San Luis Obispo County
Los Osos Wastewater Project Development

TECHNICAL MEMORANDUM

LOW PRESSURE COLLECTION SYSTEM

FINAL DRAFT
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1.0 INTRODUCTION

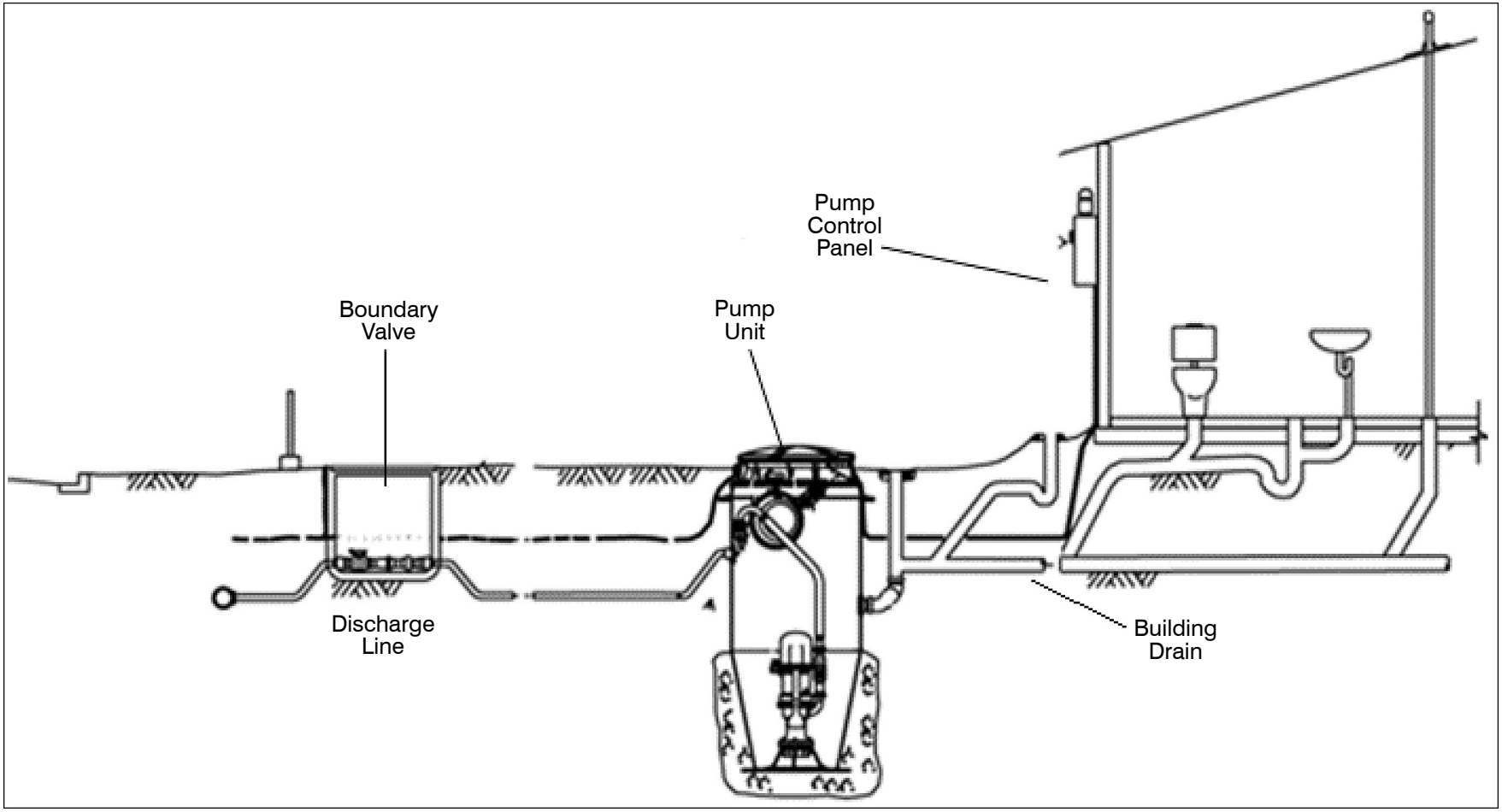
The purpose of this Technical Memorandum (TM) is to evaluate the functionality and conceptual costs of a Low Pressure Collection System (LPCS) for the Community of Los Osos. The memorandum describes a collection system that is entirely low pressure. However, due to Los Osos' high-relief terrain, it is likely that the best system to implement would be a combination of low pressure and gravity collection.

A LPCS consists of individual sumps that collect waste at each customer location. Each tank houses an electric grinder pump to grind the waste that is then conveyed in small diameter pipes to an in-street pressure collection system and then to the treatment facility. The tanks are installed just below grade and are typically 24 to 42 inches in diameter ranging from 48 to 144 inches in height. Each individual service line requires a valve at the point of connection to the common force main. This valve is typically placed in a valve box at the property line. Similar to a Septic Tank Effluent Pumping (STEP) system, the in-street collection system consists of small diameter pipes ranging in sizes from 2 to 12 inches for a community the size of Los Osos. In some cases, pipe diameters are smaller for a LPCS to meet the required self-cleansing velocities in the pipe. The entire collection and conveyance system is pressurized similar to a STEP system. However, the solids (after going through the grinder pump) are conveyed to the treatment facility, similar to a gravity collection system. Figure 1 shows a typical on-lot section layout for a LPCS.

In the previous gravity sewer design by Montgomery Watson Harza, approximately 200 homes whose elevation were below that of the planned sewer main were to be given grinder pumps and low pressure lines to the main. However, this TM evaluates the feasibility of a collection system constructed entirely with a low pressure configuration as described above.

