | | | $85,000 /yr |
| Land | | | $819,777 | 20 | ac @ | $30,989 /ac | | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area C – East Baywood Park

C–1 Conventional project

Cost for Alternative C–1 Buildout

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | | |
| 8 –in. | 8,660 | ft @ | $27 | = | $233,820 | | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | | |
| Dewatering | 8,660 | ft @ | $19 | = | $164,540 | | | | | |
| Manholes | 29 | @ | $1,750 | = | $50,750 | | | | | |
| Pressure sewer | | | | | | | | | | |
| 2 –in. | 1,220 | ft @ | $19 | = | $23,180 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 6 –in. | 1,900 | ft @ | $30 | = | $57,000 | | | | | |
| STEP systems [n] | 27 | @ | $2,000 | = | $54,000 [Includes house lateral] | @ | $140 [p] | = | $0 /yr | |
| Total | 11,780 | ft | | | | 11,780 | ft @ | $0.75 | = | $8,835 /yr |
| Y–connection and street lateral | | | | | | | | | | |
| 4 –In. { | 40 | ft ea. | | | | | | | | |
| { | 10,880 | ft [k] @ | $21 | = | $228,480 [To Stage 1] | | | | | |
| Future | 5,440 | ft [k] @ | $10 | = | $54,400 [l] | | | | | |
| Common facilities – Incremental (avoidable) costs [f,0] | | | | | | | | | | |
| FM –1 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| FM –2 | (portion = | 100.0% ) | | | $57,000 | (portion = | 100.0% ) | | | $1,425 /yr |
| FM –3 | (portion = | 24.1% ) | | | $1,447 | (portion = | 14.6% ) | | | $22 /yr |
| I–1 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| I–2 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| I–12 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| I–3 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| LS –1 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| LS –2 | (portion = | 100.0% ) | | | $185,265 | (portion = | 100.0% ) | | | $5,265 /yr |
| LS –3 | (portion = | 21.1% ) | | | $36,512 | (portion = | 32.8% ) | | | $1,638 /yr |
| PS –1 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| PS –2 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| Bayridge Estates STEP | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| Main pumping station (PS–3) | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| Interceptor to treatment plant | (portion = | 1.6% ) | | | $7,581 | (portion = | 1.0% ) | | | $75 /yr |
| Treatment plant | | | | | | (portion = | 2.6% ) | | | $8,344 /yr |
| Headworks | (portion = | 4.1% ) | | | $17,589 | | | | | |
| Secondary treatment | (portion = | 2.6% ) | | | $83,354 | | | | | |
| Tertiary treatment | (portion = | 2.6% ) | | | $37,882 | | | | | |
| Biosolids handling | (portion = | 4.1% ) | | | $84,044 | | | | | |
| Effluent pumping station | (portion = | 4.1% ) | | | $11,298 | | | | | |
| Ancillary facilities | (portion = | 3.1% ) | | | $95,414 | | | | | |
| Land | (portion = | 3.4% ) | | | $18,072 | | | | | |
| Effluent force main | (portion = | 1.6% ) | | | $21,378 | (portion = | 1.0% ) | | | $255 /yr |
| Disposal/recharge | (portion = | 3.6% ) | | | $117,243 | (portion = | 3.4% ) | | | $2,915 /yr |
| Land | (portion = | 3.4% ) | | | $21,256 | | | | | |
| Total | | | | | $1,639,504 | | | | | $28,775 /yr |
| Total including contingency @ | | 20% | | | $1,967,404 | | | | | |
| Total including engineering, administration @ | | | 20% | | $2,360,885 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $2,903,889 | | | | | |
| On–lot costs | | | | | | | | | | |
| Septic tank abandonment | | 248 | ea @ [e] | $1,000 = | $248,000 | | | | | |
| House lateral | | | | | | | | | | |
| 4 –In. { | 60 | ft ea. | | | | | | | | |
| { | 13,260 | ft [k] @ | $15 | = | $198,900 | | | | | |
| Future | 7,980 | ft [k] @ | $7 | = | $55,860 [l] | | | | | |
| Total on–lot costs | | | | | $502,760 | | | | | |
| Total including contingency @ | 20% | | | | $603,312 | | | | | |
| GRAND TOTAL | | | | | $3,507,201 | | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area C – East Baywood Park**

**C–1 Conventional project**

**Adjustment for STEP/STEG** NOT USED

| | | | | Construction | | O&M | | |
|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | |
| 2 –in. [m] | 9,880 | ft @ | $19 [k] | = | $187,720 | | | |
| 3 –in. [m] | 0 | ft @ | $21 [k] | = | $0 | | | |
| 4 –in. [m] | 0 | ft @ | $22 [k] | = | $0 | | | |
| 6 –in. | 1,900 | ft @ | $30 [k] | = | $57,000 | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | |
| Total | 11,780 | ft | | | | 11,780 ft @ | $0.50 = | $5,890 /yr |
| On–lot costs | | | | | | | | |
| New tank/pump | 248 | ea [k] @ | $2,000 = | | $496,000 [Including house lateral] | @ | $140 [p] = | $34,720 /yr |
| Lateral 2 –in. | 10,880 | ft @ | $19 = | | $206,720 Street | | | |
| Future tank/pump | 160 | ea @ | $1,000 = | | $160,000 [l] | @ | $100 [p,l] = | $16,000 /yr |
| Future lateral | 5,440 | ft @ | $9 = | | $48,960 [l] | | | |
| Septic tank abandonment | | | | | $248,000 | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($67,763) | | | ($2,253) /yr |
| Revised subtotal, STEP/STEG | | | | | $1,336,637 | | | $54,357 /yr |
| Less conventional facilities (sewers, laterals) | | | | | ($1,368,930) | | | ($8,835) /yr |
| Adjusted total, STEP/STEG | | | | | $1,607,210 | | | $74,297 /yr |
| Total including contingency @ | 20% | | | | $1,928,652 | | | |
| Total including engineering, administration @ | | 20% | | | $2,314,383 | | | |
| Total, including financing and bonding @ | | 23% | | | $2,846,691 | | | |

**Adjustment for grinder pumps** NOT USED

| | | | | Construction | | O&M | | |
|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | |
| 2 –in. | 9,880 | ft @ | $19 [k] | = | $187,720 | | | |
| 3 –in. | 0 | ft @ | $21 [k] | = | $0 | | | |
| 4 –in. | 0 | ft @ | $22 [k] | = | $0 | | | |
| 6 –in. | | ft @ | $30 [k] | = | $0 | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | |
| Total | 9,880 | ft | | | | 9,880 ft @ | $0.50 = | $4,940 /yr |
| On–lot costs | | | | | | | | |
| New pump (simplex) | 248 | ea [k] @ | $2,500 = | | $620,000 [Including house lateral] | @ | $110 [q] = | $27,280 /yr |
| Lateral 2 –in. | 10,880 | ft @ | $19 = | | $206,720 [Street] | | | |
| Future tank/pump | 160 | ea @ | $1,000 = | | $160,000 [l] | @ | $75 [q,l] = | $12,000 /yr |
| Future lateral | 5,440 | ft @ | $9 = | | $48,960 [l] | | | |
| Septic tank abandonment | | | | | $248,000 | | | |
| Revised subtotal, grinder | | | | | $1,471,400 | | | $44,220 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | ($1,368,930) | | | ($8,835)/yr |
| Adjusted total, grinder | | | | | $1,741,974 | | | $84,160 /yr |
| Total including contingency @ | 20% | | | | $2,090,368 | | | |
| Total including engineering, administration @ | | 20% | | | $2,508,442 | | | |
| Total, including financing and bonding @ | | 23% | | | $3,085,384 | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area C – East Baywood Park

### C–1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .

d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.8 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.666667 |
| Land | 0.666667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.

h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in. gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawings [2].
o. Flow portions:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 100.0% |
| FM –3 | 54.8% |
| I–1 | 0.0% |
| I–2 | 0.0% |
| I–12 | 0.0% |
| I–3 | 0.0% |
| LS –1 | 0.0% |
| LS –2 | 100.0% |
| LS –3 | 54.8% |
| PS –1 | 0.0% |
| PS –2 | 0.0% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS–3) | 0.0% |
| Force main to treatment plant | 5.1% |
| Treatment plant | 5.1% |
| Headworks | 5.1% |
| Secondary treatment | 5.1% |
| Tertiary treatment | 5.1% |
| Biosolids handling | 5.1% |
| Effluent pumping station | 5.1% |
| Ancillary facilities | 5.1% |
| Land | |
| Effluent force main | 5.1% |
| Disposal/recharge | 5.1% |
| Land | 5.1% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh; 50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh; 50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

LOS OSOS WASTEWATER STUDY Sheet C
Detailed evaluation of alternatives
Cost Estimate

Calculated: HLS
Checked: NKD
Reviewed: CEP

Area C – East Baywood Park

C–2 Local collection, treatment, and dispose/recharge

Cost for Alternative C–2 Buildout – same as C–1 unless noted

| | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 –in. | 0 | ft @ | $28 | = | $0 | | | | |
| 8 –in. | 8,660 | ft @ | $27 | = | $233,820 | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 29 | @ | $1,500 | = | $43,500 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 –in. | 1,220 | ft @ | $19 | = | $23,180 | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | |
| STEP systems | 27 | @ | $2,000 | = | $54,000 | @ | $140 | = | $3,780 /yr |
| Total | 8,660 | ft | | | | @ | $0.75 | = | $6,495 /yr |
| Y–connection; street lateral | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | |
| { | 10,880 | ft @ | $21 | = | $228,480 | | | | |
| Future | 5,440 | ft [f] @ | $10 | = | $54,400 [g] | | | | |
| Treatment plant | 0.0616 | mgd (buildout) | | | $1,995,808 [e] | | | | $72,944 /yr [b] |
| Disposal/recharge (buildout) | | | | | $461,470 [b] | | | | |
| Land (buildout) | 4 | ac @ | $88,197 | | $352,787 [b] | | | | |
| Alternative treatment plant: @ | $6.33 | /gal, | $516,337 [c] | | | $31,000 /yr [d] | | | |
| Total | | | | | $3,447,445 | | | | $83,219 /yr |
| Total including contingency @ | | 20% | | | $4,136,934 | | | | |
| Total including engineering, administration @ | | | 20% | | $4,964,320 | | | | |
| Total, including financing and bonding @ | | | 23% | | $6,106,114 | | | | |
| Revised total with alternative treatment plant | | | | | $1,987,974 | | | | $41,275 /yr |
| Total including contingency @ | | 20% | | | $2,361,568 | | | | |
| Total including engineering, administration @ | | | 20% | | $2,833,882 | | | | |
| Total, including financing and bonding @ | | | 23% | | $3,485,675 | | | | |
| On–lot costs | | | | | | | | | |
| Septic tank abandonment | | 248 ea @ | | $1,000 = | $248,000 | | | | |
| Lateral | | | | | | | | | |
| 4 –in. { | 60 | ft ea. | | | | | | | |
| { | 13,260 | ft @ | $15 | = | $198,900 | | | | |
| Future | 7,980 | ft [f] @ | $7 | = | $55,860 [g] | | | | |
| Total on–lot costs | | | | | $502,760 | | | | |
| Total including contingency @ | 20% | | | | $603,312 | | | | |
| GRAND TOTAL | | | | | $6,709,426 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $4,066,987 | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area C – East Baywood Park

### C–2 Local collection, treatment, and dispose/recharge

**Adjustment for STEP/STEG – same as C–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 8,660 | ft @ | $19 | = | $164,540 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 8,660 | ft | | | | 8,660 | ft @ | $0.50 | = | $4,330 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | | 248 | ea @ | $2,000 = | $496,000 [including house lateral] | | @ | $140 | = | $34,720 /yr |
| Lateral 2 –in. | | 10,880 | ft @ | $19 = | $206,720 Street | | | | | |
| Future tank/pump | | 160 | ea @ | $1,000 = | $160,000 [g] | | @ | $100 [g] | = | $16,000 /yr |
| Future lateral | | 5,440 | ft @ | $9 = | $48,960 [g] | | | | | |
| Septic tank abandonment | | | | | $248,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $1,000,809 | | | | | $21,746 /yr |
| Revised subtotal, STEP/STEG | | | | | $2,325,029 | | | | | $76,796 /yr |
| Less conventional plant + land (not disposal) | | | | | ($2,348,595) | | | | | ($72,944)/yr |
| Less conventional facilities | | | | | ($1,140,140) | | | | | ($10,275)/yr |
| Adjusted total, STEP/STEG | | | | | $2,283,739 | | | | | $76,796 /yr |
| Total including contingency @ | 20% | | | | $2,740,486 | | | | | |
| Total including engineering, administration @ | | 20% | | | $3,288,584 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $4,044,958 | | | | | |

**Adjustment for grinder pumps – same as C–1 unless noted.** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 8,660 | ft @ | $19 | = | $164,540 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 8,660 | ft | | | | 8,660 | ft @ | $0.50 | = | $4,330 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | | 248 | ea @ | $2,500 = | $620,000 [including house lateral] | | @ | $110 | = | $27,280 /yr |
| Lateral 2 –in. | | 10,880 | ft @ | $19 = | $206,720 [Street] | | | | | |
| Future tank/pump | | 160 | ea @ | $1,000 = | $160,000 [g] | | @ | $75 [g] | = | $12,000 /yr |
| Future lateral | | 5,440 | ft @ | $9 = | $48,960 [g] | | | | | |
| Septic tank abandonment | | | | | $248,000 | | | | | |
| Revised subtotal, grinder | | | | | $1,448,220 | | | | | $43,610 /yr |
| Less conventional facilities | | | | | ($1,140,140) | | | | | ($10,275)/yr |
| Adjusted total, grinder | | | | | $3,755,525 | | | | | |
| Total including contingency @ | 20% | | | | $4,506,630 | | | | | |
| Total including engineering, administration @ | | 20% | | | $5,407,956 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $6,651,785 | | | | | $33,335 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   12 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g Based on present worth of future installations over a 20–year period at 7%.
   For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: CEP/NKD

**Area C – East Baywood Park**

**C–3 Enhance/upgrade existing onsite systems**

Cost for Alternative C–3 Buildout – same as C–1 unless noted

| | | | Construction | | | | O&M | | |
|---|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | | |
| | % of existing units | | | | | | | | |
| Retrofit | 100% | 248 units @ | $3,000 [a] | = | $744,000 | @ | $247 [b] | = | $61,330 |
| New | 0% | 0 units @ | $4,400 [a] | = | $0 | @ | $247 [b] | = | $0 |
| New to buildout | -- | 160 units [f] @ | $3,920 [a] | = | $627,166 [d] | @ | $169 [b,e] | = | $27,038 |
| Total | | | | | $1,371,166 | | | | $88,369 |
| Total including contingency @ | | | 20% | | $1,645,399 | | | | |
| Total including engineering, administration @ | | | 20% | | $1,974,479 | | | | |
| Total, including financing and bonding @ | | | 23% | | $2,428,609 | | | | |
| **Maximum** | | | | | | | | | |
| | % of existing units | | | | | | | | |
| Retrofit | 75% | 186 units @ | $3,000 [a] | = | $558,000 | @ | $247 [b] | = | $45,998 |
| New [c] | 25% | 62 units @ | $4,400 [a] | = | $272,800 | @ | $247 [b] | = | $15,333 |
| New to buildout | -- | 160 units [f] @ | $3,920 [a] | = | $627,166 [d] | @ | $169 [b,e] | = | $27,038 |
| | | | | | | | | | $88,369 |
| Total | | | | | $1,457,966 | | | | |
| Total including contingency @ | | | 20% | | $1,749,559 | | | | |
| Total including engineering, administration @ | | | 20% | | $2,099,471 | | | | |
| Total, including financing and bonding @ | | | 23% | | $2,582,349 | | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)

b. Based on
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh

c. Table 3–1

d. Present worth over first 20 years @ 7% .

e. Average cost over 30 –year period.

f. For cost purposes only, based on 4 multiple family units = 1 DUE.

| Summary, Area D – Southeast Baywood Park –Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| D–1 Conventional (Sheet B) | $4,605,000 | -- | -- | $42,000 | -- | -- | $5,126,000 | -- | -- |
| D–2 Pkg plant } (Sheet | $9,110,000 | -- | -- | $113,000 | -- | -- | $10,512,000 | -- | -- |
| D–2– alternate } C) | $6,201,000 | -- | -- | $66,000 | -- | -- | $7,020,000 | -- | -- |
| D–2– sand filter} | -- | $6,510,000 | -- | -- | $110,000 | -- | -- | $7,875,000 | -- |
| D–3 Onsite: min.} (Sheet | $3,073,000 | | | $129,000 | | | $4,674,000 | | |
| D–3 Onsite: max} D) | $3,323,000 | | | $129,000 | | | $4,924,000 | | |
| D–4 Nothing: min.} (Sheet | $343,000 | | | $126,000 | | | $1,907,000 | | |
| D–4 Nothing: max} E) | $926,000 | | | $126,000 | | | $2,490,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area D – Southeast Baywood Park – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| D–1 Conventional (Sheet B) | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| D–2 Pkg plant } (Sheet | $78,379,000 | -- | -- | $823,000 | -- | -- | $88,592,000 | -- | -- |
| D–2– alternate } C) | $75,470,000 | -- | -- | $776,000 | -- | -- | $85,099,000 | -- | -- |
| D–2– sand filter} | -- | $6,510,000 | -- | -- | $110,000 | -- | -- | $7,875,000 | -- |
| D–3 Onsite: min.} (Sheet | $72,342,000 | | | $839,000 | | | $82,753,000 | | |
| D–3 Onsite: max} D) | $72,592,000 | | | $839,000 | | | $83,003,000 | | |
| D–4 Nothing: min.} (Sheet | $69,612,000 | | | $836,000 | | | $79,986,000 | | |
| D–4 Nothing: max} E) | $70,195,000 | | | $836,000 | | | $80,569,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

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2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

## Area D – Southeast Baywood Park

### D–1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 460 | -- | -- | -- | -- | -- | 460 | 0 | 0 |
| No. DUE [a] | 590 | 659 | 694 | | 0 | 0 | 590 | 659 | 694 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 118,000 | 131,800 | 138,800 | | 0 | 0 | 118,000 | 131,800 | 138,800 |
| Peak factor | 4.0 | 4.0 | 4.0 | | 2.0 | 2.0 | 4.0 | 4.0 | 4.0 |
| Peak flow, gpd | 472,000 | 527,200 | 555,200 | | 0 | 0 | 472,000 | 527,200 | 555,200 |

| Costs for common facilities | | | Const. [c] | | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | $179,288 | | | | | | | | $5,146 /yr [j] |
| | LS–2 | | $185,265 | | | | | | | | $5,265 /yr [j] |
| | LS–3 | | $173,312 | | | | | | | | $5,026 /yr [j] |
| Pump stations | PS–1 | | $717,153 | | | | | | | | $15,903 /yr [j] |
| | PS–2 | | $418,339 | | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | $59,763 | | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM–1 | 6 in. | 580 | ft @ | $30 | = | $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | 1,900 | ft @ | $30 | = | $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | 200 | ft @ | $30 | = | $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | 3,700 | ft @ | $39 | = | $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | 100 | ft @ | $34 | = | $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | 1,600 | ft @ | $49 | = | $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | 6,400 | ft @ | $58 | = | $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | | $1,314,781 | | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | Second stage of plant: present worth [i] | | | | | | |
| 21 in., 7,200 ft @ | | $58 | $417,600 | | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | $8,623,888 | | | | | | | | $323,000 /yr |
| Headworks | | | $428,858 | | -- | | | | | | |
| Secondary treatment | | | $2,006,834 | | $445,529 | | | | | | |
| Tertiary treatment | | | $1,199,977 | | $266,402 | | | | | | |
| Biosolids handling | | | $1,676,943 | | $372,291 | | | | | | |
| Effluent pumping station | | | $225,425 | | $50,046 | | | | | | |
| Ancillary facilities | | | $3,085,851 | | -- | | | | | | |
| Land | | | $468,638 | 9 | ac @ | | $52,071 /ac | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in., 24,500 ft @ | | $58 | $1,372,000 | | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | $2,666,615 | | $592,004 | | | | | | $85,000 /yr |
| Land | | | $619,777 | 20 | ac @ | | $30,989 /ac | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area D – Southeast Baywood Park

D–1 Conventional project

### Cost for Alternative D–1 Buildout

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | | |
| 8 –in. | 17,060 | ft @ | $27 | = | $460,620 | | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | | |
| Dewatering – none | 0 | ft @ | $19 | = | $0 | | | | | |
| Manholes | 52 | @ | $1,750 | = | $91,000 | | | | | |
| Pressure sewer | | | | | | | | | | |
| 2 –in. | 1,960 | ft @ | $19 | = | $37,240 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 6 –in. | 0 | ft @ | $30 | = | $0 | | | | | |
| STEP systems [n] | 39 | @ | $2,000 | = | $78,000 | [Includes house lateral] | @ | $140 [p] | = | $5,460 /yr |
| Total | 19,020 | ft | | | | 19,020 | ft @ | $0.75 | = | $14,265 /yr |
| Y–connection and street lateral | | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | | |
| { | 20,552 | ft @ | $21 | = | $431,589 | [To Stage 1] | | | | |
| Future | 1,471 | ft [k] @ | $10 | = | $14,710 | [l] | | | | |
| Common facilities – incremental (avoidable) costs [f,o] | | | | | | | | | | |
| FM –1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| FM –2 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| FM –3 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| I–1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| I–2 | (portion = | 7.4%) | | | $250 | (portion = | 4.3%) | | | $4 /yr |
| I–12 | (portion = | 3.8%) | | | $2,941 | (portion = | 2.2%) | | | $35 /yr |
| I–3 | (portion = | 2.9%) | | | $10,905 | (portion = | 1.7%) | | | $108 /yr |
| LS –1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| LS –2 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| LS –3 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| PS –1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| PS –2 | (portion = | 6.3%) | | | $26,506 | (portion = | 10.3%) | | | $1,028 /yr |
| Bayridge Estates STEP | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| Main pumping station (PS–3) | (portion = | 2.5%) | | | $33,179 | (portion = | 4.2%) | | | $1,357 /yr |
| Interceptor to treatment plant | (portion = | 3.1%) | | | $13,055 | (portion = | 1.8%) | | | $129 /yr |
| Treatment plant | | | | | | (portion = | 4.4%) | | | $14,328 /yr |
| Headworks | (portion = | 7.0%) | | | $30,030 | | | | | |
| Secondary treatment | (portion = | 4.4%) | | | $108,784 | | | | | |
| Tertiary treatment | (portion = | 4.4%) | | | $65,047 | | | | | |
| Biosolids handling | (portion = | 7.0%) | | | $143,496 | | | | | |
| Effluent pumping station | (portion = | 7.0%) | | | $19,290 | | | | | |
| Ancillary facilities | (portion = | 5.3%) | | | $163,524 | | | | | |
| Land | (portion = | 5.9%) | | | $27,511 | | | | | |
| Effluent force main | (portion = | 2.7%) | | | $36,847 | (portion = | 1.8%) | | | $441 /yr |
| Disposal/recharge | (portion = | 6.2%) | | | $200,556 | (portion = | 5.9%) | | | $4,990 /yr |
| Land | (portion = | 5.9%) | | | $36,383 | | | | | |
| Total | | | | | $2,031,464 | | | | | $42,143 /yr |
| Total including contingency @ | | 20% | | | $2,437,757 | | | | | |
| Total including engineering, administration @ | | | 20% | | $2,925,308 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $3,598,129 | | | | | |
| On–lot costs | | | | | | | | | | |
| Septic tank abandonment | | 460 | ea @ [e] | $1,000 = | $460,000 | | | | | |
| House lateral | | | | | | | | | | |
| 4 –in. { | 60 | ft ea. | | | | | | | | |
| { | 25,260 | ft @ | $15 | = | $378,900 | | | | | |
| Future | 3,094 | ft [k] @ | $7 | = | $21,656 | [l] | | | | |
| Total on–lot costs | | | | | $838,900 | | | | | |
| Total including contingency @ | 20% | | | | $1,006,680 | | | | | |
| GRAND TOTAL | | | | | $4,604,809 | | | | | |

Area D – Southeast Baywood Park

D–1 Conventional project

**Adjustment for STEP/STEG** NOT USED

| | | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. [m] | 19,020 | ft @ | $19 [k] | = | $361,380 | | | | | |
| 3 –in. [m] | 0 | ft @ | $21 [k] | = | $0 | | | | | |
| 4 –in. [m] | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | 0 | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 19,020 | ft | | | | 19,020 | ft @ | $0.50 | = | $9,510 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | | 460 | ea [k] @ | $2,000 = | $920,000 | [Including house lateral] | @ | $140 [p] | = | $64,400 /yr |
| Lateral 2 –in. | | 20,552 | ft @ | $19 = | $390,485 | [Street] | | | | |
| Future tank/pump | | 100 | ea @ | $1,000 = | $100,000 | [l] | @ | $100 [p,l] | = | $10,000 /yr |
| Future lateral | | 1,471 | ft @ | $9 = | $13,239 | [l] | | | | |
| Septic tank abandonment | | | | | $460,000 | | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($115,904) | | | | | ($3,873) /yr |
| Revised subtotal, STEP/STEG | | | | | $2,129,201 | | | | | $80,037 /yr |
| Less conventional facilities (sewers, laterals) | | | | | ($1,952,059) | | | | | ($19,725) /yr |
| Adjusted total, STEP/STEG | | | | | $2,208,606 | | | | | $102,455 /yr |
| Total including contingency @ | | 20% | | | $2,650,327 | | | | | |
| Total including engineering, administration @ | | | 20% | | $3,180,392 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $3,911,883 | | | | | |

**Adjustment for grinder pumps** NOT USED

| | | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 19,020 | ft @ | $19 [k] | = | $361,380 | | | | | |
| 3 –in. | 0 | ft @ | $21 [k] | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 19,020 | ft | | | | 19,020 | ft @ | $0.50 | = | $9,510 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | | 460 | ea [k] @ | $2,500 = | $1,150,000 | [Including house lateral] | @ | $110 [q] | = | $50,600 /yr |
| Lateral 2 –in. | | 20,552 | ft @ | $19 = | $390,485 | [Street] | | | | |
| Future tank/pump | | 100 | ea @ | $1,000 = | $100,000 | [l] | @ | $75 [q,l] | = | $7,500 |
| Future lateral | | 1,471 | ft @ | $9 = | $13,239 | [l] | | | | |
| Septic tank abandonment | | | | | $460,000 | | | | | |
| Revised subtotal, grinder | | | | | $2,475,104 | | | | | $67,610 /yr |
| Less conventional facilities (sewers, pumping stations, force mains, laterals) | | | | | ($1,952,059) | | | | | ($19,725)/yr |
| Adjusted total, grinder | | | | | $2,554,509 | | | | | $90,028 /yr |
| Total including contingency @ | | 20% | | | $3,065,411 | | | | | |
| Total including engineering, administration @ | | | 20% | | $3,678,493 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $4,524,547 | | | | | |

## Area D – Southeast Baywood Park

### D–1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .

d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.8 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.

h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in.gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawings [2].
o. Flow portions:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 0.0% |
| FM –3 | 0.0% |
| I–1 | 0.0% |
| I–2 | 19.6% |
| I–12 | 10.3% |
| I–3 | 8.2% |
| LS –1 | 0.0% |
| LS –2 | 0.0% |
| LS –3 | 0.0% |
| PS –1 | 0.0% |
| PS –2 | 19.6% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS–3) | 8.2% |
| Force main to treatment plant | 8.7% |
| Treatment plant | 8.7% |
| Headworks | 8.7% |
| Secondary treatment | 8.7% |
| Tertiary treatment | 8.7% |
| Biosolids handling | 8.7% |
| Effluent pumping station | 8.7% |
| Ancillary facilities | 8.7% |
| Land | |
| Effluent force main | 8.7% |
| Disposal/recharge | 8.7% |
| Land | 8.7% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling,and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area D – Southeast Baywood Park

### D-2 Local collection, treatment, and dispose/recharge

**Cost for Alternative D-2 Buildout** – same as D-1 unless noted

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 -in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 -in. | 17,060 | ft @ | $27 | = | $460,620 | | | | |
| 10 -in. | 0 | ft @ | $29 | = | $0 | | | | |
| 12 -in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 -in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 52 | @ | $1,500 | = | $78,000 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 -in. | 1,960 | ft @ | $19 | = | $37,240 | | | | |
| 3 -in. | 0 | ft @ | $21 | = | $0 | | | | |
| STEP systems | 39 | @ | $2,000 | = | $78,000 | @ | $140 | = | $5,460 /yr |
| Total | 17,060 | ft | | | | @ | $0.75 | = | $12,795 /yr |
| Y-connection; street lateral | | | | | | | | | |
| 4 -in. { | 40 | ft ea. | | | | | | | |
| { | 20,552 | ft @ | $21 | = | $431,589 | | | | |
| Future | 1,471 | ft [f] @ | $10 | = | $14,710 [g] | | | | |
| Treatment plant | 0.1388 mgd (buildout) | | | | $2,384,363 [a] | | | | $95,134 /yr [b] |
| Disposal/recharge (buildout) | | | | | $669,319 [b] | | | | |
| Land (buildout) | 6 ac @ | | $67,763 | | $406,579 [b] | | | | |
| Alternative treatment plant: @ | $5.34 /gal, | | $741,661 [c] | | | $48,000 /yr [d] | | | |
| Total | | | | | $4,560,419 | | | | $113,389 /yr |
| Total including contingency @ | | 20% | | | $5,472,503 | | | | |
| Total including engineering, administration @ | | | 20% | | $6,567,004 | | | | |
| Total, including financing and bonding @ | | | 23% | | $8,077,415 | | | | |
| Revised total with alternative treatment plant | | | | | $2,917,717 | | | | $66,255 /yr |
| Total including contingency @ | | 20% | | | $3,501,261 | | | | |
| Total including engineering, administration @ | | | 20% | | $4,201,513 | | | | |
| Total, including financing and bonding @ | | | 23% | | $5,167,861 | | | | |
| On-lot costs | | | | | | | | | |
| Septic tank abandonment | 460 ea @ | | | $1,000 = | $460,000 | | | | |
| Lateral | | | | | | | | | |
| 4 -in. { | 60 | ft ea. | | | | | | | |
| { | 25,260 | ft @ | $15 | = | $378,900 | | | | |
| Future | 3,094 | ft [f] @ | $7 | = | $21,656 [g] | | | | |
| Total on-lot costs | | | | | $860,556 | | | | |
| Total including contingency @ | 20% | | | | $1,032,668 | | | | |
| GRAND TOTAL | | | | | $9,110,082 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $6,200,529 | | | | |

## Area D – Southeast Baywood Park

### D–2 Local collection, treatment, and dispose/recharge

**Adjustment for STEP/STEG – same as D–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 17,060 | ft @ | $19 | = | $324,140 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 17,060 | ft | | | | 17,060 | ft @ | $0.50 | = | $8,530 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 460 | ea @ | $2,000 | = | $920,000 | [Including house lateral] | @ | $140 | = | $64,400 /yr |
| Lateral 2 –in. | 20,552 | ft @ | $19 | = | $390,485 | Street | | | | |
| Future tank/pump | 100 | ea @ | $1,000 | = | $100,000 | [g] | @ | $100 [g] | = | $10,000 |
| Future lateral | 1,471 | ft @ | $9 | = | $13,239 | [g] | | | | |
| Septic tank abandonment | | | | | $460,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $1,659,046 | | | | | $26,886 /yr |
| Revised subtotal, STEP/STEG | | | | | $3,866,910 | | | | | $109,816 /yr |
| Less conventional plant + land (not disposal) | | | | | ($2,790,941) | | | | | ($95,134)/yr |
| Less conventional facilities | | | | | ($1,960,715) | | | | | ($18,255)/yr |
| Adjusted total, STEP/STEG | | | | | $3,675,672 | | | | | $109,816 /yr |
| Total including contingency @ | 20% | | | | $4,410,807 | | | | | |
| Total including engineering, administration @ | | 20% | | | $5,292,968 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $6,510,351 | | | | | |

**Adjustment for grinder pumps – same as D–1 unless noted.** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 17,060 | ft @ | $19 | = | $324,140 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 17,060 | ft | | | | 17,060 | ft @ | $0.50 | = | $8,530 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 460 | ea @ | $2,500 | = | $1,150,000 | [Including house lateral] | @ | $110 | = | $50,600 /yr |
| Lateral 2 –in. | 20,552 | ft @ | $19 | = | $390,485 | [Street] | | | | |
| Future tank/pump | 100 | ea @ | $1,000 | = | $100,000 | [g] | @ | $75 [g] | = | $7,500 |
| Future lateral | 1,471 | ft @ | $9 | = | $13,239 | [g] | | | | |
| Septic tank abandonment | | | | | $460,000 | | | | | |
| Revised subtotal, grinder | | | | | $2,437,864 | | | | | $66,630 /yr |
| Less conventional facilities | | | | | ($1,960,715) | | | | | ($18,255)/yr |
| Adjusted total, grinder | | | | | $5,037,568 | | | | | |
| Total including contingency @ | 20% | | | | $6,045,082 | | | | | |
| Total including engineering, administration @ | | 20% | | | $7,254,098 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $8,922,541 | | | | | $48,375 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   18 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g Based on present worth of future installations over a 20–year period at 7%. For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area D – Southeast Baywood Park**

**D–3 Enhance/upgrade existing onsite systems**

Cost for Alternative D–3 Buildout – same as D–1 unless noted

| | | Construction | | | | O&M | | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 100% | 460 units @ | $3,000 [a] | = | $1,380,000 | @ | $247 [b] | = $113,758 |
| New | 0% | 0 units @ | $4,400 [a] | = | $0 | @ | $247 [b] | = $0 |
| New to buildout | -- | 91 units [f] @ | $3,920 [a] | = | $354,986 [d] | @ | $169 [b,e] | = $15,304 |
| Total | | | | | $1,734,986 | | | $129,062 |
| Total including contingency @ | | 20% | | | $2,081,983 | | | |
| Total including engineering, administration @ | | | 20% | | $2,498,379 | | | |
| Total, including financing and bonding @ | | | 23% | | $3,073,006 | | | |
| **Maximum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 78% | 359 units @ | $3,000 [a] | = | $1,077,000 | @ | $247 [b] | = $88,781 |
| New [c] | 22% | 101 units @ | $4,400 [a] | = | $444,400 | @ | $247 [b] | = $24,977 |
| New to buildout | -- | 91 units [f] @ | $3,920 [a] | = | $354,986 [d] | @ | $169 [b,e] | = $15,304 |
| | | | | | | | | $129,062 |
| Total | | | | | $1,876,386 | | | |
| Total including contingency @ | | 20% | | | $2,251,663 | | | |
| Total including engineering, administration @ | | | 20% | | $2,701,995 | | | |
| Total, including financing and bonding @ | | | 23% | | $3,323,454 | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)
b. Based on:
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
c. Table 3–1
d. Present worth over first 20 years @ 7%.
e. Average cost over 30 –year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area D – Southeast Baywood Park**

**D–4 Retain existing onsite systems**

**Cost for Alternative D–4 Buildout – same as D–1 unless noted**

| | | | Construction | | | | O&M | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Replacement | 0% | 0 units @ | $4,100 [a] | = | $0 | @ | $242 [b] | $0 |
| No replacement | 100% | 460 units @ | $90 [a] | = | $41,400 | @ | $242 [b] | $111,320 |
| New to buildout | -- | 91 units [f] @ | $2,172 [a] | = | $196,681 | @ | $165 [b,e] | $14,976 |
| Total | | | | | $238,081 | | | $126,296 |
| Total including contingency @ | | | 20% | | $285,697 | | | |
| Total including engineering, administration @ | | | 20% | | $342,837 | | | |
| Total, including financing and bonding @ | | | 0% | | $342,837 | | | |
| **Maximum** | | | | | | | | |
| Replacement [c] | 22% | 101 units @ | $4,100 [a] | = | $414,100 | @ | $242 [b] | $24,442 |
| No replacement | 78% | 359 units @ | $90 [a] | = | $32,310 | @ | $242 [b] | $86,878 |
| New to buildout | -- | 91 units [f] @ | $2,172 [a] | = | $196,681 [d] | @ | $165 [b,e] | $14,976 |
| Total | | | | | $643,091 | | | $126,296 |
| Total including contingency @ | | | 20% | | $771,709 | | | |
| Total including engineering, administration @ | | | 20% | | $926,051 | | | |
| Total, including financing and bonding @ | | | 0% | | $926,051 | | | |

a. Based on complete replacement of septic tank and leach field or pit (Appendix D)
For no replacement, based on initial inspection only (Appendix D).

b. Based on:
4 hr/yr @ $30 /hr (one inspection/year; administration)
2.0% of capital cost
$200 pumping every 5 years.

c. Table 3–1

d. Present worth over first 20 years @ 7% .

e. Average cost over 30 –year period.

f. For cost purposes only, based on 4 multiple family units = 1 DUE.

| Summary, Area E – West Baywood Park – Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| E-1 Conventional (Sheet B | $5,732,000 | -- | -- | $45,000 | -- | -- | $6,290,000 | -- | -- |
| E-2Pkg plant } (Sheet | $9,677,000 | -- | -- | $119,000 | -- | -- | $11,154,000 | -- | -- |
| E-2 – alternate } C) | $6,709,000 | -- | -- | $69,000 | -- | -- | $7,565,000 | -- | -- |
| E-2 – sand filter} | -- | $7,162,000 | -- | -- | $121,000 | -- | -- | $8,663,000 | -- |
| E-3Onsite: min.} (Sheet | $3,702,000 | | | $146,000 | | | $5,514,000 | | |
| E-3Onsite: max} D) | $3,891,000 | | | $146,000 | | | $5,703,000 | | |
| E-4Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| E-4Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area E – West Baywood Park – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| E-1 Conventional (Sheet B | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| E-2Pkg plant } (Sheet | $77,819,000 | -- | -- | $826,000 | -- | -- | $88,069,000 | -- | -- |
| E-2 – alternate } C) | $74,851,000 | -- | -- | $776,000 | | -- | $84,480,000 | -- | -- |
| E-2 – sand filter} | -- | $7,162,000 | -- | -- | $121,000 | -- | -- | $8,663,000 | -- |
| E-3Onsite: min.} (Sheet | $71,844,000 | | | $853,000 | | | $82,429,000 | | |
| E-3Onsite: max} D) | $72,033,000 | | | $853,000 | | | $82,618,000 | | |
| E-4Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| E-4Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES

1. Draft Background Report. Estero Area Plan Update. San Luis Obispo County Planning Department. June 1994. Appendix A – Land Use Survey.

