pumping. In 1982, this inspection program was expanded to designated septic system problem areas throughout the County. However, there was considerable property owner opposition, non-cooperation, and questionable benefits, and the program was discontinued through action by the Board of Supervisors.

One other inspection program in the Watershed was established as a condition of approval for two new subdivisions approved in the mid 1970's (Hidden Glen and Galleon Heights Unit 1). This program provided for regular inspection of systems and the turning of diversion valves between dual leachfields. However, the program was not popular with the property owners, was difficult to administer, and was not showing significant benefits. It also was discontinued in 1982.

As discussed in Section 3.2, since at least 1949, there has been consideration given to providing sewage collection for the densely-developed parts of the San Lorenzo Valley. Until recently the recommendations for sewering were not generally based on an evaluation of the adequacy of existing septic systems, but were based on a general perception that water quality was degraded, that there were some specific problem areas, and/or that sewering would be needed for the long-term development of the Valley. None of the older proposals were pursued, due to technical and/or financial limitations.

In the late 1970's and early 1980's, a comprehensive Valleywide Facilities Study was undertaken by the San Lorenzo Valley Water District, with the participation of the County and the Lompico County Water District. The purpose of this study was to determine the facility improvements needed for long-term wastewater disposal in the Valley, and to develop the designs for those facilities so that State grant monies could be secured for facility construction. The study area was defined as the area north of Henry Cowell State Park, excluding the areas along Bean Creek, Carbonera Creek, and Branciforte Creek. (A prior facilities study had been conducted in the Pasatiempo/Rolling Woods area in 1979 (JMM, 1979).)

Most of the groundwork for the San Lorenzo Valleywide Facilities Study was established by J.M. Montgomery Engineers (JMM, 1981). JMM delineated the Valley into community areas, and then evaluated overall soil and groundwater conditions, density, and past septic system failure rates for each area. Based on numerical ratings, each area was placed in a category of Class I, Class II, or Class III. There was little evaluation of individual parcels within the delineated areas. It was determined that conditions within Class I areas were so limiting for onsite sewage disposal, that all parcels within these areas must be served by sewers. Conditions within Class II areas were not so severe, and those properties could be served by upgraded individual onsite disposal systems, or shared (cluster) onsite systems. Class III areas did not need immediate facilities improvements, but were to be included in an onsite system management program, and were to be subject to new development standards to prevent the occurrence of problems that were found in the other areas.

While designs for sewage collection, treatment, and disposal facilities were commenced for Class I areas, Class II parcels were further evaluated to determine the most appropriate solution for each parcel. A set of "Class II standards" was developed to guide the parcel evaluations. The minimum standards required dual leachfields, 3 to 5 foot separation from groundwater, and a 50-75 foot setback from embankments (Larry Walker Associates, 1984). County files were checked, properties were inspected in the field, property owners were requested to complete questionnaires, and soil borings were made to determine if the existing septic system met those standards and if site conditions would allow the system to be upgraded or replaced to meet the standards.

Of the 2682 developed Class II parcels, only 2.4% of the existing septic systems met the standards and only 51% could be upgraded to meet the standards. Systems meeting the Class II standards could not be installed on the remaining 46% of the parcels due to the presence of site constraints such as small lot size, steep slopes, presence of cut-banks, poor soils, or high groundwater. Of these 1246 Class II parcels which could not meet the Class II standards for onsite waste disposal, it was proposed to connect 1088 parcels to the Class I sewer and to connect 139 parcels to cluster disposal systems (CH2M Hill, 1984).

In addition to the system improvements proposed for most of the Class II parcels, a septic system maintenance district was to be established which would provide for regular inspection, maintenance, and pumping of septic tanks. More stringent design standards were adopted for new development in the Class II areas. These included the requirement that leaching devices be no deeper than 4 feet, and that disposal would not be allowed in highly permeable soils. In addition, a minimum lot size of one acre was adopted for all new development utilizing onsite wastewater disposal in the designated San Lorenzo Watershed area. The use of seepage pits for new development was prohibited. These new standards were adopted to prevent a worsening of conditions already found in the Valley.

Both the Class I and Class II projects were abandoned in 1984 due to an erosion of public support, high cost, questioned need, and withdrawal of opportunity for State grant funding. With the loss of project funding, property owners in the Class I and II areas were required to pay off a substantial debt for the design costs of the failed projects. The Class I and Class II designations have been preserved in Resolution 82-10, which was adopted on November 5, 1982, by the Central Coast Regional Water Quality Control Board (Regional Board), and which requires the type of management approaches represented by the Class I and Class II projects. Resolution 82-10 prohibits any onsite disposal of wastewater in the Class I areas as of July 1, 1986, the date that hook-up to the sewer was expected. Currently, over 2000 parcels in Class I areas continue to discharge to their septic systems, in violation of Resolution 82-10.

In 1985, Santa Cruz County initiated a program to reevaluate the situation in the San Lorenzo Valley, and to develop new recommendations for wastewater management to revive or supplant the Class I and Class II projects. The County embarked on a program of comprehensive water quality monitoring, and lot-by-lot evaluation of septic system functioning to provide for immediate correction of failing systems and to develop the information necessary for a long-term wastewater management program in the Valley. The findings of these investigations and the effectiveness of the system improvements made are the subject of this report.

5.1.2 Relationship to Water Quality

The findings from the County's water quality investigations were discused at length in Section 4. Based on analyses of surface and ground water, it appears that the large majority of existing septic systems do not contribute to any widespread, cumulative contamination of surface water by bacteria and other pathogens, but that occasional, individual failures can cause a public health hazard and very significant localized degradation of bacterial quality in surface water. Serious bacterial contamination was only found to be associated with surfacing of untreated effluent and not with any cumulative contamination of shallow groundwater from septic systems that appear to be functioning properly. An additional water quality concern is the cumulative increase in nitrate levels in groundwater and in surface water that has occurred in the San Lorenzo Watershed. Septic systems in highly permeable soils particularly contribute to this nitrate increase.

These conclusions indicate the importance of identifying, correcting and preventing individual system failures and enforcing installation standards which minimize nitrate release. It is important to upgrade inadequate systems to ensure that effluent can be absorbed by the soils at all times of the year so that untreated effluent will not be released to the surface where it can create a health hazard and be carried into waterways.

5.1.3 Repair Criteria

Standards for the design, sizing, and siting of new septic systems have become progressively more strict as nationwide research has identified potential and cumulative water quality problems that can result from septic systems. Thus new system standards have become quite conservative, protecting against any possible eventuality. There has also been a tendency to require larger, dual systems to provide for greater longevity, accommodate greater water use, and allow for a usual lack of property owner maintenance. New system standards are necessarily conservative, in order to minimize any potential risk of future water quality degradation.

Historically, there have been no established standards for repair of existing systems, but only the guideline that such repairs should meet new system standards as much as possible. In actual practice, this has often resulted in the quick installation of a small leachfield with little regard for soil or groundwater characteristics. As a part of the Class II project, a specific set of standards was developed to govern the grant-funded upgrade of systems in Class II areas (LWA, 1984). In applying those standards, it was found that 98% of the systems would require upgrades, and 46% of the developed properties could not meet the standards (CH2M Hill, 1984).

In 1985, the County Health Services Agency and other local agencies conducted a pilot study to reevaluate the Class II inspection procedures and repair standards (SCCHSA, 1985). Findings from this study indicated that the Class II standards were unnecessarily strict. Although 98% of the existing systems did not meet the standards, there was no indication that the majority of those systems were performing unsatisfactorily or causing significant water quality degradation. The pilot study proposed a new set of repair criteria which were subsequently refined and presented to the Regional Board in a June 1986 technical report on wastewater management (SCCHSA, 1986). These criteria have been used to evaluate existing systems and guide repairs during the past three years. The criteria are summarized in Table 10 and presented in Appendix C.

Provisions where there are significant differences between the Class II repair standards and the County's current repair criteria include:

- the requirement for dual leachfields,
- leaching area requirements,
- setback from embankments,
- separation from groundwater,
- trench depth, and
- the criteria for requiring system repairs.

The current criteria are discussed in the following paragraphs.

Dual Leachfields - Dual leaching systems have good theoretical utility for extending system life through regular rotation of the leachfield, and for providing an "instant" repair in the event of failure of one leachfield. However, this utility is greatly diminished if the resident does not rotate the fields, or "loses" the diversion valve. In highly permeable soils, use of dual systems may actually diminish the amount of biological treatment provided in the leaching device because it reduces the formation of a biological mat. The biological mat forms a critical portion of the treatment environment in a leachfield. The requirement for dual systems in the Class II standards was one of the major reasons that existing systems did not and/or could not meet those standards. Such a requirement for existing systems provides a major and unnecessary burden on the property owner. For these reasons, dual leaching systems are not currently required by the County as a part of system repairs. Occasionally they are used, particularly if the old system is still functional, and can periodically be reused through the switching of a valve.

Leaching Area Requirements - The Class II standards required that the minimum leachfield would be based on soil permeability as determined by a percolation test. This is a good theoretical approach, but is limited by the vagaries of the percolation test and the availability of qualified personnel to perform the tests for all repairs. County repair standards currently require leaching area of 500 square feet for a one bedroom house, and an additional 250 square feet for each additional bedroom. This is based on a loading rate of 0.5 gallons/square foot/day. In soils with permeability faster than 60 minutes per inch (MPI), this would result in a larger leachfield than would be required under Class II standards. For soils expected to have slower permeability, the County's repair criteria require that the leaching area be made larger, or the volume of wastewater reduced through conservation.

TABLE 10: Summary of Current Santa Cruz County Septic System Repair Criteria

Requirement for System Repair

- System repair is required where there is evidence of surfacing effluent, water quality degradation, or surface discharge of greywater.

Leaching Area Requirements

- 1 bedroom - 500 square feet minimum
2 bedrooms - 750 square feet minimum
3 bedrooms - 1000 square feet minimum
Additional bedrooms - 200 additional square feet per bedroom

- If soils have permeability slower than 60 minutes per inch, or there is inadequate room on the site for the standard leaching area, leaching area shall be determined using allowable loading rates as determined by data on soil permeability. Leaching area may be reduced by installation of greywater sumps or water conservation measures.

Groundwater Separation

- Separation between the bottom of the leaching device and seasonal groundwater shall be a minimum of 3 feet, or 8 feet if the permeability is faster than 60 minutes per inch, except as provided below.

- Where there are no wells within 250 feet, or surfacing of groundwater within 100 feet, groundwater separation may be reduced, provided the leaching device does not penetrate groundwater, and groundwater is not less than 3 feet from the ground surface.

Minimum Setbacks to Leaching Devices

- Setback from cuts or embankments shall be 2 times the height of the bank, up to a setback of 25 feet. If an impermeable layer, or high groundwater is present, the setback shall be 4 times the height, up to 50 feet.

