

MEMORANDUM

OPERATIONS PLAN - ALTERNATIVE 4

TO: Ed Brauner (City of Santa Rosa)
Dan Carlson (City of Santa Rosa)
Marie Meredith (City of Santa Rosa)

FROM: Andy Hauge (HBA)
Robin Cort (Parsons ES)
Rich Maurer (Parsons ES)

DATE: October 10, 1995

RE: Santa Rosa Subregional Long-Term Wastewater Project
Summary Operations Plan - Alternative 4, Geysers

INTRODUCTION

This memorandum serves as an overview operations plan for Alternative 4 - Geysers Steamfield Recharge, Santa Rosa Subregional Long-Term Wastewater Project. It also supplements the project description for this alternative. The objective of this alternative is to deliver reclaimed water to the Geysers geothermal area for injection into the steamfield. The intent is to produce more steam, prolong the life and economic production level of the steamfield and the geothermal power plants supplied by the steamfield. This would be a beneficial reuse of reclaimed water and has an economic value. Consequently, it is understood that operators of the geothermal steamfield are willing to participate financially in development of this alternative project. This is unique to Alternative 4.

Alternative 4 has two potential configurations, although only one is described in detail in the project description. The second configuration is being promoted by a private party, and might include additional features beyond those included in the current project description. At this time these additional features are not identified, but it is believed they would be compatible with the current project description.

Some of the reclaimed water produced by the Laguna Plant would continue to be used to irrigate existing Reclamation System agricultural land in the Laguna. The amount of this reclamation reuse of water may be scaled back as the use of reclaimed water at the Geysers proves reliable over the years.

SUMMARY DESCRIPTION

Figures OV4-1 and OV4-2 are attached to show the general location of the proposed facilities for this alternative project. The proposed Geysers delivery system is shown schematically in Figure 1.

Alternative 4 includes the following physical features:

- New pipeline, from Delta Pond to the top of the ridge above the Geysers steamfield and near the end of Pine Flat Road. This pipeline would be 48" and 42" size steel pipe, using welded joints. It is proposed to be installed exclusively along public roads including Pine Flat Road.
- Four new pump stations (G1, G2, G3 and G4), the first at Delta Pond and the other three along the pipeline on the way up the mountain to the ridge and accessible from Pine Flat Road. These stations would include multiple pumps, each of several hundred horsepower, high pressure class, and would be enclosed in a building for public safety, protection of equipment, and noise control. The three pump stations along Pine Flat Road would each include a one-half million gallon steel water storage tank to serve as a supply source for the pumps at that station.
- Two one (1) million gallon water storage tanks at the end of the pipeline on the ridge, to serve as a reservoir of water for gravity distribution to the injection wells. These tanks would be above grade, each about 80 feet in diameter and 30 feet high. The tanks would be constructed on a high point along the ridge, which would be graded down to create a flat area of sufficient size for the tanks.
- Distribution pipelines from the two storage tanks to the Geysers injection wells, primarily mounted above ground on pipe supports.
- Ten to fifteen water injection wells distributed around the central and northwest portion of the Geysers geothermal fields. These are proposed to be existing steam extraction wells converted to water injection wells.
- A new electrical substation located near proposed pump stations G3, one-third way up the mountain. This substation would be supplied by connection to the nearby existing high voltage transmission line passing overhead.
- A new electrical distribution poleline from this substation to serve the three pump stations along Pine Flat Road; to pump station G3 near the substation, to down the mountain to pump station G2 at the beginning of Pine Flat Road, and up the mountain to pump station G4 in Pine Flat itself. This poleline would be installed generally along or near Pine Flat Road to allow maintenance of the line.

Reclaimed water from the Santa Rosa Laguna treatment plant would continue to be delivered to the existing reclamation system ponds and irrigation areas within the Laguna area. At the northern-most pond, Delta Pond, new pump station G1 would withdraw water from the pond to supply the new pipeline constructed northward toward the Geysers. The first segment of this pipeline would terminate at a storage tank at the second pump station (G2) near the beginning of Pine Flat Road.