2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater TreatmentPlants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

## Area E – West Baywood Park

### E–1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 472 | -- | -- | -- | -- | -- | 472 | 0 | 0 |
| No. DUE [a] | 640 | 733 | 779 | | 0 | 0 | 640 | 733 | 779 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 128,000 | 146,600 | 155,800 | | 0 | 0 | 128,000 | 146,600 | 155,800 |
| Peak factor | 4.0 | 4.0 | 4.0 | | 2.0 | 2.0 | 4.0 | 4.0 | 4.0 |
| Peak flow, gpd | 512,000 | 586,400 | 623,200 | | 0 | 0 | 512,000 | 586,400 | 623,200 |

| Costs for common facilities | | | | | Const. [c] | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | | | $179,288 | | | | | | | $5,146 /yr [j] |
| | LS–2 | | | | $185,265 | | | | | | | $5,265 /yr [j] |
| | LS–3 | | | | $173,312 | | | | | | | $5,026 /yr [j] |
| Pump stations | PS–1 | | | | $717,153 | | | | | | | $15,903 /yr [j] |
| | PS–2 | | | | $418,339 | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | | | $59,763 | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | | |
| | FM–1 | 6 in. | | 580 | ft @ | $30 | = | $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | | 1,900 | ft @ | $30 | = | $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | | 200 | ft @ | $30 | = | $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | | 3,700 | ft @ | $39 | = | $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | | 100 | ft @ | $34 | = | $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | | 1,600 | ft @ | $49 | = | $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | | 6,400 | ft @ | $58 | = | $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | | | | $1,314,781 | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant("Main") | | | | | | Second stage of plant present worth [i] | | | | | | |
| 21 in., | 7,200 | ft @ | $58 | | $417,600 | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | | | $8,623,888 | | | | | | | $323,000 /yr |
| Headworks | | | | | $428,858 | -- | | | | | | |
| Secondary treatment | | | | | $2,006,834 | $445,529 | | | | | | |
| Tertiary treatment | | | | | $1,199,977 | $266,402 | | | | | | |
| Biosolids handling | | | | | $1,676,943 | $372,291 | | | | | | |
| Effluent pumping station | | | | | $225,425 | $50,046 | | | | | | |
| Ancillary facilities | | | | | $3,085,851 | -- | | | | | | |
| Land | | | | | $468,638 | | 9 | ac @ | $52,071 /ac | | | |
| Effluent forcemain | | | | | | | | | | | | |
| 16 in., | 24,500 | ft @ | $56 | | $1,372,000 | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | | | $2,666,615 | $592,004 | | | | | | $85,000 /yr |
| Land | | | | | $619,777 | | 20 | ac @ | $30,989 /ac | | | |

**Area E – West Baywood Park**

**E-1 Conventional project**

**Cost for Alternative E-1 Buildout**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | | |
| 6 -in. | 0 | ft @ | $26 | = | $0 | | | | | |
| 8 -in. | 15,990 | ft @ | $27 | = | $431,730 | | | | | |
| 10 -in. | 2,300 | ft @ | $29 | = | $66,700 | | | | | |
| 12 -in. | 640 | ft @ | $34 | = | $21,760 | | | | | |
| 15 -in. | 860 | ft @ | $39 | = | $33,540 | | | | | |
| Dewatering | 19,790 | ft @ | $19 | = | $376,010 | | | | | |
| Manholes | 63 | @ | $1,750 | = | $110,250 | | | | | |
| Pressure sewer | | | | | | | | | | |
| 2 -in. | 1,320 | ft @ | $19 | = | $25,080 | | | | | |
| 3 -in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 6 -in. | 0 | ft @ | $30 | = | $0 | | | | | |
| STEP systems [n] | 25 | @ | $2,000 | = | $50,000 | [includes house lateral] | @ | $140 [p] | = | $3,500 /yr |
| Total | 21,110 | ft | | | | 21,110 | ft @ | $0.75 | = | $15,833 /yr |
| Y-connection and street lateral | | | | | | | | | | |
| 4 -in. { | 40 | ft ea. | | | | | | | | |
| { | 21,824 | ft @ | $21 | = | $454,094 | [To Stage 1] | | | | |
| Future | 4,136 | ft [k] @ | $10 | = | $41,365 | [l] | | | | |
| Common facilities – incremental (avoidable) costs [f,o] | | | | | | | | | | |
| FM -1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| FM -2 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| FM -3 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| I-1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| I-2 | (portion = | 8.3%) | | | $284 | (portion = | 4.9%) | | | $5 /yr |
| I-12 | (portion = | 4.2%) | | | $3,320 | (portion = | 2.4%) | | | $39 /yr |
| I-3 | (portion = | 3.3%) | | | $12,296 | (portion = | 1.9%) | | | $122 /yr |
| LS -1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| LS -2 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| LS -3 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| PS -1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| PS -2 | (portion = | 7.2%) | | | $30,085 | (portion = | 11.7%) | | | $1,161 /yr |
| Bayridge Estates STEP | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| Main pumping station (PS-3) | (portion = | 2.8%) | | | $37,420 | (portion = | 4.7%) | | | $1,529 /yr |
| Interceptor to treatment plant | (portion = | 3.5%) | | | $14,709 | (portion = | 2.0%) | | | $146 /yr |
| Treatment plant | | | | | | (portion = | 5.0%) | | | $16,129 /yr |
| Headworks | (portion = | 7.9%) | | | $33,747 | | | | | |
| Secondary treatment | (portion = | 5.0%) | | | $122,457 | | | | | |
| Tertiary treatment | (portion = | 5.0%) | | | $73,222 | | | | | |
| Biosolids handling | (portion = | 7.9%) | | | $161,254 | | | | | |
| Effluent pumping station | (portion = | 7.9%) | | | $21,677 | | | | | |
| Ancillary facilities | (portion = | 6.0%) | | | $183,972 | | | | | |
| Land | (portion = | 6.6%) | | | $30,939 | | | | | |
| Effuent force main | (portion = | 3.0%) | | | $41,526 | (portion = | 2.0%) | | | $497 /yr |
| Disposal/recharge | (portion = | 6.9%) | | | $225,505 | (portion = | 6.6%) | | | $5,612 /yr |
| Land | (portion = | 6.6%) | | | $40,917 | | | | | |
| Total | | | | | $2,643,857 | | | | | $44,571 /yr |
| Total including contingency @ | 20% | | | | $3,172,629 | | | | | |
| Total including engineering, administration @ | | 20% | | | $3,807,154 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $4,682,800 | | | | | |
| On-lot costs | | | | | | | | | | |
| Septic tank abandonment | 472 | ea @ [e] | $1,000 | = | $472,000 | | | | | |
| House lateral | | | | | | | | | | |
| 4 -in. { | 60 | ft ea. | | | | | | | | |
| { | 26,820 | ft @ | $15 | = | $402,300 | | | | | |
| Future | 8,820 | ft [k] @ | $7 | = | $61,740 | [l] | | | | |
| Total on-lot costs | | | | | $874,300 | | | | | |
| Total including contingency @ | 20% | | | | $1,049,160 | | | | | |
| GRAND TOTAL | | | | | $5,731,960 | | | | | |

## Area E – West Baywood Park

### E-1 Conventional project

**Adjustment for STEP/STEG** NOT USED

| | | | Construction | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 -in. [m] | 17,310 | ft @ | $19 [k] | = | $328,890 | | | | | |
| 3 -in. [m] | 640 | ft @ | $21 [k] | = | $13,440 | | | | | |
| 4 -in. [m] | 860 | ft @ | $22 [k] | = | $18,920 | | | | | |
| 6 -in. | 0 | ft @ | $30 [k] | = | $0 | | | | | |
| 8 -in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 -in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 -in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 18,810 | ft | | | | 18,810 | ft @ | $0.50 | = | $9,405 /yr |
| On-lot costs | | | | | | | | | | |
| New tank/pump | 472 | ea [k] @ | $2,000 | = | $944,000 | [Including house lateral] | @ | $140 [p] | = | $66,080 /yr |
| Lateral 2 -in. | 21,624 | ft @ | $19 | = | $410,847 | [Street] | | | | |
| Future tank/pump | 172 | ea @ | $1,000 | = | $172,000 | [I] | @ | $100 [p,I] | = | $17,200 /yr |
| Future lateral | 4,136 | ft @ | $9 | = | $37,228 | [I] | | | | |
| Septic tank abandonment | | | | | $472,000 | | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($130,318) | | | | | ($4,361) /yr |
| Revised subtotal, STEP/STEG | | | | | $2,267,007 | | | | | $88,324 /yr |
| Less conventional facilities (sewers, laterals) | | | | | ($2,484,829) | | | | | ($19,333) /yr |
| Adjusted total, STEP/STEG | | | | | $2,426,036 | | | | | $113,563 /yr |
| Total including contingency @ | 20% | | | | $2,911,243 | | | | | |
| Total including engineering, administration @ | | 20% | | | $3,493,492 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $4,296,995 | | | | | |

**Adjustment for grinder pumps** NOT USED

| | | | Construction | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 -in. | 17,310 | ft @ | $19 [k] | = | $328,890 | | | | | |
| 3 -in. | 640 | ft @ | $21 [k] | = | $13,440 | | | | | |
| 4 -in. | 860 | ft @ | $22 [k] | = | $18,920 | | | | | |
| 6 -in. | | ft @ | $30 [k] | = | $0 | | | | | |
| 8 -in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 -in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 -in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 18,810 | ft | | | | 18,810 | ft @ | $0.50 | = | $9,405 /yr |
| On-lot costs | | | | | | | | | | |
| New pump (simplex) | 472 | ea [k] @ | $2,500 | = | $1,180,000 | [Including house lateral] | @ | $110 [q] | = | $51,920 /yr |
| Lateral 2 -in. | 21,624 | ft @ | $19 | = | $410,847 | [Street] | | | | |
| Future tank/pump | 172 | ea @ | $1,000 | = | $172,000 | [I] | @ | $75 [q,I] | = | $12,900 /yr |
| Future lateral | 4,136 | ft @ | $9 | = | $37,228 | [I] | | | | |
| Septic tank abandonment | | | | | $472,000 | | | | | |
| Revised subtotal, grinder | | | | | $2,633,325 | | | | | $74,225 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | ($2,484,829) | | | | | ($19,333)/yr |
| Adjusted total, grinder | | | | | $2,792,354 | | | | | $99,464 /yr |
| Total including contingency @ | 20% | | | | $3,350,824 | | | | | |
| Total including engineering, administration @ | | 20% | | | $4,020,989 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $4,945,817 | | | | | |

**Area E – West Baywood Park**

**E–1 Conventional project**

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .
d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.6 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.
h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in. gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawings [2].
o. Flow portions:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 0.0% |
| FM –3 | 0.0% |
| I–1 | 0.0% |
| I–2 | 22.0% |
| I–12 | 11.6% |
| I–3 | 9.2% |
| LS –1 | 0.0% |
| LS –2 | 0.0% |
| LS –3 | 0.0% |
| PS –1 | 0.0% |
| PS –2 | 22.0% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS–3) | 9.2% |
| Force main to treatment plant | 9.7% |
| Treatment plant | 9.7% |
| Headworks | 9.7% |
| Secondary treatment | 9.7% |
| Tertiary treatment | 9.7% |
| Biosolids handling | 9.7% |
| Effluent pumping station | 9.7% |
| Ancillary facilities | 9.7% |
| Land | |
| Effluent force main | 9.7% |
| Disposal/recharge | 9.7% |
| Land | 9.7% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area E – West Baywood Park**

**E-2 Local collection, treatment, and dispose/recharge**

Cost for Alternative E-2 Buildout – same as E-1 unless noted

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 -in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 -in. | 15,990 | ft @ | $27 | = | $431,730 | | | | |
| 10 -in. | 2,300 | ft @ | $29 | = | $66,700 | | | | |
| 12 -in. | 640 | ft @ | $34 | = | $21,760 | | | | |
| 15 -in. | 860 | ft @ | $39 | = | $33,540 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 63 | @ | $1,500 | = | $94,500 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 -in. | 1,320 | ft @ | $19 | = | $25,080 | | | | |
| 3 -in. | 0 | ft @ | $21 | = | $0 | | | | |
| STEP systems | 25 | @ | $2,000 | = | $50,000 | @ | $140 | = | $3,500 /yr |
| Total | 19,790 | ft | | | | @ | $0.75 | = | $14,843 /yr |
| Y-connection; street lateral | | | | | | | | | |
| 4 -in. { | 40 | ft ea. | | | | | | | |
| { | 21,624 | ft @ | $21 | = | $454,094 | | | | |
| Future | 4,136 | ft [f] @ | $10 | = | $41,365 [g] | | | | |
| Treatment plant | 0.1558 | mgd (buildout) | | | $2,478,422 [a] | | | | $100,792 /yr [b] |
| Disposal/recharge (buildout) | | | | | $725,701 [b] | | | | |
| Land (buildout) | 6 | ac @ | $67,763 | | $406,579 [b] | | | | |
| Alternative treatment plant: @ | $5.15 /gal. | | $802,440 [c] | | | $51,000 /yr [d] | | | |
| Total | | | | | $4,829,470 | | | | $119,135 /yr |
| Total including contingency @ | 20% | | | | $5,795,364 | | | | |
| Total including engineering, administration @ | 20% | | | | $6,954,437 | | | | |
| Total, including financing and bonding @ | 23% | | | | $8,553,957 | | | | |
| Revised total with alternative treatment plant | | | | | $3,153,488 | | | | $69,343 /yr |
| Total including contingency @ | 20% | | | | $3,784,186 | | | | |
| Total including engineering, administration @ | 20% | | | | $4,541,023 | | | | |
| Total, including financing and bonding @ | 23% | | | | $5,585,458 | | | | |
| On-lot costs | | | | | | | | | |
| Septic tank abandonment | 472 | ea @ | $1,000 | = | $472,000 | | | | |
| Lateral | | | | | | | | | |
| 4 -in. { | 60 | ft ea. | | | | | | | |
| { | 26,820 | ft @ | $15 | = | $402,300 | | | | |
| Future | 8,820 | ft [f] @ | $7 | = | $61,740 | | | | |
| Total on-lot costs | | | | | $936,040 | | | | |
| Total including contingency @ | 20% | | | | $1,123,248 | | | | |
| GRAND TOTAL | | | | | $9,677,205 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $6,708,706 | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area E – West Baywood Park

### E–2 Local collection, treatment, and dispose/recharge

**Adjustment for STEP/STEG – same as E–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 15,990 | ft @ | $19 | = | $303,810 | | | | | |
| 3 –in. | 2,300 | ft @ | $21 | = | $48,300 | | | | | |
| 4 –in. | 640 | ft @ | $22 | = | $14,080 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 18,930 | ft | | | | 18,930 | ft @ | $0.50 | = | $9,465 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 472 | ea @ | $2,000 | = | $944,000 [including house lateral] | | @ | $140 | = | $66,080 /yr |
| Lateral 2 –in. | 21,624 | ft @ | $19 | = | $410,847 Street | | | | | |
| Future tank/pump | 172 | ea @ | $1,000 | = | $172,000 [g] | | @ | $100 [g] | = | $17,200 /yr |
| Future lateral | 4,136 | ft @ | $9 | = | $37,228 [g] | | | | | |
| Septic tank abandonment | | | | | $472,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $1,851,846 | | | | | $28,161 /yr |
| Revised subtotal, STEP/STEG | | | | | $4,254,111 | | | | | $120,906 /yr |
| Less conventional plant + land (not disposal) | | | | | ($2,885,001) | | | | | ($100,792)/yr |
| Less conventional facilities | | | | | ($2,154,809) | | | | | ($18,343)/yr |
| Adjusted total, STEP/STEG | | | | | $4,043,772 | | | | | $120,906 /yr |
| Total including contingency @ | 20% | | | | $4,852,526 | | | | | |
| Total including engineering, administration @ | | 20% | | | $5,823,032 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $7,162,329 | | | | | |

**Adjustment for grinder pumps – same as E–1 unless noted.** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 15,990 | ft @ | $19 | = | $303,810 | | | | | |
| 3 –in. | 2,300 | ft @ | $21 | = | $48,300 | | | | | |
| 4 –in. | 640 | ft @ | $22 | = | $14,080 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 18,930 | ft | | | | 18,930 | ft @ | $0.50 | = | $9,465 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 472 | ea @ | $2,500 | = | $1,180,000 [including house lateral] | | @ | $110 | = | $51,920 /yr |
| Lateral 2 –in. | 21,624 | ft @ | $19 | = | $410,847 [Street] | | | | | |
| Future tank/pump | 172 | ea @ | $1,000 | = | $172,000 [g] | | @ | $75 [g] | = | $12,900 /yr |
| Future lateral | 4,136 | ft @ | $9 | = | $37,228 [g] | | | | | |
| Septic tank abandonment | | | | | $472,000 | | | | | |
| Revised subtotal, grinder | | | | | $2,638,265 | | | | | $74,285 /yr |
| Less conventional facilities | | | | | ($2,154,809) | | | | | ($18,343)/yr |
| Adjusted total, grinder | | | | | $5,312,927 | | | | | |
| Total including contingency @ | 20% | | | | $6,375,512 | | | | | |
| Total including engineering, administration @ | | 20% | | | $7,650,614 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $9,410,256 | | | | | $55,943 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   19 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g Based on present worth of future installations over a 20–year period at 7%.
   For O&M, average cost over a 30–year period.

**Area E – West Baywood Park**

**E–3 Enhance/upgrade existing onsite systems**

**Cost for Alternative E–3 Buildout – same as E–1 unless noted**

| | | Construction | | | | O&M | | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 100% | 472 units @ | $3,000 [a] | = | $1,416,000 | @ | $247 [b] = | $116,726 |
| New | 0% | 0 units @ | $4,400 [a] | = | $0 | @ | $247 [b] = | $0 |
| New to buildout | -- | 172 units [f] @ | $3,920 [a] | = | $674,203 [d] | @ | $169 [b,e] = | $29,066 |
| Total | | | | | $2,090,203 | | | $145,792 |
| Total including contingency @ | | | 20% | | $2,508,244 | | | |
| Total including engineering, administration @ | | | 20% | | $3,009,892 | | | |
| Total, including financing and bonding @ | | | 23% | | $3,702,168 | | | |
| **Maximum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 84% | 396 units @ | $3,000 [a] | = | $1,188,000 | @ | $247 [b] = | $97,931 |
| New [c] | 16% | 76 units @ | $4,400 [a] | = | $334,400 | @ | $247 [b] = | $18,795 |
| New to buildout | -- | 172 units [f] @ | $3,920 [a] | = | $674,203 [d] | @ | $169 [b,e] = | $29,066 |
| | | | | | | | | $145,792 |
| Total | | | | | $2,196,603 | | | |
| Total including contingency @ | | | 20% | | $2,635,924 | | | |
| Total including engineering, administration @ | | | 20% | | $3,163,108 | | | |
| Total, including financing and bonding @ | | | 23% | | $3,890,623 | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)
b. Based on:
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
c. Table 3–1
d. Present worth over first 20 years @ 7%.
e. Average cost over 30 –year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

| Summary, Area F – Cuesta–By–The–Sea –Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| F–1 Conventional (Sheet B) | $6,930,000 | -- | -- | $57,000 | -- | -- | $7,637,000 | -- | -- |
| F–2 Pkg plant } (Sheet | $10,696,000 | -- | -- | $132,000 | -- | -- | $12,334,000 | -- | -- |
| F–2 – alternate } C) | $7,650,000 | -- | -- | $80,000 | -- | -- | $8,643,000 | -- | -- |
| F–2 – sand filter} | -- | $8,553,000 | -- | -- | $141,000 | -- | -- | $10,303,000 | -- |
| F–3 Onsite: min.} (Sheet | $4,295,000 | | | $176,000 | | | $6,479,000 | | |
| F–3 Onsite: max} D) | $4,462,000 | | | $176,000 | | | $6,646,000 | | |
| F–4 Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| F–4 Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area F – Cuesta–By–The–Sea – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| F–1 Conventional (Sheet B) | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| F–2 Pkg plant } (Sheet | $77,640,000 | -- | -- | $827,000 | -- | -- | $87,902,000 | -- | -- |
| F–2 – alternate } C) | $74,594,000 | -- | -- | $775,000 | -- | -- | $84,211,000 | -- | -- |
| F–2 – sand filter} | -- | $8,553,000 | -- | -- | $141,000 | -- | -- | $10,303,000 | -- |
| F–3 Onsite: min.} (Sheet | $71,239,000 | | | $871,000 | | | $82,047,000 | | |
| F–3 Onsite: max} D) | $71,406,000 | | | $871,000 | | | $82,214,000 | | |
| F–4 Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| F–4 Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES

1. Draft Background Report. Estero Area Plan Update. San Luis Obispo County Planning Department. June 1994. Appendix A – Land Use Survey.

2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

## Area F – Cuesta–By–The–Sea

### F–1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 607 | -- | -- | -- | -- | -- | 607 | 0 | 0 |
| No. DUE [a] | 607 | 609 | 913 | | 0 | 0 | 607 | 609 | 913 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 121,400 | 121,800 | 182,600 | | 0 | 0 | 121,400 | 121,800 | 182,600 |
| Peak factor | 4.0 | 4.0 | 4.0 | | 2.0 | 2.0 | 4.0 | 4.0 | 4.0 |
| Peak flow, gpd | 485,600 | 487,200 | 730,400 | | 0 | 0 | 485,600 | 487,200 | 730,400 |

| Costs for common facilities | | | Const. [c] | | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | $179,288 | | | | | | | | $5,146 /yr [j] |
| | LS–2 | | $185,265 | | | | | | | | $5,265 /yr [j] |
| | LS–3 | | $173,312 | | | | | | | | $5,026 /yr [j] |
| Pump stations | PS–1 | | $717,153 | | | | | | | | $15,903 /yr [j] |
| | PS–2 | | $418,339 | | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | $59,763 | | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM–1 | 6 in. | 580 | ft @ | $30 | = | $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | 1,900 | ft @ | $30 | = | $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | 200 | ft @ | $30 | = | $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | 3,700 | ft @ | $39 | = | $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | 100 | ft @ | $34 | = | $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | 1,600 | ft @ | $49 | = | $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | 6,400 | ft @ | $58 | = | $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | | $1,314,781 | | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | | | | | | | |
| 21 in. | 7,200 | ft @ $58 | $417,600 | | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | $8,623,888 | | | | | | | | $323,000 /yr |
| Headworks | | | $428,858 | | | | | | | | |
| Secondary treatment | | | $2,006,834 | | | | | | | | |
| Tertiary treatment | | | $1,199,977 | | | | | | | | |
| Biosolids handling | | | $1,676,943 | | | | | | | | |
| Effluent pumping station | | | $225,425 | | | | | | | | |
| Ancillary facilities | | | $3,085,851 | | | | | | | | |
| Land | | | $468,638 | 9 | ac @ | $52,071 /ac | | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in. | 24,500 | ft @ $56 | $1,372,000 | | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | $2,666,615 | | | | | | | | $85,000 /yr |
| Land | | | $619,777 | 20 | ac @ | $30,989 /ac | | | | | |

Second stage of plant present worth [i]

--
$445,529
$266,402
$372,291
$50,046
--

$592,004

## Area F – Cuesta-By-The-Sea

### F-1 Conventional project

**Cost for Alternative F-1 Buildout**

| | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | |
| 6 -in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 -in. | 16,780 | ft @ | $27 | = | $453,060 | | | | |
| 10 -in. | 1,300 | ft @ | $29 | = | $37,700 | | | | |
| 12 -in. | 2,340 | ft @ | $34 | = | $79,560 | | | | |
| 15 -in. | 1,400 | ft @ | $39 | = | $54,600 | | | | |
| Dewatering | 21,820 | ft @ | $19 | = | $414,580 | | | | |
| Manholes | 90 | @ | $1,750 | = | $157,500 | | | | |
| Pressure sewer | | | | | | | | | |
| 2 -in. | 3,220 | ft @ | $19 | = | $61,180 | | | | |
| 3 -in. | 0 | ft @ | $21 | = | $0 | | | | |
| 6 -in. | 0 | ft @ | $30 | = | $0 | | | | |
| STEP systems [n] | 48 | @ | $2,000 | = | $96,000 [includes house lateral] | @ | $140 [p] | = | $6,720 /yr |
| Total | 25,040 | ft | | | | 25,040 ft @ | $0.75 | = | $18,780 /yr |
| Y-connection and street lateral | | | | | | | | | |
| 4 -in. { | 40 | ft ea. | | | | | | | |
| { | 24,360 | ft @ | $21 | = | $511,560 [To Stage 1] | | | | |
| Future | 6,085 | ft [k] @ | $10 | = | $60,850 [l] | | | | |
| Common facilities – incremental (avoidable) costs [f,o] | | | | | | | | | |
| FM -1 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| FM -2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| FM -3 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| I-1 | | (portion = | 11.2% ) | | $16,215 | (portion = | 6.6% ) | | $244 /yr |
| I-2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| I-12 | | (portion = | 5.0% ) | | $3,918 | (portion = | 2.9% ) | | $46 /yr |
| I-3 | | (portion = | 3.9% ) | | $14,488 | (portion = | 2.2% ) | | $144 /yr |
| LS -1 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| LS -2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| LS -3 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| PS -1 | | (portion = | 9.7% ) | | $69,652 | (portion = | 15.7% ) | | $2,490 /yr |
| PS -2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| Bayridge Estates STEP | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| Main pumping station (PS-3) | | (portion = | 3.4% ) | | $44,111 | (portion = | 5.5% ) | | $1,799 /yr |
| Interceptor to treatment plant | | (portion = | 4.2% ) | | $17,341 | (portion = | 2.4% ) | | $172 /yr |
| Treatment plant | | | | | | (portion = | 5.9% ) | | $18,989 /yr |
| Headworks | | (portion = | 9.2% ) | | $39,623 | | | | |
| Secondary treatment | | (portion = | 5.9% ) | | $144,176 | | | | |
| Tertiary treatment | | (portion = | 5.9% ) | | $86,209 | | | | |
| Biosolids handling | | (portion = | 9.2% ) | | $189,334 | | | | |
| Effluent pumping station | | (portion = | 9.2% ) | | $25,452 | | | | |
| Ancillary facilities | | (portion = | 7.0% ) | | $216,403 | | | | |
| Land | | (portion = | 7.8% ) | | $36,371 | | | | |
| Effluent force main | | (portion = | 3.6% ) | | $48,982 | (portion = | 2.4% ) | | $587 /yr |
| Disposal/recharge | | (portion = | 8.1% ) | | $285,015 | (portion = | 7.8% ) | | $6,597 /yr |
| Land | | (portion = | 7.8% ) | | $48,100 | | | | |
| Total | | | | | $3,191,980 | | | | $56,568 /yr |
| Total including contingency @ | | 20% | | | $3,830,376 | | | | |
| Total including engineering, administration @ | | | 20% | | $4,596,451 | | | | |
| Total, including financing and bonding @ | | | 23% | | $5,653,635 | | | | |
| On-lot costs | | | | | | | | | |
| Septic tank abandonment | | 607 | ea @ [e] | $1,000 = | $607,000 | | | | |
| House lateral | | | | | | | | | |
| 4 -in. { | 50 | ft ea. | | | | | | | |
| { | 27,950 | ft @ | $15 | = | $419,250 | | | | |
| Future | 5,306 | ft [k] @ | $7 | = | $37,144 [l] | | | | |
| Total on-lot costs | | | | | $1,063,394 | | | | |
| Total including contingency @ | 20% | | | | $1,276,073 | | | | |
| GRAND TOTAL | | | | | $6,929,707 | | | | |

Area F – Cuesta-By-The-Sea

F-1 Conventional project

**Adjustment for STEP/STEG** NOT USED

| | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | |
| 2 -in. [m] | 20,000 | ft @ | $19 [k] | = | $380,000 | | | | |
| 3 -in. [m] | 2,340 | ft @ | $21 [k] | = | $49,140 | | | | |
| 4 -in. [m] | 1,400 | ft @ | $22 [k] | = | $30,800 | | | | |
| 6 -in. | 0 | ft @ | $30 [k] | = | $0 | | | | |
| 8 -in. | | ft @ | $35 [k] | = | $0 | | | | |
| 10 -in. | | ft @ | $40 [k] | = | $0 | | | | |
| 12 -in. | | ft @ | $45 [k] | = | $0 | | | | |
| Total | 23,740 | ft | | | | 23,740 | ft @ | $0.50 = | $11,870 /yr |
| On-lot costs | | | | | | | | | |
| New tank/pump | | 607 | ea [k] @ | $2,000 = | $1,214,000 [Including house lateral] | | @ | $140 [p] = | $84,980 /yr |
| Lateral 2 -in. | | 24,360 | ft @ | $19 = | $462,840 [Street] | | | | |
| Future tank/pump | | 154 | ea @ | $1,000 = | $154,125 [l] | | @ | $100 [p,l] = | $15,413 /yr |
| Future lateral | | 6,085 | ft @ | $9 = | $54,765 [l] | | | | |
| Septic tank abandonment | | | | | $607,000 | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($153,143) | | | | ($5,137) /yr |
| Revised subtotal, STEP/STEG | | | | | $2,799,527 | | | | $107,125 /yr |
| Less conventional facilities (sewers, laterals) | | | | | ($2,989,984) | | | | ($25,500) /yr |
| Adjusted total, STEP/STEG | | | | | $3,001,523 | | | | $138,193 /yr |
| Total including contingency @ | | 20% | | | $3,601,828 | | | | |
| Total including engineering, administration @ | | | 20% | | $4,322,193 | | | | |
| Total, including financing and bonding @ | | | 23% | | $5,316,298 | | | | |