1.1 Construction Methods and Impacts

There are a number of methods for installing a LPCS system. For the force mains, the line follows along the side of the road and may be installed using either traditional pipe trenching methods or directional drilling. The pipes have a smaller diameter than for a gravity sewer, so both methods are relatively low impact. In addition, because the pipes are pressurized, the installation can follow the natural contouring of the ground rather than requiring deep excavation to facilitate a constant downward slope toward the collection facility. Typically depths of installation for a LPCS system vary from 4 to 7 feet where tank diameters range from 2 to 3 1/2 feet. Directional drilling has been successfully utilized under heavily traveled roads and driveways to minimize disruption. In most installations,



Reference: Pressure Sewer Services. http://www.pressuresewerservices.com.au

Figure 1
ON-LOT LAYOUT OF A TYPICAL LPCS
LOS OSOS WASTEWATER
PROJECT DEVELOPMENT
San Luis Obispo County

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open-cut trenching is an easy and economical way to install the sewer lines and will be the primary method for on-lot installations.

1.2 On-Lot Impacts

On-lot construction includes all work taking place on private property. It consists of removing or demolishing the existing septic tank and installing a grinder pump system, including all necessary lateral piping and electrical connections. Construction of on-lot LPCS facilities is similar to that of STEP systems except that the LPCS tank is approximately one half the size of a STEP tank. To install a grinder pump system, a hole slightly larger than the diameter of the tank is augured on the property. The assembled grinder pump station is dropped into the hole and connected to the customer's effluent and pump discharge line. The tank is then backfilled to grade and covered with either a green manhole-type cover or rock shaped cover to reduce visual impact. While it is not recommended to drive heavy vehicles or machinery directly over or adjacent to the units, customers can mow their lawn around them. In addition, large plants or trees should not be planted close to the pump unit to eliminate any potential rooting problems in the line or pump system.

The pump unit is wired to an electrical control panel (also known as the alarm box) that is attached to an exterior wall or post at each customer location. Placing the alarm box next to the owner's existing breaker box helps to reduce any additional visual impact.

1.3 Power Consumption and Pump Failures

The power consumption of a grinder pump station is approximately 180 kilowatt-hours per year for normal household use.

For most grinder pump packages, if a pump fails (clogs), an audible and visual service alarm will go off. The alarm can be manually silenced on the control panel. The flashing service light can be seen by the customer and surrounding neighbors and the problem can be called in by anyone. Until the unit is inspected and repaired, customers are asked to cut down on their water usage.

In the event of a power failure, grinder pumps do not operate, since they generally are not supplied with back-up power. Grinder pumps have limited capacity to provide wastewater storage during electrical power outages, excluding uses such as running a washing machine or taking a bath. The amount of storage is based on the manufacturer but is typically equivalent to eight hours of normal use. Manufacturers point out that during power outages, the average consumption of water significantly decreases since most water-using appliances also need electricity. For example, washing machines and dishwashers would not be operable, and households with electric water heaters would not have hot water thus showers and baths would be limited. In any instance, grinder pump users are encouraged to cut down on water use during a power failure to prevent an overflow scenario.

1.4 Case Study Synopsis

Several municipal utilities that have installed low pressure sewers were contacted to gain a better understanding of issues associated with their design, construction, and operation and maintenance. Three companies that provide low pressure sewers are eOne Corporation, Hydromatic, and Barnes. The utilities and a summary of their low pressure sewer systems are presented in Table 1.

Table 1 Utilities Interviewed for Low Pressure Sewer Case Studies
Los Osos Wastewater Project Development
San Luis Obispo County

Utility	State	No. of Connections	Year Installed	Company	Retrofit of Septic System or New Development
City of Bloomingdale	GA	1000	1983-present	eOne	Retrofit
Holiday Shores Sanitary District	IL	1000	1991-present	eOne	New
Fairfield Glade Resort	TN	3000	1975-present	eOne	New
Horseshoe Bay Utility District	TX	3000	1973-present	Hydromatic and eOne	New
Hot Springs Village	AR	6000	1983-present	Hydromatic	New
City of Whitehouse	TN	2500	1983-2006	Hydromatic and eOne	Retrofit
Lookout Mountain	GA	700	1997-present	Barnes	Retrofit
West Jackson County	MS	3000	1996-present	Barnes	Retrofit
Peters Township	PA	900	1993-present	Barnes and eOne	Retrofit
City of Lincoln	AL	1800	1978-present	Barnes	Retrofit

Bloomingdale, Whitehouse, West Jackson, Peters, and Lincoln had previously relied on septic tanks for wastewater treatment. Bloomingdale, Whitehouse, and Lincoln selected low pressure sewers because of the reduced capital cost compared to conventional sewers. In all other communities, low pressure sewers were installed for new construction because they were unable to put in conventional sewers due to their proximity to lakes and/or to high-relief terrain.

Utilities reported that since the quality of the wastewater is not changed by low pressure sewerage, there are no problems where the low pressure sewers interface with the conventional gravity sewers in any of these communities. The wastewater treatment facilities are not impacted by this collection system either.

All of the communities surveyed are either somewhat satisfied or very satisfied with their low pressure sewer systems. They are all continuing to use low pressure sewers for at least part of their new development. The wastewater manager at Hot Springs has experience with both gravity and STEP sewer systems and says that the low pressure sewer is the easiest to maintain of all these. The Director of Wastewater services for Peters Township said they retrofitted 85 homes into a STEP system in 1986, but due to deterioration, all are now switching over to grinder pumps.

Both Fairfield Glade and Holiday Shores have pressure switches rather than float switches. The operations manager at Holiday Shores claims that float switches are unreliable and prone to getting clogged with grease. Lookout Mountain uses float switches as well and claim they too have issues with clogging with grease but the grease can be easily knocked off with a stick to continue operation. However, based on recent project experience, pressure switches from eOne have also proved to be problematic.

