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CITY OF RIVERSIDE

CITY COUNCIL MEMORANDUM

Riverside All-America City 1998

HONORABLE MAYOR AND CITY COUNCIL **DATE:** May 14, 2002

ITEM NO: 29

SUBJECT: **MITIGATION MEASURES FOR PROTECTING CITY'S DRINKING WATER WELLS FROM POTENTIAL CONTAMINATION FROM SEPTIC SYSTEMS IN THE NORTH ORANGE AREA**

BACKGROUND:

The City of Riverside is currently producing approximately 15 percent of its drinking water supply from the North Orange area in the Riverside Basin and is planning to increase its production substantially from this area. As a requirement under the Safe Drinking Water Act, the Public Utilities Department staff, with guidance and assistance from the California Department of Health Services staff, conducted a source water assessment for the drinking water wells in the area. The report identified and ranked the possible contaminating activities in the area and concluded that septic systems were among the activities that pose the greatest threat to the drinking water supply in the area. Septic systems are considered as potential sources of nitrate, chemicals, and microbial contamination to the wells.

Because of the abundance of the septic systems upgradient from the City's drinking water wells and potential for rapid expansion of developments with septic systems in the area, the Public Utilities staff proceeded with further evaluation of the potential impacts of the septic system and development of mitigation measures. The study included a review of the literature on potential impacts of septic systems and the case studies of groundwater pollutions caused by septic systems as well as an evaluation of hydrogeologic conditions and water quality in the study area. The study confirmed that septic systems pose a high risk of contamination to the City's drinking water wells in the area.

The Public Utilities staff also evaluated the potential mitigation measures and recommended a list of the actions to protect the City's drinking water wells in the area. The most important immediate action is to prevent future construction of septic systems in the area. This requires adoption of an ordinance by the Riverside City Council and other entities that have jurisdiction in the study area to not permit future development with septic systems within their jurisdictions in the area. Existing septic systems pose a more difficult problem and will need to be addressed in the future.

In order not to hinder future development, the Public Works and Public Utilities Department staffs have agreed to jointly fund a sewer installation to serve new developments in the vicinity of Placentia Lane in North Orange area, with an estimated cost of $1.3 million.

The Board of Public Utilities approved this item at its regular meeting on March 15, 2002. The Land Use Committee reviewed this item at its regular meeting on April 25, 2002 and recommended approval.

FISCAL IMPACT:

The cost of sewer to the Placentia Lane area is estimated at $1.3 million. There could be considerable avoided cost due to prevention of contamination and potential later treatment requirements.

ALTERNATIVES:

The alternative is to take no action in regard to future developments with septic systems in the area. This alternative is not recommended due to potential groundwater contamination.

RECOMMENDATION:

That the City Council:

1. Accept the report;

2. Endorse the future joint sewer installation with Public Works:

3. Direct staff to prepare and present for adoption an ordinance to prohibit the installation of new septic systems within the City limits in the study area referenced above; and

4. Request the Riverside County Boards of Supervisors adopt a similar position.

Prepared by:

Thomas P. Evans
Public Utilities Director

Approved by:

George A. Caravalho
City Manager

Approved as to form:

for Gregory P. Priamos
Interim City Attorney

Concurs with:

Chuck Beaty
Land Use Committee Chair

TPE/DPW/ZP/jw

Attachments: Groundwater Protection from Septic Systems in Highgrove and North Orange Areas
Board of Public Utilities minutes of March 15, 2002

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➡ MITIGATION MEASURES FOR PROTECTING CITY'S DRINKING WATER WELLS FROM POTENTIAL CONTAMINATION FROM SEPTIC SYSTEMS IN THE NORTH ORANGE AREA

At the request of Chair Newberry, Jr., P.E., this item was placed on the Discussion Calendar.

Assistant Director Wirtzfeld gave clarification about the report and Principal Water Engineer Zahra Panahi gave a PowerPoint presentation with more details. The Board members agreed that the Board should accompany staff to the Land Use Committee, Chamber Economic Development meeting, City Council, and County meetings to show support of this report.

The Board of Public Utilities:

1. Accepted the report;
2. Endorsed the future joint sewer installation with Public Works;
3. Recommended that the City Council place a moratorium on new septic systems within the City limits in the study area; and
4. Recommended that the City Council request the Riverside County Board of Supervisors adopt a similar position.

Motion – Anderson. Second – Gipson-Jimenez. All ayes.

PROPOSED CHANGES TO ELECTRIC RATE SCHEDULES, ELECTRIC AND WATER RULES AND FEES – SETTING OF PUBLIC HEARING

Assistant Director Stevener gave a presentation of the proposed changes to the electric rate. Further discussion was tabled to the end of the Board meeting due to a conflict with the proposed date of the Public Hearing for May 8 at the Utilities Operation Center for 6:30 p.m. Board members preferred the meeting to be held in the Art Pick Council Chamber so it would be more accessible to the public. Assistant Director Stevener excused herself to proceed to make a call to City Council to arrange an agreeable date in May.

RECOMMEND CHARTER CHANGE INCREASE TO $50,000

Director Evans and Supervising Deputy City Attorney Eileen Teichert gave more details and clarification regarding this recommendation. There was one change to the original recommendation and that was to replace "change Section 1202" with "**amend** Section 1202".

The Board of Public Utilities approved and recommended that the City Council approve a ballot measure to amend Section 1202 of the City Charter to increase management approval authority to $50,000.

Motion – Anderson. Second – Gipson-Jimenez.

Ayes: Anderson, Gipson-Jimenez, Tate, Hubbard, and Acharya.

CITY OF RIVERSIDE
Public Utilities Department

Groundwater Protection from Septic Systems In Highgrove and North Orange Areas

RIVERSIDE
PUBLIC UTILITIES

March 2002

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Project Team

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Aladdin Shaikh, Ph.D., P.E., Senior Water Engineer
Tom Corrigan, Senior Engineering Aide

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ACRONYMNS

AWWA	American Water Works Association
bgs	Below ground surface.
CAFO	Confined Animals Feeding Operations
Cal-EPA	California Environmental Protection Agency
CP	Contingency Plan
CWA	Clean Water Act
DBCP	Dibromochloropropane
DHS	California Department of Health Services
DWSA	Drinking Water Source Assessment
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GPZ	Groundwater Protection Zone
MBA	Methylene Blue Active Substances
MCL	Maximum Contaminant Level
RHWCO	Riverside Highland Water Company
SARA	Superfund Amendments and Re-authorization Act
SAWPA	Santa Ana Watershed Project Authority
SDWA	Safe Drinking Water Act
SWAP	Source Water Assessment Plan
SWAPP	Source Water Assessment and Protection Plan
SWL	Static water level in feet
SWPS	Source Water Protection Strategy
TDS	Total Dissolved Solids
UIC	Underground Injection Control
WHPP	Wellhead Protection Program

EXECUTIVE SUMMARY

The Riverside groundwater basin is a major source of drinking water supply for the City of Riverside and other communities. Riverside will produce more than 30 percent of its projected demands from Riverside Basin. The City of Riverside Public Utilities Department (PUD) wants to protect this valuable resource from further contamination.

Water Resources Section of the City of Riverside PUD completed a Drinking Water Source Assessment (DWSA) for the Highgrove and North Orange Area of Riverside Basin, in August 2000. The DWSA identified septic systems as one of the major potential contaminating activities (PCAs) in the area. Typical contaminants associated with effluents from septic systems and leach fields include nitrates, foaming substances, microbiological organisms, and chemicals.

Malfunctioning septic systems can release disease-carrying microorganisms including enteric viral and bacterial pathogens to groundwater. Nitrate in drinking water at levels exceeding the maximum contaminant level (MCL) of 45 mg/L is a public health concern. Recent research suggests that nitrates in concentration much lower than the MCL increases the risk of bladder cancer (Weyer, *et. al.*, 2001). A U.S. Environmental Protection Agency (EPA) report (1998) to Congress showed 31 states listing septic systems as their second greatest potential source of groundwater contamination (first being underground storage tanks).

Some Regional Water Quality Control Boards (RWQCB) in California have identified areas with high concentration of nitrates due to large concentrations of septic systems. The Santa Ana RWQCB identified septic systems as one of the most significant sources of nitrates, with a potential for long-term buildup, in groundwater

This critical water resource is particularly vulnerable to contamination due to a shallow water table, presence of only one aquifer, and the absence of a confining clay layer to protect groundwater from leaching contamination in the study area.

Many states are toughening regulations for installing septic systems and establishing management programs. In California, counties issue permits for small size septic systems, while larger sized septic systems are regulated by the U.S EPA. Riverside County permits septic systems through health ordinances that require a separation distance between the septic system and a domestic well.

Riverside PUD has expressed its concerns, regarding potential groundwater contamination from septic systems in the Highgrove area, to the Regional Water Quality Control Board, Riverside County Department of Health, and the California Department of Health Services. Riverside PUD will continue to oppose installation of additional septic systems in the area. The RWQCB has acknowledged the unsuitability of the area for commercial septic systems unless detailed engineering report evaluating the impacts of septic systems on groundwater show otherwise.

The RWQCB's Guidelines for Sewage Disposal from Land Developments states that "septic systems are an acceptable use only in the rural or low population density areas." Considering the fragile water supply in the area, the critical nature of the supply to the region and the anticipated growth in the area, actions must be taken now before it is too late.

The primary purpose of this project is groundwater protection against the adverse impacts of septic systems in the study area. To achieve this goal, the following actions are recommended:

- Request that Riverside City Council to prohibit installation of septic systems by new developments within the City limits of the study area.
- City of Riverside to request similar restrictions by County of Riverside.
- Review and research grants for groundwater protection programs.
- Encourage existing septic systems owners to properly maintain their systems, and provide users with information on how to operate and maintain septic systems, including maintenance log books.
- Expedite the extension of sewer system to the North Orange Area in cooperation with Public Works Department. The Public Works Department (PWD) estimated $1.3 million for installing sewer at the North Orange area, and has agreed to 50 percent cost sharing of up to $750,000.
- Encourage, and work in coordination with, the Public Works Department to provide sewer service outside City limits in areas where City produces domestic water.
- Monitor sewer lines for leaks, and establish a groundwater-monitoring program.

STUDY AREA

DESCRIPTION

The study area is within the incorporated Cities of Riverside, Colton, and Grand Terrace, and the unincorporated community of Highgrove in Riverside County (Figure 1). Figure 1 also shows the areas served by sewer systems. The North Orange area is located to the north of City of Riverside just south of the Riverside-San Bernardino County Line. Figure 2 shows the existing land-use within the area, and Table 1 shows the relative distribution of land use for various land use types as, of 2000.

Historically, irrigated and non-irrigated agriculture were the main land uses in the area. The rapid urbanization in the area resulted in high-density residential developments, many of which relied on on-site septic systems for sewage and waste disposal due to lack of sewer infrastructure. The non-sewered area includes the Pellisier Ranch property north of the County line, the unincorporated community of Highgrove, and areas within Riverside City limits.

Many of the wells in the area show nitrate contamination originating from septic systems or previously applied fertilizers. North Orange well field is very crucial to meeting the City of Riverside water demands. The well field is downstream of two major faults that make the two transmission mains (Gage Canal & Waterman) from the Bunker Hill Basin (BHB) vulnerable to disruption during earthquakes. In addition, Riverside has limited water export rights from BHB. Riverside plans to meet increasing water demand from Riverside Basin. It is projected that production from Riverside Basin will be more than doubled in the future.