The second station (G2) would withdraw the water from the tank and start pumping it up to the third pump station, the pipeline following Pine Flat Road. The third (G3) and fourth (G4) pump stations would be located along Pine Flat Road and would be similar to the second station, including a storage tank to supply the station's pumps.

The fourth pump station would deliver the water into the two new storage-distribution tanks atop the ridge above the Geysers steamfield area. From the two storage tanks, water would be distributed by gravity flow to the ten or so injection wells around the Geysers steamfield area.

WATER BALANCE

Alternative 4 proposes the delivery of most reclaimed water to the Geysers and some to the existing Laguna reclamation system. The proposed distribution of reclaimed water to these two uses is shown in the attached

Water Balance Table. This table shows the monthly distribution of water to the Geysers, to the existing Laguna irrigation fields, and to the existing storage ponds in the Laguna.

The total amount (for delivery to the Geysers or to irrigation) is predicted based on the computerized water balance model developed over several years for the Santa Rosa reclamation system. The structure and results of this model is presented in Technical Memorandum WBM-7, Water Balance Model Results; and WBM-8, Monthly Reclaimed Water Volume Projections from the Water Balance Model.

Because of rainfall entering the sewer system, more reclaimed water is available during the winter months than the summer. Therefore, more water would be available for delivery to the Geysers during these months. The water balance table demonstrates how the volume of water in the storage system would change by month. The total storage volume would rise during the spring months in preparation for the beginning of the next irrigation season. As the irrigation season draws to conclusion in late summer the storage volume would reach its minimum, ready to start to accept the erratic and peak wet weather flows during the coming winter months. The table demonstrates that the maximum required storage volume (about 1,250 million gallons) is less than the total available storage volume of the existing storage system (about 1,500 million gallons).

The Water Balance Table indicates that about 80% of the annual reclaimed water would be delivered to the Geysers, and about 20% to the existing Laguna irrigation system. This is a result of the assumption that the existing irrigation system would be operated at about 50% of the reclaimed water volume irrigated in 1994. This distribution of water is subject to future adjustment, which may allow a higher percentage to be delivered to the Geysers, but 80% is currently proposed in order to satisfy the contractual obligations to deliver irrigation water to private ranchers and in order to maintain the existing irrigation system in active use (although at a reduced rate) until the Geysers delivery system is demonstrated.

The attached water balance table projects total annual water delivery to the Geysers would approach 7,100 million gallons at system design capacity, for an average daily delivery of about 19.5 MGD. The peak monthly delivery would occur December through February at about 23 MGD, and the minimum about August through September at about 16.5 MGD.

During peak wet weather events releases to the Russian River would continue to be utilized for brief periods. Otherwise, more reclaimed water would be delivered into the existing storage ponds than could be removed by the Geysers pump system, and the storage level would rise above the target storage table. Analysis of the water balance model indicates that the maximum rate of such discharge to the Russian River would be less than 0.5% of river flowrate.

MONTHLY OPERATION OF THE SYSTEM

Operation of Alternative 4 would involve the coordinated actions of the City's reclamation staff and the operators of the Geysers steamfield injection wells. The City staff would regularly track the volume of reclaimed water in storage and attempt to achieve the predicted volume shown on the water balance table to assure that sufficient water is available to meet the irrigation commitments. The City staff would continue to oversee operation of some of the existing agricultural irrigation systems in the Laguna, although at the proposed reduced rate.

The City staff would be responsible for operation and maintenance of the four pump stations delivering water to the Geysers area. Funds for this operation and maintenance may be partially provided by contractual agreement with the Geysers Operators.

The Geysers Operators would be responsible for operation of the injection wells and maintenance of the storage-distribution tanks and pipelines at the Geysers. Water flow from the tanks to the wells would be controlled by

the operators of the steamfield and would be rotated among the wells, so not all wells are used at once and no well would be used continuously.