These communities have a variety of arrangements regarding ownership of the equipment and financing maintenance. At Holiday Shores, Fairfield Glade and Horseshoe Bay, the homeowner pays for the system when the home is built and pays a monthly fee thereafter for its upkeep, but it is owned and operated by the utility, which has a blanket easement to access it for maintenance. At Hot Springs, the homeowner owns the system and pays for the power and service calls. At Bloomingdale, the homeowner owns the system but the City has responsibility for its maintenance, and has a blanket easement to access it. In Whitehouse, the city owns the system, and has an easement to the pump vault. At Lookout Mountain, West Jackson, Peters, and Lincoln the City owns the system and charges a “tap fee”, which covers the price of the pump, tank, and controls. The homeowner also bears all the installation costs of the system to the sewer lateral; however, the City provides all service for lifetime of the product.

1.4.1 Construction

Open cut installation was used in all of these communities. West Jackson utilized directional drilling under questionable roads while Peters required directional drilling for all state road and railroad crossings as mandated by PennDOT.

At Bloomingdale and Lincoln, where they had previously been using septic tanks, the tanks were emptied and filled or connected to the system for overflow purposes. At Whitehouse, West Jackson, and Peters the existing septic tanks were crushed in place.

1.4.2 Operation and Maintenance (O&M)

The number of maintenance personnel required for the communities' low pressure sewers is listed in Table 2.

Table 2 Maintenance Personnel Required for Low Pressure Sewers
Los Osos Wastewater Project Development
San Luis Obispo County

Utility	No. of Connections	Number of Maintenance Personnel
City of Bloomingdale	1000	2
Holiday Shores Sanitary District	1000	4 (for all water/wastewater responsibilities)
Fairfield Glade Resort	3000	4 (for all wastewater responsibilities)
Horseshoe Bay Utility District	3000	2
Hot Springs Village	6000	Not reported
City of Whitehouse	2500	6
Lookout Mountain	700	2 (for all wastewater responsibilities)
West Jackson County	3000	12 (for all water/wastewater responsibilities)
Peters Township	900	2 (for all wastewater responsibilities)
City of Lincoln	1800	3

Maintenance is usually initiated by service calls from homeowners in response to visible/audible alarms. There does not appear to be any particular problem that accounts for the majority of service calls or maintenance needs for low pressure sewers. The wastewater manager at Hot Springs says that many of the problems they have with their Hydromatic system are electrical rather than physical. For the eOne systems, both the operations manager at Holiday Shores and the operations manager at Fairfield Glade reported that some powdered detergents could clog the pressure switches. Lookout Mountain reported an average of 15 service calls per month but no one major problem in

the system for the calls. In all the communities, grease clogging is a typical issue but respondents claimed only minor maintenance is required.

Three of the communities have systems that are combinations of pumps from two manufacturers. The operations manager at Horseshoe Bay prefers Hydromatic, and the utilities supervisor at Whitehouse prefers eOne. Each of them cites maintenance as the main reason for preferring one company's sewer system over the other. The wastewater director at Peters Township claims that Barnes system requires less maintenance than eOne systems and is a better overall product.

The operations manager at Fairfield Glade reported very positive experiences with eOne Corporation and their support of system maintenance. The utilities manager at Bloomingdale is very enthusiastic about their eOne system because he says that it doesn't require any preventative maintenance, although the operations manager at Holiday Shores reported that his community does have to perform some preventative maintenance on their eOne system. The superintendent at Lookout Mountain is extremely satisfied with their Barnes system and the cooperation with the manufacturer. West Jackson refers to the low cost of the Barnes system as being the largest advantage.

Several retrofits and new LPCS case studies are also summarized on eOne's website in which all describe successful outcomes for a large variety of projects. EOne advertises that their grinder pumps "do not require preventative maintenance and boast an average 8 to 10 years between service calls."

2.0 TREATMENT IMPACTS

The future treatment plant will be designed based on the quality of the raw influent into the plant, so influent quality will have a large impact on process design and overall cost of the treatment plant. The effluent water quality from a LPCS is similar to the quality from a gravity system. Due to increased solids influent concentrations compared to a STEP collection system, low pressure and gravity collection systems require increased capacity for plant processes such as secondary treatment and solids handling. On the other hand, an LPCS will not require the addition of an external carbon source to aid denitrification. For the purposes of this report, it is assumed that the treatment costs developed for the gravity collection system in Chapters 4 and 5 of the Fine Screening Report (Carollo, August 2007) would be similar to treatment costs for a low pressure system because the quality of influent entering the plant is the same.

3.0 ENVIRONMENTAL/PERMITTING CONSIDERATIONS

The LPCS would include over 45 miles of pipelines in most streets and approximately 5,000 lateral lines to individual properties. Abandonment of existing septic tanks and installation of grinder pumps at each customer location would also be required. The environmental issues

associated with the construction of a LPCS are listed in comparison to the other collection system alternatives.

3.1 Similar to STEP and gravity collection

- Proximity to wetlands in some areas requires special Best Management Practices (BMP) to reduce the amount of sedimentation.
- Archaeological resources are located throughout the community and may require pipeline route relocation, or possible reburials.
- Monitoring for, and relocation of snails will be required in some areas of the community, to be determined by monitoring.
- Lateral installations will be close to some areas of wetlands, possibly requiring special permitting and mitigation. Laterals will have some impacts on landscaping and native habitat.
- If the treatment plant is located east of Los Osos Creek, all of the collected untreated wastewater, and possibly some of the treated effluent will need to cross over or under the creek.

3.2 Similar to STEP collection

- Limited dewatering is required in low-lying areas. This water may require treatment or other special handling.
- Odors may be released at high points where vacuum/air release valves are required and may require treatment.
- Roadway impacts are less than for gravity collection due to the reduced amount of excavation required for main installation; however, archaeological impacts will still occur.
- Grinder pumps will be required on every property in the Prohibition Zone. Construction disturbance will occur on private properties. Increased potential of existing septic tank removal required given the small lot width of most properties.

3.3 Similar to gravity collection

- Septic systems will require removal, abandonment or refitting for use as stormwater drains at each property with all associated impacts.