The groundwater in the study area is vulnerable to contaminants associated with septic systems, such as nitrates, chemicals, and harmful pathogens. In May 1965 there was a severe outbreak of gastroenteritis in Riverside in which about 18,000 residents were affected (Ross and Creason, 1966). Boring *et al.*, (1971) reported that the illnesses resulted from exposure to *Salmonella typhimurium* in Riverside's source water. Riverside PUD wants to develop and implement a groundwater protection plan for this valuable resource. An effective groundwater protection plan will reduce the potential for a similar incidence and preserve the resource for generations to come.

HYDROGEOLOGY

The study area is located within the Riverside North and Riverside South groundwater basins. The artificial demarcation for these basins is the Riverside - San Bernardino County Line, and was made to aid in water accounting for the purposes of administering

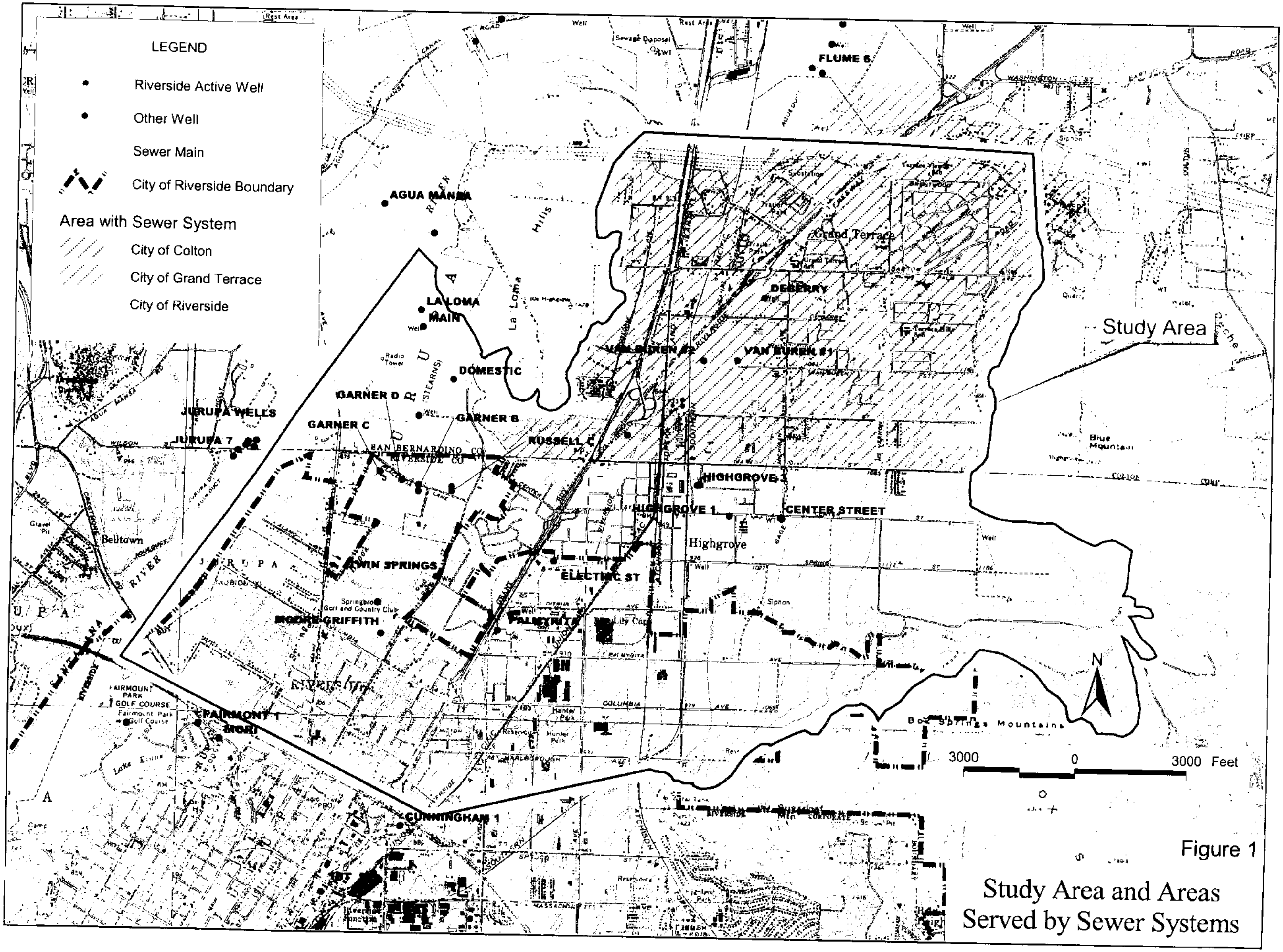
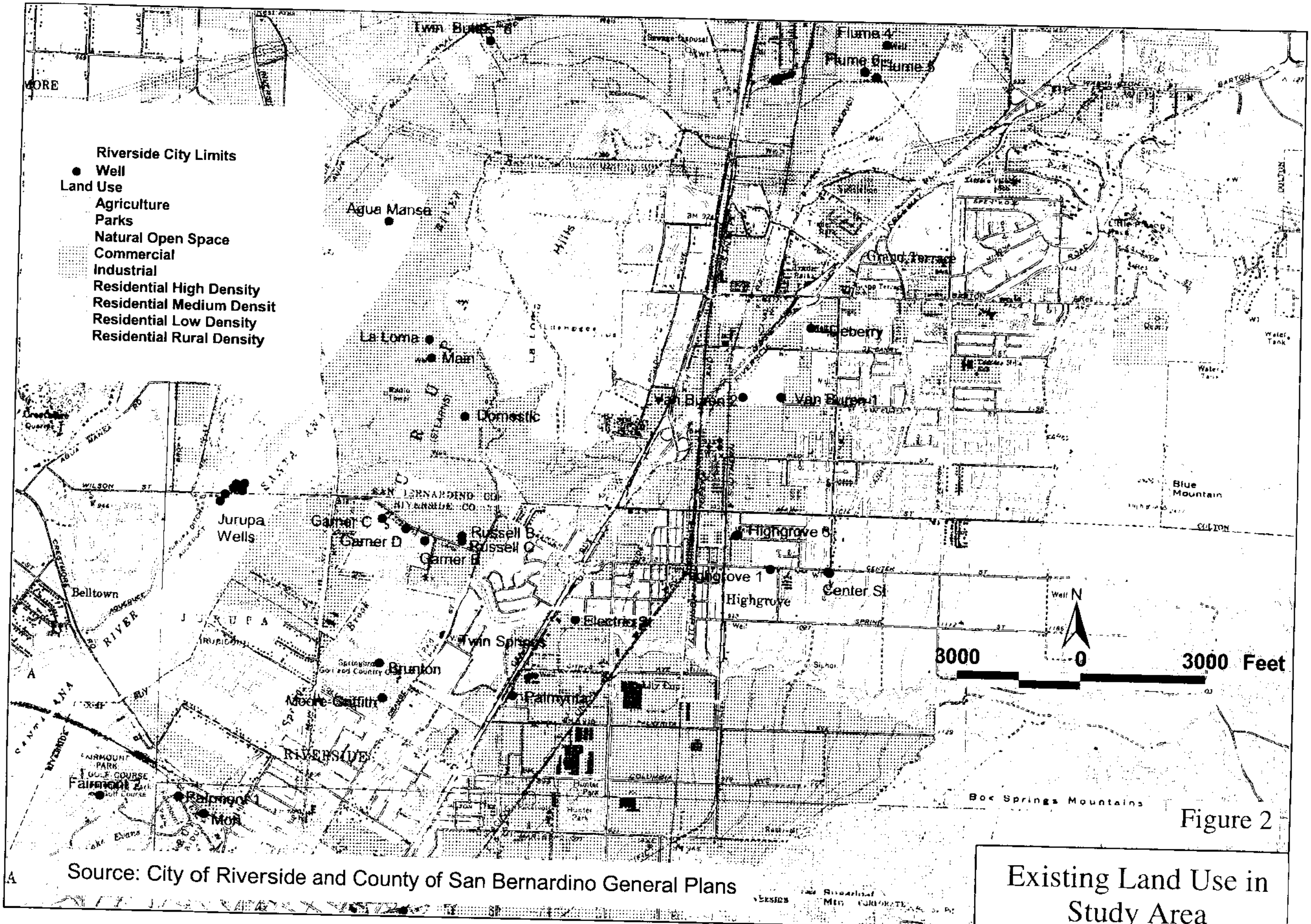


Figure 1

Study Area and Areas Served by Sewer Systems



Source: City of Riverside and County of San Bernardino General Plans

Figure 2

Existing Land Use in Study Area

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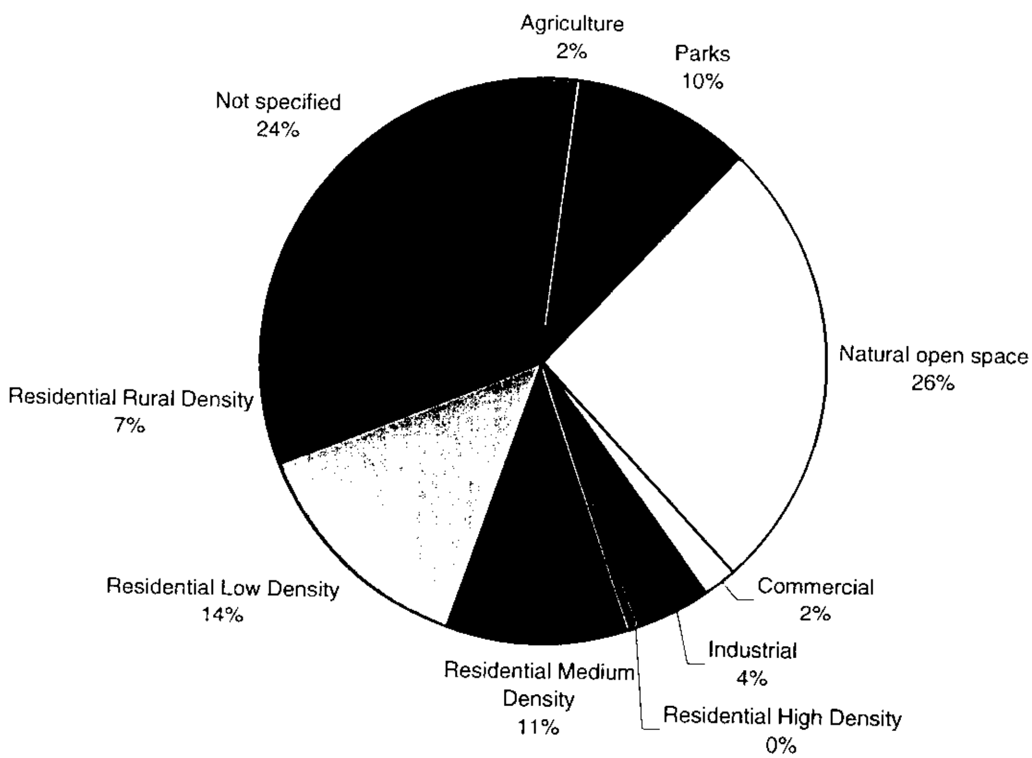
Table 1: Designated Land Use within North Orange & Highgrove Areas

Land Use	Area - acres	% of total
Agriculture	142	2%
Parks	737	10%
Natural open space	1,916	26%
Commercial	152	2%
Industrial	310	4%
Residential High Density	34	0%
Residential Medium Density	782	11%
Residential Low Density	1,001	14%
Residential Rural Density	501	7%
Not specified	1,777	24%
Total	7,352	100%



the 1969 Judgment (Superior Court, 1969). The Santa Ana River bounds the area to the north and west, and the Blue and Box Springs Mountains to the east. La Loma Hills is located within the area and serves as the westerly boundary of the groundwater aquifer in some areas. Well logs suggest the absence of a continuous protective clay layer to protect the aquifer from contaminants leaching from septic systems and other potential contaminating activities (PCAs).