Criteria for use of specific wells would be the demonstrated relationships between rate and duration of injected water versus volume of extracted steam, and rate and volume of injected water versus frequency and intensity of induced seismicity. Seasonal demand for electrical power may also influence the rate and volume injected into a given well. At any rate, it is understood that the full volume of water proposed for delivery to the Geysers would be injected into the steamfield; the demand is considered reliable.

In operation, the fluctuating water level in the storage tanks atop the Geysers' ridge would automatically control operation of the delivery system pump stations in a cascade manner. The tank level sensor would directly control operation of pump station G4. The level sensor in the tank at G4 would automatically control operation of the pumps at pump station G3. Likewise for pump stations G2 and G1. In general, the system would start from the upper pump station (G4) and cascade down to start the lower pump station (G1). The pump stations would cascade stop in similar fashion.

The pump stations would normally be unmanned although visited by the operator at least twice weekly. Malfunction of equipment at any of the stations would be transmitted to the Laguna Plant alarm terminal.

SEPT 27, 1995

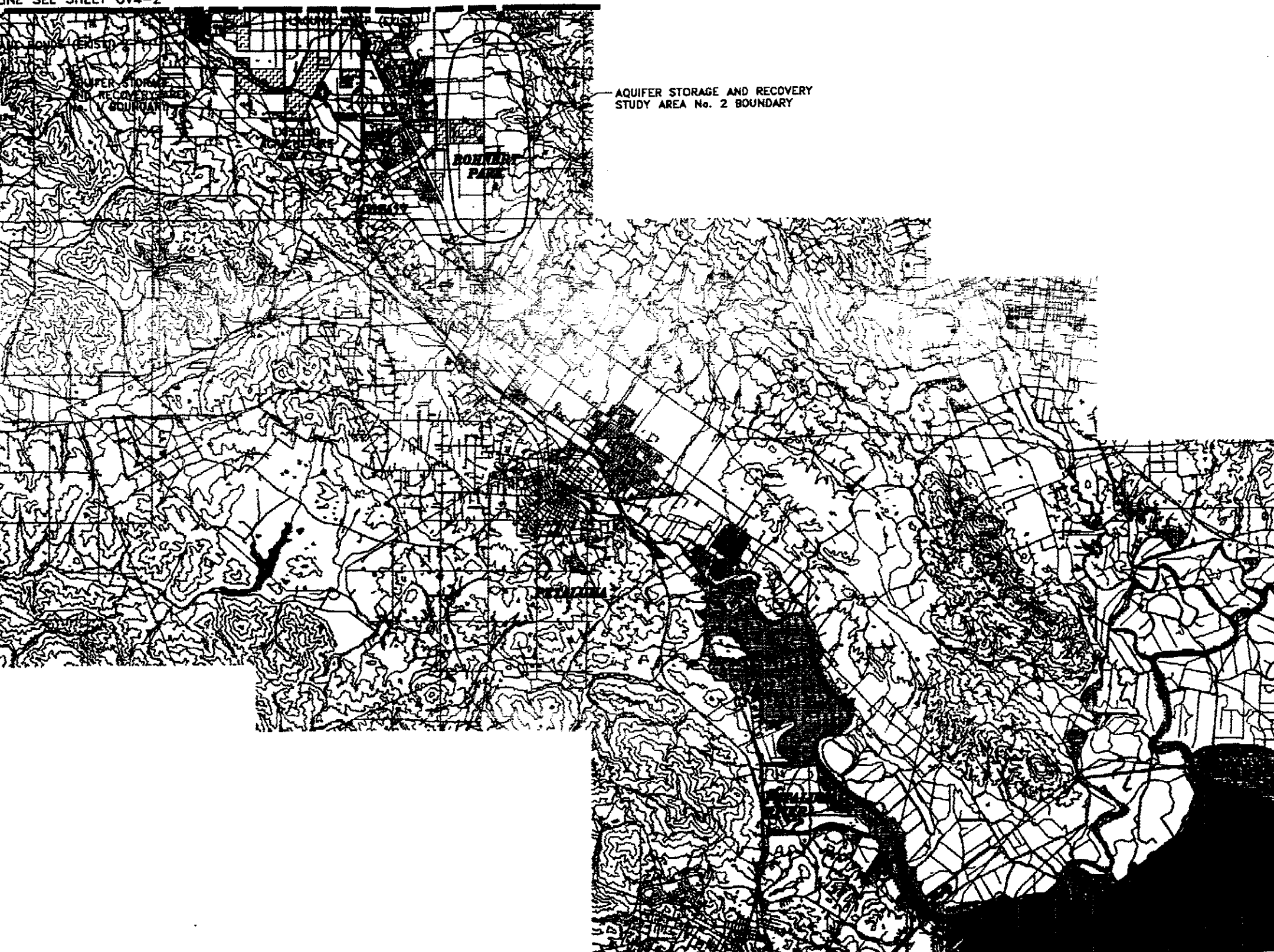
SANTA ROSA SUBREGIONAL LONG-TERM WASTEWATER PROJECT
ALTERNATIVE PROJECT NO. 4 - GEYSERS STEAMFIELD RECHARGE
WATER BALANCE PROJECTION