4.0 COST BASELINE

A gravity/LPCS was designed as part of the previous project and a cost estimate was formulated. The cost of a STEP/STEG collection system was investigated as part of the Los Osos Wastewater Management Plan Update (Ripley Pacific Team, July 2006). In the Fine Screening Analysis (Carollo, August 2007), a cost estimate was prepared for each of these collection alternatives. Both estimates will serve as a basis for the conceptual cost estimate of the LPCS.

Figure 2 illustrates a schematic of the LPCS components. The following is a brief description of significant components of the system required for a detailed cost estimate.

4.1 Force Mains and Laterals in Right-of-Way

This item is the cost to install the main collection system piping in the public right-of-way. Horizontal directional drilling (HDD), a trenchless type of pipe installation that may be employed reasonably economically for small diameter piping, is the assumed installation method. The force mains and laterals in the right-of-way design would be identical to a STEP collection system.

Force mains (pressurized piping) are used to convey the wastewater from laterals (to each property) to the wastewater treatment facility. Approximately 254,000 linear feet of PVC force mains ranging in diameter from 2 to 10-inches are included. The pipes were assumed to be approximately 4 feet deep to avoid existing utilities and provide minimal cover.

This line item includes lateral piping within the right-of-way needed to stub out the collection system from the main piping to the property line in front of each home. The laterals are assumed to be 1-1/2-inch PVC at an average depth of approximately 4 feet.

Since the piping is relatively shallow and minimal access points are required, shoring and dewatering requirements are anticipated to be minimal. In addition, the pressurized piping eliminates the need for manholes, centralized pump stations, standby power facilities and miscellaneous facility requirements necessary for a gravity collection system.

4.2 On-Lot System Costs

For the purposes of this memorandum, on-lot laterals are assumed to be the same as a STEP system; 1-1/2-inch PVC pipelines at a depth of approximately 4 feet.

As shown in Figure 2, it is anticipated that there will be three options for on-lot installation of a low pressure system. Based on an analysis of lots in Los Osos, Table 3 shows a breakdown of on-lot installation requirements.

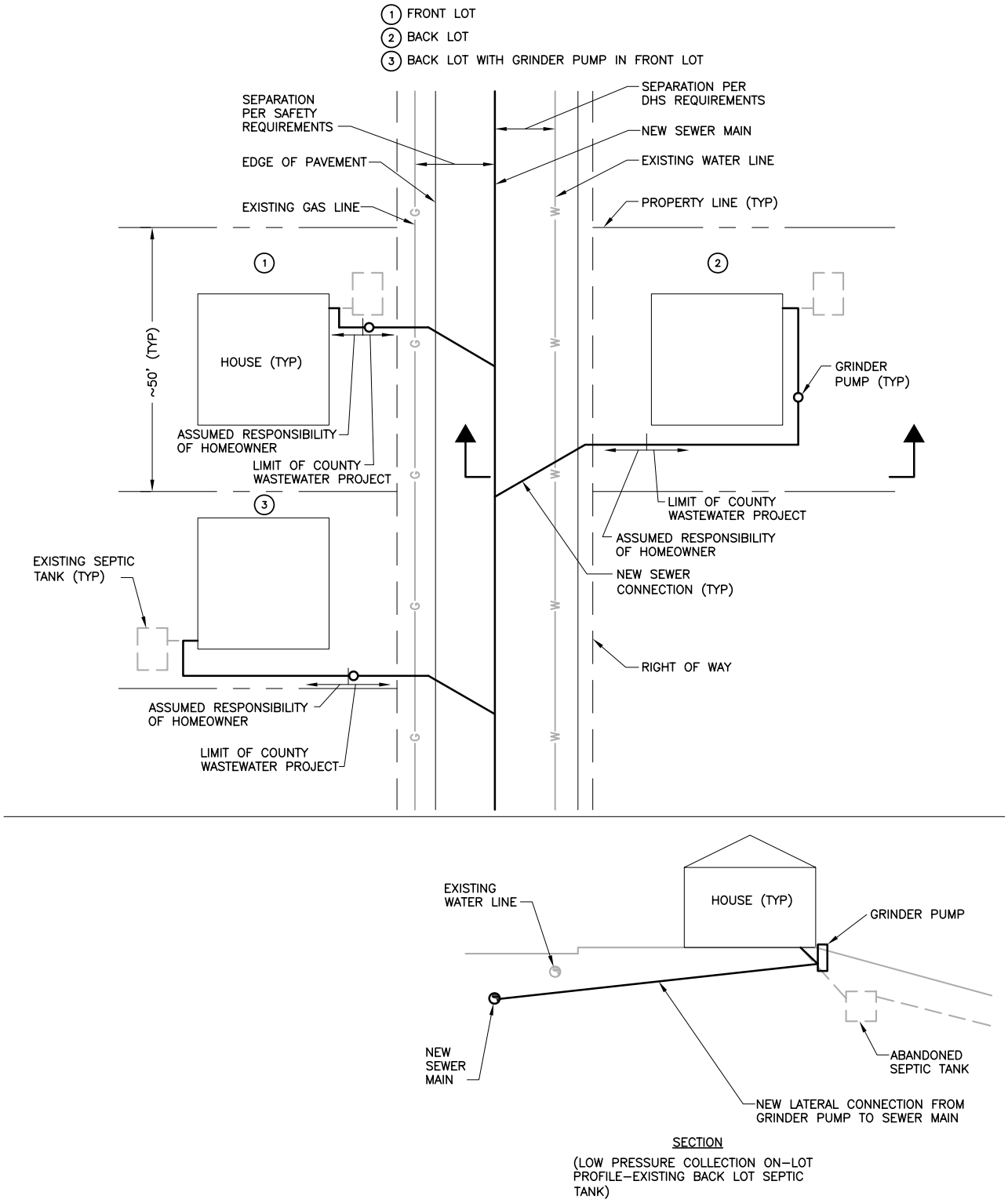

Figure 2
LOW PRESSURE COLLECTION ON-LOT INSTALLATION OPTIONS
LOS OSOS WASTEWATER PROJECT DEVELOPMENT
San Luis Obispo County

carollo engineers

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Table 3 On-Lot Installation Options for LPCS[1] Los Osos Wastewater Project Development San Luis Obispo County	
On-Lot Installation Options for Low Pressure Collection System	**Percent of Lots in Prohibition Zone Requiring Installation Option (%)**
Back of Lot Lateral	5[2]
Back of Lot Lateral with Grinder Pump Located in Front of Lot	20[3]
Front of Lot Lateral	75[4]