- Setbacks from streams shall be at least 100 feet, if possible, or a minimum of 50 feet.

Wastewater Reduction

- Required leaching area may be reduced through installation and use of water conservation devices, and enforceable restriction of water use.

- Greywater sumps may be installed to absorb washing machine water, or bathwater, to reduce the load on the leachfield.

Haulaway Systems

- When a system is failing and cannot be repaired, sewage shall be pumped on a regular basis to prevent any surfacing of effluent. Haulaway may be required on a year-round basis, or only in the winter when soils are too saturated to allow effluent leaching.

Alternative Systems

- Where repair standards for a conventional system cannot be met, an alternative system may be allowed, such as a mound system, pressure-distribution system, or other approved alternative which provides for adequate treatment and disposal.

Operating Permits

- An annual operating permit shall be required when a repair requires water conservation, an alternative system, or haulaway. The permit will include the conditions for operation, and will provide for an annual inspection by County staff.

Setback from Cuts or Embankments - Class II standards required a leachfield setback of four times the height of the embankment, up to a maximum of 75 feet. This standard was also one of the major factors that would have precluded onsite repair of Class II parcels (CH2M Hill, 1984). However, experience has shown that surfacing of effluent from an embankment has very rarely ever been a problem in the San Lorenzo Valley, unless the system is immediately adjacent to the embankment. Soils are generally quite deep, with very limited occurrence of confining layers that would induce lateral flow (HEA, 1982). For these reasons, the current setback requirement from embankments is two times the height, up to a maximum of 25 feet.

Separation from Groundwater - The standard for groundwater separation is the single standard that affects the greatest number of properties in the San Lorenzo Valley. Class II standards required a 3 - 50 foot vertical separation between the bottom of the leachfield and groundwater, depending on soil permeability and proximity to a stream or well. This precluded onsite repair of many properties. However, monitoring of groundwater quality has shown that in 98% of the cases, at distances of more than 50 feet from a leachfield, close proximity of groundwater has no significant effect on groundwater quality, even if the leachfields are submerged in groundwater (Section 4.4; and SCCHSA, 1985). Adequate treatment of effluent does take place under saturated conditions, given adequate distance of horizontal travel. Thus, at distances from wells and streams, the primary concern in developing a repair standard for groundwater separation is based on the need to prevent hydraulic interference and surfacing of effluent at or near the leachfield. Where there are no wells within 250 feet or surface water within 100 feet, the County's current repair standards require only that a leachfield not penetrate winter groundwater, and that leachfields not be installed where winter groundwater is less than 3 feet from the surface. If a well or stream is closer, the County's criteria require a 3-8 foot separation depending on soil permeability.

Trench Depth - The Class II standards limited the maximum trench depth to 10 feet. The County's current repair standards has reduced this to 6 feet for most installations. This provides for greater removal of nitrogen compounds in the upper soil layers, as indicated by the shallow groundwater monitoring (Section 4.4).

Criteria for Requiring Repair - The Class II standards required that all systems would be repaired or replaced if they did not meet the technical standards for dual systems, stream setback, or groundwater separation. As mentioned previously, this would have required significant expenditure of public and private funds for repair or replacement of 98% of the Class II systems, even though there was no indication they were adversely affecting water quality or causing a nuisance. For existing development, the County's current criteria require system improvement only in the event of system failure, or demonstrated degradation of surface water quality resulting from that system. This provides for protection of water quality and public health without imposing an unnecessary burden on the property owner. In addition, if a significant remodel or home addition is performed, it is also required that the system be upgraded to meet the repair criteria. (For additions which propose increasing the home size more than 50% or which add bedrooms, the system must be upgraded to meet new system standards.)

Although the Basin Plan recommends that system repairs meet new system standards to the greatest extent possible, the establishment of standardized repair criteria provides an adequate level of water quality protection and also provides for consistent, equitable treatment of property owners. For example, it is not equitable to require the owner of a larger parcel to bear the cost of a dual system when the owner of a smaller parcel would not have to bear that cost because his lot is too small for a dual system. However, if a lot is so constrained that the basic repair criteria cannot be met, then some other mitigation must be provided, such as installation of a greywater sump, use of water conservation devices, or use of an alternative system. If the constraints on a lot are such that a repair cannot meet the repair criteria, the repair will be approved, if in the judgement of the filed staff it has a reasonable expectation of performing adequately, without degrading water quality. However, that system will continue to be monitored closely, and required to go to haulaway if it fails.

Based on the lack of water quality degradation resulting from existing, non-failing septic systems in the Watershed, it appears that the County's repair criteria, which were developed in 1986, provide a more than adequate measure of protection for evaluating and upgrading disposal systems for existing development. However, these criteria do not provide the large margin of safety that is provided by current standards for new systems. To provide a good margin of safety for repairs, use of the repair standards should be combined with an ongoing program to ensure that systems are periodically inspected and properly maintained. These standards make the best of a pre-existing, marginal situation, and are not at all appropriate for new development, which must have more stringent standards. New system standards are discussed in Section 5.4.4.

5.2 Current Evaluation Efforts

The County's current program for evaluation and improvement of wastewater disposal systems utilizes a practical evaluation of each individual septic system on its own merits, combined with a comprehensive compilation and interpretation of data for broad areas of the Watershed. The evaluation program includes the following elements:

- development, maintenance, and use of a computerized database of information on individual properties;
- the performance of soil and groundwater investigations to determine the potential limitations to septic system performance;
- the inspection of properties to evaluate how well the septic systems are functioning; and,
- the promotion of adequate system repairs and monitoring of total repair efforts.

The following subsections describe the specific methodologies used, and are followed by sections describing the specific findings of the work.

5.2.1 Database

A computerized database has been created which summarizes the information on septic system characteristics, soil conditions, and septic system history that is available for each parcel. Information is derived from the existing files in the Environmental Health Service, and is updated by information from lot-by-lot surveys, repairs, inspection reports submitted by pumpers, and information developed from soil and groundwater investigations. All of the data is entered into the database where it can be combined, summarized, and evaluated. In addition to the database, maps are maintained showing the distribution of septic system problems and constraints on individual parcels.

Currently the database contains records for over 4000 parcels, about 30% of the parcels in the study area. The data is limited by the absence of records on system installations and repairs prior to 1963 and the somewhat sparse availability of records from 1963 to 1975. Over 75% of the developed parcels do not have any information from prior to 1975, and 42% of the developed parcels have no records at all regarding the septic system. Even where there is information on the septic system, there is very little recorded information on soil types or groundwater levels. Some soil information is available for 20-30% of the systems, and information on depth to groundwater is available for 10-20% of the systems.

Each year more parcels are added to the database, and current information is augmented by new investigations and repair activities. The County now requires that records of septic tank pumping and inspection by pumpers be submitted for every tank that is pumped. This information is also being added to the database.

5.2.2 Soil and Groundwater Investigations

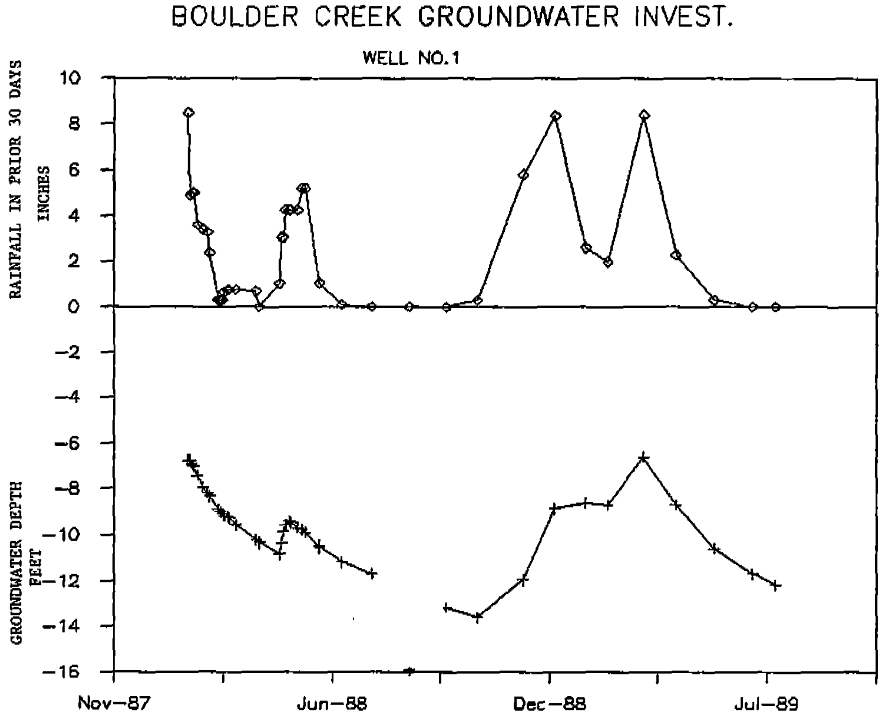
As mentioned above, available information on soil type and depth to groundwater has been limited to about 20% of the existing parcels. The lack of groundwater information is particularly a problem when a system repair must be designed during summer months. During the summer, groundwater levels may commonly be as much as 5-10 feet lower than they are in winter months, and thus give no warning of potential problems (HEA, 1982). In order to develop more information to evaluate existing disposal systems and to guide system repairs, the County has conducted various investigations of groundwater and soil type in locations throughout the San Lorenzo Valley. Work has particularly focussed in areas where surveys of system functioning have been carried out.