**Adjustment for grinder pumps** NOT USED

| | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | |
| 2 -in. | 20,000 | ft @ | $19 [k] | = | $380,000 | | | | |
| 3 -in. | 2,340 | ft @ | $21 [k] | = | $49,140 | | | | |
| 4 -in. | 1,400 | ft @ | $22 [k] | = | $30,800 | | | | |
| 6 -in. | | ft @ | $30 [k] | = | $0 | | | | |
| 8 -in. | | ft @ | $35 [k] | = | $0 | | | | |
| 10 -in. | | ft @ | $40 [k] | = | $0 | | | | |
| 12 -in. | | ft @ | $45 [k] | = | $0 | | | | |
| Total | 23,740 | ft | | | | 23,740 | ft @ | $0.50 = | $11,870 /yr |
| On-lot costs | | | | | | | | | |
| New pump (simplex) | | 607 | ea [k] @ | $2,500 = | $1,517,500 [Including house lateral] | | @ | $110 [q] = | $66,770 /yr |
| Lateral 2 -in. | | 24,360 | ft @ | $19 = | $462,840 [Street] | | | | |
| Future tank/pump | | 154 | ea @ | $1,000 = | $154,125 [l] | | @ | $75 [q,l] = | $11,559 /yr |
| Future lateral | | 6,085 | ft @ | $9 = | $54,765 [l] | | | | |
| Septic tank abandonment | | | | | $607,000 | | | | |
| Revised subtotal, grinder | | | | | $3,256,170 | | | | $90,199 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | ($2,989,984) | | | | ($25,500)/yr |
| Adjusted total, grinder | | | | | $3,458,166 | | | | $121,267 /yr |
| Total including contingency @ | | 20% | | | $4,149,799 | | | | |
| Total including engineering, administration @ | | | 20% | | $4,979,759 | | | | |
| Total, including financing and bonding @ | | | 23% | | $6,125,104 | | | | |

## Area F – Cuesta-By-The-Sea

### F-1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3-2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .

d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendic D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.6 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.

h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20-year period at 7%.
For O&M, average cost over a 30-year period.
m. Assume: 2-in. pipeline substitutes for 6- and 8-in. gravity sewer.
3-in. pipeline substitutes for 10-in. gravity sewer.
4-in. pipeline substitutes for 12-in. and greater gravity sewer.
n. Takeoffs from 200-scale drawings [2].
o. Flow portions:

| | |
|---|---|
| FM -1 | 0.0% |
| FM -2 | 0.0% |
| FM -3 | 0.0% |
| I-1 | 28.9% |
| I-2 | 0.0% |
| I-12 | 13.6% |
| I-3 | 10.8% |
| LS -1 | 0.0% |
| LS -2 | 0.0% |
| LS -3 | 0.0% |
| PS -1 | 28.9% |
| PS -2 | 0.0% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS-3) | 10.8% |
| Force main to treatment plant | 11.4% |
| Treatment plant | 11.4% |
| Headworks | 11.4% |
| Secondary treatment | 11.4% |
| Tertiary treatment | 11.4% |
| Biosolids handling | 11.4% |
| Effluent pumping station | 11.4% |
| Ancillary facilities | 11.4% |
| Land | |
| Effluent force main | 11.4% |
| Disposal/recharge | 11.4% |
| Land | 11.4% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area F – Cuesta-By-The-Sea**

**F-2 Local collection, treatment, and dispose/recharge**

**Cost for Alternative F-2 Buildout – same as F-1 unless noted**

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 -in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 -in. | 16,780 | ft @ | $27 | = | $453,060 | | | | |
| 10 -in. | 1,300 | ft @ | $29 | = | $37,700 | | | | |
| 12 -in. | 2,340 | ft @ | $34 | = | $79,560 | | | | |
| 15 -in. | 1,400 | ft @ | $39 | = | $54,600 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 90 | @ | $1,500 | = | $135,000 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 -in. | 3,220 | ft @ | $19 | = | $61,180 | | | | |
| 3 -in. | 0 | ft @ | $21 | = | $0 | | | | |
| STEP systems | 48 | @ | $2,000 | = | $96,000 | @ | $140 | = | $6,720 /yr |
| Total | 21,820 | ft | | | | @ | $0.75 | = | $16,365 /yr |
| Y-connection; street lateral | | | | | | | | | |
| 4 -in. { | 40 | ft ea. | | | | | | | |
| { | 24,360 | ft @ | $21 | = | $511,560 | | | | |
| Future | 6,085 | ft [f] @ | $10 | = | $60,850 [g] | | | | |
| Treatment plant | 0.1826 | mgd (buildout) | | | $2,613,718 [a] | | | | $109,117 /yr [b] |
| Disposal/recharge (buildout) | | | | | $810,981 [b] | | | | |
| Land (buildout) | 7 | ac @ | $61,302 | | $429,117 [b] | | | | |
| Alternative treatment plant: @ $4.90 /gal, | | | | | $894,141 [c] | | | | $57,000 /yr [d] |
| Total | | | | | $5,343,327 | | | | $132,202 /yr |
| Total including contingency @ 20% | | | | | $6,411,992 | | | | |
| Total including engineering, administration @ 20% | | | | | $7,694,391 | | | | |
| Total, including financing and bonding @ 23% | | | | | $9,464,101 | | | | |
| Revised total with alternative treatment plant | | | | | $3,623,750 | | | | $80,085 /yr |
| Total including contingency @ 20% | | | | | $4,348,499 | | | | |
| Total including engineering, administration @ 20% | | | | | $5,218,199 | | | | |
| Total, including financing and bonding @ 23% | | | | | $6,418,385 | | | | |
| On-lot costs | | | | | | | | | |
| Septic tank abandonment | 607 | ea @ | $1,000 | = | $607,000 | | | | |
| Lateral | | | | | | | | | |
| 4 -in. { | 50 | ft ea. | | | | | | | |
| { | 27,950 | ft @ | $15 | = | $419,250 | | | | |
| Future | 5,306 | ft [f] @ | $7 | = | $37,144 [g] | | | | |
| Total on-lot costs | | | | | $1,026,250 | | | | |
| Total including contingency @ 20% | | | | | $1,231,500 | | | | |
| GRAND TOTAL | | | | | $10,695,601 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $7,649,885 | | | | |

**Area F – Cuesta-By-The-Sea**

**F-2 Local collection, treatment, and dispose/recharge**

**Adjustment for STEP/STEG – same as F-1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 -in. | 16,780 | ft @ | $19 | = | $318,820 | | | | | |
| 3 -in. | 1,300 | ft @ | $21 | = | $27,300 | | | | | |
| 4 -in. | 2,340 | ft @ | $22 | = | $51,480 | | | | | |
| 6 -in. | | ft @ | $30 | = | $0 | | | | | |
| 8 -in. | | ft @ | $35 | = | $0 | | | | | |
| 10 -in. | | ft @ | $40 | = | $0 | | | | | |
| 12 -in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 20,420 | ft | | | | 20,420 | ft @ | $0.50 | = | $10,210 /yr |
| On-lot costs | | | | | | | | | | |
| New tank/pump | | 607 | ea @ | $2,000 = | $1,214,000 [Including house lateral] | | @ | $140 | = | $84,980 /yr |
| Lateral 2 -in. | | 24,360 | ft @ | $19 = | $462,840 Street | | | | | |
| Future tank/pump | | 154 | ea @ | $1,000 = | $154,125 [g] | | @ | $100 [g] | = | $15,413 /yr |
| Future lateral | | 6,085 | ft @ | $9 = | $54,765 [g] | | | | | |
| Septic tank abandonment | | | | | $607,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $2,153,773 | | | | | $30,016 /yr |
| Revised subtotal, STEP/STEG | | | | | $5,044,103 | | | | | $140,619 /yr |
| Less conventional plant + land (not disposal) | | | | | ($3,042,836) | | | | | ($109,117)/yr |
| Less conventional facilities | | | | | ($2,515,760) | | | | | ($23,085)/yr |
| Adjusted total, STEP/STEG | | | | | $4,828,834 | | | | | $140,619 /yr |
| Total including contingency @ | | 20% | | | $5,794,601 | | | | | |
| Total including engineering, administration @ | | | 20% | | $6,953,521 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $8,552,831 | | | | | |

**Adjustment for grinder pumps – same as F-1 unless noted.**

**NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 -in. | 16,780 | ft @ | $19 | = | $318,820 | | | | | |
| 3 -in. | 1,300 | ft @ | $21 | = | $27,300 | | | | | |
| 4 -in. | 2,340 | ft @ | $22 | = | $51,480 | | | | | |
| 6 -in. | | ft @ | $30 | = | $0 | | | | | |
| 8 -in. | | ft @ | $35 | = | $0 | | | | | |
| 10 -in. | | ft @ | $40 | = | $0 | | | | | |
| 12 -in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 20,420 | ft | | | | 20,420 | ft @ | $0.50 | = | $10,210 /yr |
| On-lot costs | | | | | | | | | | |
| New pump (simplex) | | 607 | ea @ | $2,500 = | $1,517,500 [Including house lateral] | | @ | $110 | = | $66,770 /yr |
| Lateral 2 -in. | | 24,360 | ft @ | $19 = | $462,840 [Street] | | | | | |
| Future tank/pump | | 154 | ea @ | $1,000 = | $154,125 [g] | | @ | $75 [g] | = | $11,559 /yr |
| Future lateral | | 6,085 | ft @ | $9 = | $54,765 [g] | | | | | |
| Septic tank abandonment | | | | | $607,000 | | | | | |
| Revised subtotal, grinder | | | | | $3,193,830 | | | | | $88,539 /yr |
| Less conventional facilities | | | | | ($2,515,760) | | | | | ($23,085)/yr |
| Adjusted total, grinder | | | | | $6,021,397 | | | | | |
| Total including contingency @ | | 20% | | | $7,225,676 | | | | | |
| Total including engineering, administration @ | | | 20% | | $8,670,812 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $10,665,098 | | | | | $65,454 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   22 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g Based on present worth of future installations over a 20-year period at 7%. For O&M, average cost over a 30-year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area F – Cuesta–By–The–Sea**

**F–3 Enhance/upgrade existing onsite systems**

Cost for Alternative F–3 Buildout – same as F–1 unless noted

| | | | Construction | | | O&M | | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 100% | 607 units @ | $3,000 [a] = | $1,821,000 | | @ | $247 [b] = | $150,111 |
| New | 0% | 0 units @ | $4,400 [a] = | $0 | | @ | $247 [b] = | $0 |
| New to buildout | -- | 154 units [f] @ | $3,920 [a] = | $604,137 [d] | | @ | $169 [b,e] = | $26,045 |
| Total | | | | $2,425,137 | | | | $176,156 |
| Total including contingency @ | | 20% | | $2,910,164 | | | | |
| Total including engineering, administration @ | | | 20% | $3,492,197 | | | | |
| Total, including financing and bonding @ | | | 23% | $4,295,402 | | | | |
| **Maximum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 89% | 540 units @ | $3,000 [a] = | $1,620,000 | | @ | $247 [b] = | $133,542 |
| New [c] | 11% | 67 units @ | $4,400 [a] = | $294,800 | | @ | $247 [b] = | $16,569 |
| New to buildout | -- | 154 units [f] @ | $3,920 [a] = | $604,137 [d] | | @ | $169 [b,e] = | $26,045 |
| | | | | | | | | $176,156 |
| Total | | | | $2,518,937 | | | | |
| Total including contingency @ | | 20% | | $3,022,724 | | | | |
| Total including engineering, administration @ | | | 20% | $3,627,269 | | | | |
| Total, including financing and bonding @ | | | 23% | $4,461,541 | | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)
b. Based on:
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
c. Table 3–1
d. Present worth over first 20 years @ 7%.
e. Average cost over 30 –year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

| Summary, Area G – Sunset Terrace – Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| G–1 Conventional (Sheet B | $2,361,000 | -- | -- | $20,000 | -- | -- | $2,609,000 | -- | -- |
| G–2Pkg plant } (Sheet | $5,169,000 | -- | -- | $63,000 | -- | -- | $5,951,000 | -- | -- |
| G–2– alternate } C) | $2,855,000 | -- | -- | $28,000 | -- | -- | $3,202,000 | -- | -- |
| G–2– sand filter} | -- | $2,681,000 | -- | -- | $50,000 | -- | -- | $3,301,000 | -- |
| G–3Onsite: min.} (Sheet | $1,324,000 | | | $55,000 | | | $2,006,000 | | |
| G–3Onsite: max} D) | $1,371,000 | | | $55,000 | | | $2,053,000 | | |
| G–4Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| G–4Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area G – Sunset Terrace – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| G–1 Conventional (Sheet B | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| G–2Pkg plant } (Sheet | $76,682,000 | -- | -- | $795,000 | -- | -- | $86,547,000 | -- | -- |
| G–2– alternate } C) | $74,368,000 | -- | -- | $760,000 | | -- | $83,799,000 | -- | -- |
| G–2– sand filter} | -- | $2,681,000 | -- | -- | $50,000 | -- | -- | $3,301,000 | -- |
| G–3Onsite: min.} (Sheet | $72,837,000 | | | $787,000 | | | $82,603,000 | | |
| G–3Onsite: max} D) | $72,884,000 | | | $787,000 | | | $82,650,000 | | |
| G–4Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| G–4Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES

1. Draft Background Report. Estero Area Plan Update. San Luis Obispo County Planning Department. June 1994. Appendix A – Land Use Survey.

2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study. CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater TreatmentPlants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

## Area G – Sunset Terrace

### G–1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 193 | -- | -- | -- | -- | -- | 193 | 0 | 0 |
| No. DUE [a] | 193 | 222 | 236 | | 0 | 0 | 193 | 222 | 236 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 38,600 | 44,400 | 47,200 | | 0 | 0 | 38,600 | 44,400 | 47,200 |
| Peak factor | 4.0 | 4.0 | 4.0 | | 2.0 | 2.0 | 4.0 | 4.0 | 4.0 |
| Peak flow, gpd | 154,400 | 177,600 | 188,800 | | 0 | 0 | 154,400 | 177,600 | 188,800 |

| Costs for common facilities | | | | Const. [c] | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | | $179,288 | | | | | | | $5,146 /yr [j] |
| | LS–2 | | | $185,265 | | | | | | | $5,265 /yr [j] |
| | LS–3 | | | $173,312 | | | | | | | $5,026 /yr [j] |
| Pump stations | PS–1 | | | $717,153 | | | | | | | $15,903 /yr [j] |
| | PS–2 | | | $418,339 | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | | $59,763 | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM–1 | 6 in. | | 580 | ft @ | $30 | = $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | | 1,900 | ft @ | $30 | = $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | | 200 | ft @ | $30 | = $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | | 3,700 | ft @ | $39 | = $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | | 100 | ft @ | $34 | = $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | | 1,600 | ft @ | $49 | = $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | | 6,400 | ft @ | $58 | = $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | | | $1,314,781 | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | | | | | | | |
| 21 in., 7,200 ft @ | | | $58 | $417,600 | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | | $8,623,888 | | | | | | | $323,000 /yr |
| Headworks | | | | $426,858 | | | | | | | |
| Secondary treatment | | | | $2,006,834 | | | | | | | |
| Tertiary treatment | | | | $1,199,977 | | | | | | | |
| Biosolids handling | | | | $1,676,943 | | | | | | | |
| Effluent pumping station | | | | $225,425 | | | | | | | |
| Ancillary facilities | | | | $3,085,851 | | | | | | | |
| Land | | | | $468,638 | 9 | ac @ | $52,071 /ac | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in., 24,500 ft @ | | | $56 | $1,372,000 | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | | $2,666,615 | | | | | | | $85,000 /yr |
| Land | | | | $619,777 | 20 | ac @ | $30,989 /ac | | | | |

Second stage of plant present worth [i]

--
$445,529
$266,402
$372,291
$50,046
--

$592,004

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area G – Sunset Terrace

### G–1 Conventional project

**Cost for Alternative G–1 Buildout**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | | |
| 8 –in. | 8,620 | ft @ | $27 | = | $232,740 | | | | | |
| 10 –in. | 760 | ft @ | $29 | = | $22,040 | | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | | |
| Dewatering | 9,380 | ft @ | $19 | = | $178,220 | | | | | |
| Manholes | 33 | @ | $1,750 | = | $57,750 | | | | | |
| Pressure sewer | | | | | | | | | | |
| 2 –in. | 0 | ft @ | $19 | = | $0 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 6 –in. | 0 | ft @ | $30 | = | $0 | | | | | |
| STEP systems [n] | 0 | @ | $2,000 | = | $0 [Includes house lateral] | @ | $140 [p] | = | $0 /yr | |
| Total | 9,380 | ft | | | | 9,380 | ft @ | $0.75 | = | $7,035 /yr |
| Y–connection and street lateral | | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | | |
| { | 5,920 | ft @ | $21 | = | $124,320 [To Stage 1] | | | | | |
| Future | 483 | ft [k] @ | $10 | = | $4,825 [l] | | | | | |
| Common facilities – incremental (avoidable) costs [f,o] | | | | | | | | | | |
| FM –1 | (portion = | 100.0%) | | | $17,400 | (portion = | 100.0%) | | | $435 /yr |
| FM –2 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| FM –3 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| I–1 | (portion = | 2.7%) | | | $3,869 | (portion = | 1.5%) | | | $57 /yr |
| I–2 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| I–12 | (portion = | 1.2%) | | | $979 | (portion = | 0.7%) | | | $11 /yr |
| I–3 | (portion = | 1.0%) | | | $3,649 | (portion = | 0.6%) | | | $36 /yr |
| LS –1 | (portion = | 100.0%) | | | $179,288 | (portion = | 100.0%) | | | $5,146 /yr |
| LS –2 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| LS –3 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| PS –1 | (portion = | 2.3%) | | | $16,514 | (portion = | 3.8%) | | | $606 /yr |
| PS –2 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| Bayridge Estates STEP | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| Main pumping station (PS–3) | (portion = | 0.8%) | | | $11,087 | (portion = | 1.4%) | | | $456 /yr |
| Interceptor to treatment plant | (portion = | 1.0%) | | | $4,354 | (portion = | 0.6%) | | | $43 /yr |
| Treatment plant | | | | | | (portion = | 1.5%) | | | $4,800 /yr |
| Headworks | (portion = | 2.4%) | | | $10,151 | | | | | |
| Secondary treatment | (portion = | 1.5%) | | | $36,443 | | | | | |
| Tertiary treatment | (portion = | 1.5%) | | | $21,791 | | | | | |
| Biosolids handling | (portion = | 2.4%) | | | $48,506 | | | | | |
| Effluent pumping station | (portion = | 2.4%) | | | $6,521 | | | | | |
| Ancillary facilities | (portion = | 1.8%) | | | $54,946 | | | | | |
| Land | (portion = | 2.0%) | | | $9,262 | | | | | |
| Effluent force main | (portion = | 0.9%) | | | $12,270 | (portion = | 0.6%) | | | $146 /yr |
| Disposal/recharge | (portion = | 2.1%) | | | $67,592 | (portion = | 2.0%) | | | $1,680 /yr |
| Land | (portion = | 2.0%) | | | $12,250 | | | | | |
| Total | | | | | $1,136,769 | | | | | $20,451 /yr |
| Total including contingency @ | | 20% | | | $1,364,123 | | | | | |
| Total including engineering, administration @ | | | 20% | | $1,636,947 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $2,013,445 | | | | | |
| On–lot costs | | | | | | | | | | |
| Septic tank abandonment | | 193 | ea @ [e] | $1,000 = | $193,000 | | | | | |
| House lateral | | | | | | | | | | |
| 4 –in. { | 45 | ft ea. | | | | | | | | |
| { | 5,790 | ft @ | $15 | = | $86,850 | | | | | |
| Future | 1,413 | ft [k] @ | $7 | = | $9,890 [l] | | | | | |
| Total on–lot costs | | | | | $289,740 | | | | | |
| Total including contingency @ | 20% | | | | $347,688 | | | | | |
| GRAND TOTAL | | | | | $2,361,133 | | | | | |

## Area G – Sunset Terrace

### G–1 Conventional project

**Adjustment for STEP/STEG** NOT USED

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. [m] | 8,620 | ft @ | $19 [k] | = | $163,780 | | | | | |
| 3 –in. [m] | 0 | ft @ | $21 [k] | = | $0 | | | | | |
| 4 –in. [m] | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | 0 | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 8,620 | ft | | | | 8,620 | ft @ | $0.50 | = | $4,310 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 193 | ea [k] @ | $2,000 | = | $386,000 [Including house lateral] | | @ | $140 [p] | = | $27,020 /yr |
| Lateral 2 –in. | 5,920 | ft @ | $19 | = | $112,480 [Street] | | | | | |
| Future tank/pump | 9 | ea @ | $1,000 | = | $9,000 [l] | | @ | $100 [p,l] | = | $900 /yr |
| Future lateral | 483 | ft @ | $9 | = | $4,343 [l] | | | | | |
| Septic tank abandonment | | | | | $193,000 | | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($39,069) | | | | | ($1,295) /yr |
| Revised subtotal, STEP/STEG | | | | | $829,533 | | | | | $30,935 /yr |
| Less conventional facilities (sewers, laterals) | | | | | ($909,635) | | | | | ($7,035) /yr |
| Adjusted total, STEP/STEG | | | | | $1,056,868 | | | | | $44,351 /yr |
| Total including contingency @ | 20% | | | | $1,268,001 | | | | | |
| Total including engineering, administration @ | | 20% | | | $1,521,601 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $1,871,570 | | | | | |

**Adjustment for grinder pumps** NOT USED

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 8,620 | ft @ | $19 [k] | = | $163,780 | | | | | |
| 3 –in. | 0 | ft @ | $21 [k] | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 8,620 | ft | | | | 8,620 | ft @ | $0.50 | = | $4,310 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 193 | ea [k] @ | $2,500 | = | $482,500 [Including house lateral] | | @ | $110 [q] | = | $21,230 /yr |
| Lateral 2 –in. | 5,920 | ft @ | $19 | = | $112,480 [Street] | | | | | |
| Future tank/pump | 9 | ea @ | $1,000 | = | $9,000 [l] | | @ | $75 [q,l] | = | $675 /yr |
| Future lateral | 483 | ft @ | $9 | = | $4,343 [l] | | | | | |
| Septic tank abandonment | | | | | $193,000 | | | | | |
| Revised subtotal, grinder | | | | | $965,103 | | | | | $26,215 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | ($909,635) | | | | | ($7,035)/yr |
| Adjusted total, grinder | | | | | $1,192,237 | | | | | $39,631 /yr |
| Total including contingency @ | 20% | | | | $1,430,684 | | | | | |
| Total including engineering, administration @ | | 20% | | | $1,716,821 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $2,111,690 | | | | | |

## Area G – Sunset Terrace

### G–1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .

d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.6 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.

h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in. gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawings [2].
o. Flow portions:

| | |
|---|---|
| FM –1 | 100.0% |
| FM –2 | 0.0% |
| FM –3 | 0.0% |
| I–1 | 7.5% |
| I–2 | 0.0% |
| I–12 | 3.5% |
| I–3 | 2.8% |
| LS –1 | 100.0% |
| LS –2 | 0.0% |
| LS –3 | 0.0% |
| PS –1 | 7.5% |
| PS –2 | 0.0% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS–3) | 2.8% |
| Force main to treatment plant | 3.0% |
| Treatment plant | 3.0% |
| Headworks | 3.0% |
| Secondary treatment | 3.0% |
| Tertiary treatment | 3.0% |
| Biosolids handling | 3.0% |
| Effluent pumping station | 3.0% |
| Ancillary facilities | 3.0% |
| Land | |
| Effluent force main | 3.0% |
| Disposal/recharge | 3.0% |
| Land | 3.0% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area G – Sunset Terrace

### G-2 Local collection, treatment, and dispose/recharge

Cost for Alternative G-2 Buildout – same as G-1 unless noted

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 -in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 -in. | 8,620 | ft @ | $27 | = | $232,740 | | | | |
| 10 -in. | 760 | ft @ | $29 | = | $22,040 | | | | |
| 12 -in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 -in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 33 | @ | $1,500 | = | $49,500 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 -in. | 0 | ft @ | $19 | = | $0 | | | | |
| 3 -in. | 0 | ft @ | $21 | = | $0 | | | | |
| STEP systems | 0 | @ | $2,000 | = | $0 | @ | $140 | = | $0 /yr |
| Total | 9,380 | ft | | | | @ | $0.75 | = | $7,035 /yr |
| Y-connection; street lateral | | | | | | | | | |
| 4 -in. { | 40 | ft ea. | | | | | | | |
| { | 5,920 | ft @ | $21 | = | $124,320 | | | | |
| Future | 483 | ft [f] @ | $10 | = | $4,825 [g] | | | | |
| Treatment plant | 0.0472 mgd (buildout) | | | | $1,661,516 [a] | | | | $55,477 /yr [b] |
| Disposal/recharge (buildout) | | | | | $314,572 [b] | | | | |
| Land (buildout) | 3 ac @ | | $106,332 | | $318,995 [b] | | | | |
| Alternative treatment plant: @ | $7.53 /gal, | | $355,513 [c] | | | $21,000 /yr [d] | | | |
| Total | | | | | $2,728,508 | | | | $82,512 /yr |
| Total including contingency @ | | 20% | | | $3,274,210 | | | | |
| Total including engineering, administration @ | | | 20% | | $3,929,052 | | | | |
| Total, including financing and bonding @ | | | 23% | | $4,832,734 | | | | |
| Revised total with alternative treatment plant | | | | | $1,422,505 | | | | $28,035 /yr |
| Total including contingency @ | | 20% | | | $1,707,006 | | | | |
| Total including engineering, administration @ | | | 20% | | $2,048,407 | | | | |
| Total, including financing and bonding @ | | | 23% | | $2,519,540 | | | | |
| On-lot costs | | | | | | | | | |
| Septic tank abandonment | 193 ea @ | | $1,000 = | | $193,000 | | | | |
| Lateral | | | | | | | | | |
| 4 -in. { | 45 | ft ea. | | | | | | | |
| { | 5,790 | ft @ | $15 | = | $86,850 | | | | |
| Future | 1,413 | ft [f] @ | $7 | = | $9,890 [g] | | | | |
| Total on-lot costs | | | | | $279,850 | | | | |
| Total including contingency @ | 20% | | | | $335,820 | | | | |
| GRAND TOTAL | | | | | $5,168,554 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $2,855,360 | | | | |

**Area G – Sunset Terrace**

**G–2 Local collection, treatment, and dispose/recharge**

**Adjustment for STEP/STEG – same as G–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 8,620 | ft @ | $19 | = | $163,780 | | | | | |
| 3 –in. | 760 | ft @ | $21 | = | $15,960 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 9,380 | ft | | | | 9,380 | ft @ | $0.50 | = | $4,690 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 193 | ea @ | $2,000 | = | $386,000 [Including house lateral] | @ | $140 | = | | $27,020 /yr |
| Lateral 2 –in. | 5,920 | ft @ | $19 | = | $112,480 Street | | | | | |
| Future tank/pump | 9 | ea @ | $1,000 | = | $9,000 [g] | @ | $100 [g] | = | | $900 /yr |
| Future lateral | 483 | ft @ | $9 | = | $4,343 [g] | | | | | |
| Septic tank abandonment | | | | | $193,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $594,512 | | | | | $17,496 /yr |
| Revised subtotal, STEP/STEG | | | | | $1,479,074 | | | | | $50,106 /yr |
| Less conventional plant + land (not disposal) | | | | | ($1,980,512) | | | | | ($55,477)/yr |
| Less conventional facilities | | | | | ($713,275) | | | | | ($7,035)/yr |
| Adjusted total, STEP/STEG | | | | | $1,513,796 | | | | | $50,106 /yr |
| Total including contingency @ | 20% | | | | $1,816,555 | | | | | |
| Total including engineering, administration @ | | 20% | | | $2,179,866 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $2,681,236 | | | | | |

**Adjustment for grinder pumps – same as G–1 unless noted.** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 8,620 | ft @ | $19 | = | $163,780 | | | | | |
| 3 –in. | 760 | ft @ | $21 | = | $15,960 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 9,380 | ft | | | | 9,380 | ft @ | $0.50 | = | $4,690 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 193 | ea @ | $2,500 | = | $482,500 [Including house lateral] | @ | $110 | = | | $21,230 /yr |
| Lateral 2 –in. | 5,920 | ft @ | $19 | = | $112,480 [Street] | | | | | |
| Future tank/pump | 9 | ea @ | $1,000 | = | $9,000 [g] | @ | $75 [g] | = | | $675 /yr |
| Future lateral | 483 | ft @ | $9 | = | $4,343 [g] | | | | | |
| Septic tank abandonment | | | | | $193,000 | | | | | |
| Revised subtotal, grinder | | | | | $981,063 | | | | | $26,595 /yr |
| Less conventional facilities | | | | | ($713,275) | | | | | ($7,035)/yr |
| Adjusted total, grinder | | | | | $2,996,298 | | | | | |
| Total including contingency @ | 20% | | | | $3,595,555 | | | | | |
| Total including engineering, administration @ | | 20% | | | $4,314,666 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $5,307,039 | | | | | $19,560 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   8 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g. Based on present worth of future installations over a 20–year period at 7%. For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area G – Sunset Terrace**

**G–3 Enhance/upgrade existing onsite systems**

Cost for Alternative G–3 Buildout – same as G–1 unless noted

| | | | Construction | | | O&M | | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 100% | 193 units @ | $3,000 [a] | = | $579,000 | @ | $247 [b] | = $47,729 |
| New | 0% | 0 units @ | $4,400 [a] | = | $0 | @ | $247 [b] | = $0 |
| New to buildout | -- | 43 units [f] @ | $3,920 [a] | = | $168,551 [d] | @ | $169 [b,e] | = $7,266 |
| Total | | | | | $747,551 | | | $54,995 |
| Total including contingency @ | | | 20% | | $897,061 | | | |
| Total including engineering, administration @ | | | 20% | | $1,076,473 | | | |
| Total, including financing and bonding @ | | | 23% | | $1,324,062 | | | |
| **Maximum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 90% | 174 units @ | $3,000 [a] | = | $522,000 | @ | $247 [b] | = $43,030 |
| New [c] | 10% | 19 units @ | $4,400 [a] | = | $83,600 | @ | $247 [b] | = $4,699 |
| New to buildout | -- | 43 units [f] @ | $3,920 [a] | = | $168,551 [d] | @ | $169 [b,e] | = $7,266 |
| | | | | | | | | $54,995 |
| Total | | | | | $774,151 | | | |
| Total including contingency @ | | | 20% | | $928,981 | | | |
| Total including engineering, administration @ | | | 20% | | $1,114,777 | | | |
| Total, including financing and bonding @ | | | 23% | | $1,371,176 | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)
b. Based on:
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
c. Table 3–1
d. Present worth over first 20 years @ 7%.
e. Average cost over 30 –year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

| Summary, Area H – Martin Tract – Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| H–1 Conventional (Sheet B | $2,023,000 | -- | -- | $18,000 | -- | -- | $2,246,000 | -- | -- |
| H–2Pkg plant } (Sheet | $6,008,000 | -- | -- | $78,000 | -- | -- | $6,976,000 | -- | -- |
| H–2– alternate } C) | $3,386,000 | -- | -- | $36,000 | -- | -- | $3,833,000 | -- | -- |
| H–2– sand filter} | -- | $3,442,000 | -- | -- | $54,000 | -- | -- | $4,112,000 | -- |
| H–3Onsite: min.} (Sheet | $1,826,000 | | | $50,000 | | | $2,446,000 | | |
| H–3Onsite: max} D) | $1,836,000 | | | $50,000 | | | $2,456,000 | | |
| H–4Nothing: min.} (Sheet | $716,000 | | | $49,000 | | | $1,324,000 | | |
| H–4Nothing: max} E) | $739,000 | | | $49,000 | | | $1,347,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area H – Martin Tract – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| H–1Conventional (Sheet B | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| H–2Pkg plant } (Sheet | $77,859,000 | -- | -- | $812,000 | -- | -- | $87,935,000 | -- | -- |
| H–2– alternate } C) | $75,237,000 | -- | -- | $770,000 | | -- | $84,792,000 | -- | -- |
| H–2– sand filter} | -- | $3,442,000 | -- | -- | $54,000 | -- | -- | $4,112,000 | -- |
| H–3Onsite: min.} (Sheet | $73,677,000 | | | $784,000 | | | $83,406,000 | | |
| H–3Onsite: max} D) | $73,687,000 | | | $784,000 | | | $83,416,000 | | |
| H–4Nothing: min.} (Sheet | $72,567,000 | | | $783,000 | | | $82,283,000 | | |
| H–4Nothing: max} E) | $72,590,000 | | | $783,000 | | | $82,306,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES

1. Draft Background Report. Estero Area Plan Update. San Luis Obispo County Planning Department. June 1994. Appendix A – Land Use Survey.