Notes:
(1) Based on Table 3.4 of the Fine Screening Report (Carollo, August 2007).
(2) Based on analysis showing 25 percent of existing tanks are in back lot and 20 percent of grinder pumps must be located in back lot.
(3) Based on analysis showing 25 percent of existing tanks are in back lot and 80 percent of grinder pumps can be relocated to the front lot at a maximum depth of 10 feet.
(4) Based on analysis showing 75 percent of existing tanks are in front lot.

4.3 Electrical Connection

Each residence with a low pressure system will require an electrical connection to provide power to the new grinder pump, controls, and alarm system. Electrical connection costs are based on service from existing residential breaker panels.

4.4 Odor Control

Odor control measures will be required at high points throughout the system where air within the piping is released to prevent air bubbles from forming. Odor control will consist of carbon media canisters that remove the odorous compounds such as hydrogen sulfide from the air as it passes through the media. The canisters and air release valves on the pressurized main lines would be enclosed in a small (approx. 3 by 4 by 4 feet) buried vault.

4.5 Road Restoration

Road restoration would be similar to a STEP collection system. The amount of road restoration required for trenchless pipe installation will be less that that required for conventional open cut methods. However, there will still be locations that require the removal of pavement to install the main piping and laterals within the right-of-way.

4.6 Pump Stations

In a preliminary analysis of a low pressure system for Los Osos, Myers Pentair Pump Group concluded that 3 pump stations requiring a total of 4 pumps would have to be

located in the system. To provide redundancy, two duplex and one triplex pump station were assumed for cost estimating purposes. The pump station estimates were based on Table 3.1 of the Fine Screening Report (Carollo, August 2007).

5.0 COST DEVELOPMENT

5.1 Assumed Construction Sequence

Figure 3 shows the assumed construction sequence for a LPCS. The common facilities such as the force mains and treatment plant are assumed be constructed and operational prior to construction of on-lot components and abandonment of the existing septic tank.

5.2 On-Lot Cost Development

Based on the location of the existing septic tank, on-lot construction requirements are divided into one of the following three options:

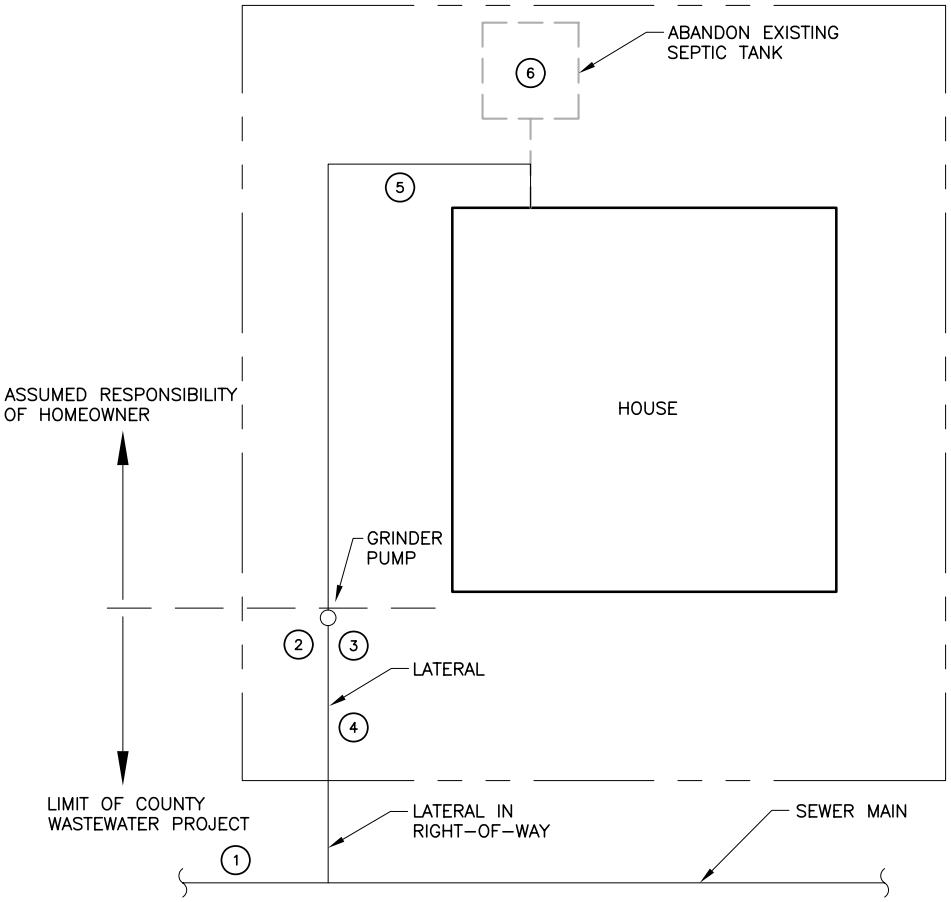
- Back of Lot Lateral
- Back of Lot Lateral with Grinder Pump Located in Front of Lot
- Front of Lot Lateral

The three options are shown in Figure 4. Tables 4 through 6 break down the major components for each option and the associated cost.