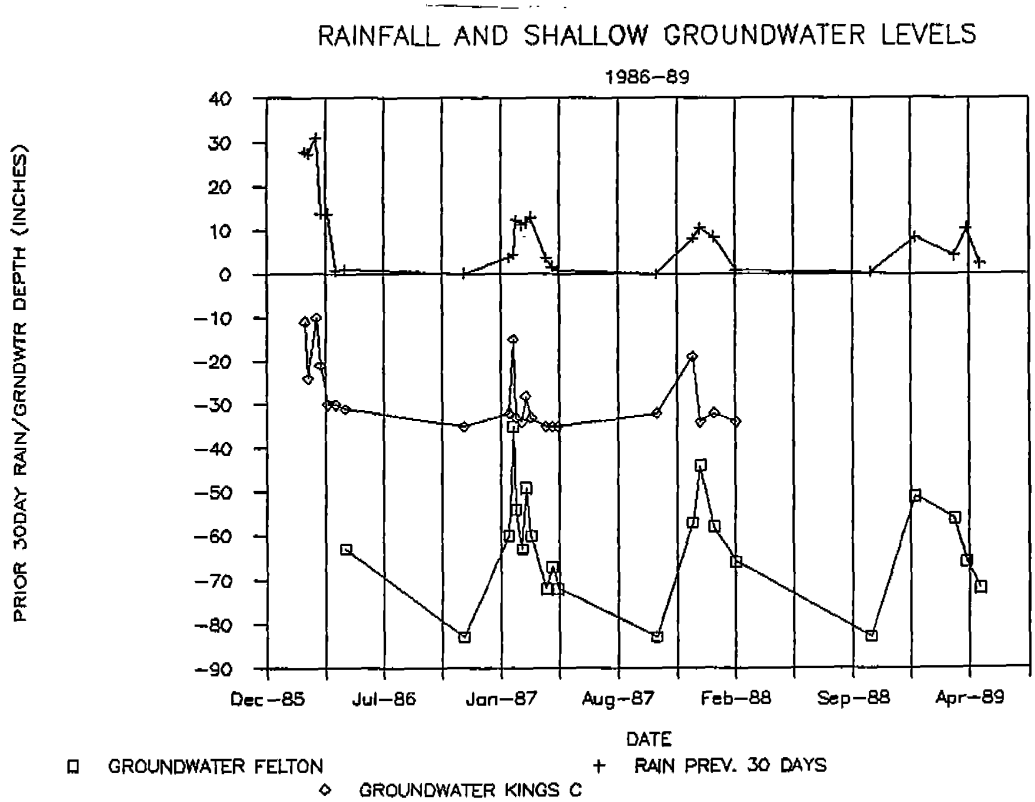
In spring of 1986 over 50 boreholes up to 10 feet deep were hand-augered throughout the San Lorenzo Valley to assess soil characteristics and monitor shallow groundwater levels. Groundwater measurements were made from late March to early May of 1986, which was a wetter year than normal. Although most of the holes were placed after the heaviest rains had ended, groundwater levels in all of them were observed during the normal period of winter water table testing, when there had been at least 6 inches of rain in the previous 30 days. These observations gave a good indication of the prevalent winter water table. During and immediately following heavy rains, transient water tables would probably be expected to be 1-2 feet higher, as indicated by observations in boreholes constructed in March, 1986.

Based on topography and surface observations of soils, the soil and groundwater information from the boreholes was extrapolated to other parcels in the surrounding areas in the Kings Creek area and Boulder Creek area. The information was entered into the parcel database.

Approximately 20 of the boreholes were cased with perforated pipe so that groundwater levels could continue to be monitored. This provided information on the response of groundwater to rainfall under different topographic and soil conditions. It has also enabled County staff to determine periods when groundwater is at typical winter levels. Despite the lower total levels of rainfall in the winters of 1987, 1988, and 1989, the borehole monitoring indicated that typical winter groundwater levels were reached for at least short periods of time each winter. However, the periods of high groundwater lasted only a few weeks during the drier winters. Information for several of the boreholes is shown in Figure 11. As of 1989, almost half of the monitoring wells had been lost to vandalism, infilling, or other damage. More wells will be placed in conjunction with future investigations.

FIGURE 11: **Rainfall and Shallow Groundwater Levels in Boulder Creek, Felton, and Kings Creek**





In winter and spring of 1988, more detailed subsurface investigations in downtown Boulder Creek were conducted in an effort to determine the cause, extent, and behavior of high groundwater in that area. Eight test holes were bored approximately 20 feet to bedrock. Seven of the holes were cased and enclosed in steel security caps for ongoing monitoring. Water quality data from these wells was reported in Section 4.4.2 of this report. As of 1989, 5 of the holes are still available for monitoring. In addition to the monitoring wells, 13 additional, temporary boreholes were bored about 8 feet deep in the two block problem area of Boulder Creek to better determine the soil type, groundwater level, and the extent of a localized, dense clay layer which severely limits onsite disposal in that area. Findings from the Boulder Creek investigations are discussed in Section 5.6.2.

5.2.3 Parcel Survey

The key element of the investigations of existing septic system performance is the lot-by-lot survey of all areas in the Valley to identify systems which are not performing satisfactorily. The survey work is done primarily during the winter when soils are saturated, groundwater elevations are high, and systems are most likely to fail if they are inadequate. Field staff walks the survey areas, checking each property, looking for signs of surfacing sewage effluent or greywater bypass. Discharge on the ground surface of greywater (water from the shower, sink, or clotheswasher) can create water quality degradation or cause a public health hazard, and is illegal. Presence of a greywater bypass may indicate problems with the septic system, which have caused the owner to modify plumbing to relieve the system. However, it has also been found from discussions with residents that many will bypass greywater for no definite reason, even when there system has plenty of capacity.

As the survey is carried out, staff also confers with residents to determine if they may be experiencing septic problems, and discusses proper septic system care and management. The main objectives of the survey efforts are to evaluate the performance of existing systems, initiate needed improvements (as discussed in the following section), and to educate residents regarding the need for proper septic system maintenance. Information from the survey is included in the parcel database.

The timing of the surveys, and the number of problems found are significantly affected by the amount of rainfall and soil saturation. Cumulative rainfall amounts are monitored, and groundwater levels in various parts of the Watershed are observed to determine when "normal" winter conditions have been reached. The County requires 60% of the average annual rainfall to have fallen, with at least 6 inches of rain in the previous 30 days, prior to allowing the determination of winter water table levels for the purpose of designing new systems. This is also used as a guideline for determining when to start the winter survey period. The survey period generally ends when water levels in groundwater monitoring wells are observed to drop significantly below normal winter levels. The proportion of observed failures also drops significantly as conditions dry out.

The first year of survey work, 1986, was a wet winter with annual rainfall of 74.6 inches in Ben Lomond, as compared to a normal of 53 inches. The winters of 1987, 1988, and 1989, were all dry years with annual rainfall of 38-41 inches in Ben Lomond. During the drier winters, the survey work was limited by less than normal amounts of rainfall, which resulted in shorter periods of soil saturation and high groundwater. Despite the lower rainfall, soils did become fully saturated and groundwater levels appear to have risen at least to within 1-2 feet of the peak levels found in the wet year of 1986. Observed groundwater levels were close to historical levels from other normal winters as indicated by information in the files for nearby parcels. Although the survey period was reduced during those dry winters, it is believed that the work that was accomplished was done during representative winter conditions and that it provides reliable information on system performance for those systems surveyed. This will be confirmed by ongoing water table monitoring and rechecks of survey results during subsequent winters.

During the first year of the effort (1986), 700 parcels were surveyed in the Greater Kings Creek area. In 1987, 460 parcels were surveyed in the Boulder Creek area, and 50 parcels were surveyed in the Brook Lomond area. In 1988, 95 parcels in the Boulder Creek area were surveyed, and 55 parcels in Brookdale and other areas were surveyed. Saturated soil conditions did not last as long in the winter of 1988, and survey work was discontinued after three weeks when it became apparent conditions were not wet enough to continue. The information on Brookdale is not considered to be reliable. In 1989, inspections were made on 54 parcels in El Solyo Heights (north Felton), 111 parcels in downtown Ben Lomond, and 29 parcels in Glen Arbor. Conditions had dried out significantly by the time the Glen Arbor survey was started, and the survey was discontinued. The delays due to dry weather have set the original survey schedule that was shown in the 1986 Technical Report back approximately three years.

5.2.4 Septic System Improvements

Improvements of existing septic systems are required whenever a failure is identified through the survey effort, by investigation of water quality problems, or in response to a citizen complaint. In addition, there has been a significantly increased effort on the part of individual property owners to initiate upgrade of their systems on their own volition. During 1986, 1987, and 1988, there were, respectively, 314, 349, and 305 repair permits issued in the San Lorenzo Watershed. Seventy-eight percent were initiated by property owners.

If a failure or greywater discharge is discovered, the owner is notified by written or legal notice and required to correct the situation through plumbing repair, removal of the washing machine, installation of a greywater sump, use of water conservation measures, and/or replacement of the septic system. System replacement is required whenever there is significant, ongoing surfacing of effluent. If the failure is only intermittent during the wettest part of the winter, the property owner may be allowed to pursue other means of correcting the situation, such as flow reduction or construction of a greywater sump, before a full replacement is required. If a system replacement is required, the work is performed according to the County's repair criteria, as described in Section 5.1.3. If there is concern that the site conditions are marginal, or that the system does not meet the conventional repair criteria, the property is rechecked the following winter to confirm that the problem has been satisfactorily corrected.

If an effective system improvement cannot be made, the property is required to go to a haulaway system, with effluent pumped from the tank as needed to prevent surfacing of effluent. This may be required on a year-round basis or just during the winter months.

Where a concentration of problems is found, with site conditions which limit the potential for successful onsite system repair, interim improvements are required while County staff evaluates the potential for a community approach. Interim measures usually involve water conservation, and pumping of the tank as necessary to prevent surfacing of effluent until a final solution can be developed. At this time, a community approach is being evaluated for downtown Boulder Creek.

The results of repair efforts are discussed in detail in Sections 5.3.2.6 and 5.4.

5.3 Description of Existing Systems

Information regarding the characteristics and performance of existing septic systems in the San Lorenzo Watershed was developed using the methodologies described in the previous sections, and is based on findings from previous studies, file information maintained by the Environmental Health Service, results of recent lot-by-lot surveys, results of soil and groundwater investigations, and information from system repair permits issued in the last three and a half years. This section will provide a summary discussion of general conditions found in the study area, and Section 5.6 provides a more detailed description of conditions found in specific areas.

The available information on system characteristics and performance is summarized in Table 11. Although information has only been compiled for 30% of the estimated 12,000 to 13,000 parcels in the study area, this information is believed to be generally representative of overall conditions, and includes most of the areas expected to have the most difficult conditions. The database includes 58% of the Class I parcels, 57% of the Class II parcels, and 53% of the Class II-C parcels (those parcels which could not meet the standards for onsite disposal).

5.3.1 System Characteristics

Major characteristics of the septic system and the site which affect system functioning, long-term performance, and potential for replacement are: system age, lot size, system size, groundwater depth, soil type, depth to bedrock, stream setback, slope, and setback from embankments. The general significance and extent of occurrence of each of these factors in the San Lorenzo Watershed will be discussed in the following sections.