2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater TreatmentPlants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittant Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

## Area H – Martin Tract

### H-1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 47 | -- | -- | -- | -- | -- | 47 | 0 | 0 |
| No. DUE [a] | 47 | 273 | 409 | | 0 | 0 | 47 | 273 | 409 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 9,400 | 54,600 | 81,800 | | 0 | 0 | 9,400 | 54,600 | 81,800 |
| Peak factor | 4.0 | 4.0 | 4.0 | | 2.0 | 2.0 | 4.0 | 4.0 | 4.0 |
| Peak flow, gpd | 37,600 | 218,400 | 327,200 | | 0 | 0 | 37,600 | 218,400 | 327,200 |

| Costs for common facilities | | | | Const. [c] | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS-1 | | | $179,288 | | | | | | | $5,146 /yr [j] |
| | LS-2 | | | $185,265 | | | | | | | $5,265 /yr [j] |
| | LS-3 | | | $173,312 | | | | | | | $5,026 /yr [j] |
| Pump stations | PS-1 | | | $717,153 | | | | | | | $15,903 /yr [j] |
| | PS-2 | | | $418,339 | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | | $59,763 | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM-1 | 6 in. | | 580 | ft @ | $30 | = $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM-2 | 6 in. | | 1,900 | ft @ | $30 | = $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM-3 | 6 in. | | 200 | ft @ | $30 | = $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I-1 | 15 in. | | 3,700 | ft @ | $39 | = $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I-2 | 12 in. | | 100 | ft @ | $34 | = $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I-12 | 18 in. | | 1,600 | ft @ | $49 | = $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I-3 | 21 in. | | 6,400 | ft @ | $58 | = $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS-3) | | | | $1,314,781 | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | | | | | | | |
| 21 in., 7,200 ft @ | | | $58 | $417,600 | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | | $8,623,888 | | | | | | | $323,000 /yr |
| Headworks | | | | $428,858 | | | | | | | |
| Secondary treatment | | | | $2,006,834 | | | | | | | |
| Tertiary treatment | | | | $1,199,977 | | | | | | | |
| Biosolids handling | | | | $1,676,943 | | | | | | | |
| Effluent pumping station | | | | $225,425 | | | | | | | |
| Ancillary facilities | | | | $3,085,851 | | | | | | | |
| Land | | | | $468,638 | 9 | ac @ | $52,071 /ac | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in., 24,500 ft @ | | | $56 | $1,372,000 | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | | $2,666,615 | | | | | | | $85,000 /yr |
| Land | | | | $619,777 | 20 | ac @ | $30,989 /ac | | | | |

Second stage of plant present worth [i]

| | |
|---|---|
| | -- |
| | $445,529 |
| | $266,402 |
| | $372,291 |
| | $50,046 |
| | -- |
| | $592,004 |

**Area H – Martin Tract**

**H–1 Conventional project**

**Cost for Alternative H–1 Buildout**

| | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 –in. | 5,140 | ft @ | $27 | = | $138,780 | | | | |
| 10 –in. | 1,120 | ft @ | $29 | = | $32,480 | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 | = | $0 | | | | |
| Manholes | 20 | @ | $1,750 | = | $35,000 | | | | |
| Pressure sewer | | | | | | | | | |
| 2 –in. | 0 | ft @ | $19 | = | $0 | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | |
| 6 –in. | 0 | ft @ | $30 | = | $0 | | | | |
| STEP systems [n] | 0 | @ | $2,000 | = | $0 | [Includes house lateral] | @ | $140 [p] = | $0 /yr |
| Total | 6,260 | ft | | | | 6,260 | ft @ | $0.75 = | $4,695 /yr |
| Y–connection and street lateral | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | |
| { | 10,920 | ft @ | $21 | = | $229,320 | [To Stage 1] | | | |
| Future | 40 | ft [k] @ | $10 | = | $400 | [l] | | | |
| Common facilities – incremental (avoidable) costs [f,o] | | | | | | | | | |
| FM –1 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| FM –2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| FM –3 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| I–1 | | (portion = | 4.7% ) | | $6,829 | (portion = | 2.7% ) | | $101 /yr |
| I–2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| I–12 | | (portion = | 2.2% ) | | $1,710 | (portion = | 1.3% ) | | $20 /yr |
| I–3 | | (portion = | 1.7% ) | | $6,361 | (portion = | 1.0% ) | | $63 /yr |
| LS –1 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| LS –2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| LS –3 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| PS –1 | | (portion = | 4.1% ) | | $29,191 | (portion = | 6.7% ) | | $1,064 /yr |
| PS –2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| Bayridge Estates STEP | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| Main pumping station (PS–3) | | (portion = | 1.5% ) | | $19,336 | (portion = | 2.4% ) | | $794 /yr |
| Interceptor to treatment plant | | (portion = | 1.8% ) | | $7,600 | (portion = | 1.0% ) | | $75 /yr |
| Treatment plant | | | | | | (portion = | 2.6% ) | | $8,365 /yr |
| Headworks | | (portion = | 4.1% ) | | $17,632 | | | | |
| Secondary treatment | | (portion = | 2.6% ) | | $63,511 | | | | |
| Tertiary treatment | | (portion = | 2.6% ) | | $37,976 | | | | |
| Biosolids handling | | (portion = | 4.1% ) | | $84,251 | | | | |
| Effluent pumping station | | (portion = | 4.1% ) | | $11,326 | | | | |
| Ancillary facilities | | (portion = | 3.1% ) | | $95,650 | | | | |
| Land | | (portion = | 3.4% ) | | $16,112 | | | | |
| Effuent force main | | (portion = | 1.6% ) | | $21,431 | (portion = | 1.0% ) | | $256 /yr |
| Disposal/recharge | | (portion = | 3.6% ) | | $117,533 | (portion = | 3.4% ) | | $2,922 /yr |
| Land | | (portion = | 3.4% ) | | $21,308 | | | | |
| Total | | | | | $993,737 | | | | $18,355 /yr |
| Total including contingency @ | | 20% | | | $1,192,485 | | | | |
| Total including contingency @ | | | 20% | | $1,430,982 | | | | |
| Total including engineering, administration @ | | | 23% | | $1,760,108 | | | | |
| On–lot costs | | | | | | | | | |
| Septic tank abandonment | | 47 | ea @ [e] | $1,000 = | $47,000 | | | | |
| House lateral | | | | | | | | | |
| 4 –in. { | 75 | ft ea. | | | | | | | |
| { | 3,525 | ft @ | $15 | = | $52,875 | | | | |
| Future | 17,025 | ft [k] @ | $7 | = | $119,175 | [l] | | | |
| Total on–lot costs | | | | | $219,050 | | | | |
| Total including contingency @ | 20% | | | | $262,860 | | | | |
| GRAND TOTAL | | | | | $2,022,968 | | | | |

Area H – Martin Tract

H–1 Conventional project

**Adjustment for STEP/STEG** NOT USED

| | | | | | Construction | | O&M |
|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | |
| 2 –in. [m] | 5,140 | ft @ | $19 [k] | = | $97,660 | | |
| 3 –in. [m] | 0 | ft @ | $21 [k] | = | $0 | | |
| 4 –in. [m] | 0 | ft @ | $22 [k] | = | $0 | | |
| 6 –in. | 0 | ft @ | $30 [k] | = | $0 | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | |
| Total | 5,140 | ft | | | | 5,140 ft @ $0.50 = | $2,570 /yr |
| On–lot costs | | | | | | | |
| New tank/pump | | 47 | ea [k] @ | $2,000 = | $94,000 [Including house lateral] | @ $140 [p] = | $6,580 /yr |
| Lateral 2 –in. | | 10,920 | ft @ | $19 = | $207,480 [Street] | | |
| Future tank/pump | | 227 | ea @ | $1,000 = | $227,000 [i] | @ $100 [p,i] = | $22,700 /yr |
| Future lateral | | 40 | ft @ | $9 = | $360 [i] | | |
| Septic tank abandonment | | | | | $47,000 | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($67,931) | | ($2,258) /yr |
| Revised subtotal, STEP/STEG | | | | | $605,569 | | $29,592 /yr |
| Less conventional facilities (sewers, laterals) | | | | | ($655,030) | | ($4,695) /yr |
| Adjusted total, STEP/STEG | | | | | $944,277 | | $43,252 /yr |
| Total including contingency @ | | 20% | | | $1,133,132 | | |
| Total including engineering, administration @ | | | 20% | | $1,359,758 | | |
| Total, including financing and bonding @ | | | 23% | | $1,672,503 | | |

**Adjustment for grinder pumps** NOT USED

| | | | | | Construction | | O&M |
|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | |
| 2 –in. | 5,140 | ft @ | $19 [k] | = | $97,660 | | |
| 3 –in. | 0 | ft @ | $21 [k] | = | $0 | | |
| 4 –in. | 0 | ft @ | $22 [k] | = | $0 | | |
| 6 –in. | | ft @ | $30 [k] | = | $0 | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | |
| Total | 5,140 | ft | | | | 5,140 ft @ $0.50 = | $2,570 /yr |
| On–lot costs | | | | | | | |
| New pump (simplex) | | 47 | ea [k] @ | $2,500 = | $117,500 [Including house lateral] | @ $110 [q] = | $5,170 /yr |
| Lateral 2 –in. | | 10,920 | ft @ | $19 = | $207,480 [Street] | | |
| Future tank/pump | | 227 | ea @ | $1,000 = | $227,000 [i] | @ $75 [q,i] = | $17,025 /yr |
| Future lateral | | 40 | ft @ | $9 = | $360 [i] | | |
| Septic tank abandonment | | | | | $47,000 | | |
| Revised subtotal, grinder | | | | | $697,000 | | $24,765 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | ($655,030) | | ($4,695)/yr |
| Adjusted total, grinder | | | | | $1,035,707 | | $38,425 /yr |
| Total including contingency @ | | 20% | | | $1,242,849 | | |
| Total including engineering, administration @ | | | 20% | | $1,491,419 | | |
| Total, including financing and bonding @ | | | 23% | | $1,834,445 | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area H – Martin Tract

### H–1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A,B,C,D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .

d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.8 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.

h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in. gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawings [2].
o. Flow portions:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 0.0% |
| FM –3 | 0.0% |
| I–1 | 12.9% |
| I–2 | 0.0% |
| I–12 | 6.1% |
| I–3 | 4.8% |
| LS –1 | 0.0% |
| LS –2 | 0.0% |
| LS –3 | 0.0% |
| PS –1 | 12.9% |
| PS –2 | 0.0% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS–3) | 4.8% |
| Force main to treatment plant | 5.1% |
| Treatment plant | 5.1% |
| Headworks | 5.1% |
| Secondary treatment | 5.1% |
| Tertiary treatment | 5.1% |
| Biosolids handling | 5.1% |
| Effluent pumping station | 5.1% |
| Ancillary facilities | 5.1% |
| Land | |
| Effluent force main | 5.1% |
| Disposal/recharge | 5.1% |
| Land | 5.1% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area H – Martin Tract

### H-2 Local collection, treatment, and dispose/recharge

Cost for Alternative H-2 Buildout – same as H-1 unless noted

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 –in. | 5,140 | ft @ | $27 | = | $138,780 | | | | |
| 10 –in. | 1,120 | ft @ | $29 | = | $32,480 | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 20 | @ | $1,500 | = | $30,000 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 –in. | 0 | ft @ | $19 | = | $0 | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | |
| STEP systems | 0 | @ | $2,000 | = | $0 | @ | $140 | = | $0 /yr |
| Total | 6,260 | ft | | | | @ | $0.75 | = | $4,695 /yr |
| Y–connection; street lateral | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | |
| { | 10,920 | ft @ | $21 | = | $229,320 | | | | |
| Future | 40 ft [f] @ | | $10 | = | $400 [g] | | | | |
| Treatment plant | 0.0818 mgd (buildout) | | | | $1,997,444 [a] | | | | $73,033 /yr [b] |
| Disposal/recharge (buildout) | | | | | $462,261 [b] | | | | |
| Land (buildout) | 4 ac @ | | $88,197 | | $352,787 [b] | | | | |
| Alternative treatment plant: @ | $6.32 /gal, | | $517,199 [c] | | | $31,000 /yr [d] | | | |
| Total | | | | | $3,243,473 | | | | $77,728 /yr |
| Total including contingency @ | | 20% | | | $3,892,168 | | | | |
| Total including engineering, administration @ | | | 20% | | $4,670,601 | | | | |
| Total, including financing and bonding @ | | | 23% | | $5,744,839 | | | | |
| Revised total with alternative treatment plant | | | | | $1,763,228 | | | | $35,695 /yr |
| Total including contingency @ | | 20% | | | $2,115,873 | | | | |
| Total including engineering, administration @ | | | 20% | | $2,539,048 | | | | |
| Total, including financing and bonding @ | | | 23% | | $3,123,029 | | | | |
| On–lot costs | | | | | | | | | |
| Septic tank abandonment | | 47 ea @ | | $1,000 = | $47,000 | | | | |
| Lateral | | | | | | | | | |
| 4 –in. { | 75 | ft ea. | | | | | | | |
| { | 3,525 | ft @ | $15 | = | $52,875 | | | | |
| Future | 17,025 | ft [f] @ | $7 | = | $119,175 [g] | | | | |
| Total on–lot costs | | | | | $219,050 | | | | |
| Total including contingency @ | 20% | | | | $262,860 | | | | |
| GRAND TOTAL | | | | | $6,007,699 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $3,385,889 | | | | |

Area H – Martin Tract

**H–2 Local collection, treatment, and dispose/recharge**

**Adjustment for STEP/STEG – same as H–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 5,140 | ft @ | $19 | = | $97,660 | | | | | |
| 3 –in. | 1,120 | ft @ | $21 | = | $23,520 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 6,260 | ft | | | | 6,260 | ft @ | $0.50 | = | $3,130 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | | 47 | ea @ | $2,000 = | $94,000 | [including house lateral] | @ | $140 | = | $6,580 /yr |
| Lateral 2 –in. | | 10,920 | ft @ | $19 = | $207,480 | Street | | | | |
| Future tank/pump | | 227 | ea @ | $1,000 = | $227,000 | [g] | @ | $100 [g] | = | $22,700 /yr |
| Future lateral | | 40 | ft @ | $9 = | $360 | [g] | | | | |
| Septic tank abandonment | | | | | $47,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $1,003,142 | | | | | $21,767 /yr |
| Revised subtotal, STEP/STEG | | | | | $1,700,162 | | | | | $54,177 /yr |
| Less conventional plant + land (not disposal) | | | | | ($2,350,232) | | | | | ($73,033)/yr |
| Less conventional facilities | | | | | ($650,030) | | | | | ($4,695)/yr |
| Adjusted total, STEP/STEG | | | | | $1,943,374 | | | | | $54,177 /yr |
| Total including contingency @ | | 20% | | | $2,332,049 | | | | | |
| Total including engineering, administration @ | | | 20% | | $2,798,458 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $3,442,104 | | | | | |

**Adjustment for grinder pumps – same as H–1 unless noted.** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 5,140 | ft @ | $19 | = | $97,660 | | | | | |
| 3 –in. | 1,120 | ft @ | $21 | = | $23,520 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 6,260 | ft | | | | 6,260 | ft @ | $0.50 | = | $3,130 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | | 47 | ea @ | $2,500 = | $117,500 | [including house lateral] | @ | $110 | = | $5,170 /yr |
| Lateral 2 –in. | | 10,920 | ft @ | $19 = | $207,480 | [Street] | | | | |
| Future tank/pump | | 227 | ea @ | $1,000 = | $227,000 | [g] | @ | $75 [g] | = | $17,025 /yr |
| Future lateral | | 40 | ft @ | $9 = | $360 | [g] | | | | |
| Septic tank abandonment | | | | | $47,000 | | | | | |
| Revised subtotal, grinder | | | | | $720,520 | | | | | $25,325 /yr |
| Less conventional facilities | | | | | ($650,030) | | | | | ($4,695)/yr |
| Adjusted total, grinder | | | | | $3,313,963 | | | | | |
| Total including contingency @ | | 20% | | | $3,976,756 | | | | | |
| Total including engineering, administration @ | | | 20% | | $4,772,107 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $5,869,691 | | | | | $20,630 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   12 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g Based on present worth of future installations over a 20–year period at 7%. For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area H – Martin Tract**

**H–3 Enhance/upgrade existing onsite systems**

**Cost for Alternative H–3 Buildout – same as H–1 unless noted**

| | | Construction | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | | |
| | % of existing units | | | | | | | | |
| Retrofit | 100% | 47 units @ | $3,000 [a] | = | $141,000 | @ | $247 [b] | = | $11,623 |
| New | 0% | 0 units @ | $4,400 [a] | = | $0 | @ | $247 [b] | = | $0 |
| New to buildout | -- | 227 units [f] @ | $3,920 [a] | = | $889,791 [d] | @ | $169 [b,e] | = | $38,360 |
| Total | | | | | $1,030,791 | | | | $49,983 |
| Total including contingency @ | | 20% | | | $1,236,950 | | | | |
| Total including engineering, administration @ | | | 20% | | $1,484,339 | | | | |
| Total, including financing and bonding @ | | | 23% | | $1,825,737 | | | | |
| **Maximum** | | | | | | | | | |
| | % of existing units | | | | | | | | |
| Retrofit | 92% | 43 units @ | $3,000 [a] | = | $129,000 | @ | $247 [b] | = | $10,634 |
| New [c] | 8% | 4 units @ | $4,400 [a] | = | $17,600 | @ | $247 [b] | = | $989 |
| New to buildout | -- | 227 units [f] @ | $3,920 [a] | = | $889,791 [d] | @ | $169 [b,e] | = | $38,360 |
| Total | | | | | $1,036,391 | | | | $49,983 |
| Total including contingency @ | | 20% | | | $1,243,670 | | | | |
| Total including engineering, administration @ | | | 20% | | $1,492,403 | | | | |
| Total, including financing and bonding @ | | | 23% | | $1,835,656 | | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)

b. Based on:
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh

c. Table 3–1

d. Present worth over first 20 years @ 7%.

e. Average cost over 30 –year period.

f. For cost purposes only, based on 4 multiple family units = 1 DUE.

**Area H – Martin Tract**

**H–4 Retain existing onsite systems**

**Cost for Alternative H–4 Buildout – same as H–1 unless noted**

| | | | Construction | | | | O&M | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Replacement | 0% | 0 units @ | $4,100 [a] | = | $0 | @ | $242 [b] | $0 |
| No replacement | 100% | 47 units @ | $90 [a] | = | $4,230 | @ | $242 [b] | $11,374 |
| New to buildout | -- | 227 units [f] @ | $2,172 [a] | = | $492,992 [d] | @ | $165 [b,e] | $37,538 |
| Total | | | | | $497,222 | | | $48,912 |
| Total including contingency @ | | 20% | | | $596,667 | | | |
| Total including engineering, administration @ | | 20% | | | $716,000 | | | |
| Total, including financing and bonding @ | | 0% | | | $716,000 | | | |
| **Maximum** | | | | | | | | |
| Replacement [c] | 8% | 4 units @ | $4,100 [a] | = | $16,400 | @ | $242 [b] | $968 |
| No replacement | 92% | 43 units @ | $90 [a] | = | $3,870 | @ | $242 [b] | $10,406 |
| New to buildout | -- | 227 units [f] @ | $2,172 [a] | = | $492,992 [d] | @ | $165 [b,e] | $37,538 |
| Total | | | | | $513,262 | | | $48,912 |
| Total including contingency @ | | 20% | | | $615,915 | | | |
| Total including engineering, administration @ | | 20% | | | $739,098 | | | |
| Total, including financing and bonding @ | | 0% | | | $739,098 | | | |

a. Based on complete replacement of septic tank and leach field or pit (Appendix D).
For no replacement, based on initial inspection only (Appendix D).

b. Based on:
4 hr/yr @ $30 /hr (one inspection/year; administration)
2.0% of capital cost
$200 pumping every 5 years.

c. Table 3–1

d. Present worth over first 20 years @ 7% .

e. Average cost over 30 –year period.

f. For cost purposes only, based on 4 multiple family units = 1 DUE.

**LOS OSOS WASTEWATERSTUDY**
Detailed evaluation of alternatives

Sheet A

| Summary, Area I – Redfield Woods/Upland – Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| I–1 Conventional (Sheet B | $8,958,000 | -- | -- | $79,000 | -- | -- | $9,938,000 | -- | -- |
| I–2 Pkg plant } (Sheet | $13,504,000 | -- | -- | $167,000 | -- | -- | $15,576,000 | -- | -- |
| I–2 – alternate } C) | $10,253,000 | -- | -- | $110,000 | -- | -- | $11,618,000 | -- | -- |
| I–2 – sand filter} | -- | $13,763,000 | -- | -- | $225,000 | -- | -- | $16,555,000 | -- |
| I–3 Onsite: min.} (Sheet | $8,997,000 | | | $298,000 | | | $12,695,000 | | |
| I–3 Onsite: max} D) | $9,220,000 | | | $298,000 | | | $12,918,000 | | |
| I–4 Nothing: min.} (Sheet | $2,527,000 | | | $292,000 | | | $6,150,000 | | |
| I–4 Nothing: max} E) | $3,046,000 | | | $292,000 | | | $6,669,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area I – Redfield Woods/Upland – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| I–1 Conventional (Sheet B | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| I–2 Pkg plant } (Sheet | $78,420,000 | -- | -- | $840,000 | -- | -- | $88,844,000 | -- | -- |
| I–2 – alternate } C) | $75,169,000 | -- | -- | $783,000 | -- | -- | $84,885,000 | -- | -- |
| I–2 – sand filter} | -- | $13,763,000 | -- | -- | $225,000 | -- | -- | $16,555,000 | -- |
| I–3 Onsite: min.} (Sheet | $73,913,000 | | | $971,000 | | | $85,962,000 | | |
| I–3 Onsite: max} D) | $74,136,000 | | | $971,000 | | | $86,185,000 | | |
| I–4 Nothing: min.} (Sheet | $67,443,000 | | | $965,000 | | | $79,418,000 | | |
| I–4 Nothing: max} E) | $67,962,000 | | | $965,000 | | | $79,937,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES


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2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater TreatmentPlants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

## Area I – Redfield Woods/Upland

### I–1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 674 | -- | -- | -- | -- | -- | 674 | 0 | 0 |
| No. DUE [a] | 674 | 1,017 | 1,526 | | 0 | 0 | 674 | 1,017 | 1,526 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 134,800 | 203,400 | 305,200 | | 0 | 0 | 134,800 | 203,400 | 305,200 |
| Peak factor | 3.0 | 3.0 | 3.0 | | 2.0 | 2.0 | 3.0 | 3.0 | 3.0 |
| Peak flow, gpd | 404,400 | 610,200 | 915,600 | | 0 | 0 | 404,400 | 610,200 | 915,600 |

| Costs for common facilities | | | Const. [c] | | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | $179,288 | | | | | | | | $5,146 /yr [j] |
| | LS–2 | | $185,265 | | | | | | | | $5,265 /yr [j] |
| | LS–3 | | $173,312 | | | | | | | | $5,026 /yr [j] |
| Pump stations | PS–1 | | $717,153 | | | | | | | | $15,903 /yr [j] |
| | PS–2 | | $418,339 | | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | $59,763 | | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM–1 | 6 in. | 580 | ft @ | $30 | = | $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | 1,900 | ft @ | $30 | = | $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | 200 | ft @ | $30 | = | $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | 3,700 | ft @ | $39 | = | $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | 100 | ft @ | $34 | = | $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | 1,600 | ft @ | $49 | = | $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | 6,400 | ft @ | $58 | = | $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | | $1,314,781 | | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | | | | | | | |
| 21 in., 7,200 ft @ $58 | | | $417,600 | | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | $8,623,888 | | | | | | | | $323,000 /yr |
| Headworks | | | $426,858 | | | | | | | | |
| Secondary treatment | | | $2,006,834 | | | | | | | | |
| Tertiary treatment | | | $1,199,977 | | | | | | | | |
| Biosolids handling | | | $1,676,943 | | | | | | | | |
| Effluent pumping station | | | $225,425 | | | | | | | | |
| Ancillary facilities | | | $3,085,851 | | | | | | | | |
| Land | | | $468,638 | 9 | ac @ | | $52,071 /ac | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in., 24,500 ft @ $58 | | | $1,372,000 | | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | $2,666,615 | | | | | | | | $85,000 /yr |
| Land | | | $619,777 | 20 | ac @ | | $30,989 /ac | | | | |

Second stage of plant present worth [i]

| | |
|---|---|
| | -- |
| | $445,529 |
| | $266,402 |
| | $372,291 |
| | $50,046 |
| | -- |
| | $592,004 |

## Area I – Redfield Woods/Upland

### I–1 Conventional project

**Cost for Alternative I–1 Buildout**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | | |
| 8 –in. | 30,480 | ft @ | $27 | = | $822,960 | | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | | |
| Dewatering – none | 0 | ft @ | $19 | = | $0 | | | | | |
| Manholes | 95 | @ | $1,750 | = | $166,250 | | | | | |
| Pressure sewer | | | | | | | | | | |
| 2 –in. | 860 | ft @ | $19 | = | $16,340 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 6 –in. | 0 | ft @ | $30 | = | $0 | | | | | |
| STEP systems [n] | 19 | @ | $2,000 | = | $38,000 | [Includes house lateral] | @ | $140 [p] | = | $2,660 /yr |
| Total | 31,340 | ft | | | | 31,340 | ft @ | $0.75 | = | $23,505 /yr |
| Y–connection and street lateral | | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | | |
| { | 40,660 | ft @ | $21 | = | $854,280 | [To Stage 1] | | | | |
| Future | 17,480 | ft [k] @ | $10 | = | $174,800 | [l] | | | | |
| Common facilities – incremental (avoidable) costs [f,0] | | | | | | | | | | |
| FM –1 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| FM –2 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| FM –3 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| I–1 | (portion = | 20.6% ) | | | $29,686 | (portion = | 12.3% ) | | | $456 /yr |
| I–2 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| I–12 | (portion = | 8.6% ) | | | $6,776 | (portion = | 5.0% ) | | | $81 /yr |
| I–3 | (portion = | 6.7% ) | | | $24,850 | (portion = | 3.9% ) | | | $248 /yr |
| LS –1 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| LS –2 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| LS –3 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| PS –1 | (portion = | 17.9% ) | | | $128,482 | (portion = | 28.0% ) | | | $4,459 /yr |
| PS –2 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| Bayridge Estates STEP | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| Main pumping station (PS–3) | (portion = | 5.8% ) | | | $75,815 | (portion = | 9.4% ) | | | $3,068 /yr |
| Interceptor to treatment plant | (portion = | 7.1% ) | | | $29,816 | (portion = | 4.1% ) | | | $298 /yr |
| Treatment plant | | | | | | (portion = | 10.0% ) | | | $32,435 /yr |
| Headworks | (portion = | 15.6% ) | | | $86,799 | | | | | |
| Secondary treatment | (portion = | 10.0% ) | | | $246,258 | | | | | |
| Tertiary treatment | (portion = | 10.0% ) | | | $147,249 | | | | | |
| Biosolids handling | (portion = | 15.6% ) | | | $319,186 | | | | | |
| Effluent pumping station | (portion = | 15.6% ) | | | $42,907 | | | | | |
| Ancillary facilities | (portion = | 11.9% ) | | | $368,007 | | | | | |
| Land | (portion = | 13.2% ) | | | $61,671 | | | | | |
| Effluent force main | (portion = | 6.2% ) | | | $84,406 | (portion = | 4.1% ) | | | $1,015 /yr |
| Disposal/recharge | (portion = | 13.8% ) | | | $448,715 | (portion = | 13.2% ) | | | $11,186 /yr |
| Land | (portion = | 13.2% ) | | | $81,560 | | | | | |
| Total | | | | | $4,234,817 | | | | | $79,410 /yr |
| Total including contingency @ | 20% | | | | $5,081,780 | | | | | |
| Total including engineering, administration @ | | 20% | | | $6,098,136 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $7,500,707 | | | | | |
| On–lot costs | | | | | | | | | | |
| Septic tank abandonment | 674 | ea @ [e] | $1,000 = | | $674,000 | | | | | |
| House lateral | | | | | | | | | | |
| 4 –in. { | 55 | ft ea. | | | | | | | | |
| { | 36,025 | ft @ | $15 | = | $540,375 | | | | | |
| Future | 41,855 | ft [k] @ | $7 | = | $292,985 | [l] | | | | |
| Total on–lot costs | | | | | $1,214,375 | | | | | |
| Total including contingency @ | 20% | | | | $1,457,250 | | | | | |
| GRAND TOTAL | | | | | $8,957,957 | | | | | |

## Area I – Redfield Woods/Upland

### I–1 Conventional project

**Adjustment for STEP/STEG** NOT USED

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. [m] | 31,340 | ft @ | $19 [k] | = | $595,460 | | | | | |
| 3 –in. [m] | 0 | ft @ | $21 [k] | = | $0 | | | | | |
| 4 –in. [m] | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | 0 | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 31,340 | ft | | | | 31,340 | ft @ | $0.50 | = | $15,670 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 674 | ea [k] @ | $2,000 | = | $1,348,000 [Including house lateral] | | @ | $140 [p] | = | $94,360 /yr |
| Lateral 2 –in. | 40,680 | ft @ | $19 | = | $772,920 [Street] | | | | | |
| Future tank/pump | 780 | ea @ | $1,000 | = | $780,000 [I] | | @ | $100 [p,I] | = | $78,000 /yr |
| Future lateral | 17,480 | ft @ | $9 | = | $157,320 [I] | | | | | |
| Septic tank abandonment | | | | | $674,000 | | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($259,244) | | | | | ($8,797) /yr |
| Revised subtotal, STEP/STEG | | | | | $4,068,456 | | | | | $179,233 /yr |
| Less conventional facilities (sewers, laterals) | | | | | ($3,287,005) | | | | | ($26,165) /yr |
| Adjusted total, STEP/STEG | | | | | $5,016,268 | | | | | $232,478 /yr |
| Total including contingency @ | 20% | | | | $6,019,522 | | | | | |
| Total including engineering, administration @ | | 20% | | | $7,223,426 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $8,884,814 | | | | | |

**Adjustment for grinder pumps** NOT USED

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 31,340 | ft @ | $19 [k] | = | $595,460 | | | | | |
| 3 –in. | 0 | ft @ | $21 [k] | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 31,340 | ft | | | | 31,340 | ft @ | $0.50 | = | $15,670 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 674 | ea [k] @ | $2,500 | = | $1,685,000 [Including house lateral] | | @ | $110 [q] | = | $74,140 /yr |
| Lateral 2 –in. | 40,680 | ft @ | $19 | = | $772,920 [Street] | | | | | |
| Future tank/pump | 780 | ea @ | $1,000 | = | $780,000 [I] | | @ | $75 [q,I] | = | $58,500 /yr |
| Future lateral | 17,480 | ft @ | $9 | = | $157,320 [I] | | | | | |
| Septic tank abandonment | | | | | $674,000 | | | | | |
| Revised subtotal, grinder | | | | | $4,664,700 | | | | | $148,310 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | ($3,287,005) | | | | | ($26,165)/yr |
| Adjusted total, grinder | | | | | $5,612,512 | | | | | $201,555 /yr |
| Total including contingency @ | 20% | | | | $6,735,014 | | | | | |
| Total including engineering, administration @ | | 20% | | | $8,082,017 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $9,940,881 | | | | | |

## Area I – Redfield Woods/Upland

### I–1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .

d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.6 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.

h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in.gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawings [2].
o. Flow portions:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 0.0% |
| FM –3 | 0.0% |
| I–1 | 48.2% |
| I–2 | 0.0% |
| I–12 | 22.8% |
| I–3 | 18.0% |
| LS –1 | 0.0% |
| LS –2 | 0.0% |
| LS –3 | 0.0% |
| PS –1 | 48.2% |
| PS –2 | 0.0% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS–3) | 18.0% |
| Force main to treatment plant | 19.1% |
| Treatment plant | 19.1% |
| Headworks | 19.1% |
| Secondary treatment | 19.1% |
| Tertiary treatment | 19.1% |
| Biosolids handling | 19.1% |
| Effluent pumping station | 19.1% |
| Ancillary facilities | 19.1% |
| Land | |
| Effluent force main | 19.1% |
| Disposal/recharge | 19.1% |
| Land | 19.1% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling,and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area I – Redfield Woods/Upland

### I–2 Local collection, treatment, and dispose/recharge

Cost for Alternative I–2 Buildout – same as I–1 unless noted

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 –in. | 30,480 | ft @ | $27 | = | $822,960 | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 95 | @ | $1,500 | = | $142,500 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 –in. | 860 | ft @ | $19 | = | $16,340 | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | |
| STEP systems | 19 | @ | $2,000 | = | $38,000 | @ | $140 | = | $2,660 /yr |
| Total | 30,480 | ft | | | | @ | $0.75 | = | $22,860 /yr |
| Y–connection; street lateral | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | |
| { | 40,680 | ft @ | $21 | = | $854,280 | | | | |
| Future | 17,480 | ft [f] @ | $10 | = | $174,800 [g] | | | | |
| Treatment plant | 0.3052 | mgd (buildout) | | | $3,104,289 [a] | | | | $141,070 /yr [b] |
| Disposal/recharge (buildout) | | | | | $1,161,902 [b] | | | | |
| Land (buildout) | 10 | ac @ | $48,617 | | $486,174 [b] | | | | |
| Alternative treatment plant: @ $4.16 /gal, | | | | | $1,269,073 [c] | | | | $84,000 /yr [d] |
| Total | | | | | $6,801,246 | | | | $166,590 /yr |
| Total including contingency @ | | 20% | | | $8,161,495 | | | | |
| Total including engineering, administration @ | | | 20% | | $9,793,794 | | | | |
| Total, including financing and bonding @ | | | 23% | | $12,046,366 | | | | |
| Revised total with alternative treatment plant | | | | | $4,966,029 | | | | $109,520 /yr |
| Total including contingency @ | | 20% | | | $5,959,235 | | | | |
| Total including engineering, administration @ | | | 20% | | $7,151,082 | | | | |
| Total, including financing and bonding @ | | | 23% | | $8,795,831 | | | | |
| On–lot costs | | | | | | | | | |
| Septic tank abandonment | | 674 ea @ | | $1,000 = | $674,000 | | | | |
| Lateral | | | | | | | | | |
| 4 –in. { | 55 | ft ea. | | | | | | | |
| { | 36,025 | ft @ | $15 | = | $540,375 | | | | |
| Future | 41,855 | ft [f] @ | $7 | = | $292,985 [g] | | | | |
| Total on–lot costs | | | | | $1,214,375 | | | | |
| Total including contingency @ | 20% | | | | $1,457,250 | | | | |
| GRAND TOTAL | | | | | $13,503,616 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $10,253,081 | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area I – Redfield Woods/Upland

### I–2 Local collection, treatment, and dispose/recharge

**Adjustment for STEP/STEG – same as I–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 30,480 | ft @ | $19 | = | $579,120 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 30,480 | ft | | | | 30,480 | ft @ | $0.50 | = | $15,240 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | | 674 | ea @ | $2,000 = | $1,348,000 | [Including house lateral] | @ | $140 | = | $94,360 /yr |
| Lateral 2 –in. | | 40,680 | ft @ | $19 = | $772,920 | Street | | | | |
| Future tank/pump | | 780 | ea @ | $1,000 = | $780,000 | [g] | @ | $100 [g] | = | $78,000 /yr |
| Future lateral | | 17,480 | ft @ | $9 = | $157,320 | [g] | | | | |
| Septic tank abandonment | | | | | $674,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $3,511,505 | | | | | $36,940 /yr |
| Revised subtotal, STEP/STEG | | | | | $7,822,865 | | | | | $224,540 /yr |
| Less conventional plant + land (not disposal) | | | | | ($3,590,464) | | | | | ($141,070)/yr |
| Less conventional facilities | | | | | ($3,263,255) | | | | | ($25,520)/yr |
| Adjusted total, STEP/STEG | | | | | $7,770,392 | | | | | $224,540 /yr |
| Total including contingency @ | | 20% | | | $9,324,471 | | | | | |
| Total including engineering, administration @ | | | 20% | | $11,189,365 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $13,762,919 | | | | | |

**Adjustment for grinder pumps – same as I–1 unless noted.** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 30,480 | ft @ | $19 | = | $579,120 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 30,480 | ft | | | | 30,480 | ft @ | $0.50 | = | $15,240 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | | 674 | ea @ | $2,500 = | $1,685,000 | [Including house lateral] | @ | $110 | = | $74,140 /yr |
| Lateral 2 –in. | | 40,680 | ft @ | $19 = | $772,920 | [Street] | | | | |
| Future tank/pump | | 780 | ea @ | $1,000 = | $780,000 | [g] | @ | $75 [g] | = | $58,500 /yr |
| Future lateral | | 17,480 | ft @ | $9 = | $157,320 | [g] | | | | |
| Septic tank abandonment | | | | | $674,000 | | | | | |
| Revised subtotal, grinder | | | | | $4,648,360 | | | | | $147,880 /yr |
| Less conventional facilities | | | | | ($3,263,255) | | | | | ($25,520)/yr |
| Adjusted total, grinder | | | | | $8,186,351 | | | | | |
| Total including contingency @ | | 20% | | | $9,823,621 | | | | | |
| Total including engineering, administration @ | | | 20% | | $11,788,345 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $14,499,664 | | | | | $122,360 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   33 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g Based on present worth of future installations over a 20–year period at 7%.
   For O&M, average cost over a 30–year period.