Table 7 summarizes the estimated homeowner cost for the entire on-lot system, using the percentages developed above of lots that fall into each of the three low pressure options and the estimated cost for each option.

Table 8 provides the costs to connect each new grinder tank to the existing electrical system. The costs are averages based on a memorandum from Thoma Electric dated May 1, 2007. The memorandum is based on connections to a STEP system; therefore, it is assumed costs for connections to a grinder pump are similar. This memorandum is included in Appendix B of the Fine Screening Analysis (Carollo, August 2007).

Table 9 shows the range of probable costs for LPCS based on development of on-lot lateral costs and electrical connections presented above. The estimated range of costs for the LPCS is between $68.5 and $85.0 million.



PROJECT RESPONSIBILITY

1. INSTALL FORCE MAINS AND LATERALS WITHIN RIGHT-OF-WAY AND TREATMENT FACILITY
2. EXCAVATE FOR GRINDER PUMP UNIT
3. INSTALL GRINDER PUMP UNIT
4. INSTALL PIPE FROM GRINDER PUMP UNIT TO LATERAL IN RIGHT-OF-WAY

HOMEOWNER RESPONSIBILITY

5. INSTALL PIPE FROM HOME TO GRINDER PUMP UNIT, DISCONNECT EXISTING TANK
6. BACKFILL EXISTING TANK WITH EXCAVATED MATERIAL FROM GRINDER PUMP UNIT

Figure 3
LOW PRESSURE COLLECTION CONSTRUCTION SEQUENCE
LOS OSOS WASTEWATER PROJECT DEVELOPMENT
San Luis Obispo County

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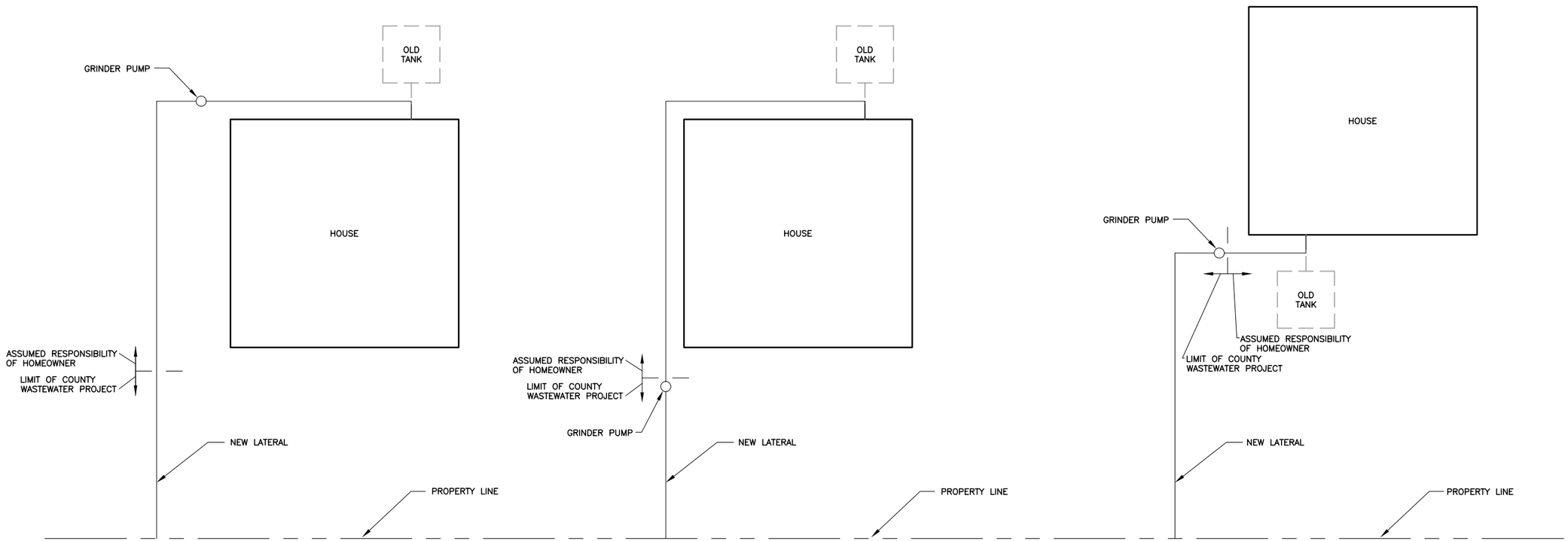

BACK OF LOT LATERAL
(TABLE 4)

BACK OF LOT LATERAL
WITH GRINDER PUMP IN FRONT OF LOT
(TABLE 5)

FRONT OF LOT LATERAL
(TABLE 6)

Figure 4
THREE LOW PRESSURE INSTALLATION OPTIONS
LOS OSOS WASTEWATER PROJECT DEVELOPMENT
SAN LUIS OBISPO COUNTY

Table 4	**Cost Estimate for Back of Lot Lateral Los Osos Wastewater Project Development San Luis Obispo County**
Item	**Cost**
Project Costs	
Sewer Lateral	$1,000[1,2]
Assumed Homeowner Responsibility	
Grinder Pump, Tank, and Controls	$4,000[4]
Abandon Existing Septic Tank	$300[1]
Sewer Lateral	$600[1,3]
Yard Restoration	$750
TOTAL ON-LOT COST	~$6,700

Notes:
(1) Based on estimate from local contractor.
(2) Based on lateral 40 feet long. Includes excavation, backfill and labor. Excavation for grinder pump included. Based on Table 3.12 from Fine Screening Analysis (Carollo, August 2007).
(3) Based on lateral 40 feet long. Includes excavation, backfill and labor.
(4) Based on estimate from Barnes and eOne.

