San Luis Obispo County
Los Osos Wastewater Project Development

TECHNICAL MEMORANDUM

ONSITE TREATMENT

FINAL DRAFT
January 2008

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1.0 INTRODUCTION

The purpose of this technical memorandum (TM) is to identify for further discussion a list of issues for the use of onsite treatment in Los Osos. The concept of onsite treatment is to treat and reuse/dispose of the wastewater at the spot where it is generated, rather than collecting the wastewater and conveying it to one centralized location for treatment. In the 1970's, regulatory agencies encouraged moving to centralized treatment for either single or multiple communities for the purpose of providing higher levels of treatment and improved water quality. However, construction of a collection system for centralized treatment can be costly in areas with low density, or in areas that are already fully developed.

This TM addresses the option of onsite treatment for the community of Los Osos and evaluates the issues and feasibility of implementation. It reviews general issues, including treatment technology, operational issues, and costs. This TM also evaluates some of the specific issues facing implementation of onsite treatment in Los Osos.

2.0 GENERAL ISSUES

On-site treatment may be favorable for communities for which the construction of a collection system is expensive. In an onsite treatment system, wastewater remains where it is generated and can be used for irrigation or to replenish the local groundwater. However, there are several issues with onsite treatment, principally the ability to treat to meet strict water quality standards.

2.1 Types of Treatment

The simplest form of onsite treatment is the septic tank. Wastewater flows from a household into a buried tank. Non-degradable solids settle to the bottom and need to be pumped every few years. Dissolved oxygen is quickly consumed during the degradation of organic material, so the tanks become anaerobic, and much of the bioavailable carbon is digested, producing carbon dioxide and methane. Because of the lack of oxygen, most of the nitrogen remains in ammonia and organic form, and is not nitrified. Therefore, denitrification cannot occur, and most of the influent nitrogen is discharged with the septic tank effluent. Septic tanks typically discharge to leachfields, which provide some further treatment by filtering the septic tank effluent. In the soil, effluent nitrogen is converted to nitrate, which can build up in the groundwater over time and lead to a public health risk.

Because septic tank and leachfield discharges provide inadequate treatment in many instances, supplementary treatment technologies can be added to treat septic tank effluent to meet higher quality effluent requirements.

2.1.1 Attached Growth Treatment Systems

The most common supplementary treatment technology is the intermittent or recirculating sand or media filter. Table 1 compares the performance and design parameters of these two filters.

Table 1 Sand/Media Filter Design Criteria and Performance[1]
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Filter	Footprint (ft^2/gal/day)	Typical Depth (inches)	%BOD Removal	%Total N Removal	%Fecal Coliform Removal
Intermittent	0.8	24	90-99	10-48	99.3-99.9
Recirculating	0.25	24	96-98	44-82	99.9

Note:
(1) From Crites and Tchobanoglous, 1998

Intermittent sand or media filters can be purchased as kits containing all of the necessary components, including a PVC liner, dosing chamber, pumps and electrical panel. The sand filter is dosed with septic tank effluent at least 18 times/day, or more with elevated BOD (>200 mg/l). Systems need to be designed to handle peak flow, which is usually calculated to be 2.5 times base flow. Therefore, an intermittent sand filter treating a household generating and average of 200 gpd will require a footprint of approximately 350 ft^2.

Recirculating sand or media filters are more complex because of the return flow, but can also be purchased as kits. Recirculation ratios are typically 4 to 1. Although they are more costly, they produce a higher quality effluent than single-pass filters with a smaller footprint. For a single home producing 200 gpd, the footprint would be approximately 110 ft^2.

2.1.2 Attached Growth Denitrification

For an onsite system to reduce effluent nitrogen to less than 7 mg/L, which is the highest concentration that would likely be permittable, at least 88% removal would have to be consistently attained. Because sand or media filters provide poor to moderate nitrogen removal that would not be sufficient for this goals, a denitrification filter will be needed where there are groundwater nitrogen limits.

There are several anoxic filters that are capable of reducing nitrate to low levels due to an organic filter medium that provides additional carbon. Most of these filters require the addition of a carbon source such as methanol or a detergent. The Nitrex™ system involves passing nitrified effluent through an organic filter medium that also provides the additional carbon source. The manufacturers claim that more than 95 percent of the nitrate is

denitrified, more than any of the other denitrifying filters. At a 35-unit senior citizen's complex located in Burford, Ontario, the Nitrex™ system was installed in 1999 and has consistently allowed the development to attain the nitrate limit of 1.5 mg/L. However, total nitrogen removal is strongly dependent on the nitrification step, since Nitrex™- will not remove organic or ammonia nitrogen, both of which will convert to nitrate after discharge to soils.