TABLE 11: Summary of Septic System Characteristics

DATA ELEMENTS / AREAS	TOTAL DATABASE SUMMARY		Greater Kings Creek		Boulder Creek		Brooklomond		El Solyo Heights		Ben Lomond	
Year Information Compiled from Files.			1985		1985		1987		1989		1989	
Developed Parcels (Systems) in Database	4056		758		777		104		80		268	
Systems with Parcel Size Information	3587	88%	722	95%	572	74%	76	73%	80	100%	268	100%
- Parcels less than 15,000 sq. ft.	2462	61%	567	75%	396	51%	48	46%	52	65%	168	63%
- Parcels less than 10,000 sq. ft	1609	40%	430	57%	276	36%	31	30%	33	41%	109	41%
- Parcels less than 6,000 sq. ft.	521	13%	157	21%	100	13%	7	7%	2	3%	34	13%
Records with Leachfield Information	2363	58%	437	58%	372	48%	66	63%	35	44%	171	64%
- Leachfields Meeting Standards for Size	1283	32%	277	37%	214	28%	33	32%	20	25%	110	41%
Records with Age of System	1984	49%	462	61%	331	43%	47	45%	45	56%	185	69%
- Systems Installed 1980-1985	432	13%	123	16%	77	10%	14	13%	6	8%	45	17%
- Systems Installed 1975-1980	492	12%	136	18%	87	11%	18	17%	16	20%	36	13%
Systems with Stream Setback Information	715	18%	230	30%	140	18%	19	18%	2	3%	18	7%
- Stream Setback less than 100 ft.	449	11%	194	26%	95	12%	12	12%	0	0%	0	0%
- Setback less than 100 ft., but undetermined	234	6%	145	19%	60	8%	4	4%	0	0%	5	2%
- Stream Setback less than 50 ft.	64	2%	11	1%	4	1%	0	0%	0	0%	2	1%
- Stream Setback less than 25 ft.	16	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Systems with Groundwater Information	900	22%	327	43%	326	42%	20	19%	17	21%	12	4%
- Groundwater less than or equal to 3 ft.	143	4%	23	3%	28	4%	7	7%	2	3%	1	0%
- Groundwater 3-6 feet below grade	268	7%	112	15%	101	13%	9	9%	4	5%	1	0%
- Groundwater 6-10 feet below grade	420	10%	184	24%	186	24%	4	4%	4	5%	4	1%
Systems with Soil Information	1369	34%	555	73%	134	17%	16	15%	27	34%	80	30%
- Soils with Significant Clay Content	586	14%	374	49%	24	3%	11	11%	19	24%	14	5%
Systems with Slope Information	398	10%	41	5%	57	7%	0		3	4%	1	0%
- Slope greater than 30%	77	2%	5	1%	1	0%			1	1%	0	0%
- Slope greater than 50%	27	1%	3	0%	0	0%			1	1%	0	0%
- Slope undetermined, may be a problem	88	2%	29	4%	48	6%			0	0%	0	0%
Systems with Information on Depth to Bedrock	81	2%	23	3%	10	1%	0		0		0	
- Depth less than 10 feet	61	2%	19	3%	5	1%						
- Depth less than 5 feet	19	0%	1	0%	2	0%						
Sources of Information *			F,G,S		F,G,S		F,II,S		F,S		F,S	
Systems with Serious Past Problems	146	4%	46	6%	38	5%	4	4%	2	3%	7	3%
Systems with Moderate Past Problems	247	6%	79	10%	63	8%	4	4%	10	13%	24	9%
Class I Parcels	1585	39%	506	67%	611	79%	0	0%	74	93%	248	93%
Class II Parcels	1532	38%	0	0%	0	0%	78	75%	0	0%	0	0%
Class II-C Parcels **	657	16%	0	0%	0	0%	46	44%	0	0%	0	0%
Unclassified Parcels	857	21%	252	33%	166	21%	26	25%	6	8%	20	7%
Systems with Record of Tank Pumping	397	10%	70	9%	69	9%	27	26%	15	19%	77	29%
Repair Actions, Jan. 1986 - June 1989	826	20%	243	32%	187	24%	11	11%	9	11%	76	15%
Year Parcels Surveyed for Failures			1986		1987-88		1987		1989		1989	
- Number of Parcels Surveyed	2264	56%	690	91%	548	71%	51	49%	53	66%	105	39%
- Number of Leachfield Failures	110	5%	51	7%	24	4%	3	6%	7	13%	2	2%
- Number of Greywater Bypasses	142	6%	74	11%	40	7%	5	10%	4	8%	8	8%
- Number of Systems Performing Satisfactorily	2012	89%	565	82%	484	88%	43	84%	42	79%	95	90%

NOTES:

* - Sources of Information:
- F - Records in Environmental Health files.
- G - County soil and groundwater investigations.
- S - Findings from County parcel-by-parcel survey.
- II- Findings from Class II investigations.

** - Class II-C are parcels not able to be upgraded to meet the Class II repair standards.

TABLE II (cont.)

DATA ELEMENTS / AREAS	TOTAL DATABASE SUMMARY		Glen Arbor		Forest Springs		Brookdale		San Lorenzo Park		Riverside Grove		Forest Lakes	
Year Information Compiled from Files.			1988		1988		1986		1983		1983		1983	
Developed Parcels (Systems) in Database	4056		470		379		403		77		89		651	
Systems with Parcel Size Information	3587	88%	447	95%	379	100%	393	98%	54	70%	73	82%	523	80%
- Parcels less than 15,000 sq. ft.	2462	61%	320	68%	291	77%	202	50%	40	52%	57	64%	321	49%
- Parcels less than 10,000 sq. ft	1609	40%	146	31%	204	54%	140	35%	19	25%	44	49%	177	27%
- Parcels less than 6,000 sq. ft.	521	13%	38	8%	72	19%	58	14%	7	9%	22	25%	24	4%
Records with Leachfield Information	2363	58%	342	73%	209	55%	236	59%	47	61%	74	83%	374	57%
- Leachfields Meeting Standards for Size	1283	32%	199	42%	94	25%	109	27%	0	0%	3	3%	224	34%
Records with Age of System	1984	49%	324	69%	189	50%	231	57%	35	45%	32	36%	103	16%
- Systems Installed 1980-1985	432	13%	50	11%	54	14%	63	16%	- -		- -		- -	
- Systems Installed 1975-1980	492	12%	32	7%	37	10%	72	18%	14	18%	14	16%	30	5%
Systems with Stream Setback Information	715	18%	24	5%	44	12%	66	16%	14	18%	21	24%	137	21%
- Stream Setback less than 100 ft.	449	11%	10	2%	27	7%	37	9%	12	16%	13	15%	49	8%
- Setback less than 100 ft., but undetermined	234	6%	0		0	0%	20	5%	0	0%	0		0	0%
- Stream Setback less than 50 ft.	64	2%	3	1%	4	1%	3	1%	11	14%	8	9%	18	3%
- Stream Setback less than 25 ft.	16	0%	0	0%	0	0%	2	0%	5	6%	3	3%	6	1%
Systems with Groundwater Information	900	22%	40	9%	20	5%	18	4%	30	39%	23	26%	67	10%
- Groundwater less than or equal to 3 ft.	143	4%	7	1%	3	1%	3	1%	22	29%	20	22%	27	4%
- Groundwater 3-6 feet below grade	268	7%	9	2%	5	1%	3	1%	8	10%	2	2%	14	2%
- Groundwater 6-10 feet below grade	420	10%	18	4%	4	1%	7	2%	0		0		9	1%
Systems with Soil Information	1369	34%	169	36%	73	19%	76	19%	41	53%	45	51%	153	24%
- Soils with Significant Clay Content	586	14%	29	6%	9	2%	24	6%	18	23%	12	13%	52	8%
Systems with Slope Information	398	10%	64	14%	1	0%	13	3%	49	64%	57	64%	112	17%
- Slope greater than 30%	77	2%	14	3%	1	0%	1	0%	22	29%	11	12%	21	3%
- Slope greater than 50%	27	1%	6	1%	1	0%	1	0%	8	10%	2	2%	5	1%
- Slope undetermined, may be a problem	88	2%	10	2%	0	0%	1	0%		0	0		0	0%
Systems with Information on Depth to Bedrock	81	2%	5	1%	0	0%	8	2%	17	22%	8	9%	10	2%
- Depth less than 10 feet	61	2%	5	1%	0	0%	5	1%	15	19%	6	7%	6	1%
- Depth less than 5 feet	19	0%	5	1%	0	0%	1	0%	5	6%	0	0%	5	1%
Sources of Information *			F,S		F		F		F,II,C		F,II,C		F,II,C	
Systems with Serious Past Problems	146	4%	13	3%	17	4%	19	5%	--		--		--	
Systems with Moderate Past Problems	247	6%	22	5%	18	5%	27	7%	--		--		--	
Class I Parcels	1585	39%	146	31%	0	0%	0	0%	0	0%	0	0%	0	0%
Class II Parcels	1532	38%	214	46%	375	99%	48	12%	77	100%	89	100%	651	100%
Class II-C Parcels **	657	16%	71	15%	297	78%	8	2%	62	81%	47	53%	126	19%
Unclassified Parcels	857	21%	28	6%	4	1%	355	88%	0	0%	0	0%	0	0%
Systems with Record of Tank Pumping	397	10%	39	8%	63	17%	37	9%	--		--		--	
Repair Actions, Jan. 1986 - June 1989	826	20%	101	21%	65	17%	37	9%	13	17%	18	20%	66	10%
Year Parcels Surveyed for Failures					--		--		1983		1983		1983	
- Number of Parcels Surveyed	2264	56%							77	100%	89	100%	651	100%
- Number of Leachfield Failures	110	5%							8	10%	5	6%	10	2%
- Number of Greywater Bypasses	142	6%							8	10%	2	2%	1	0%
- Number of Systems Performing Satisfactorily	2012	89%							61	79%	82	92%	640	98%

NOTES:

* - Sources of Information:
F - Records in Environmental Health files.
G - County soil and groundwater investigations.
S - Findings from County parcel-by-parcel survey.
II- Findings from Class II investigations.

** - Class II-C are parcels not able to be upgraded to meet the Class II repair standards.

5.3.1.1 Age

Septic systems generally are believed to have a finite lifespan, which is determined by the eventual loss of infiltrative capacity of the soils around the leachfield. This is brought on by clogging of the soil pores with organic material and biological growth which occurs in a saturated anaerobic environment. As the leachfield is used, the clogged area forms first at the bottom of the trench, and gradually rises along the sides as more of the trench becomes saturated and clogged. The average lifespan of a leachfield is typically estimated to be about 20 years. However, the lifespan can be greatly affected by sizing, loading, soil conditions, and maintenance of the system. Once a leachfield is completely clogged, surfacing of the effluent results, and the leachfield typically must be replaced by a new field in a new location on the property.

System age is a concern because the older systems may not work as well, due to reduced capacity, and they might be expected to fail completely in the near future. Older systems may also be more subject to failure because they were installed at a time when the installation standards were much less stringent than current standards. They may be undersized and placed in soil conditions that would not be considered acceptable under today's standards, further increasing the chances of system failure.

Much of the development in the San Lorenzo Valley dates back 40-50 years, or more. However, the septic systems which serve most of the older homes have been replaced at least once or twice since the initial construction of the home. Records of the age of the septic system are available for about 65% of the homes in the database (including historical records, and repair records since 1985). Of these, over half of the systems have been installed (or replaced) since 1975. These figures are derived primarily from the records of permit issuance for installation or repair of septic systems. However, in many cases, particularly prior to the mid 1970's, system replacements were frequently done without a permit. Based on field experience and questionnaire results from Class II studies, it is estimated that of the systems installed in the past 20 years, 25-50%, were installed without the benefit of a permit, and thus have no record of the date of installation. Extrapolating from the available data, it is estimated that about 40% of the systems are over 20 years old, 35% are between 10 and 20 years old, and 25% are less than 10 years old.