**Area I – Redfield Woods/Upland**

**I-3 Enhance/upgrade existing onsite systems**

**Cost for Alternative I-3 Buildout – same as I-1 unless noted**

| | | Construction | | | | O&M | | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | % of existing units | | | | | | | |
| Retrofit | 100% | 674 units @ | $3,000 [a] = | $2,022,000 | @ | $247 [b] = | $166,680 |
| New | 0% | 0 units @ | $4,400 [a] = | $0 | @ | $247 [b] = | $0 |
| New to buildout | -- | 780 units [f] @ | $3,920 [a] = | $3,057,433 [d] | @ | $169 [b,e] = | $131,811 |
| Total | | | | $5,079,433 | | | $298,491 |
| Total including contingency @ | | 20% | | $6,095,319 | | | |
| Total including engineering, administration @ | | | 20% | $7,314,383 | | | |
| Total, including financing and bonding @ | | | 23% | $8,996,691 | | | |
| **Maximum** | % of existing units | | | | | | | |
| Retrofit | 87% | 584 units @ | $3,000 [a] = | $1,752,000 | @ | $247 [b] = | $144,423 |
| New [c] | 13% | 90 units @ | $4,400 [a] = | $396,000 | @ | $247 [b] = | $22,257 |
| New to buildout | -- | 780 units [f] @ | $3,920 [a] = | $3,057,433 [d] | @ | $169 [b,e] = | $131,811 |
| | | | | | | | $298,491 |
| Total | | | | $5,205,433 | | | |
| Total including contingency @ | | 20% | | $6,246,519 | | | |
| Total including engineering, administration @ | | | 20% | $7,495,823 | | | |
| Total, including financing and bonding @ | | | 23% | $9,219,862 | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)
b. Based on:
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
c. Table 3-1
d. Present worth over first 20 years @ 7%.
e. Average cost over 30-year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area I – Redfield Woods/Upland**

**I–4 Retain existing onsite systems**

**Cost for Alternative I–4 Buildout – same as I–1 unless noted**

| | | | Construction | | | | O&M | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Replacement | 0% | 0 units @ | $4,100 [a] | = | $0 | @ | $242 [b] | $0 |
| No replacement | 100% | 674 units @ | $90 [a] | = | $60,660 | @ | $242 [b] | $163,108 |
| New to buildout | -- | 780 units [f] @ | $2,172 [a] | = | $1,693,983 [d] | @ | $165 [b,e] | $128,986 |
| Total | | | | | $1,754,643 | | | $292,094 |
| Total including contingency @ | | 20% | | | $2,105,571 | | | |
| Total including engineering, administration @ | | | 20% | | $2,526,686 | | | |
| Total, including financing and bonding @ | | | 0% | | $2,526,686 | | | |
| **Maximum** | | | | | | | | |
| Replacement [c] | 13% | 90 units @ | $4,100 [a] | = | $369,000 | @ | $242 [b] | $21,780 |
| No replacement | 87% | 584 units @ | $90 [a] | = | $52,560 | @ | $242 [b] | $141,328 |
| New to buildout | -- | 780 units [f] @ | $2,172 [a] | = | $1,693,983 [d] | @ | $165 [b,e] | $128,986 |
| Total | | | | | $2,115,543 | | | $292,094 |
| Total including contingency @ | | 20% | | | $2,538,651 | | | |
| Total including engineering, administration @ | | | 20% | | $3,046,382 | | | |
| Total, including financing and bonding @ | | | 0% | | $3,046,382 | | | |

a. Based on complete replacement of septic tank and leach field or pit (Appendix D).
For no replacement, based on initial inspection only (Appendix D).

b. Based on:
4 hr/yr @ $30 /hr (one inspection/year; administration)
2.0% of capital cost
$200 pumping every 5 years.

c. Table 3–1.

d. Present worth over first 20 years @ 7% .

e. Average cost over 30 –year period.

f. For cost purposes only, based on 4 multiple family units = 1 DUE.

**Summary, Area J – Vista de Oro – Incremental Costs**

| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Gravity [b] | | | Gravity [b] | | | Gravity [b] | | |
| J–1 Conventional (Sheet B) | $361,000 | -- | -- | $3,000 | -- | -- | $398,000 | -- | -- |
| J–2 Pkg plant } (Sheet | $2,848,000 | -- | -- | $32,000 | -- | -- | $3,245,000 | -- | -- |
| J–2 – alternate } C) | $1,101,000 | -- | -- | $9,000 | -- | -- | $1,213,000 | -- | -- |
| J–2 – sand filter} | -- | $584,000 | -- | -- | $11,000 | -- | -- | $720,000 | -- |
| J–3 Onsite (Sheet D) | $68,000 | | | $17,000 | | | $279,000 | | |
| J–4 Nothing (Sheet E) | $0 | | | $16,000 | | | $199,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

**Summary, Area J – Vista de Oro – Total Costs**

| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Gravity [b] | | | Gravity [b] | | | Gravity [b] | | |
| J–1 Conventional (Sheet B) | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| J–2 Pkg plant } (Sheet | $76,361,000 | -- | -- | $781,000 | -- | -- | $86,052,000 | -- | -- |
| J–2 – alternate } C) | $74,614,000 | -- | -- | $758,000 | -- | -- | $84,020,000 | -- | -- |
| J–2 – sand filter} | -- | $74,458,000 | -- | -- | $763,000 | -- | -- | $83,926,000 | -- |
| J–3 Onsite (Sheet D) | $73,581,000 | | | $766,000 | | | $83,086,000 | | |
| J–4 Nothing (Sheet E) | $73,513,000 | | | $765,000 | | | $83,006,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

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2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

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4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

## Area J – Vista de Oro

### J–1 Conventional project

Assumptions/parameters

Wastewater flow

| | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 40 | -- | -- | -- | -- | -- | 40 | 0 | 0 |
| No. DUE [a] | 40 | 78 | 80 | | 0 | 0 | 40 | 78 | 80 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 8,000 | 15,600 | 16,000 | | 0 | 0 | 8,000 | 15,600 | 16,000 |
| Peak factor | 4.0 | 4.0 | 4.0 | | 2.0 | 2.0 | 4.0 | 4.0 | 4.0 |
| Peak flow, gpd | 32,000 | 62,400 | 64,000 | | 0 | 0 | 32,000 | 62,400 | 64,000 |

| Costs for common facilities | | | | Const. [c] | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | | $179,288 | | | | | | | $5,146 /yr [j] |
| | LS–2 | | | $185,265 | | | | | | | $5,265 /yr [j] |
| | LS–3 | | | $173,312 | | | | | | | $5,026 /yr [j] |
| Pump stations | PS–1 | | | $717,153 | | | | | | | $15,903 /yr [j] |
| | PS–2 | | | $418,339 | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | | $59,763 | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM–1 | 6 in. | | 580 | ft @ | $30 | = $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | | 1,900 | ft @ | $30 | = $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | | 200 | ft @ | $30 | = $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | | 3,700 | ft @ | $39 | = $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | | 100 | ft @ | $34 | = $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | | 1,600 | ft @ | $49 | = $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | | 6,400 | ft @ | $58 | = $371,200 | @ | $1.00 [i] | = | $8,400 /yr |
| Main pumping station (PS–3) | | | | $1,314,781 | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | | | | | | | |
| 21 in., 7,200 ft @ | | | $58 | $417,600 | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | | $8,623,888 | | | | | | | $323,000 /yr |
| Headworks | | | | $428,858 | | | | | | | |
| Secondary treatment | | | | $2,006,834 | | | | | | | |
| Tertiary treatment | | | | $1,199,977 | | | | | | | |
| Biosolids handling | | | | $1,676,943 | | | | | | | |
| Effluent pumping station | | | | $225,425 | | | | | | | |
| Ancillary facilities | | | | $3,085,851 | | | | | | | |
| Land | | | | $468,638 | 9 | ac @ | $52,071 /ac | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in., 24,500 ft @ | | | $56 | $1,372,000 | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | | $2,666,615 | | | | | | | $85,000 /yr |
| Land | | | | $619,777 | 20 | ac @ | $30,989 /ac | | | | |

Second stage of plant present worth [i]

--
$445,529
$266,402
$372,291
$50,046
--

$592,004

**Area J – Vista de Oro**

**J–1 Conventional project**

**Cost for Alternative J–1 Buildout**

| | | | | | Construction | | O&M | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 –in. | 0 | ft @ | $27 | = | $0 | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 | = | $0 | | | | |
| Manholes | 0 | @ | $1,750 | = | $0 | | | | |
| Pressure sewer | | | | | | | | | |
| 2 –in. | 0 | ft @ | $19 | = | $0 | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | |
| 6 –in. | 0 | ft @ | $30 | = | $0 | | | | |
| STEP systems [n] | 0 | @ | $2,000 | = | $0 [Includes house lateral] | | @ $0 [p] | = | $0 /yr |
| Total | 0 | ft | | | | 0 | ft @ $0.75 | = | $0 /yr |
| Y–connection and street lateral | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | |
| { | 3,120 | ft @ | $21 | = | $65,520 [To Stage 1] | | | | |
| Future | 80 | ft [k] @ | $10 | = | $800 [l] | | | | |
| Common facilities – incremental (avoidable) costs [f,0] | | | | | | | | | |
| FM –1 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| FM –2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| FM –3 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| I–1 | | (portion = | 0.9% ) | | $1,281 | (portion = | 0.5% ) | | $19 /yr |
| I–2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| I–12 | | (portion = | 0.4% ) | | $327 | (portion = | 0.2% ) | | $4 /yr |
| I–3 | | (portion = | 0.3% ) | | $1,221 | (portion = | 0.2% ) | | $12 /yr |
| LS –1 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| LS –2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| LS –3 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| PS –1 | | (portion = | 0.8% ) | | $5,459 | (portion = | 1.3% ) | | $201 /yr |
| PS –2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| Bayridge Estates STEP | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | $0 /yr |
| Main pumping station (PS–3) | | (portion = | 0.3% ) | | $3,707 | (portion = | 0.5% ) | | $153 /yr |
| Interceptor to treatment plant | | (portion = | 0.4% ) | | $1,466 | (portion = | 0.2% ) | | $14 /yr |
| Treatment plant | | | | | | (portion = | 0.5% ) | | $1,619 /yr |
| Headworks | | (portion = | 0.8% ) | | $3,434 | | | | |
| Secondary treatment | | (portion = | 0.5% ) | | $12,293 | | | | |
| Tertiary treatment | | (portion = | 0.5% ) | | $7,350 | | | | |
| Biosolids handling | | (portion = | 0.8% ) | | $16,410 | | | | |
| Effluent pumping station | | (portion = | 0.8% ) | | $2,206 | | | | |
| Ancillary facilities | | (portion = | 0.6% ) | | $18,552 | | | | |
| Land | | (portion = | 0.7% ) | | $3,129 | | | | |
| Effluent force main | | (portion = | 0.3% ) | | $4,130 | (portion = | 0.2% ) | | $49 /yr |
| Disposal/recharge | | (portion = | 0.7% ) | | $22,845 | (portion = | 0.7% ) | | $568 /yr |
| Land | | (portion = | 0.7% ) | | $4,139 | | | | |
| Total | | | | | $174,270 | | | | $2,639 /yr |
| Total including contingency @ | | 20% | | | $209,124 | | | | |
| Total including engineering, administration @ | | | 20% | | $250,949 | | | | |
| Total, including financing and bonding @ | | | 23% | | $308,667 | | | | |
| On–lot costs | | | | | | | | | |
| Septic tank abandonment | | 0 | ea @ [e] | $1,000 = | $0 | | | | |
| House lateral | | | | | | | | | |
| 4 –in. { | 50 | ft ea. | | | | | | | |
| { | 2,000 | ft @ | $15 | = | $30,000 | | | | |
| Future | 2,000 | ft [k] @ | $7 | = | $14,000 [l] | | | | |
| Total on–lot costs | | | | | $44,000 | | | | |
| Total including contingency @ | 20% | | | | $52,800 | | | | |
| GRAND TOTAL | | | | | $361,467 | | | | |

Area J – Vista de Oro

J–1 Conventional project

**Adjustment for STEP/STEG** **NOT APPLICABLE**

| | Construction | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | |
| 2 –in. [m] | 0 ft @ | $19 [k] | = | $0 | | | | |
| 3 –in. [m] | 0 ft @ | $21 [k] | = | $0 | | | | |
| 4 –in. [m] | 0 ft @ | $22 [k] | = | $0 | | | | |
| 6 –in. | 0 ft @ | $30 [k] | = | $0 | | | | |
| 8 –in. | ft @ | $35 [k] | = | $0 | | | | |
| 10 –in. | ft @ | $40 [k] | = | $0 | | | | |
| 12 –in. | ft @ | $45 [k] | = | $0 | | | | |
| Total | 0 ft | | | | 0 ft @ | $0.50 | = | $0 /yr |
| On–lot costs | | | | | | | | |
| New tank/pump | 0 ea [k] @ | $2,000 | = | $0 [Including house lateral] | @ | $140 [p] | = | $0 /yr |
| Lateral 2 –in. | 0 ft @ | $19 | = | $0 [Street] | | | | |
| Future tank/pump | 0 ea @ | $1,000 | = | $0 [l] | @ | $100 [p,l] | = | $0 /yr |
| Future lateral | 0 ft @ | $9 | = | $0 [l] | | | | |
| Septic tank abandonment | | | | $0 | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | ($6,694) | | | | ($36) /yr |
| Revised subtotal, STEP/STEG | | | | ($6,694) | | | | ($36)/yr |
| Less conventional facilities (sewers, laterals) | | | | ($110,320) | | | | $0 /yr |
| Adjusted total, STEP/STEG | | | | ($117,014) | | | | $146 /yr |
| Total including contingency @ 20% | | | | ($140,417) | | | | |
| Total including engineering, administration @ 20% | | | | ($168,500) | | | | |
| Total, including financing and bonding @ 23% | | | | ($207,255) | | | | |

**Adjustment for grinder pumps** **NOT APPLICABLE**

| | Construction | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | |
| 2 –in. | 0 ft @ | $19 [k] | = | $0 | | | | |
| 3 –in. | 0 ft @ | $21 [k] | = | $0 | | | | |
| 4 –in. | 0 ft @ | $22 [k] | = | $0 | | | | |
| 6 –in. | ft @ | $30 [k] | = | $0 | | | | |
| 8 –in. | ft @ | $35 [k] | = | $0 | | | | |
| 10 –in. | ft @ | $40 [k] | = | $0 | | | | |
| 12 –in. | ft @ | $45 [k] | = | $0 | | | | |
| Total | 0 ft | | | | 0 ft @ | $0.50 | = | $0 /yr |
| On–lot costs | | | | | | | | |
| New pump (simplex) | 0 ea [k] @ | $2,500 | = | $0 [Including house lateral] | @ | $110 [q] | = | $0 /yr |
| Lateral 2 –in. | 0 ft @ | $19 | = | $0 [Street] | | | | |
| Future tank/pump | 0 ea @ | $1,000 | = | $0 [l] | @ | $75 [q,l] | = | $0 /yr |
| Future lateral | 0 ft @ | $9 | = | $0 [l] | | | | |
| Septic tank abandonment | | | | $0 | | | | |
| Revised subtotal, grinder | | | | $0 | | | | $0 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | ($110,320) | | | | $0 /yr |
| Adjusted total, grinder | | | | ($110,320) | | | | $182 /yr |
| Total including contingency @ 20% | | | | ($132,384) | | | | |
| Total including engineering, administration @ 20% | | | | ($158,861) | | | | |
| Total, including financing and bonding @ 23% | | | | ($195,399) | | | | |

## Area J – Vista de Oro

### J–1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .
d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.6 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.
h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in. gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawings [2].
o. Flow portions from file WW–Q.WK3:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 0.0% |
| FM –3 | 0.0% |
| I–1 | 2.5% |
| I–2 | 0.0% |
| I–12 | 1.2% |
| I–3 | 0.9% |
| LS –1 | 0.0% |
| LS –2 | 0.0% |
| LS –3 | 0.0% |
| PS –1 | 2.5% |
| PS –2 | 0.0% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS–3) | 0.9% |
| Force main to treatment plant | 1.0% |
| Treatment plant | 1.0% |
| Headworks | 1.0% |
| Secondary treatment | 1.0% |
| Tertiary treatment | 1.0% |
| Biosolids handling | 1.0% |
| Effluent pumping station | 1.0% |
| Ancillary facilities | 1.0% |
| Land | |
| Effluent force main | 1.0% |
| Disposal/recharge | 1.0% |
| Land | 1.0% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area J – Vista de Oro

### J-2 Local collection, treatment, and dispose/recharge

Cost for Alternative J-2 Buildout – same as J-1 unless noted

| | | Construction | | | O&M | | |
|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | |
| 6 –in. | 0 ft @ | $26 | = | $0 | | | |
| 8 –in. | 0 ft @ | $27 | = | $0 | | | |
| 10 –in. | 0 ft @ | $29 | = | $0 | | | |
| 12 –in. | 0 ft @ | $34 | = | $0 | | | |
| 15 –in. | 0 ft @ | $39 | = | $0 | | | |
| Dewatering – none | 0 ft @ | $19 [k] | = | $0 | | | |
| Manholes | 0 @ | $1,500 | = | $0 | | | |
| Pressure Sewer | | | | | | | |
| 2 –in. | 0 ft @ | $19 | = | $0 | | | |
| 3 –in. | 0 ft @ | $21 | = | $0 | | | |
| STEP systems | 0 @ | $2,000 | = | $0 | @ $0 | = | $0 /yr |
| Total | 0 ft | | | | @ $0.75 | = | $0 /yr |
| Y–connection: street lateral | | | | | | | |
| 4 –in. { | 40 ft ea. | | | | | | |
| { | 3,120 ft @ | $21 | = | $65,520 | | | |
| Future | 80 ft [f] @ | $10 | = | $800 [g] | | | |
| Treatment plant | 0.016 mgd (buildout) | | | $1,156,583 [a] | | | $32,300 /yr [b] |
| Disposal/recharge (buildout) | | | | $147,518 [b] | | | |
| Land (buildout) | 1 ac @ | $217,166 | | $217,166 [b] | | | |
| Alternative treatment plant: | @ $10.63 /gal, | $170,047 [c] | | | $9,000 /yr [d] | | |
| Total | | | | $1,587,586 | | | $32,300 /yr |
| Total including contingency @ | 20% | | | $1,905,104 | | | |
| Total including engineering, administration @ | | 20% | | $2,286,124 | | | |
| Total, including financing and bonding @ | | 23% | | $2,811,933 | | | |
| Revised total with alternative treatment plant | | | | $601,050 | | | $9,000 /yr |
| Total including contingency @ | 20% | | | $721,260 | | | |
| Total including engineering, administration @ | | 20% | | $865,512 | | | |
| Total, including financing and bonding @ | | 23% | | $1,064,580 | | | |
| On–lot costs | | | | | | | |
| Septic tank abandonment | 0 ea @ | $1,000 | = | $0 | | | |
| Lateral | | | | | | | |
| 4 –in. { | 50 ft ea. | | | | | | |
| { | 2,000 ft @ | $15 | = | $30,000 | | | |
| Future | 2,000 ft [f] @ | $7 | = | $14,000 [g] | | | |
| Total on–lot costs | | | | $30,000 | | | |
| Total including contingency @ | 20% | | | $36,000 | | | |
| GRAND TOTAL | | | | $2,847,933 | | | |
| GRAND TOTAL with alternative treatment plant | | | | $1,100,580 | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

Area J – Vista de Oro

J–2 Local collection, treatment, and dispose/recharge

**Adjustment for STEP/STEG – same as J–1 unless noted.** USED FOR SAND FILTER ALTERNATIVE ONLY. NO STEP/STEP COSTS INCLUDED

| | | | | | Construction | | O&M |
|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | |
| 2 –in. | 0 | ft @ | $19 | = | $0 | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | |
| 6 –in. | | ft @ | $30 | = | $0 | | |
| 8 –in. | | ft @ | $35 | = | $0 | | |
| 10 –in. | | ft @ | $40 | = | $0 | | |
| 12 –in. | | ft @ | $45 | = | $0 | | |
| Total | 0 | ft | | | | 0 ft @ $0.50 = | $0 /yr |
| On–lot costs | | | | | | | |
| New tank/pump | | 0 | ea @ | $2,000 = | $0 [Including house lateral] | @ $140 = | $0 /yr |
| Lateral 2 –in. | | 0 | ft @ | $19 = | $0 Street | | |
| Future tank/pump | | 0 | ea @ | $1,000 = | $0 [g] | @ $100 [g] = | $0 /yr |
| Future lateral | | 0 | ft @ | $9 = | $0 [g] | | |
| Septic tank abandonment | | | | | $0 | | |
| Sand filter treatment plant, including land [e]. | | | | | $212,446 | | $11,414 /yr |
| Revised subtotal, STEP/STEG | | | | | $212,446 | | $11,414 /yr |
| Less conventional plant + land (not disposal) | | | | | ($1,373,749) | | ($32,300)/yr |
| Less conventional facilities | | | | | ($96,320) | | $0 /yr |
| Adjusted total, STEP/STEG | | | | | $329,964 | | $11,414 /yr |
| Total including contingency @ | 20% | | | | $395,957 | | |
| Total including engineering, administration @ | | 20% | | | $475,148 | | |
| Total, including financing and bonding @ | | 23% | | | $584,432 | | |

**Adjustment for grinder pumps – same as J–1 unless noted.** NOT USED

| | | | | | Construction | | O&M |
|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | |
| 2 –in. | 0 | ft @ | $19 | = | $0 | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | |
| 6 –in. | | ft @ | $30 | = | $0 | | |
| 8 –in. | | ft @ | $35 | = | $0 | | |
| 10 –in. | | ft @ | $40 | = | $0 | | |
| 12 –in. | | ft @ | $45 | = | $0 | | |
| Total | 0 | ft | | | | 0 ft @ $0.50 = | $0 /yr |
| On–lot costs | | | | | | | |
| New pump (simplex) | | 0 | ea @ | $2,500 = | $0 [Including house lateral] | @ $110 = | $0 /yr |
| Lateral 2 –in. | | 0 | ft @ | $19 = | $0 [Street] | | |
| Future tank/pump | | 0 | ea @ | $1,000 = | $0 [g] | @ $75 [g] = | $0 /yr |
| Future lateral | | 0 | ft @ | $9 = | $0 [g] | | |
| Septic tank abandonment | | | | | $0 | | |
| Revised subtotal, grinder | | | | | $0 | | $0 /yr |
| Less conventional facilities | | | | | ($96,320) | | $0 /yr |
| Adjusted total, grinder | | | | | $1,491,266 | | |
| Total including contingency @ | 20% | | | | $1,789,520 | | |
| Total including engineering, administration @ | | 20% | | | $2,147,423 | | |
| Total, including financing and bonding @ | | 23% | | | $2,641,331 | | $0 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   3 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g Based on present worth of future installations over a 20–year period at 7%. For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

Area J – Vista de Oro

J-3 Enhance/upgrade existing system

Cost for Alternative J-3 Stage 1 – same as J-1 unless noted

| | Construction | | | | O&M |
|---|---|---|---|---|---|
| Enhance/upgrade | | | | | |
| Equipment (onsite reactor retrofit) | | | $25,482 | [a] | |
| Installation | | | $12,741 | [b] | |
| Total | | | $38,223 | | |
| Total including contingency @ | 20% | | $45,868 | | $17,094 /yr [c] |
| Total including engineering, administration @ | | 20% | $55,041 | | |
| Total, including financing and bonding @ | | 23% | $67,701 | | |

a. Based on AES equipment costs scaled exponentially to flow in this area.
b. Based on 50% of equipment cost; includes excavation and restoration.
c. Based on:
1 hr/wk @ $30 /hr (additional inspection, service, monitoring, administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
Also includes current (1994-95) CSA 9E budget for wastewater: $11,455 plus $3,000 capital items.

Calculated: HLS
Checked: NKD
Reviewed: CEP

Area J – Vista de Oro

J-4 Retain existing system

Cost for Alternative J-4 Stage 1 - same as J-2 unless noted

| | | Construction | O&M |
|---|---|---|---|
| Total | | $0 | |
| Total including contingency @ | 20% | $0 | $16,015 /yr [b] |

a. Scaled up from individual unit by exponent of 0.5 .
b. Based on:
1 hr/wk @ $30 /hr (additional inspection, service, monitoring, administration).
Current (1994-95) CSA 9E budget for wastewater: $11,455 plus $3,000 capital items.

| Summary, Area K – Commercial Core | | | | | | | –Incremental Costs | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| K–1 Conventional (Sheet B) | $7,382,000 | -- | -- | $64,000 | -- | -- | $8,176,000 | -- | -- |
| K–2 Pkg plant } (Sheet | $11,576,000 | -- | -- | $149,000 | -- | -- | $13,425,000 | -- | -- |
| K–2 – alternate } C) | $8,381,000 | -- | -- | $95,000 | -- | -- | $9,560,000 | -- | -- |
| K–2 – sand filter} | -- | $8,593,000 | -- | -- | $131,000 | -- | -- | $10,219,000 | -- |
| K–3 Onsite: min.} (Sheet | $4,751,000 | | | $152,000 | | | $6,637,000 | | |
| K–3 Onsite: max} D) | $4,875,000 | | | $152,000 | | | $6,761,000 | | |
| K–4 Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| K–4 Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area K – Commercial Core | | | | | | | – Total Costs | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| K–1 Conventional (Sheet B) | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| K–2 Pkg plant } (Sheet | $78,068,000 | -- | -- | $837,000 | -- | -- | $88,454,000 | -- | -- |
| K–2 – alternate } C) | $74,873,000 | -- | -- | $783,000 | -- | -- | $84,589,000 | -- | -- |
| K–2 – sand filter} | -- | $8,593,000 | -- | -- | $131,000 | -- | -- | $10,219,000 | -- |
| K–3 Onsite: min.} (Sheet | $71,243,000 | | | $840,000 | | | $81,667,000 | | |
| K–3 Onsite: max} D) | $71,367,000 | | | $840,000 | | | $81,791,000 | | |
| K–4 Nothing: min.} (Sheet | -- | | | -- | | | -- | | |
| K–4 Nothing: max} E) | -- | | | -- | | | -- | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES

1. Draft Background Report. Estero Area Plan Update. San Luis Obispo County Planning Department. June 1994. Appendix A – Land Use Survey.

2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area K – Commercial Core

### K–1 Conventional project

Assumptions/parameters

Wastewater flow

| | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 310 | -- | -- | -- | -- | -- | 310 | 0 | 0 |
| No. DUE [a] | 868 | 1,155 | 1,296 | | 0 | 0 | 868 | 1,155 | 1,296 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 173,600 | 231,000 | 259,600 | | 0 | 0 | 173,600 | 231,000 | 259,600 |
| Peak factor | 3.0 | 3.0 | 3.0 | | 2.0 | 2.0 | 3.0 | 3.0 | 3.0 |
| Peak flow, gpd | 520,800 | 693,000 | 778,800 | | 0 | 0 | 520,800 | 693,000 | 778,800 |

Costs for common facilities

| | | | | Const. [c] | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | $179,288 | | | | | | | | $5,146 /yr [j] |
| | LS–2 | | $185,265 | | | | | | | | $5,265 /yr [j] |
| | LS–3 | | $173,312 | | | | | | | | $5,026 /yr [j] |
| Pump stations | PS–1 | | $717,153 | | | | | | | | $15,903 /yr [j] |
| | PS–2 | | $418,339 | | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | $59,763 | | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM–1 | 6 in. | 580 | ft @ | $30 | = | $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | 1,900 | ft @ | $30 | = | $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | 200 | ft @ | $30 | = | $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | 3,700 | ft @ | $39 | = | $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | 100 | ft @ | $34 | = | $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | 1,600 | ft @ | $49 | = | $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | 6,400 | ft @ | $58 | = | $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | | $1,314,781 | | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | Second stage of plant present worth [i] | | | | | | |
| 21 in., 7,200 ft @ | | $58 | $417,600 | | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | $8,623,888 | | | | | | | | $323,000 /yr |
| Headworks | | | $428,858 | | -- | | | | | | |
| Secondary treatment | | | $2,006,834 | | $445,529 | | | | | | |
| Tertiary treatment | | | $1,199,977 | | $266,402 | | | | | | |
| Biosolids handling | | | $1,676,943 | | $372,291 | | | | | | |
| Effluent pumping station | | | $225,425 | | $50,046 | | | | | | |
| Ancillary facilities | | | $3,085,851 | | -- | | | | | | |
| Land | | | $466,638 | 9 | ac @ | $52,071 /ac | | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in., 24,500 ft @ | | $56 | $1,372,000 | | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | $2,666,615 | | $592,004 | | | | | | $85,000 /yr |
| Land | | | $619,777 | 20 | ac @ | $30,989 /ac | | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area K – Commercial Core

### K–1 Conventional project

**Cost for Alternative K–1 Buildout**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | | |
| 8 –in. | 16,100 | ft @ | $27 | = | $434,700 | | | | | |
| 10 –in. | 300 | ft @ | $29 | = | $8,700 | | | | | |
| 12 –in. | 240 | ft @ | $34 | = | $8,160 | | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | | |
| Dewatering | 16,640 | ft @ | $19 | = | $316,160 | | | | | |
| Manholes | 57 | @ | $1,750 | = | $99,750 | | | | | |
| Pressure sewer | | | | | | | | | | |
| 2 –in. | 0 | ft @ | $19 | = | $0 | | | | | |
| 3 –in. | 3,720 | ft @ | $21 | = | $78,120 | | | | | |
| 6 –in. | 0 | ft @ | $30 | = | $0 | | | | | |
| STEP systems [n] | 45 | @ | $2,000 | = | $90,000 [includes house lateral] | | @ | $140 [p] | = | $6,300 /yr |
| Total | 20,360 | ft | | | | 20,360 | ft @ | $0.75 | = | $15,270 /yr |
| Y–connection and street lateral | | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | | |
| { | 16,500 | ft @ | $21 | = | $346,500 [To Stage 1] | | | | | |
| Future | 13,775 | ft [k] @ | $10 | = | $137,750 [l] | | | | | |
| Common facilities – incremental (avoidable) costs [f,0] | | | | | | | | | | |
| FM –1 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| FM –2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| FM –3 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| I–1 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| I–2 | | (portion = | 14.8% ) | | $503 | (portion = | 8.7% ) | | | $9 /yr |
| I–12 | | (portion = | 7.3% ) | | $5,690 | (portion = | 4.2% ) | | | $67 /yr |
| I–3 | | (portion = | 5.8% ) | | $20,934 | (portion = | 3.3% ) | | | $209 /yr |
| LS –1 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| LS –2 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| LS –3 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| PS –1 | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| PS –2 | | (portion = | 12.8% ) | | $53,597 | (portion = | 20.4% ) | | | $2,028 /yr |
| Bayridge Estates STEP | | (portion = | 0.0% ) | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| Main pumping station (PS–3) | | (portion = | 4.9% ) | | $63,816 | (portion = | 8.0% ) | | | $2,589 /yr |
| Interceptor to treatment plant | | (portion = | 6.0% ) | | $25,090 | (portion = | 3.5% ) | | | $250 /yr |
| Treatment plant | | | | | | (portion = | 8.5% ) | | | $27,362 /yr |
| Headworks | | (portion = | 13.2% ) | | $56,633 | | | | | |
| Secondary treatment | | (portion = | 8.5% ) | | $207,747 | | | | | |
| Tertiary treatment | | (portion = | 8.5% ) | | $124,222 | | | | | |
| Biosolids handling | | (portion = | 13.2% ) | | $270,614 | | | | | |
| Effluent pumping station | | (portion = | 13.2% ) | | $36,378 | | | | | |
| Ancillary facilities | | (portion = | 10.1% ) | | $310,975 | | | | | |
| Land | | (portion = | 11.1% ) | | $52,171 | | | | | |
| Effuent force main | | (portion = | 5.2% ) | | $70,967 | (portion = | 3.5% ) | | | $852 /yr |
| Disposal/recharge | | (portion = | 11.7% ) | | $379,804 | (portion = | 11.1% ) | | | $9,463 /yr |
| Land | | (portion = | 11.1% ) | | $68,997 | | | | | |
| Total | | | | | $3,267,978 | | | | | $84,400 /yr |
| Total including contingency @ | | 20% | | | $3,921,573 | | | | | |
| Total including engineering, administration @ | | | 20% | | $4,705,888 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $5,788,242 | | | | | |
| On–lot costs | | | | | | | | | | |
| Septic tank abandonment | 310 | ea @ [e] | $1,000 | = | $310,000 | | | | | |
| House lateral | | | | | | | | | | |
| 4 –in. { | 150 | ft ea. | | | | | | | | |
| { | 39,750 | ft @ | $15 | = | $596,250 | | | | | |
| Future | 60,281 | ft [k] @ | $7 | = | $421,969 [l] | | | | | |
| Total on–lot costs | | | | | $1,328,219 | | | | | |
| Total including contingency @ | 20% | | | | $1,593,863 | | | | | |
| GRAND TOTAL | | | | | $7,382,104 | | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area K – Commercial Core