2.1.3 Suspended Growth Treatment Systems

Suspended growth systems have the advantage over attached growth systems that they generally have a smaller footprint. Like attached growth systems, they can be purchased in the form of pre-manufactured kits. They are often in the form of a cylindrical tank, where aeration and settling take place, and have a footprint of 25 to 75 ft^2. In general, suspended growth systems cannot meet effluent nitrogen limits of 7 mg/L, and would require a separate denitrification step. Some package systems have separate anoxic tanks, where denitrification takes place. However, compared to attached growth processes, energy and maintenance requirements are high, so they are not as popular as attached growth filters. Sludge removal is also a component of these systems, unlike for attached growth processes.

2.1.4 Supplementary Treatment Reliability

All of these supplementary technologies rely on biological treatment. If a household is vacant for part of the year, the microbes will die during this period, and the supplementary treatment will take some time to reestablish its microbial communities after the flows start up again. Los Osos is not a vacation community, so this issue is not a fatal flaw. However, it should be considered in choosing a treatment concept, since it could affect effluent quality in households where residents are frequently out of town.

2.1.5 Effluent Irrigation

If effluent is reused for irrigation, then some of the nitrogen will be taken up and used as fertilizer by growing plants. However, for this to represent a true removal, the plants need to be harvested (collected) and taken offsite, so the nitrogen is not reintroduced to the groundwater when they decompose. Where the irrigation is a park or golf course, this may be standard practice with grass, however if the reuse is for residential irrigation, it is difficult to ensure proper removal is occurring. Additionally, nitrogen uptake is dependent on plant type and, therefore the uptake will be slower for residences where homeowners have slow growing plants or drought tolerant plants rather than lawns that are regularly mowed and cleared of clippings. For warm weather grasses such as Bermuda grass (Table 2) uptake is reduced in the winter when the plants become dormant although their ability to uptake nitrogen in the summer is high. Cool weather grasses such as Kentucky Bluegrass can continue to grow year-round in a climate lacking temperature extremes, such as Los Osos', but their total ability to uptake nitrogen is less than warm weather grass'. Other plants such

as trees or vegetables have much less of an ability to uptake nitrogen than grass, with more than 50 percent of applied nitrogen being lost to leaching (Pettygrove and Asano, 1985).

The nitrogen uptake estimates for turf grass in Table 2 represent a best-case scenario for Los Osos, since many homes in the community have plants other than turf grass, or no landscaping at all. Wet weather increases downward transport of effluent during rainfall events, quickly moving nitrate beyond the range of plant roots. Sandy soils, like those underlying Los Osos, are particularly poor at retaining nitrate. Therefore, residential plant uptake cannot reliably remove enough nitrogen year-round from effluent to be protective of the groundwater if the effluent is not sufficiently denitrified.

Table 2 Estimated Nitrogen Uptake by Warm and Cool Weather Grasses(1)
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Grass type	Range of Nitrogen Uptake, lbs/day - Summer (2)	Range of Nitrogen Uptake, lbs/day - Winter (2)	Range of Untreated Wastewater, lbs/day(3)	Filter-Treated Wastewater, lbs/day (4)
Warm Weather Grass - Bermudagrass	680-1200	0	400-900	300
Cool Weather Grass - Kentucky Bluegrass	170 - 230	170 - 230	400-900	300

Notes:

(1) Crites et al., 2000.

(2) Assuming 330 acres of irrigated land in the Los Osos Prohibition Zone (0.07 acres per home - approx half of the most common lot size). These are best-case scenarios, since much of Los Osos is landscaped with plants other than turf grass.

(3) Assuming 0.02-0.048 lbs/day/person, population 18,428

(4) Assuming sand filter effluent concentration of 30 mg/L (Crites and Tchobanoglous, 1998)

2.2 Operational Issues

While many onsite systems require little maintenance, they often fail because owners assume that they need no maintenance. Stinson Beach, California, addressed this issue with their Onsite Wastewater Management Program. It was recognized in the 1960s that failing septic tanks and leachfields were contributing to the contamination of the nearby lagoon. After several failed attempts to construct a centralized collection and treatment system, the Stinston Beach County Water District formed a Management District for the inspection and maintenance of onsite wastewater disposal systems. This approach of allowing continued onsite systems if they were centrally managed was permitted by the San Francisco Regional Water Quality Control Board in 1978. Today in Stinson Beach, septic tanks and leachfields are regularly inspected, and new construction is required to install

systems that conform to a new code. In areas with poor percolation rates or shallow depth to groundwater, supplementary technologies such as sand filters are required to provide additional treatment to septic tank effluent.