These figures suggest that, independent of other factors, increasing system age would be expected to result in system failures and require a significant number of system repairs in the San Lorenzo Valley. This is borne out by information on repairs made since 1985, 75% of which were upgrades of systems which were either installed prior to 1970 or which have no record of prior installation date. This provides further indication that a significant number of systems in the Valley tend to perform satisfactorily for more than 20 years. The incompleteness of records prior to 1970 prevents an accurate determination of the typical system lifetime.

Septic system lifetime can be greatly shortened by adverse site conditions, substandard design, or lack of maintenance. Of the leachfield repairs performed since 1985, 40 of the systems (6%) had been recently repaired (subsequent to 1979), and were less than 10 years old. Substandard leachfield size was a contributing factor in 95% of those premature leachfield failures, with clay soils contributing to 38% of the premature failures, and high groundwater contributing to 18% of the premature failures. The influence of such factors as maintenance or unusual loading could not be determined.

The greatly increased system size required by current repair standards would be expected to result in much longer system performance than provided by the older systems. The increased use of water conservation measures and greywater sumps to reduce hydraulic loading of the system will also slow down the formation of the clogging mat in the leachfield. The more frequent practice of regular tank pumping will also help to extend system lifetime.

5.3.1.2 System Size

The performance of a septic system is in great part determined by its capability to discharge effluent into the soil, where most of the effluent treatment takes place. If the absorbtion area is too small in relation to the wastewater load and the permeability of the soil, the leachfield will become saturated, with surfacing of untreated effluent. Short of immediate system failure, overloading maintains saturated anaerobic conditions in the leachfield, which reduces treatment, increases the rate of long-term soil clogging, and reduces the lifetime of the leachfield. System overloading can also result in a system which meets the standards for size, if site constraints such as high groundwater or clay soil are not taken into account in the design of the system.

The County's repair criteria for leachfield sizing are relatively conservative and allow for a daily load of 250 gallons for a 1 bedroom house, 375 gallons for a 2 bedroom house, and 500 gallons for a three bedroom house. The leachfield standards also allow for a 200% peaking capacity and assume a sidewall absorbtion rate of 0.5 gallons per square foot per day. This results in a leachfield requirement of 500 square feet for a 1 bedroom home, 750 square feet for a two bedroom home, and 1000 square feet for a three bedroom home, with an additional 200 square feet per additional bedroom. However, if soils have high clay content with a permeability slower than 60 minutes per inch, the leachfield must be sized larger, or water use reduced. In the San Lorenzo Valley, domestic water use figures are generally much lower than the design allowance, generally about 50% of the projected amount, with an average water use of 166 gallons per day per home (Gilchrist and Associates, 1984). The repair system size standards are, thus, generally fairly conservative.

Records of existing septic systems have been evaluated to determine how many of the current systems meet the repair criteria for adequate sizing. Records of septic system size are available for 58% of the developed parcels. Of these systems, 55% meet the current criteria for adequate sizing. It is assumed that the systems for which there are no records are older systems, or those installed without benefit of a permit, and are therefore likely to be undersized. If it is assumed that all of the systems for which there are no records are undersized, then only about one third of the existing systems in the study area would be expected to meet the current criteria for leaching area size. Despite the apparent substandard size, the large majority of existing systems have performed adequately for many years, probably facilitated by the general low-water use habits of San Lorenzo residents.

Although the presence of a large number of small systems may indicate an increased potential for eventual system failure, it also indicates a good potential for improving overall system performance through the replacement of existing systems with larger systems, provided there is adequate room on the parcel. Of the leachfield replacements that are currently being installed, 63% are able to meet current standards for size of leaching area. Where full size cannot be provided, the property owner is required to install water conservation devices to further reduce wastewater flow to an amount that can easily be handled by the smaller leachfield.

5.3.1.3 Lot Size

Lot size has a direct bearing on the ability to install an adequately sized leachfield on the property, and to have enough room for eventual replacement of the leachfield. The amount of room required for system installation and replacement also depends on the allowed depth of the leachfield, which is controlled by the soil type and presence of groundwater. Adequate area can be limited by presence of steep slopes, cutbanks, streams or wells, which require minimum setbacks from the leachfield. If a 5 foot deep trench is used, approximately 1200 square feet of area would be required for a leachfield and future expansion area meeting the repair criteria for a three bedroom house. For new development, the new system standards require about 3000 square feet of area for the septic system and expansion area. The County currently requires a minimum lot size of 15,000 square feet for new development in septic system constraint areas outside of the Sam Lorenzo Watershed. Within the San Lorenzo Watershed area, the minimum lot size for new development is 1 acre (43,560 square feet).

Parcel sizes in the older, developed areas of concern in the San Lorenzo Valley are generally quite small, and present some constraints for upgrade of existing septic systems. Of the records compiled at this time, for areas in the developed corridors of the Valley, 61% of the parcels are less than 15,000 square feet, 40% are less than 10,000 square feet, and 13% are less than 6000 square feet. Despite these small lot sizes, it does appear that in most cases there is still adequate room for system improvements, based on information from the Class II investigations.

As a part of the Class II investigations, parcels were evaluated to determine whether there was adequate room to upgrade the system to meet the Class II standards, which included the requirement for dual leachfields. The information developed for each parcel by those investigations was subsequently reevaluated to determine the adequacy of expansion area for system replacements to meet current repair criteria. This information was compiled for 750 parcels in Forest Lakes, San Lorenzo Park, and Riverside Grove. It appears that 78% of the parcels have adequate room and site conditions for system replacement, 13% of the parcels have marginal room, and 9% of the parcels had very limited area. In Forest Lakes, only 2% of the parcels had very limited room. Lot sizes and other conditions in these three areas are representative of general lot sizes found throughout the remainder of the study area. It thus appears that, despite the high number of small lots, there is still adequate room for system replacement on most lots in the study area.

5.3.1.4 Groundwater

Seasonally high groundwater is one of the most common potential constraints to septic system performance in the San Lorenzo Watershed. The major impact of high groundwater is hydraulic interference, which can lead to septic system failure. When soils are saturated and the leachfield is already full of groundwater, there is not adequate absorbtion capacity and effluent rises to the ground surface or the plumbing backs up. High groundwater can cause marginal systems to fail intermittently during the winter time, even though they perform satisfactorily during most of the year. High groundwater can also result in groundwater contamination, but this has not been found to be a significant problem in the study area (see Section 4.4).

The duration of the period of high groundwater is of importance in determining the severity of the impact on septic system functioning. If groundwater is only high for a few days in immediate response to a storm, the impact is probably not significant. Rainfall is so heavy in the San Lorenzo Valley, that in most locations there are brief periods when soils are completely saturated. Under such conditions, septic systems may experience very transitory problems. But if the groundwater remains high for up to a month following heavy rains, it will present a significant constraint to system performance. Records of groundwater levels over time have been provided by HEA (1982), and the County's current monitoring network (see <u>Figure 11</u>). Of primary concern are the levels of groundwater that persist for periods of several weeks or more.

Areas of seasonal high groundwater occur at various locations throughout the San Lorenzo Watershed. The worst areas seem to be flat alluvial areas, particularly at the base of hillsides. In some areas, clay soils, or shallow depth to bedrock lead to periods of soil saturation or perched water tables. The groundwater depth varies quite significantly over short periods of time and short distances. In most areas, records of groundwater depth are only available on the average for about 5-10% of the developed parcels. Groundwater data is much more available in areas known to have groundwater problems, than in areas where groundwater is deep enough to not be encountered. However, even in areas of known high groundwater, data is only available for about 20% of the parcels that would be expected to have high groundwater. The actual parcel counts in Table 11 for high groundwater in areas where there have been no parcel-by-parcel investigation should thus be multiplied by five to get a more accurate estimate of the number of parcels in those areas with high groundwater.

In communities where special investigations have been conducted, either through the Class II studies, or the County's current program, groundwater levels have been estimated for 40% of the parcels, generally including all the areas within those communities which have high groundwater constraints. These estimates are based on extrapolations from information from monitoring wells, soil borings, file records, and observed topography.

Most of the Class II information was not based on observations of groundwater, but on the presence of soil mottling, which indicates periodic presence of groundwater, but does not necessarily indicate the frequency or the duration of time that high groundwater might be expected to occur. The occurrence of mottling and the Class II estimates of groundwater depth were consistent with observations of actual groundwater levels during the very wet winter of 1982, after quite heavy rains (over 27 inches in 30 days). These observations are generally several feet higher than file records for normal winters and thus are not necessarily representative of typical winter conditions.

High groundwater less than 3 feet from the surface is estimated to occur on about 3-6% of the developed parcels in the study area. (The lower estimate represents actual measurements recorded in the files and parcel-specific estimates in areas that have had special surveys [San Lorenzo Park, Riverside Grove, Kings Creek, Boulder Creek, and Forest Lakes]; the higher figure includes the extrapolation of file information by a factor of five for areas which have not been surveyed.) Although systems can function under such groundwater conditions, particularly if the soils have good permeability, the rate of failure is higher, and the repair criteria would limit the use of standard systems in such conditions.

Moderately high groundwater (3-6 feet) probably occurs in about 6-20% of the parcels in the study area. This proportion is higher in Boulder Creek and Kings Creek, communities that are known to have areas of high groundwater and where groundwater investigations have been carried out. Shallow disposal systems can be designed to function in these kind of conditions. Based on file records and special studies, 10-25% of the systems in the study area would be expected to experience groundwater levels of 6-10 feet. This depth of groundwater does not present a significant problem for septic system functioning, if the systems are installed shallow enough. In the past, leachfields were installed fairly deeply, with over 50% installed greater than

8 feet deep. Of the repairs made since 1985, only 25% are over 8 feet deep, and more than half are 5 feet or less deep. This should provide for significantly improved performance in areas of high groundwater.

5.3.1.5 Soil Constraints

Primary soil constraints to system functioning result from presence of excessive amounts of clay, which limit soil permeability. This can greatly limit the absorbtion capacity of leachfields, especially during periods of saturation. This can lead to system failure, particularly if the leachfield is undersized.

The availability of soil information in the files is somewhat limited, with information only available for about 10-30% of the parcels, except for areas where there have been special investigations. In the past, soil information was often not recorded by field inspectors, unless it was particularly notable. Records indicate that about 14% of the parcels in the database have soils with significant amounts of clay: clay loams, sandy clays, sandy clay loams, or clays. If this data is extrapolated to parcels for which no information is available, it would be expected that 25% of the parcels in the study area have clay soils. Because only a few percolation tests have been made for most parcels in the database, it is not possible to determine what proportion of these clay soils have such a low permeability as to present a serious constraint to system performance. Problems resulting from clay soils do not seem to be extensive. The problematic clay soils tend to be more concentrated in specific areas where the underlying geology leads to the formation of clay soils: San Lorenzo Park, Kings Creek, El Solyo Heights, and pockets of Forest Lakes. Smaller pockets of clay soils do occur in other areas, but these probably only affect 5-10% of the parcels.