### K–1 Conventional project

**Adjustment for STEP/STEG** NOT USED

| | | | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | | |
| 2 –in. [m] | 16,100 | ft @ | $19 [k] | = | $305,900 | | | | | | |
| 3 –in. [m] | 3,960 | ft @ | $21 [k] | = | $83,160 | | | | | | |
| 4 –in. [m] | 0 | ft @ | $22 [k] | = | $0 | | | | | | |
| 6 –in. | 0 | ft @ | $30 [k] | = | $0 | | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | | |
| Total | 20,060 | ft | | | | 20,060 | ft @ | $0.50 | = | $10,030 /yr | |
| On–lot costs | | | | | | | | | | | |
| New tank/pump | 310 | ea [k] @ | $2,000 | = | $620,000 | [including house lateral] | @ | $140 [p] | = | $43,400 /yr | |
| Lateral 2 –in. | 16,500 | ft @ | $19 | = | $313,500 | [Street] | | | | | |
| Future tank/pump | 447 | ea @ | $1,000 | = | $446,875 | [I] | @ | $100 [p,I] | = | $44,688 /yr | |
| Future lateral | 13,775 | ft @ | $9 | = | $123,975 | [I] | | | | | |
| Septic tank abandonment | | | | | $310,000 | | | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($219,446) | | | | | ($7,414) /yr | |
| Revised subtotal, STEP/STEG | | | | | $1,983,964 | | | | | $90,703 /yr | |
| Less conventional facilities (sewers, laterals) | | | | | ($2,848,059) | | | | | ($21,570) /yr | |
| Adjusted total, STEP/STEG | | | | | $2,403,882 | | | | | $133,533 /yr | |
| Total including contingency @ | 20% | | | | $2,884,659 | | | | | | |
| Total including engineering, administration @ | | 20% | | | $3,461,591 | | | | | | |
| Total, including financing and bonding @ | | 23% | | | $4,257,756 | | | | | | |

**Adjustment for grinder pumps** NOT USED

| | | | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | | |
| 2 –in. | 16,100 | ft @ | $19 [k] | = | $305,900 | | | | | | |
| 3 –in. | 3,960 | ft @ | $21 [k] | = | $83,160 | | | | | | |
| 4 –in. | 0 | ft @ | $22 [k] | = | $0 | | | | | | |
| 6 –in. | | ft @ | $30 [k] | = | $0 | | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | | |
| Total | 20,060 | ft | | | | 20,060 | ft @ | $0.50 | = | $10,030 /yr | |
| On–lot costs | | | | | | | | | | | |
| New pump (simplex) | 310 | ea [k] @ | $2,500 | = | $775,000 | [including house lateral] | @ | $110 [q] | = | $34,100 /yr | |
| Lateral 2 –in. | 16,500 | ft @ | $19 | = | $313,500 | [Street] | | | | | |
| Future tank/pump | 447 | ea @ | $1,000 | = | $446,875 | [I] | @ | $75 [q,I] | = | $33,516 /yr | |
| Future lateral | 13,775 | ft @ | $9 | = | $123,975 | [I] | | | | | |
| Septic tank abandonment | | | | | $310,000 | | | | | | |
| Revised subtotal, grinder | | | | | $2,358,410 | | | | | $77,646 /yr | |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | ($2,848,059) | | | | | ($21,570)/yr | |
| Adjusted total, grinder | | | | | $2,778,329 | | | | | $120,475 /yr | |
| Total including contingency @ | 20% | | | | $3,333,995 | | | | | | |
| Total including engineering, administration @ | | 20% | | | $4,000,794 | | | | | | |
| Total, including financing and bonding @ | | 23% | | | $4,920,976 | | | | | | |

## Area K – Commercial Core

### K–1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .

d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.8 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.

h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in. gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawings [2].
o. Flow portions:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 0.0% |
| FM –3 | 0.0% |
| I–1 | 0.0% |
| I–2 | 36.7% |
| I–12 | 19.4% |
| I–3 | 15.3% |
| LS –1 | 0.0% |
| LS –2 | 0.0% |
| LS –3 | 0.0% |
| PS –1 | 0.0% |
| PS –2 | 36.7% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS–3) | 15.3% |
| Force main to treatment plant | 16.2% |
| Treatment plant | 16.2% |
| Headworks | 16.2% |
| Secondary treatment | 16.2% |
| Tertiary treatment | 16.2% |
| Biosolids handling | 16.2% |
| Effluent pumping station | 16.2% |
| Ancillary facilities | 16.2% |
| Land | |
| Effluent force main | 16.2% |
| Disposal/recharge | 16.2% |
| Land | 16.2% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh; 50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh; 50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area K – Commercial Core

### K–2 Local collection, treatment, and dispose/recharge

Cost for Alternative K–2 Buildout – same as K–1 unless noted

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 –in. | 16,100 | ft @ | $27 | = | $434,700 | | | | |
| 10 –in. | 300 | ft @ | $29 | = | $8,700 | | | | |
| 12 –in. | 240 | ft @ | $34 | = | $8,160 | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 57 | @ | $1,500 | = | $85,500 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 –in. | 0 | ft @ | $19 | = | $0 | | | | |
| 3 –in. | 3,720 | ft @ | $21 | = | $78,120 | | | | |
| STEP systems | 45 | @ | $2,000 | = | $90,000 | @ | $140 | = | $6,300 /yr |
| Total | 16,640 | ft | | | | @ | $0.75 | = | $12,480 /yr |
| Y–connection; street lateral | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | |
| { | 16,500 | ft @ | $21 | = | $346,500 | | | | |
| Future | 13,775 | ft [f] @ | $10 | = | $137,750 [g] | | | | |
| Treatment plant | 0.2596 mgd (buildout) | | | | $2,940,545 [a] | | | | $130,105 /yr [b] |
| Disposal/recharge (buildout) | | | | | $1,037,465 [b] | | | | |
| Land (buildout) | 9 ac @ | | $52,064 | | $468,572 [b] | | | | |
| Alternative treatment plant: @ $4.38 /gal, | | | | | $1,136,516 [c] | | | | $76,000 /yr [d] |
| Total | | | | | $5,636,012 | | | | $148,885 /yr |
| Total including contingency @ 20% | | | | | $6,763,215 | | | | |
| Total including engineering, administration @ 20% | | | | | $8,115,858 | | | | |
| Total, including financing and bonding @ 23% | | | | | $9,982,505 | | | | |
| Revised total with alternative treatment plant | | | | | $3,831,984 | | | | $94,760 /yr |
| Total including contingency @ 20% | | | | | $4,598,380 | | | | |
| Total including engineering, administration @ 20% | | | | | $5,518,056 | | | | |
| Total, including financing and bonding @ 23% | | | | | $6,787,209 | | | | |
| On–lot costs | | | | | | | | | |
| Septic tank abandonment | 310 ea @ | | $1,000 | = | $310,000 | | | | |
| Lateral | | | | | | | | | |
| 4 –in. { | 150 | ft ea. | | | | | | | |
| { | 39,750 | ft @ | $15 | = | $596,250 | | | | |
| Future | 60,281 | ft [f] @ | $7 | = | $421,969 [g] | | | | |
| Total on–lot costs | | | | | $1,326,219 | | | | |
| Total including contingency | 20% | | | | $1,593,863 | | | | |
| GRAND TOTAL | | | | | $11,576,368 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $8,381,072 | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area K – Commercial Core**

**K–2 Local collection, treatment, and dispose/recharge**

**Adjustment for STEP/STEG – same as K–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 16,100 | ft @ | $19 | = | $305,900 | | | | | |
| 3 –in. | 300 | ft @ | $21 | = | $6,300 | | | | | |
| 4 –in. | 240 | ft @ | $22 | = | $5,280 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 16,640 | ft | | | | 16,640 | ft @ | $0.50 | = | $8,320 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 310 | ea @ | $2,000 | = | $620,000 [Including house lateral] | @ | $140 | = | | $43,400 /yr |
| Lateral 2 –in. | 16,500 | ft @ | $19 | = | $313,500 Street | | | | | |
| Future tank/pump | 447 | ea @ | $1,000 | = | $446,875 [g] | @ | $100 [g] | = | | $44,688 /yr |
| Future lateral | 13,775 | ft @ | $9 | = | $123,975 [g] | | | | | |
| Septic tank abandonment | | | | | $310,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $3,010,306 | | | | | $34,595 /yr |
| Revised subtotal, STEP/STEG | | | | | $5,142,136 | | | | | $131,002 /yr |
| Less conventional plant + land (not disposal) | | | | | ($3,409,117) | | | | | ($130,105)/yr |
| Less conventional facilities | | | | | ($2,517,649) | | | | | ($18,780)/yr |
| Adjusted total, STEP/STEG | | | | | $4,851,382 | | | | | $131,002 /yr |
| Total including contingency @ | 20% | | | | $5,821,659 | | | | | |
| Total including engineering, administration @ | | 20% | | | $6,985,991 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $8,592,768 | | | | | |

**Adjustment for grinder pumps – same as K–1 unless noted.** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 16,100 | ft @ | $19 | = | $305,900 | | | | | |
| 3 –in. | 300 | ft @ | $21 | = | $6,300 | | | | | |
| 4 –in. | 240 | ft @ | $22 | = | $5,280 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 16,640 | ft | | | | 16,640 | ft @ | $0.50 | = | $8,320 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 310 | ea @ | $2,500 | = | $775,000 [Including house lateral] | @ | $110 | = | | $34,100 /yr |
| Lateral 2 –in. | 16,500 | ft @ | $19 | = | $313,500 [Street] | | | | | |
| Future tank/pump | 447 | ea @ | $1,000 | = | $446,875 [g] | @ | $75 [g] | = | | $33,516 /yr |
| Future lateral | 13,775 | ft @ | $9 | = | $123,975 [g] | | | | | |
| Septic tank abandonment | | | | | $310,000 | | | | | |
| Revised subtotal, grinder | | | | | $2,286,830 | | | | | $75,936 /yr |
| Less conventional facilities | | | | | ($2,517,649) | | | | | ($18,780)/yr |
| Adjusted total, grinder | | | | | $5,405,194 | | | | | |
| Total including contingency @ | 20% | | | | $6,486,232 | | | | | |
| Total including engineering, administration @ | | 20% | | | $7,783,479 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $9,573,679 | | | | | $57,156 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   29 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g. Based on present worth of future installations over a 20–year period at 7%. For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area K – Commercial Core**

**K–3 Enhance/upgrade existing onsite systems**

Cost for Alternative K–3 Buildout – same as K–1 unless noted

| | | | Construction | | | O&M | | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 100% | 310 units @ | $3,000 [a] | = | $930,000 | @ | $247 [b] = | $76,663 |
| New | 0% | 0 units @ | $4,400 [a] | = | $0 | @ | $247 [b] = | $0 |
| New to buildout | -- | 447 units [f] @ | $3,920 [a] | = | $1,752,144 [d] | @ | $169 [b,e] = | $75,538 |
| Total | | | | | $2,682,144 | | | $152,201 |
| Total including contingency @ | | | 20% | | $3,218,573 | | | |
| Total including engineering, administration @ | | | 20% | | $3,862,287 | | | |
| Total, including financing and bonding @ | | | 23% | | $4,750,613 | | | |
| **Maximum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Retrofit | 84% | 260 units @ | $3,000 [a] | = | $780,000 | @ | $247 [b] = | $64,298 |
| New [c] | 16% | 50 units @ | $4,400 [a] | = | $220,000 | @ | $247 [b] = | $12,365 |
| New to buildout | -- | 447 units [f] @ | $3,920 [a] | = | $1,752,144 [d] | @ | $169 [b,e] = | $75,538 |
| | | | | | | | | $152,201 |
| Total | | | | | $2,752,144 | | | |
| Total including contingency @ | | | 20% | | $3,302,573 | | | |
| Total including engineering, administration @ | | | 20% | | $3,963,087 | | | |
| Total, including financing and bonding @ | | | 23% | | $4,874,597 | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)
b. Based on:
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
c. Table 3–1
d. Present worth over first 20 years @ 7%.
e. Average cost over 30 –year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

| Summary, Area L – Bayview Heights – Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| L–1 Conventional (Sheet B | $1,537,000 | -- | -- | $22,000 | -- | -- | $1,810,000 | -- | -- |
| L–2 Pkg plant } (Sheet | $4,449,000 | -- | -- | $52,000 | -- | -- | $5,094,000 | -- | -- |
| L–2 – alternate } C) | $2,491,000 | -- | -- | $25,000 | -- | -- | $2,801,000 | -- | -- |
| L–2 – sand filter} | -- | $1,523,000 | -- | -- | $33,000 | -- | -- | $1,932,000 | -- |
| L–3 Onsite: min.} (Sheet | $648,000 | | | $30,000 | | | $1,020,000 | | |
| L–3 Onsite: max} D) | $705,000 | | | $30,000 | | | $1,077,000 | | |
| L–4 Nothing: min.} (Sheet | $16,000 | | | $30,000 | | | $388,000 | | |
| L–4 Nothing: max} E) | $149,000 | | | $30,000 | | | $521,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area L – Bayview Heights – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| L–1 Conventional (Sheet B | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| L–2 Pkg plant } (Sheet | $76,786,000 | -- | -- | $782,000 | -- | -- | $86,490,000 | -- | -- |
| L–2 – alternate } C) | $74,828,000 | -- | -- | $755,000 | | -- | $84,197,000 | -- | -- |
| L–2 – sand filter} | -- | $1,523,000 | -- | -- | $33,000 | -- | -- | $1,932,000 | -- |
| L–3 Onsite: min.} (Sheet | $72,985,000 | | | $760,000 | | | $82,416,000 | | |
| L–3 Onsite: max} D) | $73,042,000 | | | $760,000 | | | $82,473,000 | | |
| L–4 Nothing: min.} (Sheet | $72,353,000 | | | $760,000 | | | $81,784,000 | | |
| L–4 Nothing: max} E) | $72,486,000 | | | $760,000 | | | $81,917,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES

1. Draft Background Report. Estero Area Plan Update. San Luis Obispo County Planning Department. June 1994. Appendix A – Land Use Survey.

2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–196–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

## Area L – Bayview Heights

### L-1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 122 | -- | -- | -- | -- | -- | 122 | 0 | 0 |
| No. DUE [a] | 122 | 122 | 122 | | 0 | 0 | 122 | 122 | 122 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 24,400 | 24,400 | 24,400 | | 0 | 0 | 24,400 | 24,400 | 24,400 |
| Peak factor | 3.0 | 3.0 | 3.0 | | 2.0 | 2.0 | 3.0 | 3.0 | 3.0 |
| Peak flow, gpd | 73,200 | 73,200 | 73,200 | | 0 | 0 | 73,200 | 73,200 | 73,200 |

| Costs for common facilities | | | Const. [c] | | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS-1 | | $179,288 | | | | | | | | $5,148 /yr [j] |
| | LS-2 | | $185,265 | | | | | | | | $5,265 /yr [j] |
| | LS-3 | | $173,312 | | | | | | | | $5,026 /yr [j] |
| Pump stations | PS-1 | | $717,153 | | | | | | | | $15,903 /yr [j] |
| | PS-2 | | $418,339 | | | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | $59,763 | | | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM-1 | 6 in. | 580 | ft @ | $30 | = | $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM-2 | 6 in. | 1,900 | ft @ | $30 | = | $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM-3 | 6 in. | 200 | ft @ | $30 | = | $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I-1 | 15 in. | 3,700 | ft @ | $39 | = | $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I-2 | 12 in. | 100 | ft @ | $34 | = | $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I-12 | 18 in. | 1,600 | ft @ | $49 | = | $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I-3 | 21 in. | 6,400 | ft @ | $58 | = | $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS-3) | | | $1,314,781 | | | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | Second stage of plant present worth [i] | | | | | | |
| 21 in., 7,200 ft @ $58 | | | $417,600 | | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | $8,623,888 | | | | | | | | $323,000 /yr |
| Headworks | | | $428,858 | | -- | | | | | | |
| Secondary treatment | | | $2,006,834 | | $445,529 | | | | | | |
| Tertiary treatment | | | $1,199,977 | | $266,402 | | | | | | |
| Biosolids handling | | | $1,676,943 | | $372,291 | | | | | | |
| Effluent pumping station | | | $225,425 | | $50,046 | | | | | | |
| Ancillary facilities | | | $3,085,851 | | -- | | | | | | |
| Land | | | $468,838 | 9 | ac @ | $52,071 | /ac | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in., 24,500 ft @ $58 | | | $1,372,000 | | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | $2,666,615 | | $592,004 | | | | | | $85,000 /yr |
| Land | | | $619,777 | 20 | ac @ | $30,989 | /ac | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area L – Bayview Heights

### L–1 Conventional project

**Cost for Alternative L–1 Buildout**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | | |
| 8 –in. | 5,620 | ft @ | $27 | = | $151,740 | | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | | |
| Dewatering – none | 0 | ft @ | $19 | = | $0 | | | | | |
| Manholes | 19 | @ | $1,750 | = | $33,250 | | | | | |
| Pressure sewer | | | | | | | | | | |
| 2 –in. | 8,440 | ft @ | $19 | = | $160,360 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 6 –in. | 0 | ft @ | $30 | = | $0 | | | | | |
| STEP systems [n] | 56 | @ | $2,000 | = | $112,000 | [includes house lateral] | @ | $140 [p] | = | $7,840 /yr |
| Total | 14,060 | ft | | | | 14,060 | ft @ | $0.75 | = | $10,545 /yr |
| Y–connection and street lateral | | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | | |
| { | 4,880 | ft @ | $21 | = | $102,480 | [To Stage 1] | | | | |
| Future | 0 | ft [k] @ | $10 | = | $0 | [l] | | | | |
| Common facilities – incremental (avoidable) costs [f,o] | | | | | | | | | | |
| FM –1 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| FM –2 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| FM –3 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| I–1 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| I–2 | (portion = | 1.1% ) | | | $39 | (portion = | 0.7% ) | | | $1 /yr |
| I–12 | (portion = | 0.6% ) | | | $469 | (portion = | 0.3% ) | | | $5 /yr |
| I–3 | (portion = | 0.5% ) | | | $1,749 | (portion = | 0.3% ) | | | $17 /yr |
| LS –1 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| LS –2 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| LS –3 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| PS –1 | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| PS –2 | (portion = | 1.0% ) | | | $4,083 | (portion = | 1.6% ) | | | $161 /yr |
| Bayridge Estates STEP | (portion = | 0.0% ) | | | $0 | (portion = | 0.0% ) | | | $0 /yr |
| Main pumping station (PS–3) | (portion = | 0.4% ) | | | $5,311 | (portion = | 0.7% ) | | | $219 /yr |
| Interceptor to treatment plant | (portion = | 0.5% ) | | | $2,240 | (portion = | 0.3% ) | | | $22 /yr |
| Treatment plant | | | | | | (portion = | 0.8% ) | | | $2,472 /yr |
| Headworks | (portion = | 1.2% ) | | | $5,240 | | | | | |
| Secondary treatment | (portion = | 0.8% ) | | | $18,771 | | | | | |
| Tertiary treatment | (portion = | 0.8% ) | | | $11,224 | | | | | |
| Biosolids handling | (portion = | 1.2% ) | | | $25,039 | | | | | |
| Effluent pumping station | (portion = | 1.2% ) | | | $3,366 | | | | | |
| Ancillary facilities | (portion = | 0.9% ) | | | $28,322 | | | | | |
| Land | (portion = | 1.0% ) | | | $4,777 | | | | | |
| Effluent force main | (portion = | 0.5% ) | | | $6,311 | (portion = | 0.3% ) | | | $75 /yr |
| Disposal/recharge | (portion = | 1.1% ) | | | $34,866 | (portion = | 1.0% ) | | | $866 /yr |
| Land | (portion = | 1.0% ) | | | $6,317 | | | | | |
| Total | | | | | $717,953 | | | | | $22,224 /yr |
| Total including contingency @ | 20% | | | | $861,544 | | | | | |
| Total including engineering, administration @ | | 20% | | | $1,033,853 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $1,271,639 | | | | | |
| On–lot costs | | | | | | | | | | |
| Septic tank abandonment | 122 | ea @ [e] | $1,000 | = | $122,000 | | | | | |
| House lateral | | | | | | | | | | |
| 4 –in. { | 100 | ft ea. | | | | | | | | |
| { | 6,600 | ft @ | $15 | = | $99,000 | | | | | |
| Future | 0 | ft [k] @ | $7 | = | $0 | [l] | | | | |
| Total on–lot costs | | | | | $221,000 | | | | | |
| Total including contingency @ | 20% | | | | $265,200 | | | | | |
| GRAND TOTAL | | | | | $1,536,839 | | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

Area L – Bayview Heights

L–1 Conventional project

**Adjustment for STEP/STEG** NOT USED

| | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | |
| 2 –in. [m] | 14,060 | ft @ | $19 [k] | = | $267,140 | | | | |
| 3 –in. [m] | 0 | ft @ | $21 [k] | = | $0 | | | | |
| 4 –in. [m] | 0 | ft @ | $22 [k] | = | $0 | | | | |
| 6 –in. | 0 | ft @ | $30 [k] | = | $0 | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | |
| Total | 14,060 | ft | | | | 14,060 | ft @ | $0.50 = | $7,030 /yr |
| On–lot costs | | | | | | | | | |
| New tank/pump | 122 | ea [k] @ | $2,000 = | | $244,000 [including house lateral] | @ | $140 [p] = | | $17,080 /yr |
| Lateral 2 –in. | 4,880 | ft @ | $19 = | | $92,720 [Street] | | | | |
| Future tank/pump | 0 | ea @ | $1,000 = | | $0 [l] | @ | $100 [p,l] = | | $0 /yr |
| Future lateral | 0 | ft @ | $9 = | | $0 [l] | | | | |
| Septic tank abandonment | | | | | $122,000 | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($20,154) | | | | ($687) /yr |
| Revised subtotal, STEP/STEG | | | | | $705,706 | | | | $23,443 /yr |
| Less conventional facilities (sewers, laterals) | | | | | ($780,830) | | | | ($18,385) /yr |
| Adjusted total, STEP/STEG | | | | | $642,829 | | | | $27,282 /yr |
| Total including contingency @ | 20% | | | | $771,395 | | | | |
| Total including engineering, administration @ | | 20% | | | $925,674 | | | | |
| Total, including financing and bonding @ | | 23% | | | $1,138,579 | | | | |

**Adjustment for grinder pumps** NOT USED

| | | | Construction | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | |
| 2 –in. | 14,060 | ft @ | $19 [k] | = | $267,140 | | | | |
| 3 –in. | 0 | ft @ | $21 [k] | = | $0 | | | | |
| 4 –in. | 0 | ft @ | $22 [k] | = | $0 | | | | |
| 6 –in. | | ft @ | $30 [k] | = | $0 | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | |
| Total | 14,060 | ft | | | | 14,060 | ft @ | $0.50 = | $7,030 /yr |
| On–lot costs | | | | | | | | | |
| New pump (simplex) | 122 | ea [k] @ | $2,500 = | | $305,000 [including house lateral] | @ | $110 [q] = | | $13,420 /yr |
| Lateral 2 –in. | 4,880 | ft @ | $19 = | | $92,720 [Street] | | | | |
| Future tank/pump | 0 | ea @ | $1,000 = | | $0 [l] | @ | $75 [q,l] = | | $0 /yr |
| Future lateral | 0 | ft @ | $9 = | | $0 [l] | | | | |
| Septic tank abandonment | | | | | $122,000 | | | | |
| Revised subtotal, grinder | | | | | $786,860 | | | | $20,450 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | ($780,830) | | | | ($18,385)/yr |
| Adjusted total, grinder | | | | | $723,983 | | | | $24,289 /yr |
| Total including contingency @ | 20% | | | | $868,780 | | | | |
| Total including engineering, administration @ | | 20% | | | $1,042,536 | | | | |
| Total, including financing and bonding @ | | 23% | | | $1,282,319 | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area L – Bayview Heights

### L–1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .

d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.6 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.

h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in. gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawing [2].
o. Flow portions:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 0.0% |
| FM –3 | 0.0% |
| I–1 | 0.0% |
| I–2 | 3.2% |
| I–12 | 1.7% |
| I–3 | 1.3% |
| LS –1 | 0.0% |
| LS –2 | 0.0% |
| LS –3 | 0.0% |
| PS –1 | 0.0% |
| PS –2 | 3.2% |
| Bayridge Estates STEP | 0.0% |
| Main pumping station (PS–3) | 1.3% |
| Force main to treatment plant | 1.5% |
| Treatment plant | 1.5% |
| Headworks | 1.5% |
| Secondary treatment | 1.5% |
| Tertiary treatment | 1.5% |
| Biosolids handling | 1.5% |
| Effluent pumping station | 1.5% |
| Ancillary facilities | 1.5% |
| Land | |
| Effluent force main | 1.5% |
| Disposal/recharge | 1.5% |
| Land | 1.5% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh;
50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area L – Bayview Heights

### L-2 Local collection, treatment, and dispose/recharge

Cost for Alternative L-2 Buildout – same as L-1 unless noted

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 -in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 -in. | 5,620 | ft @ | $27 | = | $151,740 | | | | |
| 10 -in. | 0 | ft @ | $29 | = | $0 | | | | |
| 12 -in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 -in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 19 | @ | $1,500 | = | $28,500 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 -in. | 8,440 | ft @ | $19 | = | $160,360 | | | | |
| 3 -in. | 0 | ft @ | $21 | = | $0 | | | | |
| STEP systems | 56 | @ | $2,000 | = | $112,000 | @ | $140 | = | $7,840 /yr |
| Total | 5,620 | ft | | | | @ | $0.75 | = | $4,215 /yr |
| Y-connection; street lateral | | | | | | | | | |
| 4 -in. { | 40 | ft ea. | | | | | | | |
| { | 4,880 | ft @ | $21 | = | $102,480 | | | | |
| Future | 0 | ft [f] @ | $10 | = | $0 [g] | | | | |
| Treatment plant | 0.0244 mgd (buildout) | | | | $1,332,133 [a] | | | | $39,888 /yr [b] |
| Disposal/recharge (buildout) | | | | | $198,213 [b] | | | | |
| Land (buildout) | 2 ac @ | | $138,396 | | $276,791 [b] | | | | |
| Alternative treatment plant: @ $9.29 /gal, | | | | | $226,729 [c] | | | | $13,000 /yr [d] |
| Total | | | | | $2,362,218 | | | | |
| Total including contingency @ 20% | | | | | $2,834,662 | | | | $51,943 /yr |
| Total including engineering, administration @ 20% | | | | | $3,401,594 | | | | |
| Total, including financing and bonding @ 23% | | | | | $4,183,961 | | | | |
| Revised total with alternative treatment plant | | | | | $1,256,813 | | | | |
| Total including contingency @ 20% | | | | | $1,508,176 | | | | $25,055 /yr |
| Total including engineering, administration @ 20% | | | | | $1,809,811 | | | | |
| Total, including financing and bonding @ 23% | | | | | $2,226,068 | | | | |
| On-lot costs | | | | | | | | | |
| Septic tank abandonment | 122 ea @ | | $1,000 | = | $122,000 | | | | |
| Lateral | | | | | | | | | |
| 4 -in. { | 100 | ft ea. | | | | | | | |
| { | 6,500 | ft [f] @ | $15 | = | $99,000 | | | | |
| Future | 0 | ft [f] @ | $7 | = | $0 [g] | | | | |
| Total on-lot costs | | | | | $221,000 | | | | |
| Total including contingency @ | 20% | | | | $265,200 | | | | |
| GRAND TOTAL | | | | | $4,449,161 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $2,491,268 | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

Area L – Bayview Heights

**L–2 Local collection, treatment, and dispose/recharge**

**Adjustment for STEP/STEG – same as L–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 5,620 | ft @ | $19 | = | $106,780 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 5,620 | ft | | | | 5,620 | ft @ | $0.50 | = | $2,810 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | | 122 | ea @ | $2,000 = | $244,000 [Including house lateral] | @ | $140 | = | | $17,080 /yr |
| Lateral 2 –in. | | 4,880 | ft @ | $19 = | $92,720 Street | | | | | |
| Future tank/pump | | 0 | ea @ | $1,000 = | $0 [g] | @ | $100 [g] | = | | $0 /yr |
| Future lateral | | 0 | ft @ | $9 = | $0 [g] | | | | | |
| Septic tank abandonment | | | | | $122,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $317,373 | | | | | $13,479 /yr |
| Revised subtotal, STEP/STEG | | | | | $882,873 | | | | | $33,369 /yr |
| Less conventional plant + land (not disposal) | | | | | ($1,608,925) | | | | | ($39,888)/yr |
| Less conventional facilities | | | | | ($776,080) | | | | | ($12,055)/yr |
| Adjusted total, STEP/STEG | | | | | $860,087 | | | | | $33,369 /yr |
| Total including contingency @ | | 20% | | | $1,032,104 | | | | | |
| Total including engineering, administration @ | | | 20% | | $1,238,525 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $1,523,386 | | | | | |

**Adjustment for grinder pumps – same as L–1 unless noted.**

**NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 5,620 | ft @ | $19 | = | $106,780 | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 5,620 | ft | | | | 5,620 | ft @ | $0.50 | = | $2,810 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | | 122 | ea @ | $2,500 = | $305,000 [Including house lateral] | @ | $110 | = | | $13,420 /yr |
| Lateral 2 –in. | | 4,880 | ft @ | $19 = | $92,720 [Street] | | | | | |
| Future tank/pump | | 0 | ea @ | $1,000 = | $0 [g] | @ | $75 [g] | = | | $0 /yr |
| Future lateral | | 0 | ft @ | $9 = | $0 [g] | | | | | |
| Septic tank abandonment | | | | | $122,000 | | | | | |
| Revised subtotal, grinder | | | | | $626,500 | | | | | $16,230 /yr |
| Less conventional facilities | | | | | ($776,080) | | | | | ($12,055)/yr |
| Adjusted total, grinder | | | | | $2,212,638 | | | | | |
| Total including contingency @ | | 20% | | | $2,655,166 | | | | | |
| Total including engineering, administration @ | | | 20% | | $3,186,199 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $3,919,024 | | | | | $4,175 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   5 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g. Based on present worth of future installations over a 20–year period at 7%. For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area L – Bayview Heights**

**L–3 Enhance/upgrade existing onsite systems**

Cost for Alternative L–3 Buildout – same as L–1 unless noted

| | | | Construction | | | O&M | |
|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | |
| | % of existing units | | | | | | |
| Retrofit | 100% | 122 units @ | $3,000 [a] = | $366,000 | @ | $247 [b] = | $30,171 |
| New | 0% | 0 units @ | $4,400 [a] = | $0 | @ | $247 [b] = | $0 |
| New to buildout | -- | 0 units [f] @ | $3,920 [a] = | $0 [d] | @ | -- [b,e] = | $0 |
| Total | | | | $366,000 | | | $30,171 |
| Total including contingency @ | | 20% | | $439,200 | | | |
| Total including engineering, administration @ | | | 20% | $527,040 | | | |
| Total, including financing and bonding @ | | | 23% | $648,259 | | | |
| **Maximum** | | | | | | | |
| | % of existing units | | | | | | |
| Retrofit | 81% | 99 units @ | $3,000 [a] = | $297,000 | @ | $247 [b] = | $24,483 |
| New [c] | 19% | 23 units @ | $4,400 [a] = | $101,200 | @ | $247 [b] = | $5,688 |
| New to buildout | -- | 0 units @ | $3,920 [a] = | $0 [d] | @ | -- [b,e] = | $0 |
| Total | | | | $398,200 | | | $30,171 |
| Total including contingency @ | | 20% | | $477,840 | | | |
| Total including engineering, administration @ | | | 20% | $573,408 | | | |
| Total, including financing and bonding @ | | | 23% | $705,292 | | | |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)
b. Based on:
6 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
c. Table 3–1
d. Present worth over first 20 years @ 7%.
e. Average cost over 30 –year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