Maximum aquifer depth in Riverside basin ranges from about 600 feet to 700 feet, with water bearing units comprised of sand and gravel deposits

Table 2 shows the range of the static water levels (SWL) in both groundwater basins. Deberry well represents the northernmost of the City wells. The SWL at Deberry well is the deepest averaging about 124 feet below ground surface. Figure 3 shows the relative elevation of SWL at various wells. The effects of the drought can be seen in the chart. Table 2 and Figure 3 show that depth to groundwater can be as shallow as 5 feet at some wells, mainly in the Riverside South basin, and other wells with averages shallower than 30 feet. These wells are highly vulnerable to surface and sub-surface contaminates due to the fact that there is only one aquifer, groundwater is shallow and there is no continuous clay layer to protect the aquifer from leaching contaminants that may be released from sources such as septic tanks and leach fields.

SOURCE WATER ASSESSMENT

Water Resources Section of the City of Riverside PUD completed a Drinking Water Source Assessment (DWSA) for the study area in August 2000. Figure 4 shows the delineated Groundwater Protection Zones (GPZ) for the North Orange and other wells in the study area. About 16 percent of the area is within the two-year time of travel (A2 zone), which is vulnerable to microbial contamination such as from septic systems.

The Source Water Assessment identified effluents from septic systems in the study area as one of the major potential sources of contamination to wells in the Highgrove and North Orange areas.

WATER QUALITY IMPACTS OF SEPTIC SYTEMS

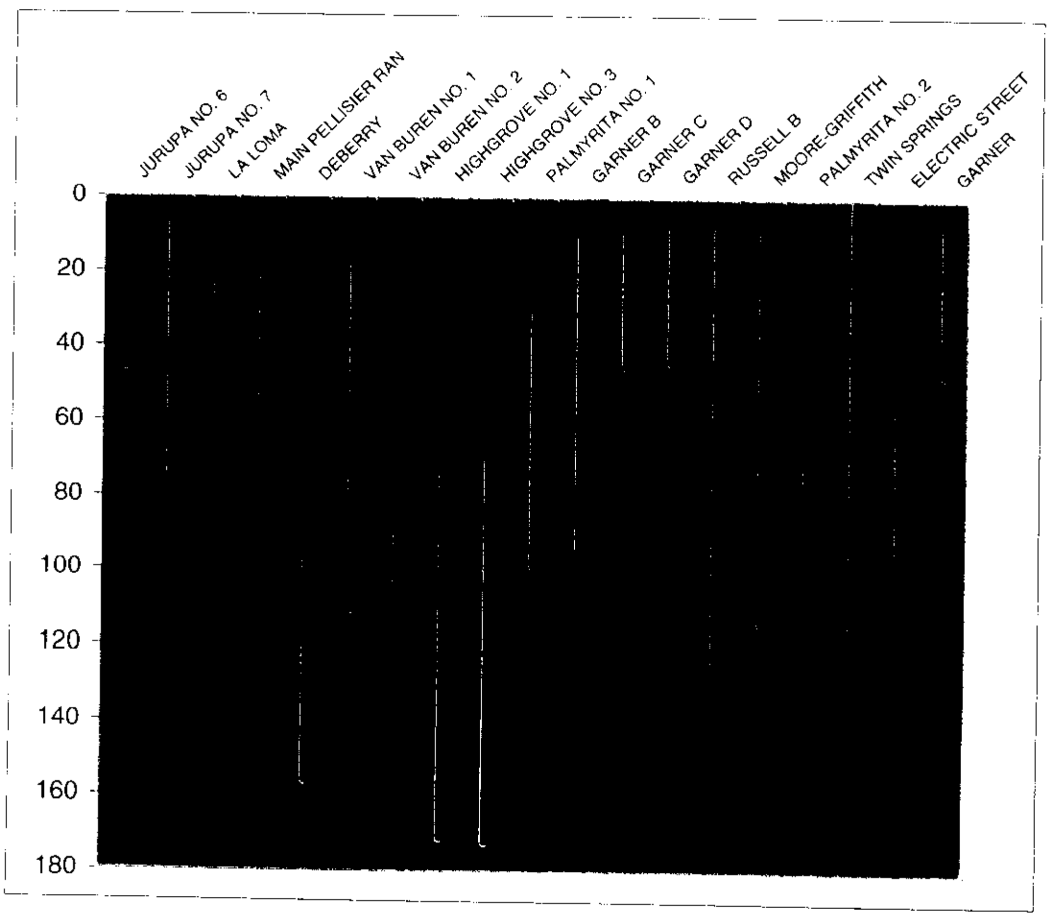
The conventional septic system is more often designed to dispose household wastewater, rather than to treat it (CSUC, 2000). Major groundwater quality impacts of septic systems that are of concern include microbial and nitrates contamination. The wastes disposal and collection of solids in the septic tank is shown in Figure 5, and flow of effluent and movement of gases are illustrated in Figure 6. The typical resident discharges about 40 to 50 gallons per day into the septic system.

Table 2 - Summary Statistics of Static Water Levels in Riverside North and Riverside South Basins

Basin	Well	Elevation ft amsl	# of readings	Highest SWL ft bgs	Lowest SWL ft bgs	Average SWL ft bgs*	Ave SWL ft amsl
RN	JURUPA NO. 6	840	119	11	46	23	817
RN	JURUPA NO. 7	840	60	5	75	19	821
RN	LA LOMA	852	26	18	40	25	827
RN	MAIN PELLISIER RAN	850	13	20	85	30	820
RN	DEBERRY	970	310	96	156	124	846
RN	VAN BUREN NO. 1	980	10	12	111	77	903
RN	VAN BUREN NO. 2	960	7	77	105	92	868
RS	HIGHGROVE NO. 1	988	133	65	171	128	860
RS	HIGHGROVE NO. 3	964	40	70	172	122	841
RS	PALMYRITA NO. 1	884	216	30	99	71	812
RS	GARNER B	833	64	10	95	31	802
RS	GARNER C	834	21	9	45	23	811
RS	GARNER D	830	18	8	44	27	803
RS	RUSSELL B	836	84	8	124	32	803
RS	MOORE-GRIFFITH	823	143	9	114	28	795
RS	PALMYRITA NO. 2	884	20	71	76	74	810
RS	TWIN SPRINGS	836	127	1	117	34	802
RS	ELECTRIC STREET	883	162	47	107	70	813
RS	GARNER	833	75	6	47	25	808

* Average of all readings

Figure 3 - High, Low, and average depths to groundwater (in feet below ground surface) at selected wells



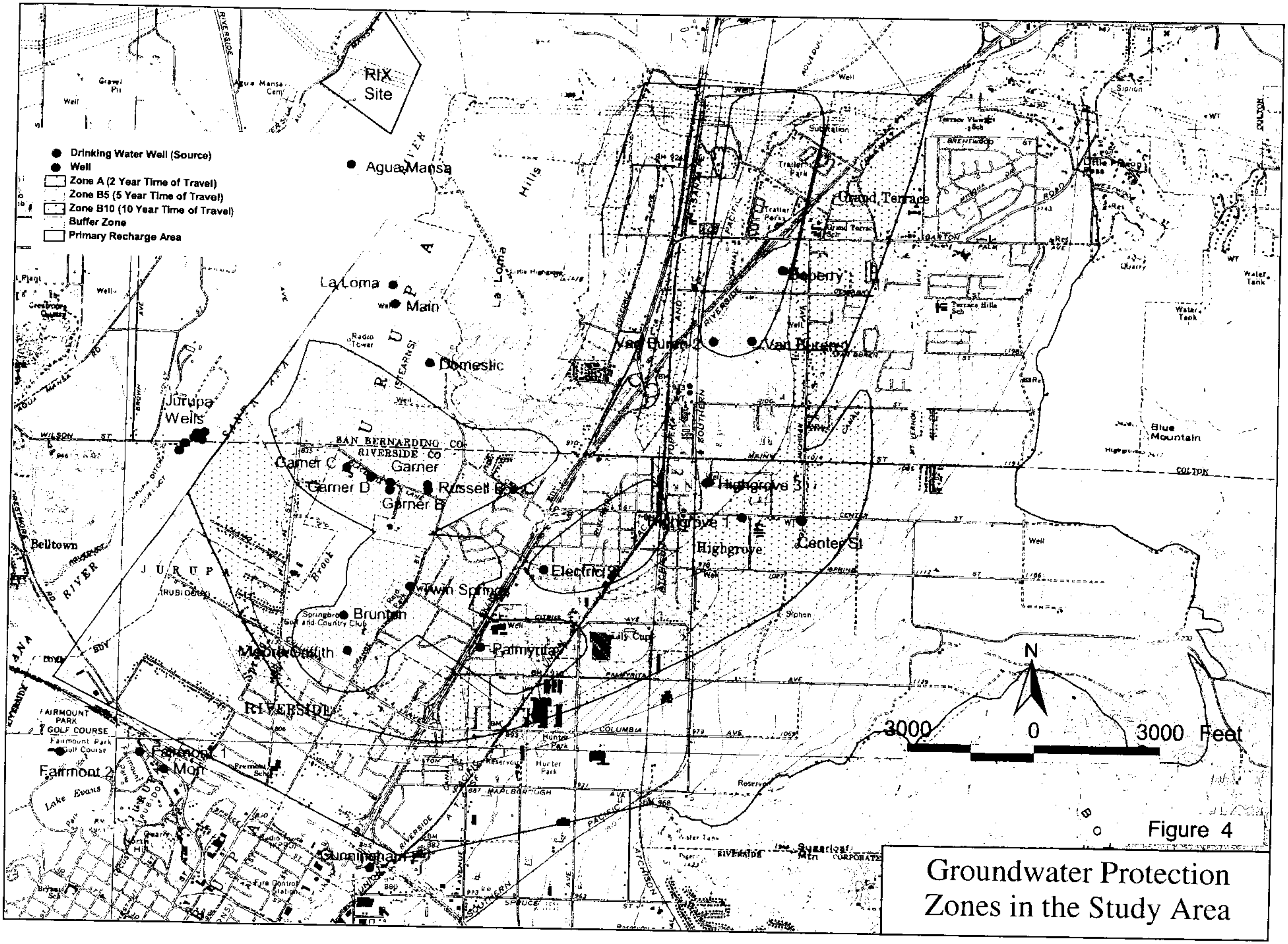


Figure 4

Groundwater Protection Zones in the Study Area

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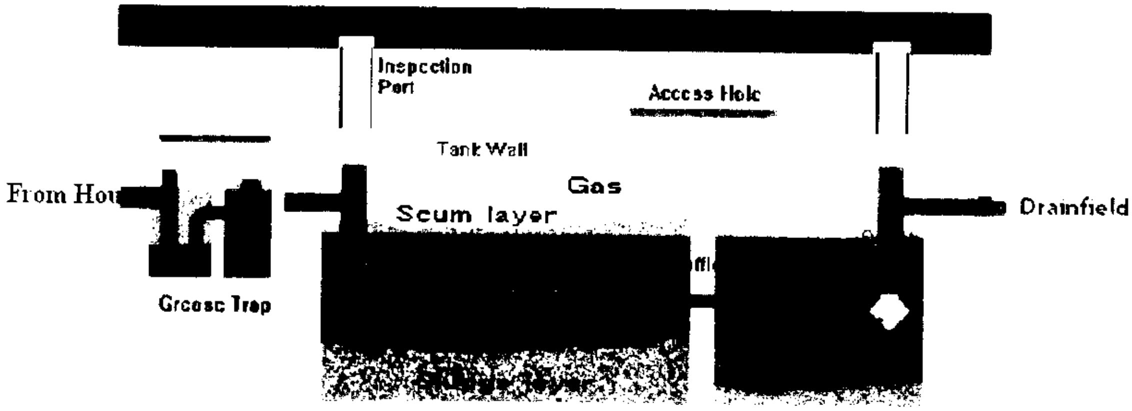