Very permeable soils can also limit system performance, by allowing the rapid movement of effluent to groundwater or surface water before it is adequately treated. Based on water quality monitoring in shallow groundwater of the San Lorenzo Watershed, the impacts of wastewater discharge in highly permeable soils are limited primarily to elevation of nitrate levels in groundwater and surface water. The occurrence of highly permeable soils is limited to the areas underlain by Santa Margarita sandstone, and a few areas along Boulder Creek and in Brookdale where soils are very rocky or gravelly.

5.3.1.6 Shallow Depth to Bedrock

Shallow depth to bedrock can limit the effective depth of septic systems and lead to perched groundwater conditions. This does not appear to be a widespread problem in the San Lorenzo Watershed, with only 2% of the parcels reporting soil depth of less than 10 feet, and less than 1% showing depth less than 5 feet. In general, the high annual rainfall and heavy vegetation cover has lead to deep weathering of the soil mantle. Shallow soils typically only occur on ridgetops, steep slopes, or areas underlain by outcrops of highly resistant rock.

5.3.1.7 Stream Setback

Close proximity of a septic system to a stream increases the potential for contamination by subsurface movement of untreated effluent or surface failure and runoff to the stream. Current standards for new systems require a setback of 100 feet. However, repair standards require 50 feet, or as little as 25 feet in special circumstances where a greater distance cannot be obtained and enhanced effluent treatment is provided prior to disposal. Groundwater monitoring has shown that in most circumstances, even under saturated conditions, there is not significant groundwater contamination over 25-50 feet from a leachfield (See Section 4.5). Although in some regions, close proximity to a stream may indicate high groundwater and increased potential for system failure, in the San Lorenzo Watershed, stream channels are usually deeply incised and groundwater levels are actually lower near the stream bank. A stream is defined as any watercourse with well-defined banks and which generally carries water for at least 30 days after the last significant rain.

Past streamside inspection programs conducted by the County have shown that about 14% of the septic systems in the San Lorenzo Watershed are located within 100 feet of a major perennial stream. Of the parcels in the database, 11% are indicated as within 100 feet of a stream, 2% are within 50 feet and less than 1% are within 25 feet. Although this does not seem to represent a significant area-wide concern, the systems that are too close to creeks will need to be addressed on a case-by-case basis. The small number of systems close to the streams can have a much greater surface water quality impact far out of proportion to their limited number.

5.3.1.8 Slope and Embankment Setback

Placement of septic systems on steep slopes, or in close proximity to cuts or embankments, may lead to lateral migration and surfacing of untreated effluent in the face of the cut or slope. Despite the steep slopes and presence of cuts in many areas of the San Lorenzo Watershed, these have not been observed to be a major cause of water quality degradation (HEA, 1982). However, the presence of excessively steep slopes (over 50%) may limit the availability of areas on a parcel suitable for system replacement.

Although data on slope is only infrequently available in the files, information currently in the database indicates that 2% of the systems are on slopes over 30%. More information on slope is available for the Class II areas, including San Lorenzo Park, Riverside Grove and Forest Lakes, where individual site surveys were carried out. Eleven percent of the parcels in these areas have slopes over 30%. For 2% of the parcels, the only available leachfield area was on slopes greater than 50%. On the average, these areas probably have steeper slopes than most of the rest of the Valley and slope does not appear to present widespread limitations.

5.3.2 Performance of Existing Onsite Disposal Systems

The discussion of system characteristics presented above indicates that there are many potential constraints to septic system performance in the San Lorenzo Watershed. However, the actual extent of problems is much lower than might otherwise be expected. This section will present an evaluation of system performance, as indicated by historical file information, past studies, the opinions of residents, current investigations, observations of system maintenance, and rates of system repair. Section 5.4 will discuss the improvements in system performance that have been made in the past four years.

In order to provide some guidelines for evaluation of system performance, an onsite wastewater disposal system which provides adequate performance can be defined as a system which provides subsurface disposal of sewage for an average period of at least 20 years, with no surfacing of untreated effluent, no pollution of groundwater or surface water, or backup of sewage into the house. An adequate system would be expected to receive a normal amount of maintenance, including tank pumping every 3-7 years, occasional clearing of blocked pipes, and possible structural repair of the tank if it is constructed of redwood. If all these conditions are met, the system should be considered to be performing satisfactorily. In addition, there should also be room on the parcel for a system replacement which will meet the repair criteria.

In most circumstances, in order to provide adequate protection of water quality, the primary objective for system effectiveness is to ensure effluent is discharged under ground and remains underground long enough to receive an adequate level of treatment to remove pathogens. Surfacing of untreated effluent presents by far the greatest threat to water quality, and any disposal system which is not designed, installed, and maintained to provide for subsurface absorbtion of effluent is not an adequate system for water quality protection. To provide an additional increment of protection, in areas where soils are highly permeable or groundwater is high, effluent disposal should take place in disposal devices placed as shallow as possible, in conformance with the repair criteria.

5.3.2.1 Historical Performance

File information was evaluated to identify parcels with some history of poor septic system performance. Parcels identified as having had serious problems were those which had: leachfield replacements after less than 10 years of use; repeated failures; or, unresolved leachfield failures subsequent to 1980. Parcels identified as having had moderate problems were those for which: leachfields were replaced after 10-15 years of service; a septic tank pumper had identified a failure during routine pumping; pumping was required more than once a year; there had been a repair in response to a system failure; or, there was a record of an unresolved failure prior to 1980.

Based on the review of the file information, 4% of the parcels in the database have shown indications of serious problems, and 6% have evidenced moderate problems (see Table 11 for a breakdown of problems in different communities). Many of these past system deficiencies have apparently been corrected by system upgrades subsequent to the time of the problem. The current survey effort revealed 80% of the past problem systems to be now working satisfactorily. However, 20% of the parcels with past problems also had current system failures or greywater discharges, indicating that 2% of all parcels surveyed have chronic, ongoing problems, which may be difficult to remedy through conventional means.

5.3.2.2 Past Inspection Programs

The County has conducted two past parcel-by-parcel inspection programs of septic systems in the San Lorenzo Watershed. In both of these programs, all 1690 septic systems within 100 feet of major perennial streams were inspected. The inspection included a survey of the property for signs of failure or greywater discharge, and an inspection of the tank to determine its condition and the need for pumping. Systems were inspected throughout the year, with both inspection periods conducted in relatively dry years, when failure rates would be expected to be lower. In the 1975-78 program, 11% of the systems were found to have leachfield failures or surface discharge of greywater, and 30% of the tanks needed pumping. About half the failures were greywater bypasses. In 1981, 1.3% of the systems were found to be failing, 3% had greywater bypasses, and 36% needed pumping. This indicates an improved performance rate, probably as a result of the repairs required in 1975-78. However, it also indicated that at least one-third of the property owners were not providing adequate maintenance through pumping, even after one round of inspection and education.

As a comparison to the past streamside inspections, in the recent surveys conducted during wet periods in 1986 and 1987, 286 streamside parcels were inspected in the Kings Creek and Boulder Creek areas. At that time 3% of the systems had leachfield failures, and 10% had greywater bypasses. The overall failure rate for the whole survey area, including parcels away from creeks, was 12%, not significantly different from the creekside areas. The higher failure rates in 1986-87 was probably a result of conducting the survey during saturated conditions when failure rates would be higher. About 30% of the parcels with failures in 1986-87, had also had failures in one of the earlier inspection programs. Although over 85% of these repeat failures were greywater bypasses, this repeat failure rate would be indicative of chronic problems on 4% of the streamside parcels.

One other cursory inspection program was carried out in summer of 1983 as a part of the Class II evaluations of parcels to determine recommended corrective measures. Leachfield failures and greywater bypasses were noted and are tabulated in Table 11 for San Lorenzo Park, Riverside Grove, and Forest Lakes. The percentage of leachfield failures ranged from 10% in San Lorenzo Park to 2% in Forest Lakes. In San Lorenzo Park, another 10% of the parcels had greywater bypasses, compared to less than 1% observed greywater bypasses in Forest Lakes.

5.3.2.3 Property Owner Perceptions

As a part of the Class II evaluations, questionnaires were distributed to all property owners to obtain their knowledge of their septic system and its performance. One question asked if they experienced any problems with their system. Questionnaire results were recently reviewed and tabulated for the San Lorenzo Park and the Brook Lomond areas, both of which would be expected to have a high number of problem systems, based on site conditions. In San Lorenzo Park, there was a 74% rate of response, with 95% of the respondents indicating no problem with their system. In Brook Lomond, there was a 70% response rate, with 88% of the respondents indicating no problem with their system. If these results are representative, a very small proportion of the septic systems thus appear to be creating a significant problem for their owners. Even in what would be expected to be some of the worst problem areas, the large majority of owners are satisfied with their system performance.

5.3.2.4 Current Survey Results

The County's current program of system evaluation during the wet periods of the year so far has covered 1450 parcels in Kings Creek, Boulder Creek, Brook Lomond, El Solyo Heights, and Ben Lomond. The results are shown in Table 11, and the findings from each area are discussed in Section 5.6. Of all the parcels surveyed, 6% had leachfield failures and 9% had greywater bypasses. This is a higher failure rate than found in previous inspection programs, but this difference is attributed to conducting the inspections during the wet winter periods, when more failures occur, and to directing the survey efforts toward areas expected to have a relatively high occurrence of problems.

Approximately 80% of the failing systems identified were systems that have had no previous record of poor performance, and are probably reaching the end of their useful lifetime. The other 20% of the failing systems have had previous problems. Extrapolating, this would indicate that some 3% of all systems have limitations that result in chronic, ongoing problems. The remainder are either performing satisfactorily, or can be effectively repaired. Correction of the problems discovered during the survey is discussed in Section 5.3.3.

The survey program also identified systems suspected of having potential problems, based on the judgement of the field inspector. This usually amounted to an additional 7% of the systems. However, a comparison of subsequent repair activities does not indicate any strong correlation between suspected problem systems, and those needing repairs in subsequent years. Rates of suspected problems have not been shown in Table 11.

5.3.2.5 Maintenance

Septic systems require a certain amount of maintenance to ensure they continue to operate properly. This includes periodic inspection and pumping of the tank to remove accumulated solids and grease, keeping pipes open and root-free, limiting the volume of the discharge to prevent overloading of the system, and minimizing the discharge of materials that may be harmful to the system. Pumping is the major element of maintenance and should probably be done every 3-7 years, depending on the size of the tank, the wastewater load, the use of a garbage grinder, and other habits of the occupants. The objective is to check the tank and pump it before so much grease or solids accumulate that material is carried out into the leachfield where it can permanently clog the infiltrative surface and cause the system to fail. Other forms of maintenance include rotating leachfields if a dual system is present, and reducing water use to minimize loading of the system, particularly in the winter months. Some residents may add various types of septic tank additives to their system to promote treatment. However, there is little scientific evidence that such additives actually improve treatment (EPA, 1980).