Onsite Wastewater Management Districts have become a common way to centrally administer onsite systems and ensure that they function properly and that their effluent is protective of the groundwater. Besides Stinson Beach, such programs exist in Paradise, Georgetown, Placerville and Sea Ranch, California.

In addition and in response to inspection and monitoring, onsite systems require maintenance, which is usually the responsibility of the homeowner. Many package systems include automatic alarms to alert the homeowner if there is a problem, and are sold with service contracts. But rather than depending on emergency maintenance, on site systems need regular maintenance, such as removal and off-hauling of sludge from systems with septic tanks and suspended growth systems.

Los Osos homeowners likely would be regulated under a County code, which may need to be drafted for this project in conjunction with the CCRWQCB. If similar monitoring requirements apply to onsite systems as centralized systems then tests would have to be run on each home, multiplying the project monitoring cost over those of centralized treatment by a factor of the number of households. These requirements are further discussed in Section 4.1.

2.3 Year Round Disposal

The two most common disposal methods of effluent from an onsite treatment system are subsurface irrigation of onsite plants and grasses, or ground disposal via leachfields. While subsurface irrigation would be tenable during most of the year, during storm events it would not be practicable, due to the excess ground moisture. Therefore, each treatment system would either need to include storage or a switch automatically activated by a sensor to connect to the existing leachfields.

3.0 LOS OSOS-SPECIFIC ISSUES

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

3.1 Approximate Size Required/on-Lot Impacts

Installing an on-site treatment system would incur extensive on-lot impacts in Los Osos. First, any treatment system that included the use of a septic tank would require the replacement of the existing septic tanks to ensure no leakage. Additional treatment steps would require between 25 ft^2 of excavation adjacent to the septic tanks to install a small

suspended growth system to 350 ft^2 to install an intermittent attached growth filter. There are some households in Los Osos where it would be difficult to site a supplementary system.

For effluent disposal, either direct discharge to the groundwater via existing leachfields, or subsurface irrigation would be used. If the latter were selected, then each yard would need to be redeveloped to include a network of irrigation lines. Some homes do not have any irrigation, so the effluent would need to be routed to the existing leachfields.

3.2 GW Balance/Recharge

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

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

3.3 GW Contamination

Because the upper aquifer below Los Osos is contaminated with nitrate, if an onsite system was permitted, the effluent nitrogen limits would be low. In waste discharge requirements (WDRs) issued for previous project, the Regional Water Quality Control Board has established effluent limits at 7 mg/l to be protective of groundwater in Los Osos. However, when issuing a WDR for onsite systems, more stringent effluent nitrogen limits could be imposed.

3.4 Cost Estimates

The cost of the onsite treatment option depends on what supplementary treatment technology is considered and how the effluent is disposed (Table 3). The range of costs is comparable to that of the centralized treatment option.

Table 3 Onsite Treatment Costs per Household[1]
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Item	Cost[1] ($M)
Package Aerobic Treatment System	$10,000 - $20,000[2]
Denitrification Filter	$5,000[3]
Septic Tank Replacement	$3,000[4]
Subsurface Drip Installation	$6,000 - $15,000[5]
Cost Per Household	**$24,000 - $43,000**
Construction Cost for 4,769 Households	**$110M - $200M**

Notes:
(1) Conceptual level estimate.
(2) Leverenz et al., 2002; LOCSD presentation of pilot project from Ventura county evaluating onsite systems.
(3) Lombardo and Associates http://www.lombardoassociates.com/nitrex.shtml.
(4) Fine Screening Report.
(5) Drip irrigation costs based on installation at $2-5/ft^2, 0.07 acres per household. Includes lawn restoration.