Figure 5. Typical section through a septic tank
Source: http://danpatch.ecn.purdue.edu/~epados/septics/web.htm

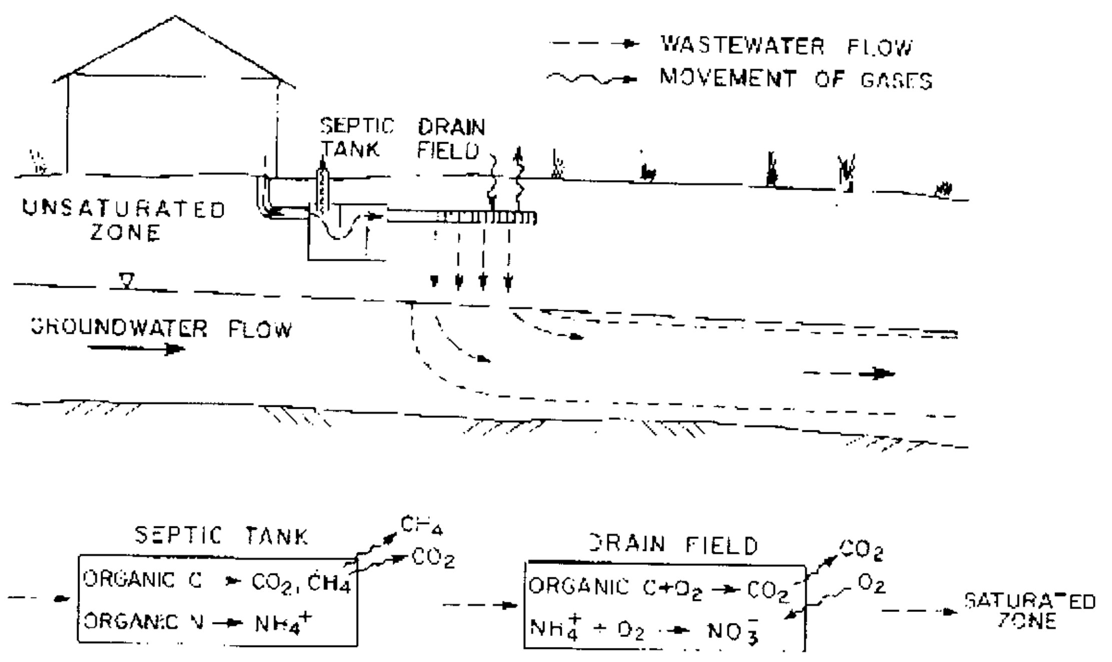


Figure 6: Biogeochemical processes, water flow, and movement of gases through a conventional septic system.
Source: Wilhem, S.R., S.L. Schiff, and J. A. Cherry, 1994.

A properly functioning septic-system with adequate separation from the water table could allow sufficient degree of denitrification and pathogen removal prior to reaching the underlying groundwater. However, in California, more public supply wells have been shutdown because of nitrates than any other contaminant (Groundwater Protection Council, 1999). The septic systems are one of the sources of contamination for nitrates. National Small Flows Clearinghouse (1996) estimated that as many as 20 to 30 percent of existing conventional single family septic systems fail during their design lifetime. Historically, failure of a septic system is determined by inability to dispose sewage such as backups and surfacing of effluent (CSUC, 2000).

For proper functioning of the system, the solids that remain after digestion in the septic tank, must be removed periodically - an average of every three years (Buchholz and Ellis, 1979). Pumping of septage in residential areas occur less frequently than the recommended three-year period, dictated more often as a measure to stop overflowing, as opposed to being used for preventive maintenance. An improperly maintained septic system may result in microbial and chemical contamination of groundwater.

MICROBIAL IMPACTS

Tchobanoglous and Burton (1991) identified the type and number of microorganisms commonly found in wastewater, of which up to 3 or 4 percent of the total coliform group is the pathogenic *E. coli*. The fate and transport of protozoa and parasites, bacteria, and viruses from sewage effluent are affected by the operation of the septic tank and their treatment units, if any, preceding the drainfield, the loading pattern and rate, as well as the characteristics of the subsurface environment.

Many soils are capable of filtering parasites and bacteria as the effluent moves through soil pores. Bacteria, which have many nutritional requirements, usually die off once filtered from the effluent (U.S. EPA, 1999b). Cases have been reported of active bacteria traveling distances of up to 300 feet in sandy aquifers, 2,800 feet in gravelly aquifers, and 3,300 feet in limestone bedrock (Kaplan, 1991). Viruses are less easily filtered and are better removed under unsaturated than saturated conditions (U.S. EPA, 1999b). The major means of viral removal is through adsorption onto soil particles. Dry soils may also inactivate viruses (Kaplan, 1991). Changing environmental conditions, such as heavy rainfall, can reverse initial virus removal or inactivation (Yates, 1987). Los Angeles Regional Water Quality Control Board (2000) identified septic systems in Malibu Valley as a major source of microbial contamination.

The State and San Bernardino County Health Departments documented cases of "summer flu" in residents of Lytle Creek, caused by contamination of individual wells from septic tank effluent.

GENERAL MINERALS IMPACTS

Tchobanoglous and Burton (1991) also estimated that domestic usage of water increases the mineral content of effluent water by increasing levels of: nitrate (20 - 40 mg/L), bicarbonate (50 -100 mg/L), chloride (20 -50 mg/L), total dissolved solids or TDS (150 - 380 mg/L), fluoride (0.2 - 0.4 mg/L), etc.

Nitrogen reduction is one of the treatment goals for sewage treatment systems (CSUC, 2000). Wastewater contains various forms of nitrogen compounds, and a series of microorganisms use and transform the various compounds into different forms as the wastewater migrates through the treatment processes as illustrated in Figure 6. Nitrate in drinking water at levels exceeding the maximum contaminant level (MCL) of 45 mg/L is a public health concern, especially for infants under six months old. Recent research suggests that nitrates in concentration much lower than the MCL increases the risk of bladder cancer (Weyer, *et. al.*, 2001).

Denitrification may not be complete for a septic system that relies on subsurface soil absorption that cannot support sufficient number of needed microorganisms. Soluble nitrates, the non-denitrified prevalent final nitrogen product from septic system, may eventually leach into the groundwater, and contribute to the total nitrate concentration.

Some Regional Water Quality Control Boards in California have identified areas with high concentration of nitrates due to large concentrations of septic systems (CSUC, 2000). The areas include Fontana/Bloomington Area, Cathedral City and Yucca Valley in San Bernardino County; Chico in Butte County; the Oxnard Plain in Ventura County; and the Livermore Valley in Alameda County.

WATER QUALITY IMPACT STUDIES

Santa Ana Regional Impacts

Groundwater contamination by septic systems has been documented at various locations, including within the Inland Empire. The California Regional Water Quality Control Board, Santa Ana Region (1989) reviewed the contribution of septic disposal systems to the nitrate problems in the Santa Ana Region. They determined that sources of nitrates input to groundwater included agricultural activities, sewage effluents, urban run-offs, and septic systems. The Regional Board identified septic systems as one of the most significant sources of nitrates with a potential for long-term buildup of nitrates in groundwater. It estimated that septic systems on the average contribute about 407 pounds of nitrate loading per acre per year compared to 144 pounds/acre/year from irrigated vineyards. Historic high-density use of septic systems resulted in nitrates contamination of groundwater at the Fontana /Bloomington in Santa Ana Watershed. As such, Regional

Board Staff recommended control on septic systems. Regional Board estimated that the typical septic tank effluent contributes about 35 - 100 mg/L of nitrates.

Regional Board staff estimated critical development density for all possible land use and hydrogeological scenario range from 0.23 to 9.67 acres/dwelling unit and that it was impossible to select a lot size that would assure equal water quality protection within Santa Ana region. The Regional Board staff recommended the average, 0.5 acre per dwelling unit, as a minimum lot size requirement as the best control option. Developments within the Highgrove area that rely on septic systems are now based on that recommended minimum lot size. However, this may not be protective of groundwater sources in the area due to the site-specific characteristics.

Desert Water Agency Septic Impacts

The Desert Water Agency and the University of California, Riverside (1993) evaluated the impacts of sub-surface waste disposal systems on groundwater quality below un-sewered areas of Cathedral City. The study focused especially on impacts of nitrates and selected biological pathogens. An estimated 2,500 septic systems, or 2.4 systems per acre were in operation in the study area.

The study included monitoring groundwater quality in shallow monitoring wells (less than 200 feet) and analyzing for nitrate, coliphage (an indicator virus) and enteroviruses (a group of human pathogens). Analyses for coliphage and confirmatory enteroviruses were to confirm impacts by wastewater from septic systems, because enteroviruses are specific to fecal matter of humans and other primates.

The study found nitrate levels in groundwater that were significantly higher than natural levels of less than 5 mg/L. Nitrate levels in some wells were found to be 2 to 6 times above the MCL of 45 mg/L.

Viruses that are indigenous to the intestinal tract of warm-blooded animals were found in some samples. A review of Riverside County Department of Health records found that one in hundred homes in the study area received a notice of violation as a result of wastewater from septic systems overflowing or surfacing. Over seven percent of the households in the area divert graywater from septic systems, even though studies show that graywater can contain higher amounts of pathogenic organisms than subsurface disposal systems.

Malibu Valley Septic Impacts

The Los Angeles Regional Water Quality Control Board (2000) investigated the impacts of septic systems on groundwater quality in the Malibu Valley area. The Regional Board collected groundwater and surface water samples and analyzed the samples for ammonia, nitrate, nitrite, organic nitrogen, foaming agents (methyl blue active substances or

MBAs), total and fecal coliform, etc. The investigation confirmed that constituents typical of sewage are in the groundwater adjacent to septic system leach fields. The Regional Board then concluded that septic systems in the Malibu study area contribute to the pollution of groundwater, Malibu Creek, Malibu lagoon, and the water in the immediate shoreline of Pacific Ocean.