Many long-term residents of the San Lorenzo Watershed are very adept at maintaining their septic system, and are careful to limit the loads imposed on it. Some may have the tank pumped once or twice during the winter to reduce loading. Careful septic system management on the part of the property owner may help to explain the continued performance of the many substandard systems in the Watershed.

Up to half of the residents probably do not give enough attention to septic system maintenance. A lack of adequate maintenance was evident in the results of the property owner questionnaires circulated as a part of the Class I and Class II projects. In 1981, the streamside inspection program revealed that 36% of the tanks needed pumping, even though the same properties had been involved in an inspection program 3-6 years earlier. Since that time, more work has been done to educate property owners and remind them of the need for maintenance.

Until recently there was no effective way to determine the frequency that septic tanks were being pumped. Beginning in September 1987, septic tank pumpers have been required to submit individual reports of each tank pumped. The effect of this recent increase in submittal of pumping reports is evident in the data for Ben Lomond, the area that has most recently been added to the database. Ben Lomond shows more records of pumping than other areas, as shown in Table 11. In the period from October 1987 through April 1989, pumping reports were filed for 12% of the developed parcels in Ben Lomond. This would indicate an average pumping frequency of once every 12 years, which is probably about half what it should be for an adequate level of maintenance. Pumping frequencies will be more closely monitored in the future as more information becomes available.

5.3.2.6 Repair Rates

The rate of system repairs in an area provides an indication of the performance of the existing septic systems, but the information should be interpreted carefully. Although a repair indicates some deficiency with the old system prior to the time of the repair, it does not necessarily indicate a long-term failure of onsite wastewater disposal on that property. The great majority of repairs result in a greatly improved wastewater disposal system which should be expected to function satisfactorily on a long-term basis. Many prior studies have equated repairs with long-term failures and repair rates with failure rates. Septic systems do have a finite lifetime, particularly the older, smaller systems present in the San Lorenzo Watershed. It would thus be expected that there will be a certain rate of system repairs and improvements that takes place, that is not particularly indicative of long-term problems. Persistent, higher rates of repair would be more indicative of constraints to septic system performance.

All of the repair actions in the Watershed from January 1, 1986 to June 30, 1989, have been tabulated. For about 50% of the repair actions (including all the actions in the Kings Creek and Boulder Creek areas), the specific circumstances of the repair and the conditions leading to it have been entered in the database for further analysis. Repair actions include any action to resolve a greywater discharge, a leachfield failure, a plumbing blockage or breakage, an upgrade for the purpose of a home sale, or a repair or replacement of a system for any other reason. A repair permit issued by the County Environmental Health Service is required for any repair action which involves a leachfield replacement or addition, tank replacement, or installation of a greywater sump. During the study period, there were over 1300 repair actions. Based on the number of applications for repair permits for the same period, it is estimated that 85% of the repair actions required a repair permit. (See Section 5.4 for a description of the types of system improvements made through the repairs.)

Of the repair actions, approximately 4% were initiated as a result of investigation of a complaint, 3% were initiated as a result of a system inspection by County staff at the time of property transfer, and 15% (210 cases) were initiated as a result of the parcel survey and other direct investigative efforts of the Wastewater Management Program. The remaining 78% were initiated by a property owner application for a repair permit. (Some of the latter permits may have resulted from property transfer inspections by private contractors, which are the preferred method of sale inspections.) The effects of the survey on repair activity were quite pronounced in the survey areas. In the greater Kings Creek area, 51% of the repair actions were initiated by the survey, and in the Boulder Creek area, 33% of the actions were initiated by the survey.

Of all the repair actions, for which information on the type of repair is available, 11% have been actions to improve systems that had been repaired since 1979, and were less than 10 years old. Less than two thirds of these (a total of 6%) required leachfield replacements. Three quarters of the repairs were upgrades or replacement of systems that had been installed prior to 1970, or for which there was no record of the installation date, indicating an old, or unpermitted system.

During the last three and a half years approximately 20% of the septic systems contained in the database have been subject to repair activities. For the entire study period, the repair rate ranged from 32% in the Kings Creek area to about 10% in areas that were not yet subject to the survey program, such as the Forest Lakes area (see Table 11). In areas contained in the database, but not yet surveyed, the annual repair rate ranged from 3% to 5%. Even in areas that were surveyed, there was an annual repair rate of 4-5% for repairs that were done independently of the survey program. It did appear that the annual rate of repairs was significantly lower after the problems identified by the survey had been repaired, than it had been prior to the survey. However, a longer period of study will be needed to confirm that.

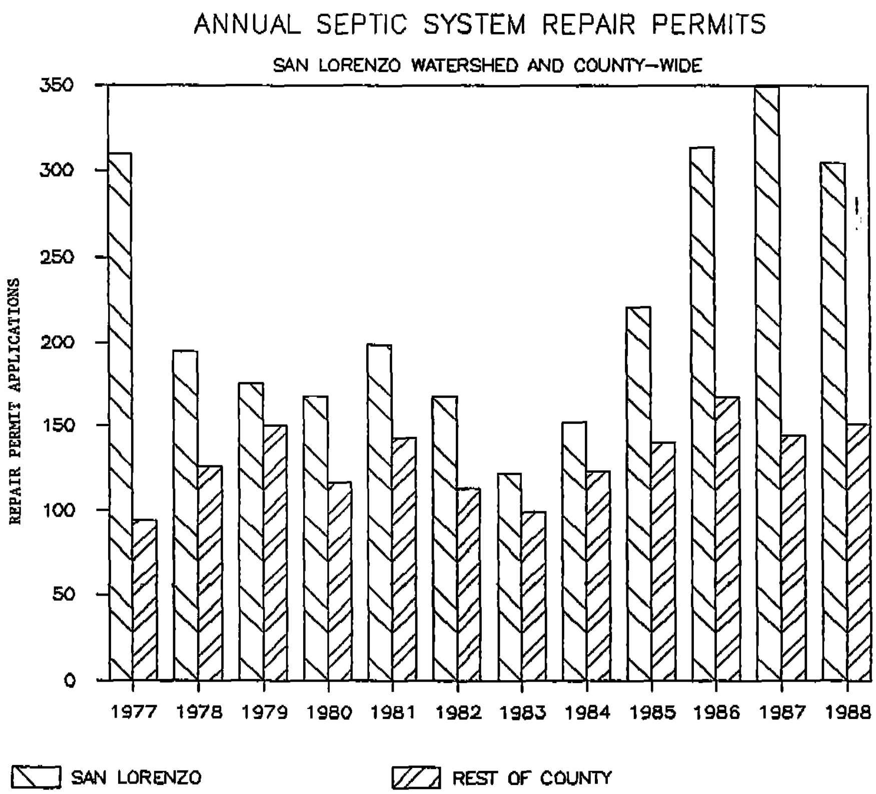
The current 3-5% annual repair rate would indicate an average septic system lifetime of 20 to 33 years, which does not seem indicative of significant problems. In fact, because the current repair rates are significantly higher than the average longterm rates, the average septic system lifetimes are probably much longer than currently indicated.

Long-term repair rates were assessed by looking at the annual number of repair permit applications received by the County each year. The repair permit activity over the last 10 years is shown in Figure 12. Current rates of repair permit activity are about 60% more than average rates prior to 1985, and are double the rates of that prevailed from 1982 to 1985. The repair rates for the San Lorenzo Watershed have also increased significantly in relation to repair rates for the rest of the County. At this time, although the Watershed contains about half of the systems in the county, repair rates in the Watershed are over double the rates of the remainder of the County. Prior to 1985, the rates in the Watershed were more comparable to the rest of the County.

There are probably a number of reasons for the increase in repair activity in the San Lorenzo Watershed. Only 20% of the increase is related to the 75 repair permits issued to repair problems discovered through the survey program. The remainder of the increase is attributable to a significant increase in repairs initiated by the property owners for any of a number of possible reasons. The knowledge that the County will eventually inspect all systems in the San Lorenzo Valley may have induced some residents to repair their system before the County discovered the problems. The conduct of the sewer study from 1981 to 1984 probably induced a number of owners to postpone any system improvements pending a possible sewer hook-up or grant-funded system repair. Once the project was abandoned, people went ahead with needed repairs on their own. Current rates of repair in the Class I and Class II areas, unrelated to the inspection program, are double the rates for the unclassified areas, which were not going to get any grant assistance. In addition to these influences, the increased education and public awareness of the need for improved septic system maintenance associated with the current program may have induced owners to repair their systems.

Whatever the reason, current rates of repair are much higher than the long-term rates, and should not be used as a measure of the number of systems with long-term problems. The possible presence of long-term problems may be better addressed by evaluating the effectiveness of current repairs, which is the subject of the next section.

FIGURE 12: Septic System Repair Rates, 1977 - 1988



5.4 Improvements in System Performance

The County's current wastewater management program in the San Lorenzo Watershed has resulted in significant improvements in the wastewater disposal practices in the Watershed. These improvements have resulted from system repairs, promotion of greater efforts for system maintenance, and requirement of stricter standards for disposal systems to serve new development. The following subsections will discuss the types of repairs accomplished, the expected effectiveness and longevity of the repairs, enhanced maintenance efforts, the standards for new development, and the improvements in water quality that might be expected to result from the program efforts.

5.4.1 Types of Repairs

The high level of recent repair activities has resulted in significant improvements in the wastewater disposal systems in the Watershed. As discussed in the previous section, during the period since January 1986, over 1300 repair actions have taken place, which represent actions on about 10% of the parcels in the Watershed. Within the 1600 parcels in Boulder Creek, Kings Creek, and Brook Lomond, which have been the subject of the County's surveys and focussed management efforts, repair actions have affected 27% of the 1600 parcels.

Under the current program, the improvement of disposal system performance generally follows one of two approaches: 1) complete replacement of the existing absorbtion system (leachfield), or 2) modification of the existing system or the water use to make the existing system perform satisfactorily. The first approach is used when a property owner initiates the repair or when a major leachfield failure is found which seems to be directly caused by inadequate absorbtion capacity. The second approach is used when a greywater bypass is discovered, or when a minor leachfield failure is found which appears to be caused by reasons other than failure of the absorbtion capacity of the leachfield. The latter approach is particularly used to address problems discovered through the parcel-by-parcel survey. Through this incremental approach to system improvement, County staff has sought to develop an effective working relationship with residents to encourage improved longterm management of their system. The County staff, however, cannot prescribe a particular repair, but is limited to approval or rejection of property owner proposals.