Table 5	**Cost Estimate for Back of Lot Lateral with Grinder Pump Located in Front of Lot Los Osos Wastewater Project Development San Luis Obispo County**
Item	**Cost**
Project Costs	
Grinder Pump, Tank, and Controls	$4,000[4]
Sewer Lateral	$1,000[1,2]
Assumed Homeowner Responsibility	
Abandon Existing Septic Tank	$300[1]
Sewer Lateral	$600[1,3]
Yard Restoration	$750
TOTAL ON-LOT COST	~$6,700

Notes:
(1) Based on estimate from local contractor.
(2) Based on lateral 40 feet long. Includes excavation, backfill and labor. Excavation for grinder pump included. Based on Table 3.12 from Fine Screening Analysis (Carollo, August 2007).
(3) Based on lateral 40 feet long. Includes excavation, backfill and labor. Based on Table 3.12 from Fine Screening Analysis (Carollo, August 2007).
(4) Based on estimate from Barnes and eOne.

Table 6	**Cost Estimate for Front of Lot Lateral Los Osos Wastewater Project Development San Luis Obispo County**
Item	**Cost**
Project Costs	
Grinder Pump, Tank, and Controls	$4,000[4]
Sewer Lateral	$700[1,2]
Assumed Homeowner Responsibility	
Abandon Existing Septic Tank	$300[1]
Sewer Lateral	$200[1,3]
Yard Restoration	$500
TOTAL ON-LOT COST	~$5,700

Notes:
(1) Based on estimate from local contractor.
(2) Based on lateral 30 feet long. Includes excavation, backfill and labor. Excavation for grinder pump included. Based on Table 3.11 from Fine Screening Analysis (Carollo, August 2007).
(3) Based on lateral 10 feet long. Includes excavation, backfill and labor. Based on Table 3.11 from Fine Screening Analysis (Carollo, August 2007).
(4) Based on estimate from Barnes and eOne.

Table 7 **Estimated Cost Summary for On-Lot Low Pressure System**
Los Osos Wastewater Project Development
San Luis Obispo County

Option	**Project Cost ($M)[1]**	**Homeowner Cost ($ M)[1]**	**Total Estimated Cost ($M)[1,2]**
Back of Lot Lateral	0.2	1.4	1.6
Back of Lot Lateral with Restricted Access to Backyard	4.8	1.6	6.4
Front of Lot Lateral	16.8	3.6	20.4
TOTAL CONSTRUCTION COST	21.8	6.6	28.4

Notes:
(1) Based on 4,769 septic tanks in the Prohibition Zone, percent breakdown in Table 3 and on-lot costs developed in Tables 4, 5, and 6.
(2) Electrical connection costs not included.

Table 8	Low Pressure Electrical Connection Cost Los Osos Wastewater Project Development San Luis Obispo County	
Option	**Low(1)**	**High(1)**
New Sub-Panel or Modification to Existing Panel(2)	$800	$1,300
Connection Between Home and Grinder Pump	$1,100(3)	$1,700(4)
TOTAL COST PER CONNECTION	$1,900	$3,000

Note:
(1) Costs from Electrical System Evaluation Memorandum (Thoma Electric, May 2007). Electrical for grinder pump assumed to be the same as electrical for STEP system.
(2) Includes an average service upgrade of $5,000 for 5% of homes.
(3) Based on 40 feet connection between sub-panel and grinder pump.
(4) Based on 60 feet connection between sub-panel and grinder pump.

The force main and lateral costs presented in Table 9 are representative of a STEP system and were assumed to be the same for a LPCS. In 2005, Paul Paixao of Myers Pentair Pump Group performed a preliminary LPCS layout for the City of Los Osos. Two rough costs estimates were put together which included directional drilling and pipe material costs. The resulting estimates were 12.7 and 13.4 million dollars (escalated to April 2007 dollars) for all collection system piping. Their low estimate used quoted unit prices that included restoration. However, conveyance to an out-of -town treatment facility was not included. The high estimate used rule-of-thumb unit prices and included conveyance to an out-of-town treatment facility. Both estimates included all in-street collection piping as well as on-lot piping costs. These estimates fall within the Team's estimated range of 11.7 to 15.2 million for force mains and laterals.

5.2.1 O&M Costs

Table 10 shows the estimated O&M costs for a LPCS.

The LPCS has been estimated to have an annual O&M cost of approximately $690,000.

Table 9 Range of Probable Costs for LPCS
Los Osos Wastewater Project Development
San Luis Obispo County

Item [2]	Range of Probable Costs Low ($M) [1]	Range of Probable Costs High ($M) [1]	Notes on Development of Range
Mobilization/Demobilization/General Conditions	2.7	3.4	Based on 5% of Construction Cost Subtotal.
COMMON FACILITIES[5]			
Force Mains and Laterals in Right-of-Way	11.7	15.2	Low estimate based on Los Osos Wastewater Management Plan Update (Ripley 2006) and installation costs from Tidwell. High estimate includes 30% contingency due to conceptual design level.
Duplex Pump Station (2)	0.9	0.9	Based on Bid Tab Values and Table 3.1, Fine Screening Report
Triplex Pump Station (1)	0.6	0.6	Based on Bid Tab Values and Table 3.1, Fine Screening Report
Standby Power Facility (3)	1.1	1.1	Based on Bid Tab Values and Table 3.1, Fine Screening Report
Miscellaneous Facility Requirements	1.4	1.4	Based on Bid Tab Values and Table 3.1, Fine Screening Report
Odor Control	0.1	0.3	Low and High estimates based on 100 and 500 air release valves respectively at $500 each.
Road Restoration	1.3	2.6	Low and High estimates based on 25% and 50% of the gravity system requirements, respectively, due to estimated reduction in pavement disturbance.
Land and Easement Acquisition	Assumed No Additional Cost[3]	Assumed No Additional Cost[3]	
ON LOT FACILITIES			
Project Facilities	21.8	24.0	Based on on-lot options and cost development information presented above. High estimate includes 10% contingency similar to gravity system.
Homeowner Facilities	6.6	7.3	Based on on-lot options and cost development information presented above. High estimate includes 10% contingency similar to gravity system.
Electrical Connection	9.1	14.3	Low and High estimates based on $1,900 and $3,000 per connection as presented in Table 8 for 4769 Prohibition Zone lots.
Subtotal	$57.3	$71.1	
Overhead and Profit (15%)	$8.6	$10.7	
Subtotal	$65.9	$81.8	
Sales Tax (8%)[4]	$2.6	$3.2	
TOTAL CONSTRUCTION COST[6]	$68.5	$85.0	