IMPACTS OF SEPTIC SYSTEMS IN THE STUDY AREA

The primary concerns of Riverside PUD regarding septic systems in the study area include the possible leaching of nitrates, microbial and other pathogens, and dissolved salts into groundwater. In addition, improper disposal of hazardous chemicals into septic systems may introduce unknown chemicals into the aquifer.

In determining the water quality impacts of the septic systems on groundwater quality, it is typical to evaluate certain water quality parameters including nitrates, bacteria, viruses, foaming agents, bicarbonates, and chlorides. Some of those chemical parameters such as nitrates and chlorides could also originate from sources other than septic systems, such as storm runoff and agricultural drainage. Therefore, it is typical to further speciate the parameters.

This preliminary assessment was focused on reviewing the existing water quality data and hydrogeological information. Water quality in wells upstream of septic systems, such as Deberry well in Grand Terrace, is compared to the water quality in wells downstream and located within areas with septic systems. Grand Terrace is sewered since 1980 (Silva, 1996), and any previous septic impacts have potentially faded away. Deberry well served as the background well because of its upstream location within a sewered area, and depth to groundwater is least vulnerable to contamination from septic systems. Water quality data reviewed for incremental septic systems impacts on groundwater include foaming agents (MBAs) and nitrates.

Table 3 shows the wells have been contaminated with MBAs, which could be attributed to septic systems. The last detections were in 1995 and first appeared in 1991. Wells located in non-sewered areas, such as Garner D and Electric Street, show MBAs levels from 0.08 to 0.14 mg/L. MBAs were also detected at Deberry and Van Buren 1 and 2 wells at lower levels (0.01 to 0.09 mg/L) than Electric Street well.

Tables 4 and 5 show nitrate and total dissolved solids (TDS) concentrations, respectively, at the wells located in the study area. Although, it is difficult to infer the impact of septic systems due to other factors, the data indicate that nitrate and TDS concentrations are higher in the wells located in nonsewered areas.

The potential future impacts of septic systems cannot be overlooked. Studies in other areas and a review of trends in Riverside Basin provide a clear signal that corrective

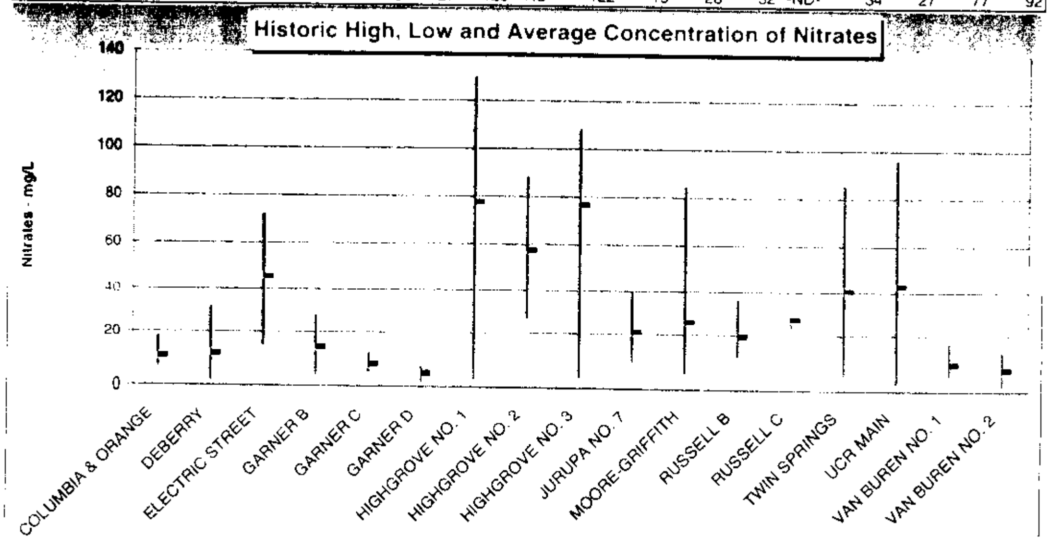
Table 3. Wells with detectable MBAs

Well	Perforated* - ft bgs	Date	Sodium	Potassium	Calcium	Magnessiu	Sulfate	Bicarbonate	Chloride	Nitrates	TDS	pH	Manganese	Boron	MBAs
Deberry	152 - 251	July 14, 1992	60	5	97	19	130	305	56	8	520	7.3	0.01	0.2	0.06
Deberry	152 - 251	July 6, 1995	52	6	77	15	46	200	91	10	450	7.0	<0.030		0.01
Electric Street	82 - 153	July 24, 1992	54	5	110	19	89	308	73	49	505	7.5	<0.01	0.2	0.1
Electric Street	82 - 153	July 27, 1995	59	7	120	20	87	260	71	40	600	7.2	<0.03		0.13
Garner C	184 - 500	July 23, 1992	27	2	73	12	59	232	31	6	340	7.8	<0.01	<0.1	0.06
Garner D	185 - 400	July 23, 1992	30	2	76	13	70	235	33	4	355	7.8	<0.01	<0.1	0.08
Garner D	185 - 400	July 27, 1995	35	3	82	14	68	200	34	4	380	7.6	<0.03		0.14
Jurupa 7	204 - 430	August 16, 1995	35	0	70	9	56	170	24	32	390	7.6	<0.050		0.11
Palmyrita	192 - 282	November 17, 1989	71	5	112	23	82	329	80	54	590	7.4			0.1
Russell B	100 - 390	July 23, 1992	44	3	82	15	86	250	53	16	430	7.6	<0.01	0.2	0.11
Van Buren 1	235 - 410	July 23, 1991	50	4	100	17	130	278	51	12	500	7.5	<0.01	0.2	0.08
Van Buren 1	235 - 410	July 24, 1992	50	15	94	17	130	275	52	12	520	7.4	<0.01	0.2	0.08
Van Buren 1	235 - 410	July 7, 1993	56	4	94	15	130	253	50	6	495	7.6	<0.01	0.2	0.09
Van Buren 2	215 - 410	June 11, 1992	59	5	95	17	140	271	59	4	490	7.4	<0.01	0.3	0.07

Concentrations in mg/L for all parameters except pH which is in pH units.
* Perforated or Screened interval may not be continuous

Table 4. Annual Maximum of Nitrate Concentrations (mg/L nitrate)

Year	COLUMBIA & ORANGE	DEBERRY	ELECTRIC STREET	GARNER B	GARNER C	GARNER D	HIGHGROVE NO. 1	HIGHGROVE NO. 2	HIGHGROVE NO. 3	JURUPA NO. 7	MOORE-GRIFFITH	RUSSELL B	RUSSELL C	TWIN SPRINGS	UCR MAIN	VAN BUREN NO. 1	VAN BUREN NO. 2
1957							26	27									
1961							64	88									
1963			40														
1964									90								
1965			36														
1966			36				4		4								
1967			32														
1968			48				3		80								
1969			26														
1970		14	64	15			120		100		11	36		28			
1971		32	60	22			84		64		10	24		6			
1972		28	56	24			100		74		6	20		22			
1973		24	56	14			120		80		14	21		21			
1974		15	52	14							14	18		24	68		
1975		16	60	18			125		90		16	16		22	85		
1976		20	62	24			130		108		23	24		42	80		
1977		18	72	25							21	24		44	96		
1978		13	50	18							6	17		64			
1979		6	47								25	26		32			
1980		6	54	28							24	28		66			
1981		6	31	18						14	21	23		35	3		
1982		4	40	16						11	24	20		39	2		
1983		2	52	15							31	24		47			
1984		7	44	13							26	20		42			
1985		12	46	9						10	38	17		53	17		
1986		7	42	6							26	14		43	13		
1987		6	40	4	6						84	15		67	17		
1988		7	38	4	6						66	14		67	17	6	4
1989		9	44	6	6							14		54	31	9	5
1990		19	44	5	5							12		85	45	9	6
1991	7	11	15	5	5	3					45	18		64	59	12	4
1992		8	49		6	4						16		24	77	12	4
1993	14	6	54	15		2						18				6	2
1994	8	9	44	7								16		18		17	5
1995	8	10	40		10	4				32	9	14		17		9	11
1996		6	42	5	9	5					23	15		32		8	13
1997		11	45	6	10	6				37		16			34	8	14
1998	12	9	40	16	11	6						21					14
1999	14	7	42	23	12	7							27			6	9
2000	18	16	44	27						40	42		23	53		6	8
Maximum	18	32	72	28	12	7	130	88	108	40	84	36	27	85	96	17	14
Minimum	7	2	15	4	5	2	3	27	4	10	6	12	23	6	2	6	2
Average	11	12	46	14	8	5	78	58	77	21	26	19	27	41	43	9	8
Count	7	31	37	28	11	8	10	2	9	6	23	29	2	27	15	12	13
Screen - ft bgs	Not a well	152 - 251	82 - 153	100 - 405	184 - 500	185 - 400	270 - 417	120 - 190	171 - 485	204 - 430	215 - 384	100 - 390	205 - 385	155 - 400	Unknown	235 - 410	215 - 410
Ave. SWL ft bgs	7	124	70	31	23	27	128	-ND-	122	19	28	32	-ND-	34	27	77	92



NOTES:

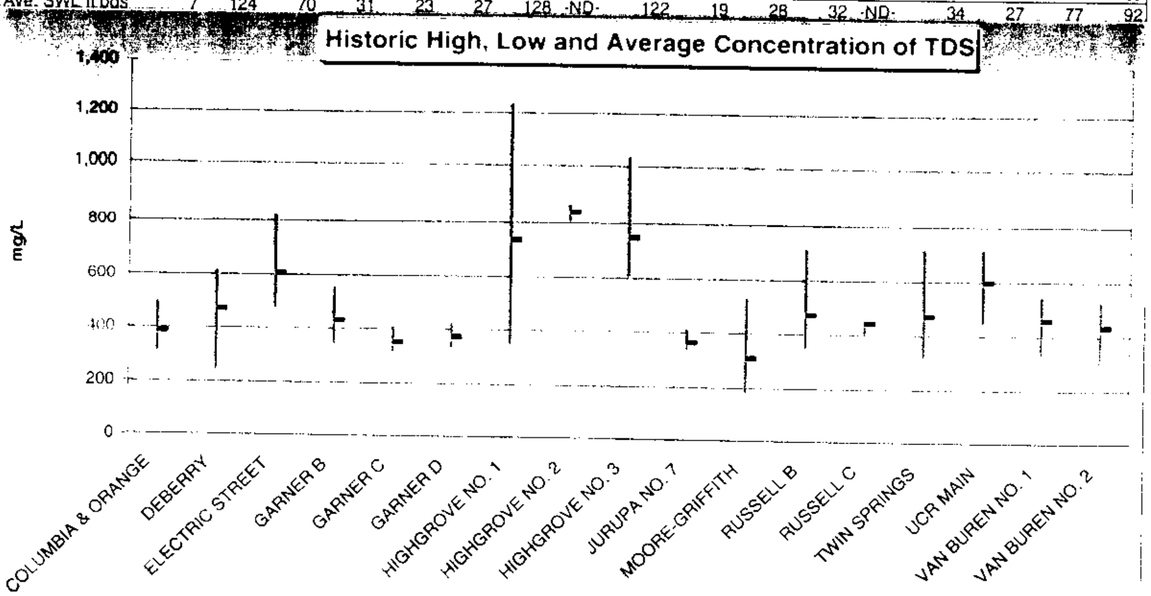
Nitrates level at Columbia and Orange, the blended location for Garner B, Garner C, Garner D, and Russell B/C wells increased because nitrates level increased at Garner B and/or Russell B well(s).