The types of different repair actions which have been performed are tabulated in Table 12 and described in the following paragraphs. Table 12 separates the findings for repairs resulting from the parcel surveys, and the other types of repairs which are usually initiated by the property owner.

Leachfield Replacement - Leachfield replacements are required when the existing leachfield is determined to have inadequate infiltrative capacity, as indicated by continuous and significant surfacing of effluent, or intermittent surfacing in conjunction with small leachfield size, old age, and/or significant site constraints at the location of the existing leachfield, such as high groundwater, clay soils or close proximity to a stream or embankment. Leachfield replacements should meet the repair criteria for sizing and design in relation to groundwater, slopes, or streams. If site constraints are too severe, the leachfield may be reduced in size in order to provide adequate setback to groundwater, streams, or embankments. In this case, wastewater reduction measures, such as water conservation, clotheswasher removal, or a greywater sump are typically required as a condition of the repair permit. In extreme circumstances, where a high level of system monitoring and maintenance is required, an operating permit may be required under the new alternative systems program. Sixty percent of the repair actions have resulted in leachfield replacements. For repairs not initiated by parcel surveys, the proportion of leachfield replacements was 76%.

Leachfield Addition - If the existing leachfield is not too old, and appears to be working most of the time, it can be augmented by the addition of another trench or additional leaching area to increase the overall system capacity. Six percent of the repair actions resulted in leachfield additions.

Leachfield Renovation - Leachfields fail due to the clogging of the sidewalls and adjacent soil by organic matter and biological growth. Although it is not as easy as replacement, a leachfield can be renovated by excavating the old trench and sidewall, removing the clogged soil layer. The wider trench is then refilled with clean drainrock and the leachfield is reestablished in the same location. Although this has only been done for a few systems in the study area, this technique holds promise for future repairs where the available area is severely limited.

Table 12 - Types of Repair Actions Completed, January 1, 1986 - June 30, 1989

	Repair Actions from Survey		Other Repair Actions		All Repair Actions	
Total Repair Actions	195		1144		1339	
Information Available	195		437		632	
Leachfield Replacements	43	22%	334	76%	377	60%
Leachfield Additions	13	7%	23	5%	36	6%
Greywater Sumps	25	13%	2	0%	27	4%
Greywater Connections	80	41%	9	2%	89	14%
Clotheswasher Removal	6	3%	0	0%	6	1%
Water Conservation	18	9%	16	4%	34	5%
Plumbing Repair	8	4%	3	1%	11	2%
Tank Replacement/Repair	32	16%	3	1%	223	35%
No Improvement Needed	2	1%	37	8%	39	6%
Fully Meets Repair Criteria	53	27%	264	60%	317	50%
Marginally Meets Criteria	81	42%	92	21%	173	27%
Does Not Meet Criteria	46	24%	57	13%	103	16%
(Absorbtion Area Substandard)	38	19%	46	11%	84	13%
Pending Actions	5	3%	7	2%	12	2%
Inadequate Information	10	5%	17	4%	27	4%

Percentages indicate percent of systems for which information is available.

Greywater Sump - Instead of adding leaching area to the existing septic system, a separate greywater sump may be constructed to discharge the water from the clotheswasher, and occasionally showers or sinks (other than the kitchen sink). A repair permit must be obtained for a greywater sump, and it must be sized adequately to handle the expected load. Sumps are used particularly to correct greywater bypasses, or for other cases where the existing system is occasionally overloaded and/or there is not room in the vicinity of the existing system to add leaching area. Greywater sumps were used primarily to correct greywater bypasses found during the parcel survey, and were used in 13% of those repair actions.

Greywater Connection - The most common remedy for a greywater bypass is the reconnection of the pipes to direct the greywater into the septic system. This is appropriate if the system has adequate capacity to handle the greywater flow, as indicated by its age, size, or current performance. However, in many cases, the property owner elected to connect the greywater to the existing system even if the existing system did not meet current criteria. In such circumstances, the system continues to be monitored by County staff to observe it works properly. Greywater connections were the most common correction used for greywater bypasses, with 41% of the repair actions from the survey program resulting in greywater connections. About 15% of those repairs subsequently failed and required leachfield replacements.

Water Conservation - Strict water conservation measures can be used to extend the life of a marginal system, or to augment the effectiveness of a repair. Installation of ultra low flow toilets and low flow showerheads is usually required if the system is substantially less than standard size. Water conservation measures were explicitly required for 5% of all the repair actions. Although it is less common, removal of the clotheswasher may also be required, particularly in the case of greywater bypasses. This was the solution used in 3% of the survey repair actions.

Plumbing Repair - In some instances a sewage failure may result from a broken pipe, a clogged pipe, or failure of the pump in a pump-up system. In this case, the failure can be easily corrected by plumbing or electrical repairs that do not require a septic repair permit. Two percent of the total repair actions were plumbing repairs.

Tank Repair - Very occasionally a problem will develop with the septic tank itself, such as collapse of an old wooden tank. Repairs or replacements of tanks are straightforward and not considered to be indicative of the potential for satisfactory long-term performance of the septic system. Although a structurally sound and properly designed tank is critical to the performance of the leachfield, tanks can be installed in practically any situation and will always perform their function, provided they are maintained and pumped periodically. Fifty three percent of the leachfield replacements included replacement of the tank. Less than 2% of the total repair actions involved replacement or repair of the tank only.

No Improvement Needed - Repair actions in the database include all responses to complaints and system inspections at the time of property transfer. In some cases it was found that the system was performing satisfactorily and that no improvements would be required. This was the case in 6% of the repair actions contained in the database.

Alternative Systems - Where a conventional system cannot be expected to perform adequately, use of an alternative system may be required for a system repair. In January 1989, the County initiated a program for the use of alternative systems. Although only a few repairs have used alternative systems at this time, it is expected that this will increase in the future. The types of alternative systems used include mounded bed systems, pressure-distribution systems, and sand filters. When an alternative system is required, the property owner is also required to obtain an annual operating permit, which sets out the conditions for maintenance of the system and also provides for regular monitoring of the system by the County. Operating permits may also be required if necessary to ensure adequate performance of substandard conventional systems. Since the program began in January 1989, 12 alternative systems with operating permits have been required for system repairs.

Haulaway Systems - If a system fails and cannot be repaired to meet even minimal standards for groundwater separation, stream setback, or sufficiently permeable soil, the owner will be required to pump the tank as necessary to prevent surfacing of effluent. This may be required only during periods of winter soil saturation, or it may be required on a full time basis, depending on the severity of the constraints. Only about 25 parcels in the study area are currently on mandatory haulaway. Twenty of these are in downtown Boulder Creek, and have been hauling away for many years. Some property owners have their tank pumped periodically during winter months on a voluntary basis to prevent system failure. Where it is found that an owner with a mandated haulaway system is not pumping the tank as needed, an operating permit will be required, which will establish minimum requirements such as high level alarms, and will also provide for monitoring by County staff.

Offsite Disposal - If onsite disposal is impossible and there is suitable disposal area nearby, effluent can be piped to another site for disposal. Several parcels may use a shared "cluster" system in the immediate neighborhood. A larger number of systems in a larger area may dispose of their effluent in a "community" disposal area. Both cluster systems and community disposal were recommended for some areas as part of the Class II project. No such systems have been developed yet under the current program, but they are still under consideration for some areas.

Table 12 also includes an assessment of the extent to which the repaired systems meet the County's repair criteria for a conventional repair. This evaluation is based primarily on the size of the leaching area in relation to the number of bedrooms, but also includes an assessment of the adequacy of the separation from groundwater, and the extent to which absorbtion capacity may be limited by presence of clay soils, as determined from information available in the database.

Half of the total repair actions resulted in systems that appeared to be in full compliance with the repair criteria. Slightly over one quarter of the systems were identified as marginally meeting the repair criteria. Marginal systems included those which were not less than 80% of the required size, which were older than 15 years or of unknown age, or which had a potential site constraint which might violate the criteria. Of the marginal systems, 70% were limited by old age or small size. Sixteen percent of the total systems subject to repair actions remained in noncompliance with the conventional repair criteria. These had leaching area less than 80% of the required size, or site constraints which significantly deviated from the criteria, usually separation to winter groundwater. Substandard leaching area was the limiting factor for 82% of the systems not meeting conventional criteria. Reduced groundwater separation was the limitation for most of the remainder.

There were two circumstances in which a repair action resulted in a system that is not in compliance with the repair criteria: 1) a substandard replacement system was installed, or 2) a substandard system was allowed to continue in use. About half of the substandard repairs, or 8% of the total repair actions, were situations where a substandard system replacement was installed because that was the best repair that could be made on that property. Although these individual systems are not in compliance with repair criteria, they do represent significant improvements over the pre-existing system, and in the judgement of the field staff should be able to perform adequately, given proper management by the property owner. These repairs are limited by site constraints, primarily inadequate area available for a full size leachfield.

Half of the substandard repairs are not in compliance with repair criteria because the problem was resolved through some action other than a leachfield replacement, and an old substandard leachfield remains in use. In many circumstances, if the failure can be eliminated through a plumbing repair, or greywater sump, the County does not require a leachfield replacement. In these cases, which represent half of the substandard repairs, the lack of a standard repair does not necessarily indicate that one cannot be installed on that parcel. Based on repair success for other parcels, it would be expected that most of these substandard systems could eventually be replaced with a system meeting repair criteria.

Systems which were repaired as a result of the parcel survey show a lower rate of compliance with the repair standards than the repairs completed as a result of property owner application. This was due both to the type of problems found by the survey, and by the approach used in dealing with the problems. About 60% of the problems found were greywater bypasses. In most instances the property owner chose to correct the problem by connecting the greywater to the existing system, even though it might be substandard. Although in these cases County staff recommended a leachfield replacement, they could not require a leachfield replacement unless the leachfield was observed to be failing. These substandard systems identified during the survey process have been subject to followup inspections. The large majority have been observed to be performing adequately, but in the Kings Creek and Boulder Creek areas, 13 parcels required subsequent follow-up action to replace the old leachfield after it had failed as a result of connecting the greywater.

Even with the non-compliance with repair criteria for some repairs, all repairs currently being made are a substantial improvement over the systems that existed previously. Of the older systems that have been replaced, only about one third met the current criteria for system size, and over half the leachfields were deeper than 8 feet. Of the new replacement systems, 63% meet the criteria for adequate size and over half are 5 feet or less in depth. The overall design of new replacement systems is also much improved with more attention given to soil and groundwater constraints. Where systems cannot meet the standard criteria, the present and future property owners are given notice of the need for careful management, and the systems are subject to followup inspections by County staff to ensure adequate performance.

5.4.2 Expected Long-term Performance of System Repairs

The long-term suitability of onsite wastewater disposal in the San Lorenzo Watershed is a function of the performance of existing systems, the effectiveness of the repairs currently being made, the expected longevity of