4.0 REGULATORY CONCERNS

4.1 Monitoring Requirements

4.1.1 AB 885

California Assembly Bill 885 is legislation related to statewide minimum standards for onsite sewage treatment systems that was signed by the Governor in September, 2000. Currently, the resulting regulations exist in draft form. If the Central Coast Regional Water Quality Control Board (Regional Board) were to permit continued use of onsite systems in Los Osos, it would be with the provision that each homeowner install treatment components supplemental to the septic tank. Under the draft regulations, these components are required to be intensively monitored, which could be a considerable burden on the homeowner, or a central management district, if the responsibility for monitoring was transferred to such a body.

The draft regulations also outline the following effluent limits for onsite treatment:

- The 30-day average carbonaceous BOD (CBOD) concentration shall not exceed 25 milligrams per liter (mg/L), or alternately, the 30-day average BOD shall not exceed 30 mg/L;

and

- The 30-day average TSS concentration shall not exceed 30 mg/L;
- Supplemental treatment components designed to perform disinfection shall have sufficient pretreatment of the wastewater so that effluent does not exceed a 30-day average TSS of 10 mg/L and shall further achieve an effluent total coliform bacteria concentration, at the 95 percentile, of not greater-than either of the following;
    - 10 MPN per 100 milliliters prior to discharge into a dispersal field where the soils exhibit percolation rates between 1 and 10 minutes per inch (MPI) or where the soil texture is sand; or
    - 1000 MPN per 100 milliliters prior to discharge into a dispersal field where the soils exhibit percolation rates greater than 10 MPI or consist of a soil texture other than sand.

The 10 MPN limit would apply to Los Osos because the underlying soil is sand.

- Effluent from supplemental treatment components shall not exceed a 30-day average TN concentration of 10 mg/L as nitrogen.

4.1.2 Reuse Regulations

The draft regulations under AB 885 apply to onsite systems but don't specifically address reuse applications. Because Los Osos prohibition zone represents a unique regulatory situation, it is difficult to anticipate the monitoring frequency that will be required. Onsite systems would not be regulated under Title 22, although, the monitoring requirements in Title 22 could be adopted in a permit issued by the CCRWQCB.

According to Title 22, for reuse applications, daily sampling of some effluent parameters such as coliform and continuous monitoring of turbidity in the effluent is required. The turbidity could be monitored and reported automatically but the coliform tests would need to be collected from each of the treatment facilities and sent to a lab, where the cost per analysis would be approximately $50/sample. Additionally, due to the nitrate contamination of the upper aquifer, the waste discharge requirements may include an interim provision for weekly total nitrogen monitoring, until it is demonstrated after a specified period that the effluent is consistently low in nitrogen and sampling frequencies can be reduced to monthly or quarterly. The cost of a total nitrogen analysis is approximately $150 per sample.

4.2 Permitting Issues

Gaining a permit from the Regional Board to discharge to the groundwater basin in the Prohibition Zone may be another potential problem for onsite systems. In the RWQCB Resolution 83-13, "discharges from individual and community sewage disposal systems are prohibited in the…groundwater prohibition zone." While this requirement was written about relatively untreated septic discharges, the Regional Board may decide that it also applies to more highly treated individual systems.

For example, in response to the submission of information on a proprietary treatment technology by a vendor, the Regional Board recently replied in a letter, dated September 6, 2007: "The Central Coast Water Quality Control Plan (Basin Plan) prohibits *all* discharges from individual onsite systems. Residents of Los Osos considering your technology should know that using the Reclamator does not relieve anyone of the obligation to comply with the Basin Plan discharge prohibition and does not relieve them of the obligation to comply with the requirement to hook up to a community system when it is available or use some other option with no on-site discharges."

The Regional Board is not the only agency with permitting authority. Any new wastewater treatment and collection system will also have to get a permit from the California Coastal Commission. The Coastal Commission is especially concerned with take of environmentally sensitive habitat areas (ESHA). The majority of the prohibition zone in Los Osos is designated as ESHA. The permitting constraints of developing onsite systems for each household on ESHA could make this alternative unpermittable where an out-of-town (and out-of-ESHA) site is feasible.

5.0 SUMMARY

Onsite treatment can be an effective way to provide treatment at reuse sites. For Los Osos, it could significantly address the groundwater balance issues. Technologies exist to attain low effluent nitrogen levels for onsite systems. Systems at households where residents are often out of town and flows are intermittent could have reliability problems. It would be difficult to construct supplementary treatment systems at homes with small yards, adding to the cost and inconvenience (disruption) of construction. Additionally, there would like be permitting problems due to discharging effluent in the Prohibition Zone and installing systems on ESHA land, and monitoring costs could be substantial.

6.0 REFERENCES

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