**Area L – Bayview Heights**

**L–4 Retain existing onsite systems**

**Cost for Alternative L–4 Buildout– same as L–1 unless noted**

| | | | Construction | | | | O&M | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Replacement | 0% | 0 units @ | $4,100 [a] | = | $0 | @ | $242 [b] | $0 |
| No replacement | 100% | 122 units @ | $90 [a] | = | $10,980 | @ | $242 [b] | $29,524 |
| New to buildout | -- | 0 units @ | $2,172 [a] | = | $0 [d] | @ | $0 [b,e] | $0 |
| Total | | | | | $10,980 | | | $29,524 |
| Total including contingency @ | | 20% | | | $13,176 | | | |
| Total including engineering, administration @ | | 20% | | | $15,811 | | | |
| Total, including financing and bonding @ | | 0% | | | $15,811 | | | |
| **Maximum** | | | | | | | | |
| Replacement [c] | 19% | 23 units @ | $4,100 [a] | = | $94,300 | @ | $242 [b] | $5,566 |
| No replacement | 81% | 99 units @ | $90 [a] | = | $8,910 | @ | $242 [b] | $23,958 |
| New to buildout | -- | 0 units @ | $2,172 [a] | = | $0 [d] | @ | $121 [b,e] | $0 |
| Total | | | | | $103,210 | | | $29,524 |
| Total including contingency @ | | 20% | | | $123,852 | | | |
| Total including engineering, administration @ | | 20% | | | $148,622 | | | |
| Total, including financing and bonding @ | | 0% | | | $148,622 | | | |

a. Based on complete replacement of septic tank and leach field or pit (Appendix D).
For no replacement, based on initial inspection only (Appendix D).
b. Based on:
4 hr/yr @ $30 /hr (one inspection/year; administration)
2.0% of capital cost
$200 pumping every 5 years.
c. Table 3–1.
d. Present worth over first 20 years @ 7% .
e. Average cost over 30 –year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

| Summary, Area M – Bayridge Estates – Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | | | Gravity [b] | | | Gravity [b] | | |
| M–1 Conventional (Sheet B) | $1,782,000 | -- | -- | $26,000 | -- | -- | $2,105,000 | -- | -- |
| M–2 Pkg plant } (Sheet | $5,953,000 | -- | -- | $92,000 | -- | -- | $7,095,000 | -- | -- |
| M–2 – alternate } C) | $3,074,000 | -- | -- | $45,000 | -- | -- | $3,632,000 | -- | -- |
| M–2 – sand filter} | -- | $3,880,000 | -- | -- | $26,000 | -- | -- | $4,203,000 | -- |
| M–3 Onsite (Sheet D) | $184,000 | | | $49,000 | | | $792,000 | | |
| M–4 Nothing (Sheet E) | $0 | | | $43,000 | | | $534,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area M – Bayridge Estates – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | | | Gravity [b] | | | Gravity [b] | | |
| M–1 Conventional (Sheet B) | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| M–2 Pkg plant } (Sheet | $78,045,000 | -- | -- | $818,000 | -- | -- | $88,196,000 | -- | -- |
| M–2 – alternate } C) | $75,166,000 | -- | -- | $771,000 | -- | -- | $84,733,000 | -- | -- |
| M–2 – sand filter} | -- | $77,754,000 | -- | -- | $778,000 | -- | -- | $87,408,000 | -- |
| M–3 Onsite (Sheet D) | $72,276,000 | | | $775,000 | | | $81,893,000 | | |
| M–4 Nothing (Sheet E) | $72,092,000 | | | $769,000 | | | $81,635,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

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2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD. Part I. Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L.; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittant Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area M – Bayridge Estates

### M–1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 466 | -- | -- | -- | -- | -- | 466 | 0 | 0 |
| No. DUE [a] | 694 | 591 | 654 | | 0 | 0 | 694 | 591 | 654 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 138,800 | 118,200 | 130,800 | | 0 | 0 | 138,800 | 118,200 | 130,800 |
| Peak factor | 4.0 | 4.0 | 4.0 | | 2.0 | 2.0 | 4.0 | 4.0 | 4.0 |
| Peak flow, gpd | 555,200 | 472,800 | 523,200 | | 0 | 0 | 555,200 | 472,800 | 523,200 |

| Costs for common facilities | | | | | Const. [c] | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | | | $179,288 | | | | | | $5,146 /yr [j] |
| | LS–2 | | | | $185,265 | | | | | | $5,265 /yr [j] |
| | LS–3 | | | | $173,312 | | | | | | $5,026 /yr [j] |
| Pump stations | PS–1 | | | | $717,153 | | | | | | $15,903 /yr [j] |
| | PS–2 | | | | $418,339 | | | | | | $9,927 /yr [j] |
| Bayridge Estates community STEP | | | | | $59,763 | | | | | | $2,755 /yr |
| Forcemains [c] | | | | | | | | | | | |
| | FM–1 | 6 in. | | | 580 | ft @ | $30 = $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | | | 1,900 | ft @ | $30 = $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | | | 200 | ft @ | $30 = $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | | | 3,700 | ft @ | $39 = $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | | | 100 | ft @ | $34 = $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | | | 1,600 | ft @ | $49 = $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | | | 6,400 | ft @ | $58 = $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | | | | $1,314,781 | | | | | | $32,536 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | | | Second stage of plant present worth [l] | | | | |
| 21 in., | 7,200 | ft @ | | $58 | $417,600 | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | | | $8,623,888 | | | | | | $323,000 /yr |
| Headworks | | | | | $428,858 | | -- | | | | |
| Secondary treatment | | | | | $2,006,834 | | $445,529 | | | | |
| Tertiary treatment | | | | | $1,199,977 | | $266,402 | | | | |
| Biosolids handling | | | | | $1,676,943 | | $372,291 | | | | |
| Effluent pumping station | | | | | $225,425 | | $50,048 | | | | |
| Ancillary facilities | | | | | $3,085,851 | | -- | | | | |
| Land | | | | | $468,638 | 9 | ac @ $52,071 /ac | | | | |
| Effluent forcemain | | | | | | | | | | | |
| 16 in., | 24,500 | ft @ | | $56 | $1,372,000 | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | | | $2,666,615 | | $592,004 | | | | $85,000 /yr |
| Land | | | | | $619,777 | 20 | ac @ $30,989 /ac | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area M – Bayridge Estates**

**M–1 Conventional project**

**Cost for Alternative M–1 Buildout**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | | |
| 8 –in. | 1,020 | ft @ | $27 | = | $27,540 | | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | | |
| Dewatering – none | 0 | ft @ | $19 | = | $0 | | | | | |
| Manholes | 4 | @ | $1,750 | = | $7,000 | | | | | |
| Pressure sewer | | | | | | | | | | |
| 2 –in. | 0 | ft @ | $19 | = | $0 | | | | | |
| 3 –in. | 2,260 | ft @ | $21 | = | $47,460 | | | | | |
| 6 –in. | 0 | ft @ | $30 | = | $0 | | | | | |
| STEP systems [n] | 0 | @ | $2,000 | = | $0 | [includes house lateral] | @ | $140 [p] | = | $0 /yr |
| Total | 3,280 | ft | | | | 3,280 | ft @ | $0.75 | = | $2,460 /yr |
| Y–connection and street lateral | | | | | | | | | | |
| 4 –in. { | 0 | ft ea. | | | | | | | | |
| { | 0 | ft [k] @ | $21 [k] | = | $0 | | | | | |
| Future | 0 | ft [k] @ | $10 | = | $0 [l] | | | | | |
| Common facilities – incremental (avoidable) costs [f,o] | | | | | | | | | | |
| FM –1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| FM –2 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| FM –3 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| I–1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| I–2 | (portion = | 6.9%) | | | $235 | (portion = | 4.0%) | | | $4 /yr |
| I–12 | (portion = | 3.5%) | | | $2,766 | (portion = | 2.0%) | | | $33 /yr |
| I–3 | (portion = | 2.8%) | | | $10,261 | (portion = | 1.6%) | | | $102 /yr |
| LS –1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| LS –2 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| LS –3 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| PS –1 | (portion = | 0.0%) | | | $0 | (portion = | 0.0%) | | | $0 /yr |
| PS –2 | (portion = | 5.9%) | | | $24,864 | (portion = | 9.7%) | | | $964 /yr |
| Bayridge Estates STEP | (portion = | 100.0%) | | | $59,763 | (portion = | 100.0%) | | | $2,755 /yr |
| Main pumping station (PS–3) | (portion = | 2.4%) | | | $31,213 | (portion = | 3.9%) | | | $1,277 /yr |
| Interceptor to treatment plant | (portion = | 2.9%) | | | $12,281 | (portion = | 1.7%) | | | $122 /yr |
| Treatment plant | | | | | | (portion = | 4.2%) | | | $13,484 /yr |
| Headworks | (portion = | 6.6%) | | | $28,284 | | | | | |
| Secondary treatment | (portion = | 4.2%) | | | $102,377 | | | | | |
| Tertiary treatment | (portion = | 4.2%) | | | $61,216 | | | | | |
| Biosolids handling | (portion = | 6.6%) | | | $135,153 | | | | | |
| Effluent pumping station | (portion = | 6.6%) | | | $18,168 | | | | | |
| Ancillary facilities | (portion = | 5.0%) | | | $153,935 | | | | | |
| Land | (portion = | 5.5%) | | | $25,902 | | | | | |
| Effluent force main | (portion = | 2.5%) | | | $34,658 | (portion = | 1.7%) | | | $414 /yr |
| Disposal/recharge | (portion = | 5.8%) | | | $188,846 | (portion = | 5.5%) | | | $4,698 /yr |
| Land | (portion = | 5.5%) | | | $34,256 | | | | | |
| Total | | | | | $1,006,178 | | | | | $26,313 /yr |
| Total including contingency @ | 20% | | | | $1,207,414 | | | | | |
| Total including engineering, administration @ | | | 20% | | $1,448,897 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $1,782,143 | | | | | |
| On–lot costs | | | | | | | | | | |
| Septic tank abandonment | 0 | ea @ [e] | $1,000 | = | $0 | | | | | |
| House lateral | | | | | | | | | | |
| 4 –in. { | 0 | ft ea. | | | | | | | | |
| { | 0 | ft [k] @ | $15 | = | $0 | | | | | |
| Future | 0 | ft [k] @ | $7 | = | $0 [l] | | | | | |
| Total on–lot costs | | | | | $0 | | | | | |
| Total including contingency @ | 20% | | | | $0 | | | | | |
| GRAND TOTAL | | | | | $1,782,143 | | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area M – Bayridge Estates

### M–1 Conventional project

**Adjustment for STEP/STEG** **NOT APPLICABLE**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. [m] | 0 | ft @ | $19 [k] | = | $0 | | | | | |
| 3 –in. [m] | 0 | ft @ | $21 [k] | = | $0 | | | | | |
| 4 –in. [m] | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | 0 | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 0 | ft | | | | 0 | ft @ | $0.50 | = | $0 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 0 | ea [k] @ | $2,000 = | | $0 [Including house lateral] | | @ | $140 [p] | = | $0 /yr |
| Lateral 2 –in. | 0 | ft @ | $19 = | | $0 [Street] | | | | | |
| Future tank/pump | 0 | ea @ | $1,000 = | | $0 [l] | | @ | $100 [p,l] | = | $0 /yr |
| Future lateral | 0 | ft @ | $9 = | | $0 [l] | | | | | |
| Septic tank abandonment | | | | | $0 | | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | -- | | | | | ($3,644) /yr |
| Revised subtotal, STEP/STEG | | | | | $0 | | | | | ($3,644)/yr |
| Less conventional facilities (sewers, laterals) | | | | | $0 | | | | | ($2,460) /yr |
| Adjusted total, STEP/STEG | | | | | $0 | | | | | $20,209 /yr |
| Total including contingency @ | 20% | | | | $0 | | | | | |
| Total including engineering, administration @ | | 20% | | | $1 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $1 | | | | | |

**Adjustment for grinder pumps** **NOT APPLICABLE**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 0 | ft @ | $19 [k] | = | $0 | | | | | |
| 3 –in. | 0 | ft @ | $21 [k] | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 0 | ft | | | | 0 | ft @ | $0.50 | = | $0 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 0 | ea [k] @ | $2,500 = | | $0 [Including house lateral] | | @ | $110 [q] | = | $0 /yr |
| Lateral 2 –in. | 0 | ft @ | $19 = | | $0 [Street] | | | | | |
| Future tank/pump | 0 | ea @ | $1,000 = | | $0 [l] | | @ | $75 [q,l] | = | $0 /yr |
| Future lateral | 0 | ft @ | $9 = | | $0 [l] | | | | | |
| Septic tank abandonment | | | | | $0 | | | | | |
| Revised subtotal, grinder | | | | | $0 | | | | | $0 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | $0 | | | | | ($2,460)/yr |
| Adjusted total, grinder | | | | | $0 | | | | | $23,853 /yr |
| Total including contingency @ | 20% | | | | $0 | | | | | |
| Total including engineering, administration @ | | 20% | | | $0 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $0 | | | | | |

**Area M – Bayridge Estates**

**M–1 Conventional project**

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
b. M&E Task F report, Appendix D.
c. [2] unless noted, adjusted to ENR 6550 from 5480 .
d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).
e. Appendix D.
f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.6 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.
h. Based on $1.00 /ft/yr.
i. Based on 12 years at 7% .
j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.
k. For cost purposes only, based on 4 multiple family units = 1 DU.
l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.
m. Assume: 2–in. pipeline substitutes for 6– and 8–in. gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.
n. Takeoffs from 200–scale drawings [2].
o. Flow portions:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 0.0% |
| FM –3 | 0.0% |
| I–1 | 0.0% |
| I–2 | 18.5% |
| I–12 | 9.8% |
| I–3 | 7.7% |
| LS –1 | 0.0% |
| LS –2 | 0.0% |
| LS –3 | 0.0% |
| PS –1 | 0.0% |
| PS –2 | 18.5% |
| Bayridge Estates STEP | 100.0% |
| Main pumping station (PS–3) | 7.7% |
| Force main to treatment plant | 8.2% |
| Treatment plant | 8.2% |
| Headworks | 8.2% |
| Secondary treatment | 8.2% |
| Tertiary treatment | 8.2% |
| Biosolids handling | 8.2% |
| Effluent pumping station | 8.2% |
| Ancillary facilities | 8.2% |
| Land | |
| Effluent force main | 8.2% |
| Disposal/recharge | 8.2% |
| Land | 8.2% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh; 50 ft average TDH; $200 septage pumping every 5 years.
q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh; 50 ft average TDH.
r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area M – Bayridge Estates

### M–2 Local collection, treatment, and dispose/recharge

Cost for Alternative M–2 Buildout – same as M–1 unless noted

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 –in. | 0 | ft @ | $27 | = | $0 | | | | |
| 10 –in. | 0 | ft @ | $29 | = | $0 | | | | |
| 12 –in. | 0 | ft @ | $34 | = | $0 | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 0 | @ | $1,500 | = | $0 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 –in. | 0 | ft @ | $19 | = | $0 | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | |
| STEP systems | 0 | @ | $2,000 | = | $0 | @ | $140 | = | $0 /yr |
| Total | 0 | ft | | | | @ | $0.75 | = | $0 /yr |
| Y–connection; street lateral | | | | | | | | | |
| 4 –in. { | 0 | ft ea. | | | | | | | |
| { | 0 | ft @ | $21 | = | $0 | | | | |
| Future | 0 | ft [f] @ | $10 | = | $0 [g] | [g] | | | |
| Treatment plant | 0.1308 | mgd (buildout) | | | $2,337,431 [a] | | | | $92,352 /yr [b] |
| Disposal/recharge (buildout) | | | | | $642,075 [b] | | | | |
| Land (buildout) | 5 | ac @ | $76,289 | | $381,444 [b] | | | | |
| Alternative treatment plant: @ | $5.45 | /gal. | $712,245 [c] | | | $45,000 /yr [d] | | | |
| Total | | | | | $3,360,951 | | | | $92,352 /yr |
| Total including contingency @ | 20% | | | | $4,033,141 | | | | |
| Total including engineering, administration @ | | 20% | | | $4,839,769 | | | | |
| Total, including financing and bonding @ | | 23% | | | $5,952,916 | | | | |
| Revised total with alternative treatment plant | | | | | $1,735,764 | | | | $45,000 /yr |
| Total including contingency @ | 20% | | | | $2,082,917 | | | | |
| Total including engineering, administration @ | | 20% | | | $2,499,501 | | | | |
| Total, including financing and bonding @ | | 23% | | | $3,074,386 | | | | |
| On–lot costs | | | | | | | | | |
| Septic tank abandonment | | 0 ea @ | | $1,000 = | $0 | | | | |
| Lateral | | | | | | | | | |
| 4 –in. { | 0 | ft ea. | | | | | | | |
| { | 0 | ft @ | $15 | = | $0 | | | | |
| Future | 0 | ft [f] @ | $7 | = | $0 [g] | | | | |
| Total on–lot costs | | | | | $0 | | | | |
| Total including contingency @ | 20% | | | | $0 | | | | |
| GRAND TOTAL | | | | | $5,952,916 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $3,074,386 | | | | |

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area M – Bayridge Estates

### M–2 Local collection, treatment, and dispose/recharge

**Adjustment for STEP/STEG – same as M–1 unless noted.** **USED FOR SAND FILTER ALTERNATIVE ONLY. NO STEP/STEG COSTS INCLUDED.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | (1,020) | ft @ | $19 | = | ($19,380) | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | (1,020) | ft | | | | (1,020) | ft @ | $0.50 | = | ($510)/yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | | 0 | ea @ | $2,000 = | $0 [including house lateral] | @ | $140 | = | $0 /yr | |
| Lateral 2 –in. | | 0 | ft @ | $19 = | $0 Street | | | | | |
| Future tank/pump | | 0 | ea @ | $1,000 = | $0 [g] | @ | $100 [g] | = | $0 /yr | |
| Future lateral | | 0 | ft @ | $9 = | $0 [g] | | | | | |
| Septic tank abandonment | | | | | $0 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $1,567,929 | | | | | $26,254 /yr |
| Revised subtotal, STEP/STEG | | | | | $1,548,549 | | | | | $25,744 /yr |
| Less conventional plant + land (not disposal) | | | | | ($2,718,876) | | | | | ($92,352)/yr |
| Less conventional facilities | | | | | $0 | | | | | $0 /yr |
| Adjusted total, STEP/STEG | | | | | $2,190,623 | | | | | $25,744 /yr |
| Total including contingency @ | | 20% | | | $2,628,748 | | | | | |
| Total including engineering, administration @ | | | 20% | | $3,154,498 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $3,880,032 | | | | | |

**Adjustment for grinder pumps – same as M–1 unless noted.** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | (1,020) | ft @ | $19 | = | ($19,380) | | | | | |
| 3 –in. | 0 | ft @ | $21 | = | $0 | | | | | |
| 4 –in. | 0 | ft @ | $22 | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | (1,020) | ft | | | | (1,020) | ft @ | $0.50 | = | ($510)/yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | | 0 | ea @ | $2,500 = | $0 [including house lateral] | @ | $110 | = | $0 /yr | |
| Lateral 2 –in. | | 0 | ft @ | $19 = | $0 [Street] | | | | | |
| Future tank/pump | | 0 | ea @ | $1,000 = | $0 [g] | @ | $75 [g] | = | $0 /yr | |
| Future lateral | | 0 | ft @ | $9 = | $0 [g] | | | | | |
| Septic tank abandonment | | | | | $0 | | | | | |
| Revised subtotal, grinder | | | | | ($19,380) | | | | | ($510)/yr |
| Less conventional facilities | | | | | $0 | | | | | $0 /yr |
| Adjusted total, grinder | | | | | $3,341,571 | | | | | |
| Total including contingency @ | | 20% | | | $4,009,885 | | | | | |
| Total including engineering, administration @ | | | 20% | | $4,811,862 | | | | | |
| Total, including financing and bonding @ | | | 23% | | $5,918,590 | | | | | ($510)/yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   17 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g. Based on present worth of future installations over a 20–year period at 7%. For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area M – Bayridge Estates**

**M-3 Enhance/upgrade existing system**

Cost for Alternative M-3 Stage 1 – same as M-1 unless noted

| | Construction | | | | O&M |
|---|---|---|---|---|---|
| Enhance/upgrade | | | | | |
| Equipment (onsite reactor retrofit) | | | $69,277 | [a] | |
| Installation | | | $34,638 | [b] | |
| Total | | | $103,915 | | |
| Total including contingency @ | 20% | | $124,698 | | $48,740 /yr [c] |
| Total including engineering, administration @ | | 20% | $149,638 | | |
| Total, including financing and bonding @ | | 23% | $184,054 | | |

a. Based on AES equipment costs scaled exponentially to flow in this area.
b. Based on 50% of equipment cost, including excavation and restoration.
c Based on:
1 hr/wk @ $30 /hr (additional inspection, service, monitoring, administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
Also includes current (1994-95) CSA 9F budget for wastewater: $32,480 plus $9,000 capital items.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area M – Bayridge Estates**

**M-4 Retain existing system**

Cost for Alternative M-4 Stage 1 – same as M-2 unless noted

| | Construction | | | O&M |
|---|---|---|---|---|
| Total | | | $0 | |
| Total including contingency @ | | 20% | $0 | $43,040 /yr [b] |

a. Based on:
1 hr/wk @ $30 /hr (additional inspection, service, monitoring, administration).
Current (1994-95) CSA 9E budget for wastewater: $32,480 plus $9,000 capital items.

| Summary, Area Q – Combination of Areas A, D, H, I, J, L, M – Incremental Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| Q–1 Conventional (Sheet B) | $25,889,000 | -- | -- | $254,000 | -- | -- | $29,041,000 | -- | -- |
| Q–2 Pkg plant } (Sheet | $25,927,000 | -- | -- | $350,000 | -- | -- | $30,270,000 | -- | -- |
| Q–2– alternate } C) | $22,653,000 | -- | -- | $246,000 | -- | -- | $25,706,000 | -- | -- |
| Q–2– sand filter} | -- | $32,571,000 | | -- | $496,000 | | -- | $38,726,000 | -- |
| Q–3 Onsite: min.} (Sheet | $21,822,000 | | | $515,000 | | | $28,213,000 | | |
| Q–3 Onsite: max} D) | $22,469,000 | | | $515,000 | | | $28,860,000 | | |
| Q–4 Nothing: min.} (Sheet | $6,246,000 | | | $579,000 | | | $13,431,000 | | |
| Q–4 Nothing: max} E) | $7,753,000 | | | $579,000 | | | $14,938,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

| Summary, Area Q – Combination of Areas A, D, H, I, J, L, M – Total Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Capital, $ | | | O&M, $/yr | | | Total present worth [a] | | |
| | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder | Gravity [b] | STEP/STEG | Grinder |
| Q–1 Conventional (Sheet B) | $73,874,000 | -- | -- | $752,000 | -- | -- | $83,206,000 | -- | -- |
| Q–2 Pkg plant } (Sheet | $73,912,000 | -- | -- | $848,000 | -- | -- | $84,435,000 | -- | -- |
| Q–2– alternate } C) | $70,638,000 | -- | -- | $744,000 | -- | -- | $79,870,000 | -- | -- |
| Q–2– sand filter} | -- | $80,556,000 | -- | -- | $994,000 | -- | -- | $92,891,000 | -- |
| Q–3 Onsite: min.} (Sheet | $69,807,000 | | | $1,013,000 | | | $82,377,000 | | |
| Q–3 Onsite: max} D) | $70,454,000 | | | $1,013,000 | | | $83,024,000 | | |
| Q–4 Nothing: min.} (Sheet | $54,231,000 | | | $1,077,000 | | | $67,596,000 | | |
| Q–4 Nothing: max} E) | $55,738,000 | | | $1,077,000 | | | $69,103,000 | | |

a. Based on 30 yr average lifespan and 7.0% interest.
b. Conventional system; may have some STEP/STEG units and pressure sewers.

REFERENCES

1. Draft Background Report. Estero Area Plan Update. San Luis Obispo County Planning Department. June 1994. Appendix A – Land Use Survey.

2. Phase Two– Basis of Design Report. CSA No. 9. Engineering–Science. February 1987.

3. Phase One – Sewerage Planning Study, CSA No. 9. Engineering–Science. May 1986.

4. County of San Luis Obispo. Los Osos/Baywood Park CSA No. 9. Estimated Cost Update. Metcalf & Eddy. July 1989.

5. Engineer's Report for the County of San Luis Obispo Los Osos/Baywood Park Assessement District. John L. Wallace & Associates. January 1990.

6. Iowa State University. Department of Industrial Engineering. **Estimating Staffing and cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD.** Part I. Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD. USEPA Office of Water Program Operations. Washington, D.C. Grant No. 5P2–WP–195–0452. June 1973.

7. Anderson, D.L; R.L. Siegrist; R.J. Otis. Technology Assessment of Intermittent Sand Filters. USEPA. Cincinnati, OH. Undated (probably mid 1980s based on references). Obtained from National Small Flows Clearinghouse, Morgantown, WVA.

Calculated: HLS
Checked: NKD
Reviewed: CEP

## Area Q – Combination of Areas A, D, H, I, J, L, M

### Q–1 Conventional project

Assumptions/parameters

| Wastewater flow | Residential dwelling units (DU) | | | Nonresidential | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout | Current | Stage 1 | Buildout |
| No. services [a] | 1,533 | -- | -- | -- | -- | -- | 1,533 | 0 | 0 |
| No. DUE [a] | 2,203 | 3,038 | 3,817 | | 0 | 0 | 2,203 | 3,038 | 3,817 |
| Unit flow, gpd [b] | 200 | 200 | 200 | | | | | 200 | 200 |
| Total flow, gpd | 440,664 | 607,600 | 763,400 | | 0 | 0 | 440,664 | 607,600 | 763,400 |
| Peak factor | 2.5 | 2.5 | 2.5 | | 2.0 | 2.0 | 2.5 | 2.5 | 2.5 |
| Peak flow, gpd | 1,101,659 | 1,519,000 | 1,908,500 | | 0 | 0 | 1,101,659 | 1,519,000 | 1,908,500 |

| Costs for common facilities | | | | | Const. [c] | | | | O&M [d] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lift stations | LS–1 | | | | $179,288 | | | | | | | $5,630 /yr [j] |
| | LS–2 | | | | $185,265 | | | | | | | $6,655 /yr [j] |
| | LS–3 | | | | $173,312 | | | | | | | $5,889 /yr [j] |
| Pump stations | PS–1 | | | | $717,153 | | | | | | | $25,797 /yr [j] |
| | PS–2 | | | | $418,339 | | | | | | | $13,201 /yr [j] |
| Bayridge Estates community STEP | | | | | $59,763 | | | | | | | $3,964 /yr |
| Forcemains [c] | | | | | | | | | | | | |
| | FM–1 | 6 in. | | | 580 | ft @ | $30 | = $17,400 | @ | $0.75 [h] | = | $435 /yr |
| | FM–2 | 6 in. | | | 1,900 | ft @ | $30 | = $57,000 | @ | $0.75 [h] | = | $1,425 /yr |
| | FM–3 | 6 in. | | | 200 | ft @ | $30 | = $6,000 | @ | $0.75 [h] | = | $150 /yr |
| | I–1 | 15 in. | | | 3,700 | ft @ | $39 | = $144,300 | @ | $1.00 [i] | = | $3,700 /yr |
| | I–2 | 12 in. | | | 100 | ft @ | $34 | = $3,400 | @ | $1.00 [i] | = | $100 /yr |
| | I–12 | 18 in. | | | 1,600 | ft @ | $49 | = $78,400 | @ | $1.00 [i] | = | $1,600 /yr |
| | I–3 | 21 in. | | | 6,400 | ft @ | $58 | = $371,200 | @ | $1.00 [i] | = | $6,400 /yr |
| Main pumping station (PS–3) | | | | | $1,314,781 | | | | | | | $73,462 /yr [g] |
| Interceptor to treatment plant ("Main") | | | | | | | | | | | | |
| 21 in., 7,200 ft @ | | | | $58 | $417,600 | | | | | | | $7,200 /yr [h] |
| Treatment plant – total | | | | | $8,823,868 | | | | | | | $323,000 /yr |
| Headworks | | | | | $428,858 | | | | | | | |
| Secondary treatment | | | | | $2,006,834 | | | | | | | |
| Tertiary treatment | | | | | $1,199,977 | | | | | | | |
| Biosolids handling | | | | | $1,676,943 | | | | | | | |
| Effluent pumping station | | | | | $225,425 | | | | | | | |
| Ancillary facilities | | | | | $3,085,851 | | | | | | | |
| Land | | | | | $468,838 | 9 | ac @ | $52,071 /ac | | | | |
| Effluent forcemain | | | | | | | | | | | | |
| 16 in., 24,500 ft @ | | | | $56 | $1,372,000 | | | | | | | $24,500 /yr [h] |
| Disposal/recharge | | | | | $2,666,615 | | | | | | | $85,000 /yr |
| Land | | | | | $619,777 | 20 | ac @ | $30,989 /ac | | | | |

Second stage of plant: present worth [f]

| | |
|---|---|
| | -- |
| | $1,003,417 |
| | $599,988 |
| | $838,472 |
| | $112,713 |
| | -- |
| | $1,333,307 |

## Area Q – Combination of Areas A, D, H, I, J, L, M

### Q–1 Conventional project

Cost for Alternative Q–1 Buildout

| | | | | | Construction | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer [n] | | | | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | | | | |
| 8 –in. | 67,770 | ft @ | $27 | = | $1,829,790 | | | | | | | |
| 10 –in. | 1,120 | ft @ | $29 | = | $32,480 | | | | | | | |
| 12 –in. | 240 | ft @ | $34 | = | $8,160 | | | | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | | | | |
| Dewatering – none | 0 | ft @ | $19 | = | $0 | | | | | | | |
| Manholes | 220 | @ | $1,750 | = | $385,000 | | | | | | | |
| Pressure sewer | | | | | | | | | | | | |
| 2 –in. | 12,280 | ft @ | $19 | = | $233,320 | | | | | | | |
| 3 –in. | 2,260 | ft @ | $21 | = | $47,460 | | | | | | | |
| 6 –in. | 0 | ft @ | $30 | = | $0 | | | | | | | |
| STEP systems [n] | 141 | @ | $2,000 | = | $282,000 | [includes house lateral] | | | @ | $140 [p] | = | $19,740 /yr |
| Total | 83,670 | ft | | | | | 83,670 | ft @ | $0.75 | = | | $62,753 /yr |
| Y–connection and street lateral | | | | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | | | | |
| { | 121,520 | ft @ | $21 | = | $2,551,920 | [To Stage 1] | | | | | | |
| Future | 17,143 | ft [k] @ | $10 | = | $171,425 | [l] | | | | | | |
| Common facilities – incremental (avoidable) costs [f,o] | | | | | | | | | | | | |
| FM –1 | | (portion = | 0.0% ) | | $0 | | (portion = | 0.0% ) | | | | $0 /yr |
| FM –2 | | (portion = | 0.0% ) | | $0 | | (portion = | 0.0% ) | | | | $0 /yr |
| FM –3 | | (portion = | 0.0% ) | | $0 | | (portion = | 0.0% ) | | | | $0 /yr |
| I–1 | | (portion = | 29.8% ) | | $43,054 | | (portion = | 18.3% ) | | | | $678 /yr |
| I–2 | | (portion = | 41.1% ) | | $1,398 | | (portion = | 26.1% ) | | | | $26 /yr |
| I–12 | | (portion = | 35.3% ) | | $27,701 | | (portion = | 22.0% ) | | | | $353 /yr |
| I–3 | | (portion = | 25.1% ) | | $93,156 | | (portion = | 15.2% ) | | | | $974 /yr |
| LS –1 | | (portion = | 0.0% ) | | $0 | | (portion = | 0.0% ) | | | | $0 /yr |
| LS –2 | | (portion = | 0.0% ) | | $0 | | (portion = | 0.0% ) | | | | $0 /yr |
| LS –3 | | (portion = | 0.0% ) | | $0 | | (portion = | 0.0% ) | | | | $0 /yr |
| PS –1 | | (portion = | 26.2% ) | | $187,846 | | (portion = | 39.7% ) | | | | $10,247 /yr |
| PS –2 | | (portion = | 36.5% ) | | $152,633 | | (portion = | 53.1% ) | | | | $7,006 /yr |
| Bayridge Estates STEP | | (portion = | 100.0% ) | | $59,763 | | (portion = | 100.0% ) | | | | $3,964 /yr |
| Main pumping station (PS–3) | | (portion = | 21.9% ) | | $288,452 | | (portion = | 33.8% ) | | | | $24,845 /yr |
| Interceptor to treatment plant | | (portion = | 20.3% ) | | $84,787 | | (portion = | 12.2% ) | | | | $876 /yr |
| Treatment plant | | | | | | | (portion = | 27.7% ) | | | | $89,438 /yr |
| Headworks | | (portion = | 40.5% ) | | $173,569 | | | | | | | |
| Secondary treatment | | (portion = | 27.7% ) | | $833,536 | | | | | | | |
| Tertiary treatment | | (portion = | 27.7% ) | | $498,409 | | | | | | | |
| Biosolids handling | | (portion = | 40.5% ) | | $1,018,049 | | | | | | | |
| Effluent pumping station | | (portion = | 40.5% ) | | $136,853 | | | | | | | |
| Ancillary facilities | | (portion = | 32.2% ) | | $994,564 | | | | | | | |
| Land | | (portion = | 35.1% ) | | $164,478 | | | | | | | |
| Effluent force main | | (portion = | 17.7% ) | | $242,533 | | (portion = | 12.2% ) | | | | $2,980 /yr |
| Disposal/recharge | | (portion = | 36.5% ) | | $1,459,359 | | (portion = | 35.1% ) | | | | $29,832 /yr |
| Land | | (portion = | 35.1% ) | | $217,523 | | | | | | | |
| Total | | | | | $12,219,216 | | | | | | | $253,711 /yr |
| Total including contingency @ | | 20% | | | $14,663,059 | | | | | | | |
| Total including engineering, administration @ | | | 20% | | $17,595,671 | | | | | | | |
| Total, including financing and bonding @ | | | 23% | | $21,642,675 | | | | | | | |
| On–lot costs | | | | | | | | | | | | |
| Septic tank abandonment | 1,533 | ea @ [e] | $1,000 | = | $1,533,000 | | | | | | | |
| House lateral | | | | | | | | | | | | |
| 4 –in. { | 60 | ft ea. | | | | | | | | | | |
| { | 83,520 | ft @ | $15 | = | $1,252,800 | | | | | | | |
| Future | 107,554 | ft [k] @ | $7 | = | $752,876 | [l] | | | | | | |
| Total on–lot costs | | | | | $3,538,676 | | | | | | | |
| Total including contingency @ | 20% | | | | $4,246,412 | | | | | | | |
| GRAND TOTAL | | | | | $25,889,087 | | | | | | | |