Nitrate levels at Highgrove wells were very high because the wells are located within orchard groves, and leaching fertilizers contributed to the elevated levels.

Nitrate levels are increasing at Garner B and Russell B/C wells even though annual average of depth to groundwater is lowering, reflecting increasing contribution of poorer groundwater flow from the north-east.

Table 5. Annual Maximum of TDS Concentrations (mg/L)

Year	COLUMBIA & ORANGE	DEBERRY	ELECTRIC STREET	GARNER B	GARNER C	GARNER D	HIGHGROVE NO 1	HIGHGROVE NO 2	HIGHGROVE NO 3	JURUPA NO 7	MOORE-GRIFFITH	RUSSELL B	RUSSELL C	TWIN SPRINGS	UCR MAIN	VAN BUREN NO. 1	VAN BUREN NO. 2
1957							776	877									
1961							1,236	814									
1963			632														
1964									736								
1965			567														
1966			580				415		1,031								
1967			625														
1968			757				353		919								
1969			575														
1970		293	799	381			829		652		281	719		516			
1971		490	735	510			785		695		290	595		365			
1972		575	825	555			875		685		305	540		445			
1973		560	655	405			750		610		300	480		325			
1974		515	620	455							355	490		330	700		
1975		525	690	455			575		680		315	470		370	620		
1976		530	635	450			795		755		315	495		390	720		
1977		530	610	435							295	520		380	690		
1978		520	565	405							185	495		595			
1979		345	665								320	460		380			
1980		390	530	465							305	485		720			
1981		335	610	455						355	315	460		395	525		
1982		385	565	365						345	275	385		360	450		
1983		495	645	425							340	445		435			
1984		545	550	455							300	450		425			
1985		525	480	455						385	290	455		405	465		
1986		585	530	450							295	415		445	530		
1987		605	550	480	325						530	460		535	585		
1988		615	545	470	410						450	475		610	575	400	385
1989		605	560	455	395							500		470	620	465	435
1990		600	555	425	375							455		715	630	545	525
1991		–				420										500 –	
1992		520	505		340	355						430		590	670	520	490
1993	315	420	580	435		335						450				495	480
1994	500	380	560	360	320	410						420		530		420	490
1995	430	450	600		380	380				390	220	460		500		440	450
1996		359	545	346	338	377					241	395		504		388	368
1997		410	568	346	338	374				351		415			577	397	369
1998	358	368	572	355	325	345						354					398
1999	334	249	586	402	320	360							440			432	337
2000	360	376		425						411	348		402	552		339	305
Maximum	500	615	825	555	410	420	1,236	877	1,031	411	530	719	440	720	720	545	525
Minimum	315	249	480	346	320	335	353	814	610	345	185	354	402	325	450	339	305
Average	387	473	605	431	351	373	739	846	751	365	311	470	440	469	597	455	430
Count	6	30	35	27	11	9	10	2	9	6	22	28	2	26	14	12	12
Screen - ft bgs	Not a well	152 - 251	82 - 153	100 - 405	184 - 500	185 - 400	270 - 417	120 - 190	171 - 485	204 - 430	215 - 384	100 - 390	205 - 385	155 - 400	Unknown	235 - 410	215 - 410
Ave. SWL ft bgs	7	124	70	31	23	27	128	-ND-	122	19	28	32	-ND-	34	27	77	92



actions must be taken. As the existing septic systems age, there is potential for further contamination. The 1965 outbreak of water-related disease in Riverside was suspected to originate from the North Orange area wells (Boring *et. al.*, 1971). In addition, new developments would only increase the loading rate. There is potential for other contaminations from improper disposal of chemicals into septic systems from commercial and industrial activities in the area.

GROUNDWATER PROTECTION PLANS

Groundwater is vulnerable to contamination from many possible-contaminating activities (PCAs) associated with overlying land use and within the recharge area of the aquifers. For example, effluents from septic tanks can contaminate underlying groundwater with nitrates, pathogens, salts and chemicals.

It is much cheaper to prevent contamination than to characterize, monitor, and remediate contaminated groundwater. Cleanup of nitrates contaminated groundwater within the Santa Ana watershed could cost as much as $6 billion (The Sun, 1991). Beside the costs, it takes a long time to cleanup groundwater contamination. The cost for nitrate removal with ion exchange treatment at Rubidoux Community Services District is $288 per acre-foot, with treatment plant operated 70 percent of the time.

Groundwater should be reasonably free from pathogens. Malfunctioning septic systems can release disease-carrying microorganisms including enteric viral and bacterial pathogens to groundwater. U.S. EPA (2000) estimated that between 1971 and 1996, contaminated source waters (surface- and groundwater) were the cause of 86 percent of waterborne disease outbreaks within the United States. The U.S. EPA also estimated that about 10 percent of public water supplies derived from groundwater exceeded standards for biological contamination. Septic systems can pose significant threat to groundwater. A U.S. EPA (1998) report to Congress showed 31 states listing septic systems as their second greatest potential source of groundwater contamination.

The Drinking Water Source Assessment conducted by Riverside PUD confirmed that groundwater in the study area is very vulnerable to contamination from septic systems. Depth to groundwater is shallow in some sections of the area, making those wells particularly vulnerable to contamination.

GROUNDWATER PROTECTION REGULATIONS

Federal, state, regional, county, and municipal governments have enacted many regulations to protect groundwater quality. A detailed listing of regulations is provided in Appendix A.

At the Federal level, a septic system is regarded as an underground injection, and Federal laws apply to large capacity septic systems receiving more than 2,000 gallons per day. Federal laws on groundwater now emphasize source water protection.

California Department of Health Services (DHS) administers the Safe Drinking Water Act, under primacy from U.S. EPA. DHS has prepared guidelines for a public water system to implement a voluntary Source Water Protection Strategy. DHS recognized that cooperation of the entire community is vital for source water protection management measures to work.

The Regional Water Quality Control Boards establish basin plans that include general guidelines to local agencies on septic systems. Actual regulation and oversight of septic systems occur at the County level.

The single-family residential septic systems are usually regulated at the County level, through health ordinances that require a separation distance or setback between the septic system and a domestic well, pipeline, and reservoirs.

The Riverside County Department of Environmental Health issues permits for septic systems within the county. Riverside County has no formal maintenance requirements, but the County distributes a maintenance guide for homeowners. Code citations are issued only when the septic system creates a public nuisance.

ACTIONS BY OTHER AGENCIES

Many agencies have adopted plans to protect groundwater from adverse impacts of septic systems. Such plans may include the extension of public sewers to non-sewered areas, septic system rehabilitation and replacement programs, programs for alternative design of septic systems, etc. (CSUC, 2000). Many states are toughening regulations for installing septic systems.

Many communities and states are also establishing septic systems management programs. The state of Georgia has banned the use of single-compartment septic tanks (Georgia Division of Public Health, 2001). Noah (2000) identified California as one of the states that neither has certification, nor licensing programs for onsite wastewater contractors, installers, and inspectors.

The Los Angeles Regional Water Quality Control Board had issued a prohibition on construction of onsite systems in the Oxnard Forebay due to nitrate and coliform bacteria concerns (CSUC, 2000). California is evicting residents of Crystal Cove in Orange County in order to remove aging septic systems and replace them with a $10 million sewer in the area (Orange County Register, 2001).

The California Regional Water Quality Control Board in Redding adopted a prohibition restricting the use of septic systems in the Chico Urban Area (CSUC, 2000). The California Regional Water Quality Control Board, Los Angeles Region is now requiring commercial septic system users to install monitoring wells and meet discharge limits for nutrients and bacteria, and prohibited the construction of new onsite systems in the Oxnard Bay (CSUC, 2000).

The Desert Water Agency recommended a groundwater monitoring program and installation of sewers in the non-sewered areas of Cathedral City. Public funding of sewers was also sought in Chassahowitzka, Florida, where data show that septic tanks are influencing water quality of adjacent surface waters.

The Massachusetts Water Resource Authority spent about $58 million to install sewers to replace 40 percent of septic systems in its Wachusett watershed and established a regional wastewater management district to provide regular inspection and maintenance of septic systems (EPA, 1999a). Onondaga County Water Authority, Syracuse, New York established an inspection program that includes periodic dye tests on septic systems (EPA, 1999a).

The City of Austin, Texas (2001), is considering Alternative Wastewater Management Projects. They found that more than half of the septic system users were not aware of the recommended O&M practices for the septic systems. Their plan includes the following management programs for onsite wastewater systems:

- Criteria for determining an appropriate type of wastewater system for a given site and set of conditions;
- Possible revisions to the City's Land Development Code for certain situations in which limitations may currently exist for the use onsite or cluster systems;
- Appropriate inspection intervals for residential and commercial onsite systems;
- O&M requirements for various types of systems;
- Who will be responsible for O&M in various circumstances;
- Local certification requirements (if more stringent than state requirements) for private companies providing O&M services;
- Acceptable technical standards for conventional and alternative systems (including designs, materials and equipment specifications);
- Record-keeping needs and/or requirements;
- Appropriate rate structures for various types of onsite and larger-scale decentralized systems which would be managed by the City;
- Enforcement procedures to ensure compliance with local requirements; and
- Public education and information needs.

GROUNDWATER PROTECTION PLAN FOR THE STUDY AREA

The most appropriate protection plan can be site specific. A successful and practical groundwater protection plan would require the cooperation of all impacted agencies. The Santa Ana Regional Water Quality Control Board, City of Riverside, City of Colton, County of Riverside, and the County of San Bernardino each has political jurisdiction over all or part of the non-sewered portions of the study area. Other important stakeholders for groundwater protection include the Western Municipal Water District, San Bernardino Valley Municipal Water District, the Riverside-Highland Water Company, the Gage Canal Company, the Santa Ana Watershed Project Authority (SAWPA), and the University of California, Riverside.

Existing measures for protecting groundwater quality in the North Orange area were fragmented and uncoordinated, and sometimes reactive. Riverside PUD had relied on regulations by other agencies to protect groundwater in the study area. Such regulations include the Underground Injection Control (UIC) Regulations of the Safe Drinking Water Act (SDWA), the well abandonment ordinance of Riverside County, minimum setback requirements from septic systems (Department of Health Services), and the basin plan of the California Regional Water Quality Control Board etc.

The California Regional Water Quality Control Board, Santa Ana Region placed a moratorium on septic systems within the City of Grand Terrace because the previous septic systems in the area were failing because of high groundwater and poor percolation (Silva, 1996). The building moratorium was lifted after the City of Grand Terrace installed sewers in 1980.

The California Regional Water Quality Control Board, Santa Ana Region (1989) recommended a minimum lot size of 0.5 acre per residential development in the area in order to minimize leaching of nitrates from septic systems. The Board acknowledged that it was impossible to select a lot size that would assure equal water quality protection within its region and depending on hydrogeological considerations critical development density can be up to 9.67 acres per dwelling unit.