Notes:
(1) All costs in April 2007 dollars, based on an ENR of 7879.
(2) Prohibition Zone lots only - 4769 connections.
(3) Land and easement acquisition assumed to be sunk cost as part of the previous Tri-W project.
(4) Sales Tax included on materials only. Assumed 60 percent materials cost for common and on-lot facilities.
(5) Common Facilities estimates assumed to be the same for low pressure system as for STEP system.
(6) Pump station costs are not included.

Table 10	Estimated O&M Costs for LPCS Los Osos Wastewater Project Development San Luis Obispo County			
Item	**Units**	**Quantity**	**Unit Price ($)**	**Annual O&M ($)**
Labor	Hrs/year	6,300(1)	40(2)	250,000
Power	kWh/year	425,000(3)	0.12(2)	50,000
Electrical Maintenance/ Replacement	%/year	1	Electrical Connection Construction Costs	90,000
Pump/Controls Maintenance/ Replacement	Pumps/year	700(4)	400(5)	280,000
Odor Control Maintenance/ Replacement	%/year	20	Odor Control Construction Costs	20,000
TOTAL O&M COST				~$690,000

Notes:
(1) Based on 3 full-time employees from Holiday Shores, Fairfield Glade and other case studies contacted for Rough Screen Analysis. Full-time equivalent (FTE) employee based on 2,080 hours per year.
(2) From Basis of Cost Evaluation Technical Memorandum (Carollo, August 2007).
(3) Based on energy required to convey 1.2 mgd to an out-of-town treatment facility.
(4) Assumes full pump replacement every 7 years.
(5) Based on pump cost provided by Barnes and eOne.

6.0 ALTERNATIVES COMPARISON

A LPCS combines aspects of a STEP system and gravity collection system. Table 11 provides a comparison of the above two systems with a low pressure system.

The LPCS probable cost ranges from $68.5 to $85.0 million, including conveyance to an out-of-town facility. This estimate includes design contingencies, contractor overhead and profit, and sales tax for comparison to the baseline bid tab values. Project costs, including design, construction management, and legal and administrative are not provided in the scope of this memorandum. A separate electrical service is also not included, and for the purpose of comparison, STEP costs in Table 12 also do not include a separate electrical service.

Table 12 provides a cost summary and comparison of three possible collection systems, low pressure, STEP, and gravity collection.

Table 11 LPCS Advantages and Disadvantages
Los Osos Wastewater Project Development
San Luis Obispo County

LPCS in Comparison to	Advantage of LPCS Compared to:	Disadvantage of LPCS Compared to:
STEP Collection	• Reduced septage handling • Will utilize same or smaller diameter pipes for conveyance • Less on-lot disturbance due to compact size of a grinder pump versus a septic tank • Lower capital and maintenance costs	• Less storage capabilities during a power outage • Pump stations will be required for mains
Gravity Collection	• Minimized clogging because of grinder pumps • Shallower excavation for pipe installation • Smaller diameter pipes and no manholes • Minimal I/I • Lower capital costs	• Primary power supply required at individual properties • Limited hydraulic capacity • Lack of storage for long-term power outage

Table 12	Cost Summary Comparison Los Osos Wastewater Project Development San Luis Obispo County		
Collection System	Range of Probable Construction Costs[2]		Annual O&M ($)
	Low ($M)	High ($M)	
Low pressure	68.5	85.0	690,000
STEP[1]	65.0	81.4	790,000
Gravity[1]	80.4	87.6	480,000

Notes:
(1) Based on Fine Screening Analysis (Carollo, August 2007).
(2) Includes conveyance to an out-of-town treatment facility.

From Table 12, it can be concluded that the LPCS is between, but within the range of the costs of STEP and gravity collection systems. However, cost estimates for a STEP system do not include pump stations. Therefore, if hydraulic analysis shows that pump stations are necessary for STEP collection, LPCS could be less expensive than STEP. Annual operation and maintenance costs for LPCS fall between the two other systems.

The affect on treatment facility costs must also be considered. A LPCS will lead to similar treatment costs to a facility fed by a gravity system because the plant influent quality will be the same. However, construction costs for a treatment facility associated with a Level 2 project (mitigating 190-240 AFY of seawater intrusion) were nearly the same for facilities treating both STEP and gravity/low pressure influent (see Table 7.4, Fine Screening Report). Therefore, assuming the collection system represents the only differences in cost between a gravity, STEP and LPCS system, then LPCS remains cost-competitive with the other two collection systems.

7.0 SUMMARY

A LPCS consists of small-diameter pressurized pipes, similar to a STEP system. However, instead of making use of a large septic tank, it has a smaller grinder pump tank at every lot. This means that the cost savings and lessened neighborhood impacts of constructing a STEP system compared to a gravity system are maintained, but with reduced on-lot impacts. Unlike a STEP system, some pump stations may be required to maintain cleaning velocities in the pipes, necessitating pump stations. The influent quality is similar to that of a gravity system, so the savings associated with reduced solids and BOD is lost, but an external carbon source for denitrification will not be needed. A disadvantage to LPCS over the other systems is the limited capacity of the grinder tank in the event of a power outage, and manufacturers recommend reduction of water use in such an event. Several

communities with LPCS were contacted and they were all satisfied with the system. A LPCS is a viable alternative to gravity and STEP collection systems, however, a fully low pressure system is likely not realistic for Los Osos. A combination of a low pressure and gravity system is a more practical solution.