## Area Q – Combination of Areas A, D, H, I, J, L, M

### Q–1 Conventional project

**Adjustment for STEP/STEG** NOT USED

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. [m] | 80,050 | ft @ | $19 [k] | = | $1,520,950 | | | | | |
| 3 –in. [m] | 2,500 | ft @ | $21 [k] | = | $52,500 | | | | | |
| 4 –in. [m] | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | 0 | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 82,550 | ft | | | | 82,550 | ft @ | $0.50 | = | $41,275 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 1,533 | ea [k] @ | $2,000 | = | $3,066,000 [including house lateral] | | @ | $140 [p] | = | $214,620 /yr |
| Lateral 2 –in. | 121,520 | ft @ | $19 | = | $2,308,880 [Street] | | | | | |
| Future tank/pump | 1,934 | ea @ | $1,000 | = | $1,934,000 [l] | | @ | $100 [p,l] | = | $193,400 /yr |
| Future lateral | 17,143 | ft @ | $9 | = | $154,283 [l] | | | | | |
| Septic tank abandonment | | | | | $1,533,000 | | | | | |
| Savings in treatment by reduced BOD and SS in septic tank effluent [r] | | | | | ($812,213) | | | | | ($22,863) /yr |
| Revised subtotal, STEP/STEG | | | | | $9,757,399 | | | | | $426,432 /yr |
| Less conventional facilities (sewers, laterals) | | | | | ($9,080,231) | | | | | ($82,493) /yr |
| Adjusted total, STEP/STEG | | | | | $12,896,384 | | | | | $597,650 /yr |
| Total including contingency @ | 20% | | | | $15,475,660 | | | | | |
| Total including engineering, administration @ | | 20% | | | $18,570,793 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $22,842,075 | | | | | |

**Adjustment for grinder pumps** NOT USED

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 80,050 | ft @ | $19 [k] | = | $1,520,950 | | | | | |
| 3 –in. | 2,500 | ft @ | $21 [k] | = | $52,500 | | | | | |
| 4 –in. | 0 | ft @ | $22 [k] | = | $0 | | | | | |
| 6 –in. | | ft @ | $30 [k] | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 [k] | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 [k] | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 [k] | = | $0 | | | | | |
| Total | 82,550 | ft | | | | 82,550 | ft @ | $0.50 | = | $41,275 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 1,533 | ea [k] @ | $2,500 | = | $3,832,500 [including house lateral] | | @ | $0 [q] | = | $0 /yr |
| Lateral 2 –in. | 121,520 | ft @ | $19 | = | $2,308,880 [Street] | | | | | |
| Future tank/pump | 1,934 | ea @ | $1,000 | = | $1,934,000 [l] | | @ | $75 [q,l] | = | $145,050 /yr |
| Future lateral | 17,143 | ft @ | $9 | = | $154,283 [l] | | | | | |
| Septic tank abandonment | | | | | $1,533,000 | | | | | |
| Revised subtotal, grinder | | | | | $11,336,113 | | | | | $186,325 /yr |
| Less conventional facilities (sewers, pumping stations, forcemains, laterals) | | | | | ($9,080,231) | | | | | ($82,493)/yr |
| Adjusted total, grinder | | | | | $14,475,097 | | | | | $357,544 /yr |
| Total including contingency @ | 20% | | | | $17,370,117 | | | | | |
| Total including engineering, administration @ | | 20% | | | $20,844,140 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $25,638,292 | | | | | |

## Area Q – Combination of Areas A, D, H, I, J, L, M

### Q–1 Conventional project

NOTE: references in [brackets] are on Sheet A.

a. Table 3–2A, B, C, D.
Number of services excludes areas J and M, which have existing community sewer systems.

b. M&E Task F report, Appendix D.

c. [2] unless noted, adjusted to ENR 6550 from 5480 .

d. [3] unless noted adjusted for ENR: 5377 in [3] and 6550 current (Los Angeles/San Francisco).

e. Appendix D.

f. Based on the following exponent factors applied to average flow.

| | Capital | O&M |
|---|---|---|
| Lift/pumping stations | 0.3 | 0.5 |
| Force mains, interceptors | 0.35 | 0.2 |
| Treatment plant | -- | 0.5 |
| Headworks | 0.8 | -- |
| Secondary treatment | 0.5 | -- |
| Tertiary treatment | 0.5 | -- |
| Biosolids handling | 0.8 | -- |
| Effluent pumping station | 0.8 | -- |
| Ancillary facilities | 0.6 | -- |
| Effluent forcemain | 0.3 | 0.2 |
| Disposal/recharge | 0.7 | 0.6666667 |
| Land | 0.66667 | -- |

g. Based on $0.10 / kwh/hr, 4 hr/wk @ $30 /hr, and 2% of capital costs.

h. Based on $1.00 /ft/yr.

i. Based on 12 years at 0% .

j. Based on $0.10 / kwh/hr, 1 hr/wk @ $30 /hr, and 2% of capital costs.

k. For cost purposes only, based on 4 multiple family units = 1 DU.

l. Based on present worth of future installations over a 20–year period at 7%.
For O&M, average cost over a 30–year period.

m. Assume: 2–in. pipeline substitutes for 6– and 8–in. gravity sewer.
3–in. pipeline substitutes for 10–in. gravity sewer.
4–in. pipeline substitutes for 12–in. and greater gravity sewer.

n. Takeoffs from 200–scale drawings [2].

o. Flow portions:

| | |
|---|---|
| FM –1 | 0.0% |
| FM –2 | 0.0% |
| FM –3 | 0.0% |
| I–1 | 63.7% |
| I–2 | 78.0% |
| I–12 | 71.2% |
| I–3 | 56.2% |
| LS –1 | 0.0% |
| LS –2 | 0.0% |
| LS –3 | 0.0% |
| PS –1 | 63.7% |
| PS –2 | 78.0% |
| Bayridge Estates STEP | 100.0% |
| Main pumping station (PS–3) | 56.2% |
| Force main to treatment plant | 47.7% |
| Treatment plant | 47.7% |
| Headworks | 47.7% |
| Secondary treatment | 47.7% |
| Tertiary treatment | 47.7% |
| Biosolids handling | 47.7% |
| Effluent pumping station | 47.7% |
| Ancillary facilities | 47.7% |
| Land | |
| Effluent force main | 47.7% |
| Disposal/recharge | 47.7% |
| Land | 47.7% |

p. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh; 50 ft average TDH; $200 septage pumping every 5 years.

q. Based on:
2 hr/yr inspection and service at $30 /hr; 2% of capital for maintenance; electricity at $0.10 /kwh; 50 ft average TDH.

r. Based on reduced costs of headworks, secondary treatment, biosolids handling, and land in proportion to a 50% reduction in BOD and SS and exponents in note f. O&M costs proportional to capital costs and exponent in note f.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area Q – Combination of Areas A, D, H, I, J, L, M**

**Q–2 Local collection, treatment, and dispose/recharge (existing systems at Vista de Oro and Bayridge Estates not retained)**

**Cost for Alternative Q–2 Buildout – same as Q–1 unless noted**

| | Construction | | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gravity sewer | | | | | | | | | |
| 6 –in. | 0 | ft @ | $26 | = | $0 | | | | |
| 8 –in. | 67,770 | ft @ | $27 | = | $1,829,790 | | | | |
| 10 –in. | 1,120 | ft @ | $29 | = | $32,480 | | | | |
| 12 –in. | 240 | ft @ | $34 | = | $8,160 | | | | |
| 15 –in. | 0 | ft @ | $39 | = | $0 | | | | |
| Dewatering – none | 0 | ft @ | $19 [k] | = | $0 | | | | |
| Manholes | 220 | @ | $1,500 | = | $330,000 | | | | |
| Pressure Sewer | | | | | | | | | |
| 2 –in. | 12,280 | ft @ | $19 | = | $233,320 | | | | |
| 3 –in. | 2,260 | ft @ | $21 | = | $47,460 | | | | |
| STEP systems | 141 | @ | $2,000 | = | $282,000 | @ | $140 | = | $19,740 /yr |
| Total | 69,130 | ft | | | | @ | $0.75 | = | $51,848 /yr |
| Y–connection; street lateral | | | | | | | | | |
| 4 –in. { | 40 | ft ea. | | | | | | | |
| { | 121,520 | ft @ | $21 | = | $2,551,920 | | | | |
| Future | 17,143 | ft [f] @ | $10 | = | $171,425 [g] | | | | |
| Treatment plant | 0.7634 | mgd (buildout) | | | $4,219,835 [a] | | | | $278,567 /yr [b] |
| Disposal/recharge (buildout) | | | | | $2,459,155 [b] | | | | |
| Land (buildout) | 17 | ac @ | $34,435 | | $585,395 [b] | | | | |
| Alternative treatment plant: @ | $3.11 /gal, | | $2,370,968 [c] | | | $174,000 /yr [d] | | | |
| Total | | | | | $12,750,940 | | | | $350,154 /yr |
| Total including contingency @ | 20% | | | | $15,301,129 | | | | |
| Total including engineering, administration @ | 20% | | | | $18,361,354 | | | | |
| Total, including financing and bonding @ | 23% | | | | $22,584,466 | | | | |
| Revised total with alternative treatment plant | | | | | $10,902,074 | | | | $245,588 /yr |
| Total including contingency @ | 20% | | | | $13,082,488 | | | | |
| Total including engineering, administration @ | 20% | | | | $15,698,986 | | | | |
| Total, including financing and bonding @ | 23% | | | | $19,309,753 | | | | |
| On–lot costs | | | | | | | | | |
| Septic tank abandonment | 1,533 | ea @ | $1,000 | = | $1,533,000 | | | | |
| Lateral | | | | | | | | | |
| 4 –in. { | 60 | ft ea. | | | | | | | |
| { | 83,520 | ft @ | $15 | = | $1,252,800 | | | | |
| Future | 107,554 | ft [f] @ | $7 | = | $752,876 [g] | | | | |
| Total on–lot costs | | | | | $2,785,800 | | | | |
| Total including contingency @ | 20% | | | | $3,342,960 | | | | |
| GRAND TOTAL | | | | | $25,927,426 | | | | |
| GRAND TOTAL with alternative treatment plant | | | | | $22,652,713 | | | | |

Area Q – Combination of Areas A, D, H, I, J, L, M

Q–2 Local collection, treatment, and dispose/recharge (existing systems at Vista de Oro and Bayridge Estates not retained)

**Adjustment for STEP/STEG – same as Q–1 unless noted.** **NOT USED**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 67,770 | ft @ | $19 | = | $1,287,630 | | | | | |
| 3 –in. | 1,120 | ft @ | $21 | = | $23,520 | | | | | |
| 4 –in. | 240 | ft @ | $22 | = | $5,280 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 69,130 | ft | | | | 69,130 | ft @ | $0.50 | = | $34,565 /yr |
| On–lot costs | | | | | | | | | | |
| New tank/pump | 1,533 | ea @ | $2,000 | = | $3,066,000 [including house lateral] | | @ | $140 | = | $214,620 /yr |
| Lateral 2 –in. | 121,520 | ft @ | $19 | = | $2,308,880 Street | | | | | |
| Future tank/pump | 1,934 | ea @ | $1,000 | = | $1,934,000 [g] | | @ | $100 [g] | = | $193,400 /yr |
| Future lateral | 17,143 | ft @ | $9 | = | $154,283 [g] | | | | | |
| Septic tank abandonment | | | | | $1,533,000 | | | | | |
| Sand filter treatment plant, including land [e]. | | | | | $8,403,368 | | | | | $53,801 /yr |
| Revised subtotal, STEP/STEG | | | | | $18,715,961 | | | | | $496,386 /yr |
| Less conventional plant + land (not disposal) | | | | | ($4,805,230) | | | | | ($278,567)/yr |
| Less conventional facilities | | | | | ($8,272,355) | | | | | ($71,588)/yr |
| Adjusted total, STEP/STEG | | | | | $18,389,316 | | | | | $496,386 /yr |
| Total including contingency @ | 20% | | | | $22,067,179 | | | | | |
| Total including engineering, administration @ | | 20% | | | $26,480,615 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $32,571,157 | | | | | |

**Adjustment for grinder pumps – same as Q–1 unless noted.**

| | Construction | | | | | O&M | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure sewer/forcemain | | | | | | | | | | |
| 2 –in. | 67,770 | ft @ | $19 | = | $1,287,630 | | | | | |
| 3 –in. | 1,120 | ft @ | $21 | = | $23,520 | | | | | |
| 4 –in. | 240 | ft @ | $22 | = | $5,280 | | | | | |
| 6 –in. | | ft @ | $30 | = | $0 | | | | | |
| 8 –in. | | ft @ | $35 | = | $0 | | | | | |
| 10 –in. | | ft @ | $40 | = | $0 | | | | | |
| 12 –in. | | ft @ | $45 | = | $0 | | | | | |
| Total | 69,130 | ft | | | | 69,130 | ft @ | $0.50 | = | $34,565 /yr |
| On–lot costs | | | | | | | | | | |
| New pump (simplex) | 1,533 | ea @ | $2,500 | = | $3,832,500 [including house lateral] | | @ | $0 | = | $0 /yr |
| Lateral 2 –in. | 121,520 | ft @ | $19 | = | $2,308,880 [Street] | | | | | |
| Future tank/pump | 1,934 | ea @ | $1,000 | = | $1,934,000 [g] | | @ | $75 [g] | = | $145,050 /yr |
| Future lateral | 17,143 | ft @ | $9 | = | $154,283 [g] | | | | | |
| Septic tank abandonment | | | | | $1,533,000 | | | | | |
| Revised subtotal, grinder | | | | | $11,079,093 | | | | | $179,615 /yr |
| Less conventional facilities | | | | | ($8,272,355) | | | | | ($71,588)/yr |
| Adjusted total, grinder | | | | | $15,557,678 | | | | | |
| Total including contingency @ | 20% | | | | $18,669,214 | | | | | |
| Total including engineering, administration @ | | 20% | | | $22,403,056 | | | | | |
| Total, including financing and bonding @ | | 23% | | | $27,555,759 | | | | | $108,028 /yr |

NOTE: references in [brackets] are on Sheet A.

a. Based on SBR technology, quotes from vendors, and percentages of site work, mechanical, electrical, etc.
b. Proportional to costs on Sheet B with exponents from note f on Sheet B.
c. Based on AES system but is representative of other treatment systems.
d. Based on:
   67 hr/wk @ $30 /hr [6]
   2.0% of capital cost
   0.001 kwh/gal from AES.
   $0.10 /kwh
e. Based on [7].
f. For cost purposes only, based on 4 multiple family units = 1 DUE.
g. Based on present worth of future installations over a 20–year period at 7%. For O&M, average cost over a 30–year period.

Calculated: HLS
Checked: NKD
Reviewed: CEP

**Area Q – Combination of Areas A, D, H, I, J, L, M**

**Q–3 Enhance/upgrade existing onsite systems (including existing systems at Vista de Oro and Bayridge Estates)**

**Cost for Alternative Q–3 Buildout – same as Q–1 unless noted**

| | | | Construction | | | O&M | | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | % of existing units | | | | | | | |
| Retrofit | 100% | 1,533 units @ | $3,000 [a] | = | $4,599,000 | @ | $157 [b] = | $241,141 |
| New | 0% | 0 units @ | $4,400 [a] | = | $0 | @ | $157 [b] = | $0 |
| New to buildout | -- | 1,934 units [f] @ | $3,920 [a] | = | $7,579,150 [d] | @ | $107 [b,e] = | $207,835 |
| Total | | | | | $12,178,150 | | | $448,976 |
| Total including contingency @ | | 20% | | | $14,613,780 | | | |
| Total including engineering, administration @ | | | 20% | | $17,536,536 | | | |
| Total, including financing and bonding @ | | | 23% | | $21,569,939 | | | |
| Total including costs from Areas J and M | | | | | $21,821,694 | | | $514,810 |
| **Maximum** | % of existing units | | | | | | | |
| Retrofit | 83% | 1,272 units @ | $3,000 [a] | = | $3,816,000 | @ | $157 [b] = | $200,086 |
| New [c] | 17% | 261 units @ | $4,400 [a] | = | $1,148,400 | @ | $157 [b] = | $41,055 |
| New to buildout | -- | 1,934 units [f] @ | $3,920 [a] | = | $7,579,150 [d] | @ | $107 [b,e] = | $207,835 |
| | | | | | | | | $448,976 |
| Total | | | | | $12,543,550 | | | |
| Total including contingency @ | | 20% | | | $15,052,260 | | | |
| Total including engineering, administration @ | | | 20% | | $18,062,712 | | | |
| Total, including financing and bonding @ | | | 23% | | $22,217,135 | | | |
| Total including costs from Areas J and M | | | | | $22,468,890 | | | $514,810 |

a. Based on AES system. "New to buildout" cost includes leach field/pit for first 20 years (Appendix D)
b. Based on:
3 hr/yr @ $30 /hr (one inspection and one service call/year; administration)
2.0% of equipment (retrofit) capital cost
0.001 kwh/gal from AES.
$0.10 /kwh
c. Table 3–1
d. Present worth over first 20 years @ 7%.
e. Average cost over 30 –year period.
f. For cost purposes only, based on 4 multiple family units = 1 DUE.

**Area Q – Combination of Areas A, D, H, I, J, L, M**

**Q–4 Retain existing onsite systems (including existing systems at Vista de Oro and Bayridge Estates)**

Cost for Alternative Q–4 Buildout – same as Q–1 unless noted

| | | | Construction | | | | O&M | |
|---|---|---|---|---|---|---|---|---|
| **Minimum** | | | | | | | | |
| | % of existing units | | | | | | | |
| Replacement | 0% | 0 | units @ | $4,100 [a] | = | $0 | @ $182 [b] | $0 |
| No replacement | 100% | 1,533 | units @ | $90 [a] | = | $137,970 | @ $182 [b] | $279,006 |
| New to buildout | -- | 1,934 | units [f] @ | $2,172 [a] | = | $4,199,259 [d] | @ $124 [b,e] | $240,471 |
| Total | | | | | | $4,337,229 | | $519,477 |
| Total including contingency @ | | | 20% | | | $5,204,674 | | |
| Total including engineering, administration @ | | | | 20% | | $6,245,609 | | |
| Total, including financing and bonding @ | | | | 0% | | $6,245,609 | | |
| Total including costs from Areas J and M | | | | | | $6,245,609 | | $578,532 |
| **Maximum** | | | | | | | | |
| Replacement [c] | 17% | 261 | units @ | $4,100 [a] | = | $1,070,100 | @ $182 [b] | $47,502 |
| No replacement | 83% | 1,272 | units @ | $90 [a] | = | $114,480 | @ $182 [b] | $231,504 |
| New to buildout | -- | 1,934 | units [f] @ | $2,172 [a] | = | $4,199,259 [d] | @ $124 [b,e] | $240,471 |
| Total | | | | | | $5,383,839 | | $519,477 |
| Total including contingency @ | | | 20% | | | $6,460,606 | | |
| Total including engineering, administration @ | | | | 20% | | $7,752,728 | | |
| Total, including financing and bonding @ | | | | 0% | | $7,752,728 | | |
| Total including costs from Areas J and M | | | | | | $7,752,728 | | $578,532 |

a. Based on complete replacement of septic tank and leach field or pit (Appendix D).
For no replacement, based on initial inspection only (Appendix D).

b. Based on:
2 hr/yr @ $30 /hr (one inspection/year; administration)
2.0% of capital cost
$200 pumping every 5 years.

c. Table 3–1

d. Present worth over first 20 years @ 7%.

e. Average cost over 30 –year period.

f. For cost purposes only, based on 4 multiple family units = 1 DUE.

# APPENDIX D
# OTHER COST BACKUP

# APPENDIX D
# OTHER COST BACKUP

**TABLE D-1. NEW ONSITE SYSTEM CONSTRUCTION COSTS**
**New Septic Tank/Leach Pit or Leach Field System**

| | Cost, $ |
|---|---|
| Initial inspection | 90[a] |
| Excavation, backfill | 148 |
| Septic tank and installation | 1,000 |
| Leach pit | 2,000 |
| Restoration | 380 |
| Subtotal | 3,618 |
| (say) | 3,600 |
| Excavation, backfill | 148 |
| Septic tank and installation | 1,000 |
| Leach field | 3,000 |
| Restoration | 380 |
| Subtotal | 4,618 |
| (say) | 4,600 |
| Average septic tank and leach pit or leach field | 4,100 |

Note: Sources are contractor quotes unless noted.
a. Based on 3 hr @ $30/hr.

## TABLE D-2. ONSITE REACTOR CONSTRUCTION COSTS

| | Labor, hr | Labor, $[a] | Equipment/ fees, $ | Total, $ |
|---|---|---|---|---|
| Retrofit | | | | |
| Pump tank | -- | -- | 200 | 200 |
| Install equipment[b] | -- | -- | 2,000 | 2,000 |
| Restoration | -- | -- | 380[c] | 380 |
| Subtotal | 10 | 300 | 2,580 | 2,880 |
| Inspection/startup | 4 | 120 | -- | 120 |
| Total | 14 | 420 | 2,580 | 3,000 |
| New | | | | |
| Excavate/backfill, install tank and equipment[b] | -- | -- | 2,800 | 2,800 |
| Restoration | -- | -- | 380[c] | 380 |
| Subtotal | 4 | 120 | 3,180 | 3,300 |
| Inspection/startup | 3 | 90 | -- | 90 |
| Abandon existing system | -- | -- | 1,000 | -- |
| Total | 7 | 210 | 4,180 | 3,390 |
| (say) | | | | 3,400 |
| New cost with installation of leach field/pit | | | 3,000 | 7,400 |

Note: Sources are vendor or contractor quotes unless noted.
a. Based on $30/hr.
b. Includes electrical and/or plumbing connections.
c. Table D-1.

FIGURE D-1. CONSTRUCTION COSTS OF TREATMENT PLANTS

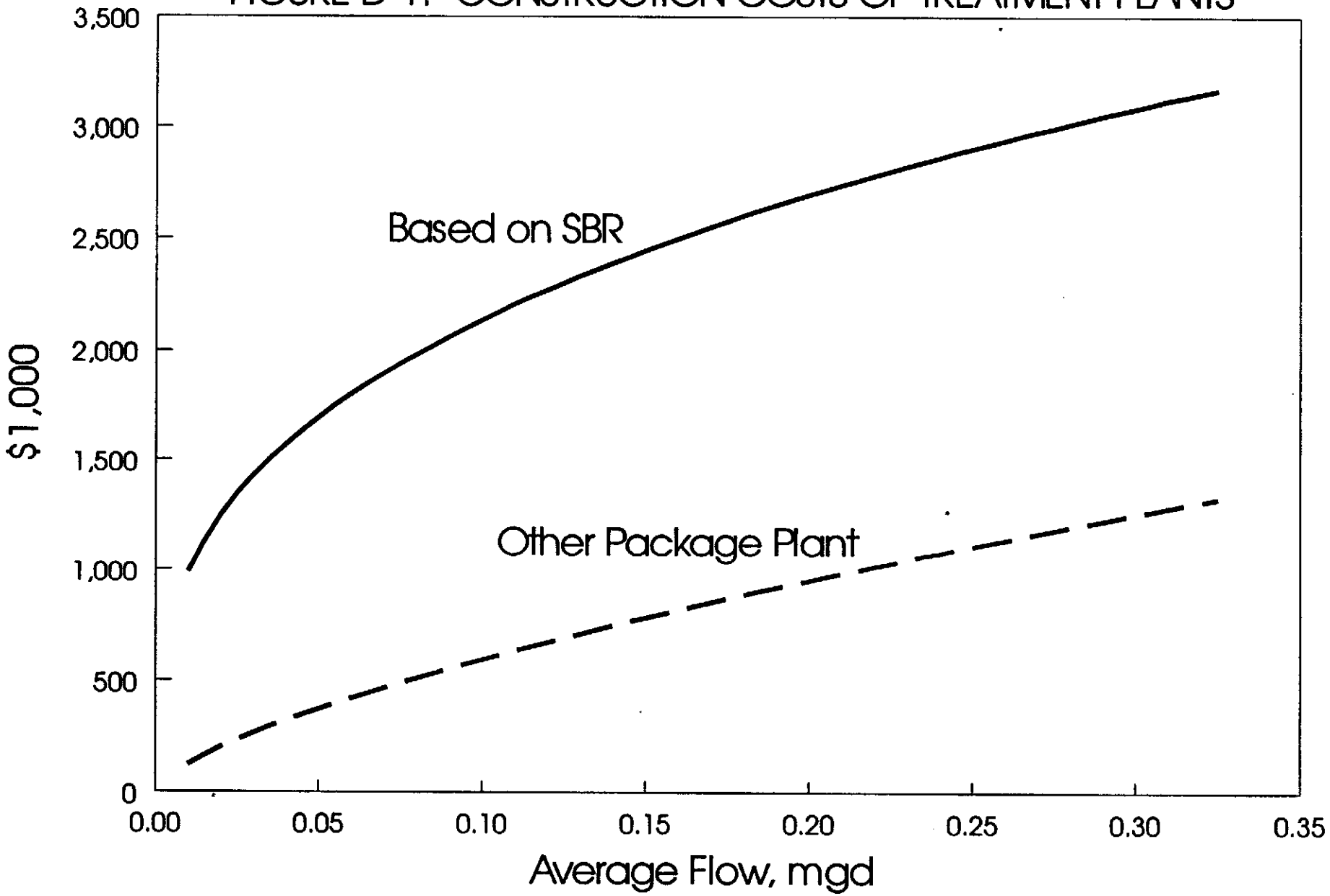


FIGURE D-2. O&M COSTS OF TREATMENT PLANTS

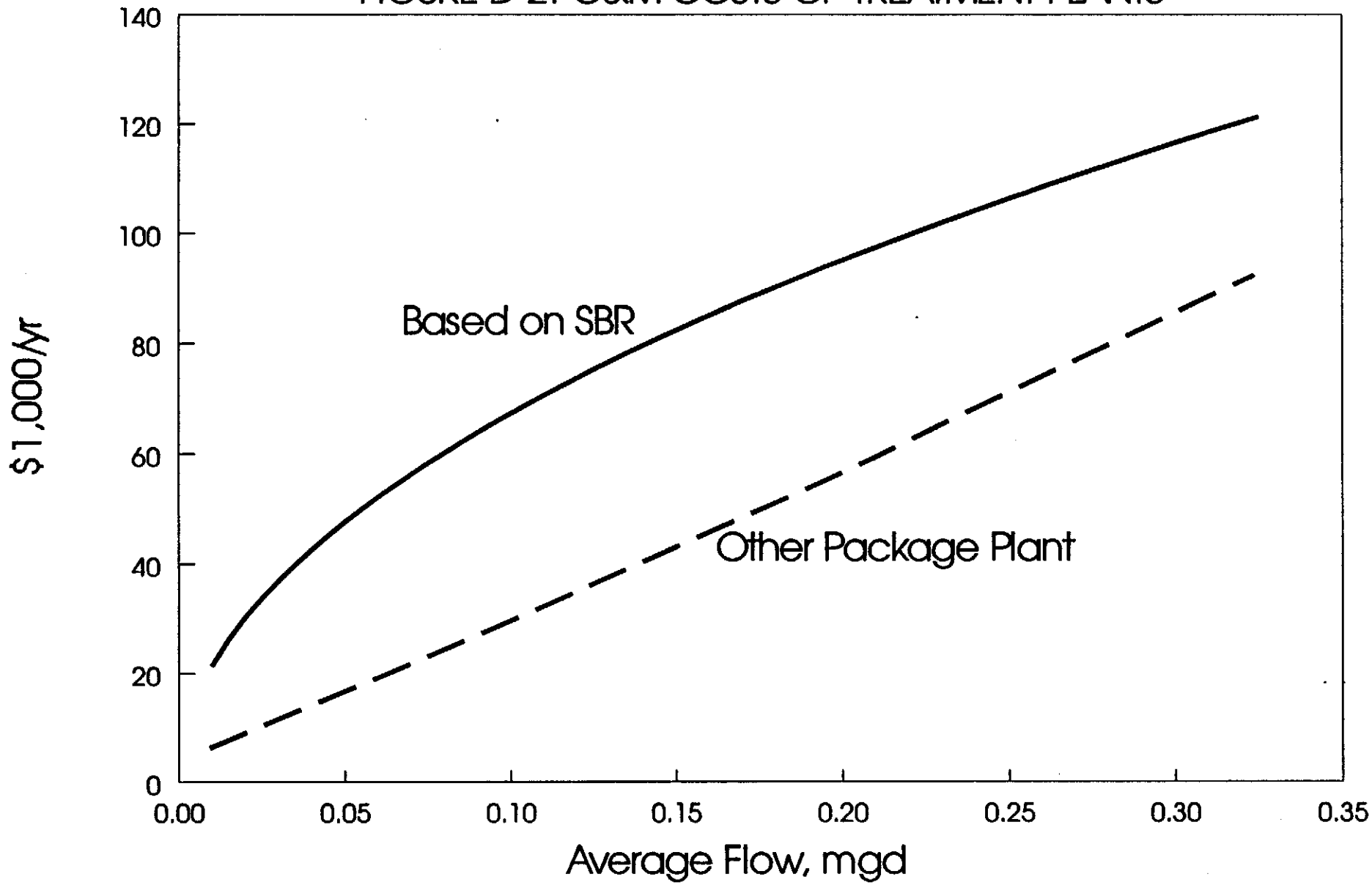
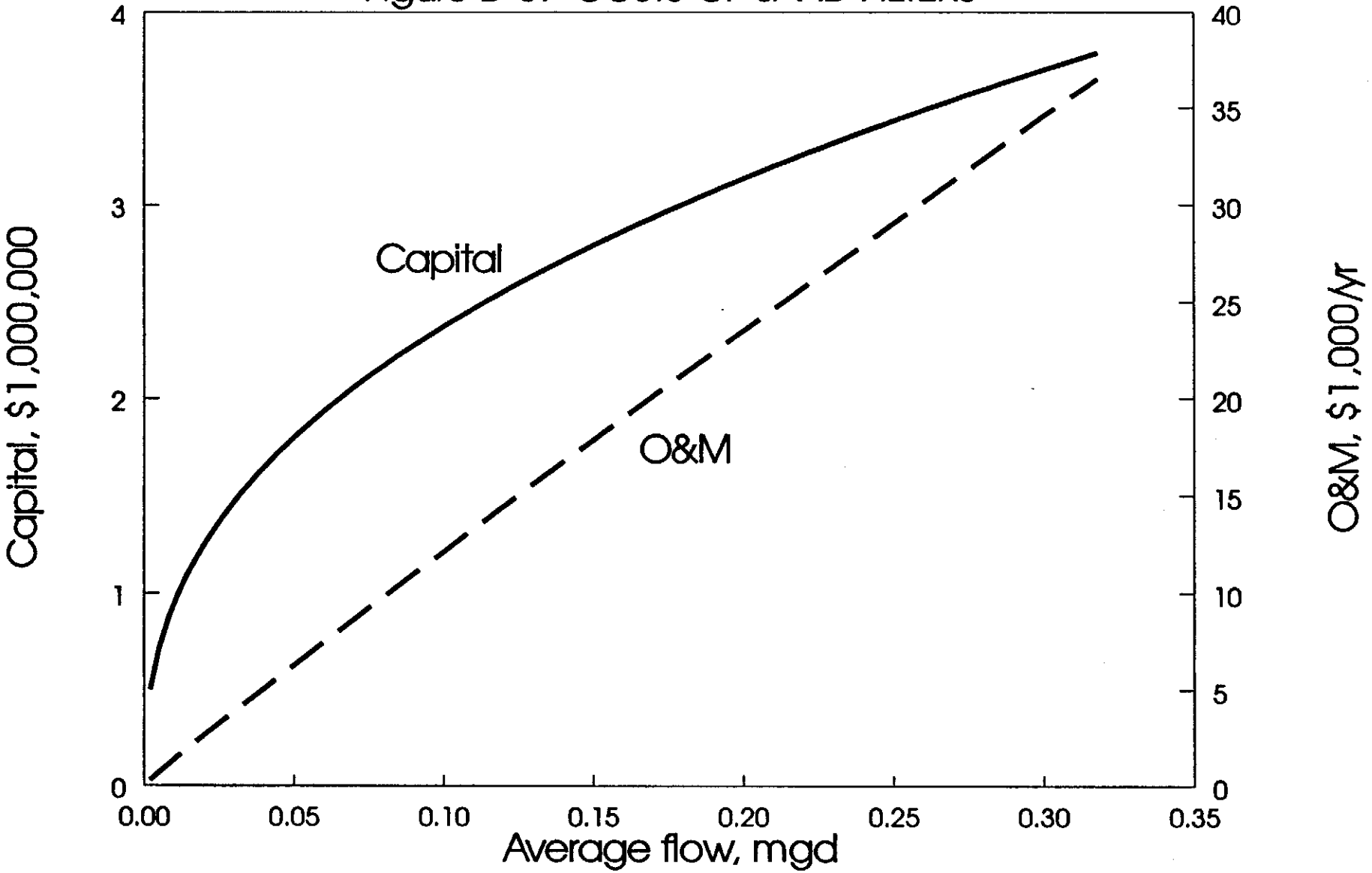


Figure D-3. COSTS OF SAND FILTERS



# APPENDIX E

# ONSITE WASTEWATER DISPOSAL
# SURVEY

## Table E-1 SURVEY OF ONSITE WASTEWATER DISPOSAL ZONE PROGRAMS
### Telephone Survey, June 1995

| | The Sea Ranch | Town of Paradise | Stinson Beach | Georgetown |
|---|---|---|---|---|
| Year formed | 1990 | 1992 | 1978 | 1972 |
| No. developed lots | 1,557 | 12,000 | 676 | 900 |
| Startup activities | • Inventory of existing systems<br>• Soil data<br>• Develop inspection forms | • Develop brochures<br>• Other activities, N/A | • Initial inspections<br>• Repair, permitting, education | • Soil testing<br>• Standard designs<br>• Billing program<br>• Inventory of existing systems |
| Startup costs | $100,000 | $50,000 | N/A | N/A |
| Failing systems at initial inspection | N/A | • 15% initial<br>• 3-5%/yr thereafter | 10% | 5% |
| Ongoing activities | • Inspection every 3 years<br>• Issue permits for repairs<br>• Sampling and testing surface and ground water | • Issue permits<br>• Inspection every 1-7 years<br>• Water quality monitoring | • Inspection every 6 months to 2 years<br>• Water quality monitoring | • Inspection every 4-17 months<br>• Water quality monitoring<br>• Education<br>• Minor repairs |
| Other comments | • No maintenance done by Zone | • No repair work done | • No repair work done | |
| Annual fees per system | $92 | $30-35[a] | $318 | $75-268[b] |

a. Actual is $14.40, but this does not cover all costs. Figure shown represents charge that would probably cover costs.
b. Depending on type of system.
N/A: information not available