Riverside PUD has periodically expressed its concerns regarding potential groundwater contamination from septic systems in the area, to the Regional Water Quality Control Board and Riverside County. The Regional Board has acknowledged the unsuitability of the area for septic systems unless detailed engineering report evaluating the impacts of septic systems on groundwater show otherwise. In 1996, after protests from Riverside PUD, the County of Riverside decided to connect the Highgrove Fire Station/Community Center to the City of Grand Terrace sewer system.

Riverside's Public Works Department is aware of the need to sewer the North Orange area. Many property owners in the area were not willing to pay for the proposed sewer improvements. The Public Works Department does not provide sewer service outside the

City limits. However, some portions the North Orange areas that are non-sewered are within the City limits. The Public Works Department estimated that it would cost about $1.3 million to install sewers in the North Orange area on Placentia and Garner Street, between Main Street and Orange Street, and on Sieck Road and Public Utility Easement, between Garner Street and the northerly City Limits.

RECOMMENDATIONS

The primary purpose of this project is to develop a groundwater protection plan targeting in this initial phase the adverse impacts of septic systems in the study area. The septic systems can introduce nitrates, pathogens, and hazardous materials into water sources.

Riverside PUD had been active in challenging the use of commercial size septic systems in the Highgrove area and had brought those concerns to the attention of the Riverside County Department of Health, and the California Department of Health Services. The Department would continue to oppose installation of additional commercial septic systems in the area.

The RWQCB's "Guidelines for Sewage Disposal from Land Developments" states that septic systems are an acceptable use only in the rural or low population density areas. Considering the fragile water supply in the area, the critical nature of the supply to the region, and the planned developments in the area, actions must be taken now.

The primary purpose of this project is groundwater protection against the adverse impacts of septic systems in the study area. To achieve this goal, the following actions are recommended:

- Request that Riverside City Council to prohibit installation of septic systems by new developments within the City limits of the study area.
- City of Riverside to request similar actions by the County of Riverside.
- Review and research grants for groundwater protection plan.
- Institute a public education campaign focusing on groundwater awareness.
- Encourage existing septic systems owners to properly maintain their systems, and provide users with information on how to operate and maintain septic systems, including maintenance log books.
- Expedite the extension of sewer system to the North Orange Area by cost sharing with Public Works Department. The Public Works Department (PWD) estimated $1.3 million for installing sewer at the North Orange area, and has agreed to 50 percent cost sharing of up to $750,000.
- Monitor sewer lines for leaks, and establish a groundwater-monitoring program.
- Encourage Public Works Department to consider sewering outside the City limits in areas where City produces domestic water.

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APPENDIX A

GROUNDWATER PROTECTION REGULATIONS

Federal, state, regional, county, and municipal governments have enacted many regulations to protect groundwater quality.

FEDERAL PROGRAMS AND REGULATIONS

The Federal Government is only involved in large capacity septic systems receiving more than 2,000 gallons per day. Federal laws on groundwater now emphasize source water protection. Federal laws that protect groundwater quality are as follows.

Federal Laws Administered by EPA Affecting Ground Water

Clean Water Act (CWA)
Ground water protection is addressed in Section 102 of the CWA, providing for the development of federal, state, and local comprehensive programs for reducing, eliminating, and preventing ground water contamination.

Safe Drinking Water Act (SDWA)
Under the SDWA, EPA is authorized to ensure that water is safe for human consumption. To support this effort, SDWA gives EPA the authority to promulgate Maximum Contaminant Levels (MCLs) that define safe levels for some contaminants in public drinking water supplies. One of the most fundamental ways to ensure consistently safe drinking water is to protect the source of that water (i.e., ground water). Source water protection is achieved through four programs: the Wellhead Protection Program (WHP), the Sole Source Aquifer Program, the Underground Injection Control (UIC) Program, and, under the 1996 Amendments, the Source Water Assessment Program.

Resource Conservation and Recovery Act (RCRA)
The intent of RCRA is to protect human health and the environment by establishing a comprehensive regulatory framework for investigating and addressing past, present, and future environmental contamination or ground water and other environmental media. In addition, management of underground storage tanks is also addressed under RCRA.

Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA)
CERCLA provides a federal "Superfund" to clean-up soil and ground water contaminated by uncontrolled or abandoned hazardous waste sites as well as accidents, spill, and other emergency releases of pollutants and contaminants into the environment. Through the Act, EPA was given power to seek out those parties responsible for any release and assure their cooperation in the clean-up. The program is designed to recover costs, when possible, from financially viable individuals and companies when the clean-up is complete.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
FIFRA protects human health and the environment from the risks of pesticide use by requiring the testing and registration of all chemicals used as active ingredients of pesticides and pesticide products. Under the Pesticide Management Program, States and Tribes wishing to continue use of chemicals of concern are required to prepare a prevention plan that targets specific areas vulnerable to ground water contamination.

Source: United States Environmental Protection Agency. 1999. Safe Drinking Water Act, Section 1429 Ground Water Report to Congress. Office of Water (4606), EPA-816-R-99-016, October 1999. Washington, D.C.

There are major programs within the SDWA devoted to source water protection, such as Wellhead Protection Program (WHPP), Underground Injection Control (UIC), source water assessment, and comprehensive groundwater protection grants.

In 1980, Congress established the UIC program to address injection practices that contaminate sources of drinking water (U.S. EPA, 1999d). Revisions to UIC regulations in 1999 included a nation-wide ban on large-capacity cesspools and locating certain types of Class V UIC wells within groundwater protection areas (U.S. EPA, 1999d). Class V wells include poorly-designed or malfunctioning large-capacity septic tanks, leach fields and cesspools associated with solely sanitary wastewater disposal (EPA, 2000).

Federal UIC program does not regulate individual or single family residential septic systems and cesspools that inject solely sanitary wastewater.

The Federal UIC program, defines large-capacity septic systems (LCSSs) as septic systems serving 20 or more persons per day and that are designed to receive, treat, and dispose of solely sanitary wastes. Congress acknowledged that septic systems (regardless of the size and capacity of the system) pose risks to groundwater if improperly sited, managed, or operated. Congress, however, chose to differentiate between small and large-capacity septic systems because it believed that the larger volume of sanitary waste (and potentially wider range of contaminants) being disposed of in LCSSs posed sufficient risk to warrant special consideration (U.S. EPA, 1999b).

EPA noted that deep wells are not immune from biological contamination. Lawson *et al.* (1991) reported an outbreak of gastroenteritis caused by Norwalk virus in water produced from a 600-foot deep well. The proposed GWR does not address the issues of toxic and carcinogenic chemicals but includes hydrogeologic assessments to identify wells vulnerable to fecal contamination -- an element of a WHPP. The U.S. EPA proposed to incorporate States' WHPP and Source Water Assessment and Protection Plan (SWAPP) into an overall program for protecting groundwater quality.

The Federal Government is working towards comprehensive groundwater protection. Section 1429 of the Safe Drinking Water Act (SDWA) authorizes the U.S. Environmental Protection Agency (EPA) Administrator to make grants to the states for the development and implementation of programs that ensure the coordinated and comprehensive protection of groundwater resources. Under this authority, EPA is also required every three years to evaluate funded state groundwater protection programs and report to Congress on the status of groundwater quality in the United States and the effectiveness of state programs for protecting groundwater resources.

The U.S. EPA proposed a Groundwater Rule (GWR) to address risks of pathogens in groundwater (U.S. EPA, 2000). The proposed GWR is a targeted risk-based regulatory strategy that addresses risks through a multiple-barrier approach.

The five major components of the strategy are:

- Periodic sanitary surveys of groundwater systems and the identification of significant deficiencies;
- Hydrogeologic assessments to identify wells sensitive to fecal contamination.
- Source water monitoring for systems drawing from sensitive wells without treatment or other indications of risk;
- A requirement for correction of significant deficiencies and fecal contamination; and
- Compliance monitoring to insure disinfection treatment is reliably operated where it is used.

The chronology of EPA's groundwater protection activities follows.

Chronology of EPA Ground Water Protection Activities

1972	Federal Water Pollution Control Act Amendments
1972	Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
1974	Safe Drinking Water Act (SDWA)
1976	Resource Conservation and Recovery Act (RCRA)
1980	Underground Injection Control Program established
1980	Comprehensive Environmental Response and Compensation and Liability Act (Superfund)
1984	Hazardous and Solid Waste Amendments to RCRA
1984	U.S.EPA Ground Water Strategy and Office of Ground Water Protection established
1986	Superfund Amendments and Reauthorization Act: Underground Storage Tank Program
1986	SDWA Amendments: Wellhead Protection and Sole Source Aquifer Programs
1987	Clean Water Act
1991	EPA Ground Water Strategy Revised
1992	Comprehensive State Ground Water Protection Program Guidance
1992	Interagency Task Force on Monitoring Water Quality (through 1996)
1993	Pesticide State Management Plans under FIFRA
1996	SDWA Amendments: Source Water Assessment and Protection Program
1996	FIFRA Amendments under the Food Quality Control Act of 1996
1997	National Water Quality Monitoring Council formed
1998	Clean Water Action Plan
1998	Underground Storage Tank Closure/Upgrade Requirements
1999	(planned) Class V Underground Injection Control Final Rule
2000	(planned) Ground Water Final Rule

Source: United States Environmental Protection Agency. 1999. Safe Drinking Water Act, Section 1429 Ground Water Report to Congress. Office of Water (4606), EPA-816-R-99-016, October 1999. Washington, D.C.

CALIFORNIA PROGRAMS AND REGULATIONS

Table A-1 lists the primary statues addressing groundwater protection in California. Groundwater protection in California is a joint multi-agency, public-private effort (Groundwater Protection Council, 1999). Table A-2 lists the state agencies and the principal programs for addressing groundwater quality in California, and the complementary roles of local and Federal agencies.

The principal state agencies include the California Environmental Protection Agency (Cal-EPA) and its sub-agencies which include Department of Toxic Substances Control, the State Water Resources Control Board, Regional Water Quality Control Boards, and the Integrated Waste Management Board; Department of Water Resources; Department of Pesticide Regulation; and the Department of Health Services of the California Health and Welfare Agency.

Cal-EPA administers programs to protect, and if necessary cleanup contaminated water. Cal-EPA programs also include *Waste Disposal to Land Regulations, Underground Storage Tank* (UST), *Non-point Source Pollution Control, and the Spills, Leaks, Investigation, and* Cleanup. In addition, the California Regional Water Quality Control Board, Santa Ana Region (1989) has regulations to protect water quality in the Santa Ana River watershed, such as the minimum-lot size requirement to minimize the contribution of septic systems to nitrate loading of underground aquifers.

The California Department of Water Resources monitors groundwater resources and develops standards on well construction, maintenance, and destruction (well abandonment). California Department of Health Services (DHS) administers the Safe Drinking Water Act, under primacy from U.S. EPA.

DHS has prepared guidelines for a public water system to implement a voluntary Source Water Protection Strategy (SWPS). The implementation of Drinking Water Source Assessment and Protection Plan (DWSAPP) includes the following steps:

- Establish a local advisory committee;
- Review initial DWSA and determine if and where to expand and refine it;
- Review the State's DWSA Program;
- Prepare reports and maps;
- Develop a protection program based on revised assessment;
- Submit the protection program and revised amendment to DHS, other agencies, and the public;

- Implement the protection program and its management approaches; and
- Conduct contingency planning.

Potential management measures for local source water protection programs listed in Table A-3.

DHS (1999) recommended that the protection strategy could identify measures to be accomplished at the local level, and by affected agencies, districts or communities. DHS recognized that cooperation of the entire community is vital for source water protection management measures to work.

Within California, there are approximately 1.2 million onsite sewage treatment systems serving about 3.5 million people, or 10 percent of the population (CSUC, 2000) and handling about 420 million gallons of wastewater per day. California has a tiered regulatory structure for septic systems

The Regional Water Quality Control Boards establish basin plans that include general guidelines to local agencies on septic systems. Actual regulation and oversight of septic systems occur at the County level. Only the Los Angeles Regional Water Quality Control Board had issued a prohibition on construction of onsite systems in the Oxnard Forebay due to nitrate and coliform bacteria concerns (CSUC, 2000). California is evicting residents of Crystal Cove in Orange County in order to remove aging septic systems and replace them with a $10 million sewer in the area (Orange County Register, 2001).

The State Water Resources Control Board (1994) identified the following 14 issues of concern that local agencies must be aware if they choose to continue to rely on onsite sewage disposal:

- Degradation in water quality;
- Increasing number of systems;
- Long-term dependence on onsite;
- Inconsistent standards between jurisdictions;
- Inconsistent approach statewide;
- Inadequate coordination between agencies;
- Limited knowledge of alternative technologies;
- Lack of inspection and maintenance;
- Need of upgrade and repair of existing systems;
- Need for education and training of personnel;
- Need of funds for upgrade/repairs;
- Lack of guidance for real estate transactions;
- Inadequate septage disposal facilities; and
- Potential problems with gray water use.

RIVERSIDE COUNTY PROGRAMS AND REGULATIONS

Septic systems are usually regulated locally (County) through health ordinances that require a separation distance or setback between the septic system and a domestic well, pipeline, and reservoirs.

The Riverside County Department of Environmental Health issues permits for septic systems within the county. There are over 113,235 housing units using septic systems and serving about 240,000 residents of Riverside County (CSUC, 2000). Every year, another 2,100 septic systems are added while another 2,500 are repaired. Riverside County has no formal maintenance requirements, but the County distributes a maintenance guide for homeowners (Riverside County, undated). Code citations are issued only when the septic system creates a public nuisance.

Source Water Assessment and Protection Program
(For North Orange Area)

Prepared By:

Public Utilities - Water Resources

RIVERSIDE

PUBLIC UTILITIES

RIVERSIDE PUBLIC UTILITIES

Board of Public Utilities' Goal

- Safeguard the Supply and Quality of Riverside Water Resources For The Next 100 Years
- Key Performance Indicator: Implement a Water Basin Protection Plan For The North Orange Area

RIVERSIDE PUBLIC UTILITIES

Recommendations

- Extend Sewer System to North Orange Area
- Prohibit Installation of New Septic Systems Within the City Limits in Study Area
- Request Similar Actions from County of Riverside Board of Supervisors

RIVERSIDE PUBLIC UTILITIES

Purpose

- Well Head Protection
- Keep the Water Supply Safe
- Avoid High Cost of Treatment

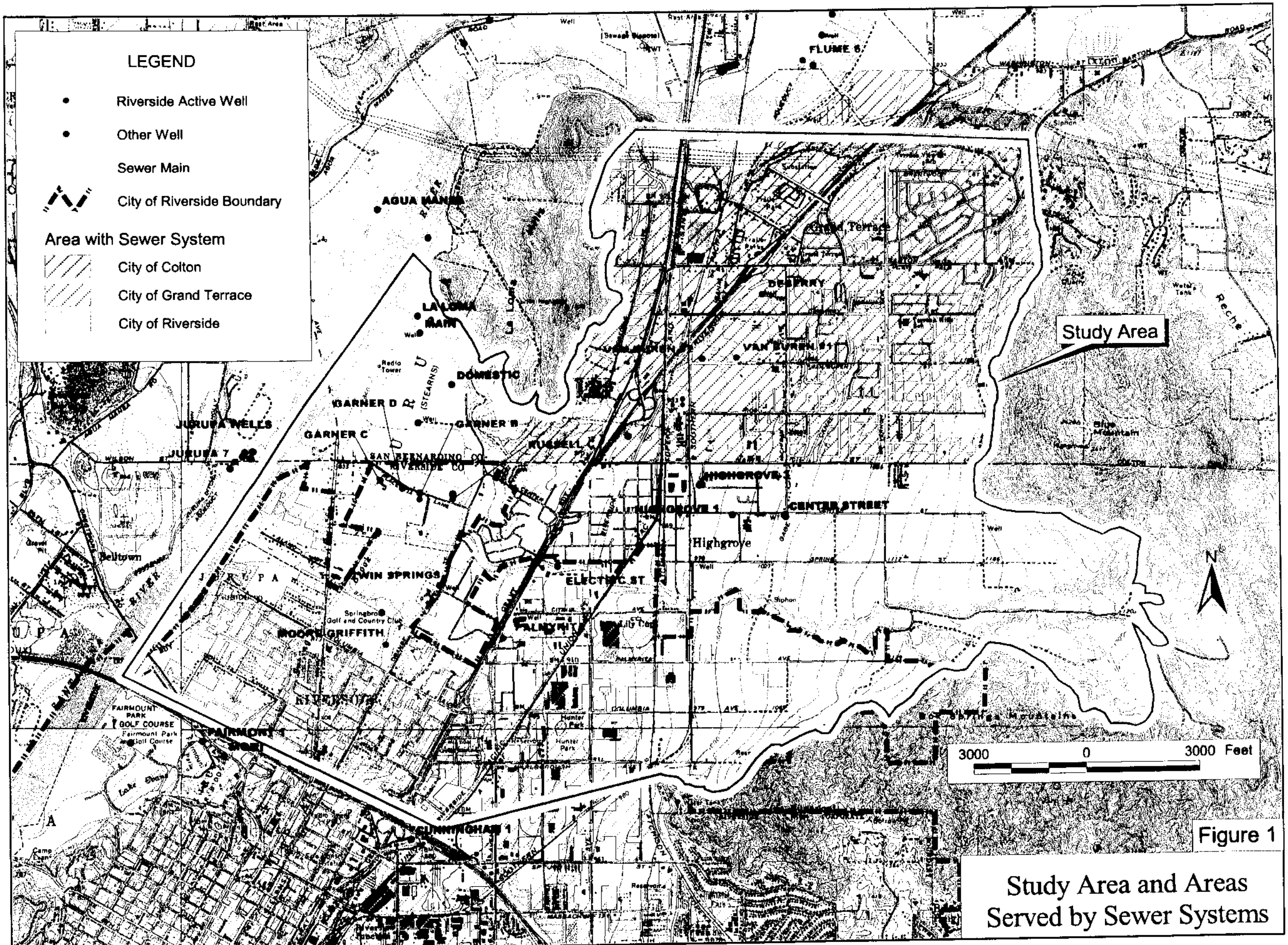


Figure 1

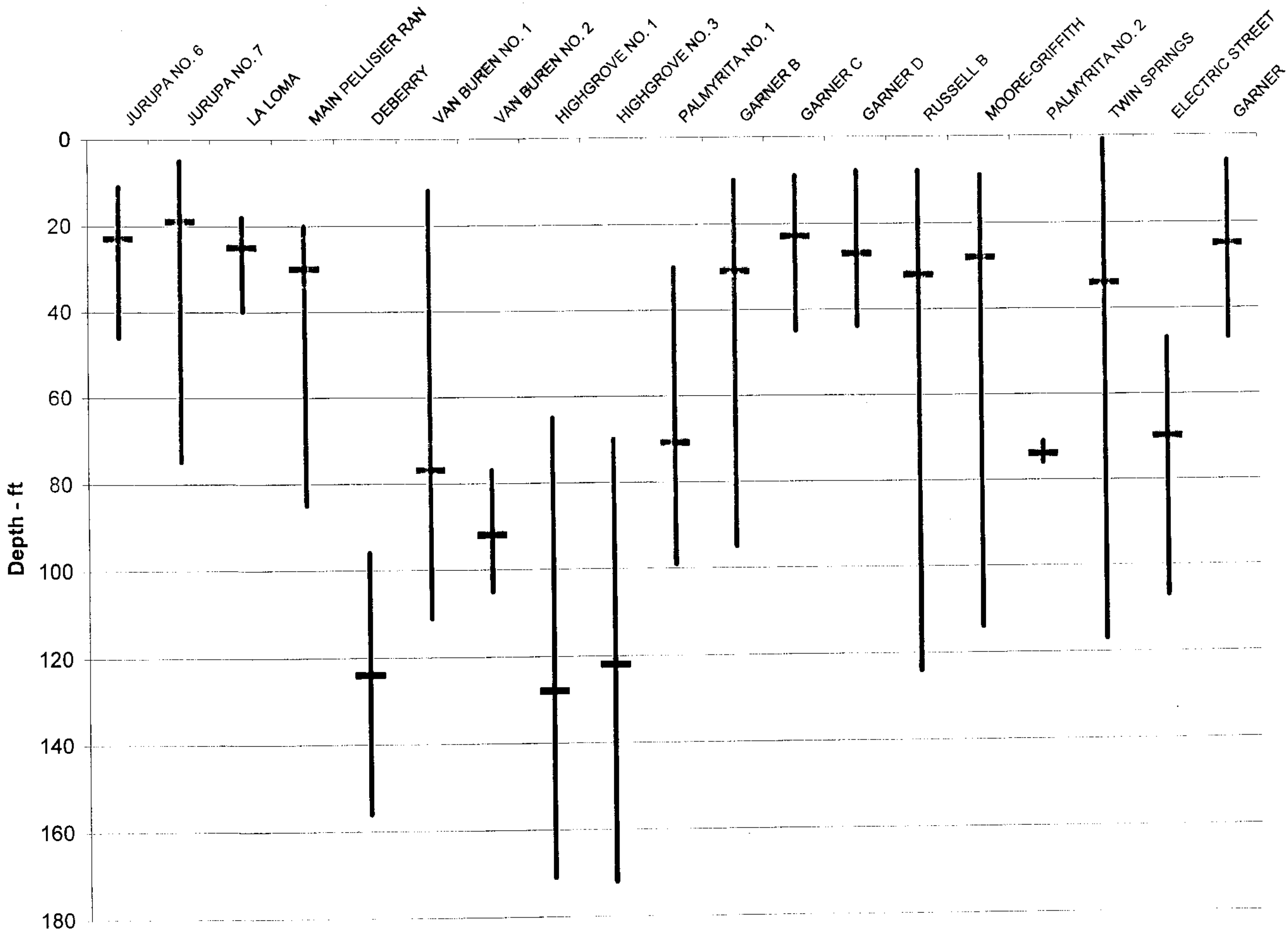
Study Area and Areas Served by Sewer Systems

RIVERSIDE
PUBLIC UTILITIES

The Aquifer

- Shallow Groundwater
- No Continuous Clay Layer

High, Low, and Average depths to Groundwater



RIVERSIDE PUBLIC UTILITIES

Problems With Septic Systems

- Disease-Causing Microorganism
- Nitrate
- Chemicals
- Significant Source of Nitrate in Santa Ana Watershed
- Reported as 2nd Greatest Threat in 31 States (EPA 1998)

RIVERSIDE PUBLIC UTILITIES

Recommendations

- Extend Sewer System to North Orange Area
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