MONTH	RECLAIMED WATER GENERATED BY LAGUNA PLANT (MG/MONTH) (1)	RECLAIMED WATER DELIVERED TO THE GEYSERS (MG/MONTH) (2)	RECLAIMED WATER TO IRRIGATION IN THE LAGUNA (MG/MONTH) (3)	RECLAIMED WATER TO STORAGE (MG/MONTH) (4)	NET STORAGE VOLUME (MG) (5)
DEC	791	700	0	91	191
JAN	1,007	700	0	307	498
FEB	881	700	0	181	679
MAR	966	600	0	366	1,045
APR	783	600	25	158	1,203
MAY	681	550	150	(19)	1,184
JUN	631	550	300	(219)	965
JLY	622	550	400	(328)	637
AUG	588	500	400	(312)	325
SEPT	581	500	250	(169)	156
OCT	636	550	150	(64)	92
NOV	656	600	50	6	98
TOTAL (MG/YR)	8,823	7,100	1,725		
(% OF TOTAL)	1.00	0.80	0.20		

- (1) PROJECTED RECLAIMED WATER GENERATION TAKEN AS 95% PERCENTILE PROJECTION FROM PROJECT WATER BALANCE MODEL, BASED ON PROJECTED ADWF = 21 MGD FOR DESIGN YEAR AND WET WEATHER FLOWS PATTERNED ON 70 YEARS OF RECORD FOR RUSSIAN RIVER
- (2) DISCHARGE TO GEYSERS DETERMINED AS DIFFERENCE BETWEEN THE GENERATED VOLUME AND THE VOLUME COMMITTED TO IRRIGATION (AND STORAGE FOR LATER IRRIGATION)
- (3) ASSUMES MONTHLY IRRIGATION FLOWS FIXED AT APPROXIMATELY 50% OF 1994 FLOWS
- (4) FLOW INTO STORAGE NECESSARY TO MEET IRRIGATION COMMITMENTS AND TO MAINTAIN MORE UNIFORM DELIVERY THROUGHOUT THE YEAR TO THE GEYSERS
- (5) MINIMUM STORAGE = 100 MG ALLOWS FOR "DEAD STORAGE" IN PONDS; MAXIMUM STORAGE = 1203 MG ALLOWS CUSHION TO ACCEPT PEAK WET WEATHER FLOWS AND STORAGE OF WATER DURING EMERGENCY SHUT DOWN OR PARTIAL DRAINING OF GEYSER DELIVERY SYSTEM.
THE 1203 MG MAX STORAGE CAN BE ACCOMMODATED BY THE EXISTING 1,500 MG TOTAL POND CAPACITY.

QGEYWBAL.1

LINE SEE SHEET OV4-2



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SUBREGIONAL LONG-TERM
WASTEWATER PROJECT**

PROJECT ALTERNATIVE No.4: GEYSERS STEAMFIELD RECHARGE

**PROJECT OVERVIEW MAP
SOUTH**

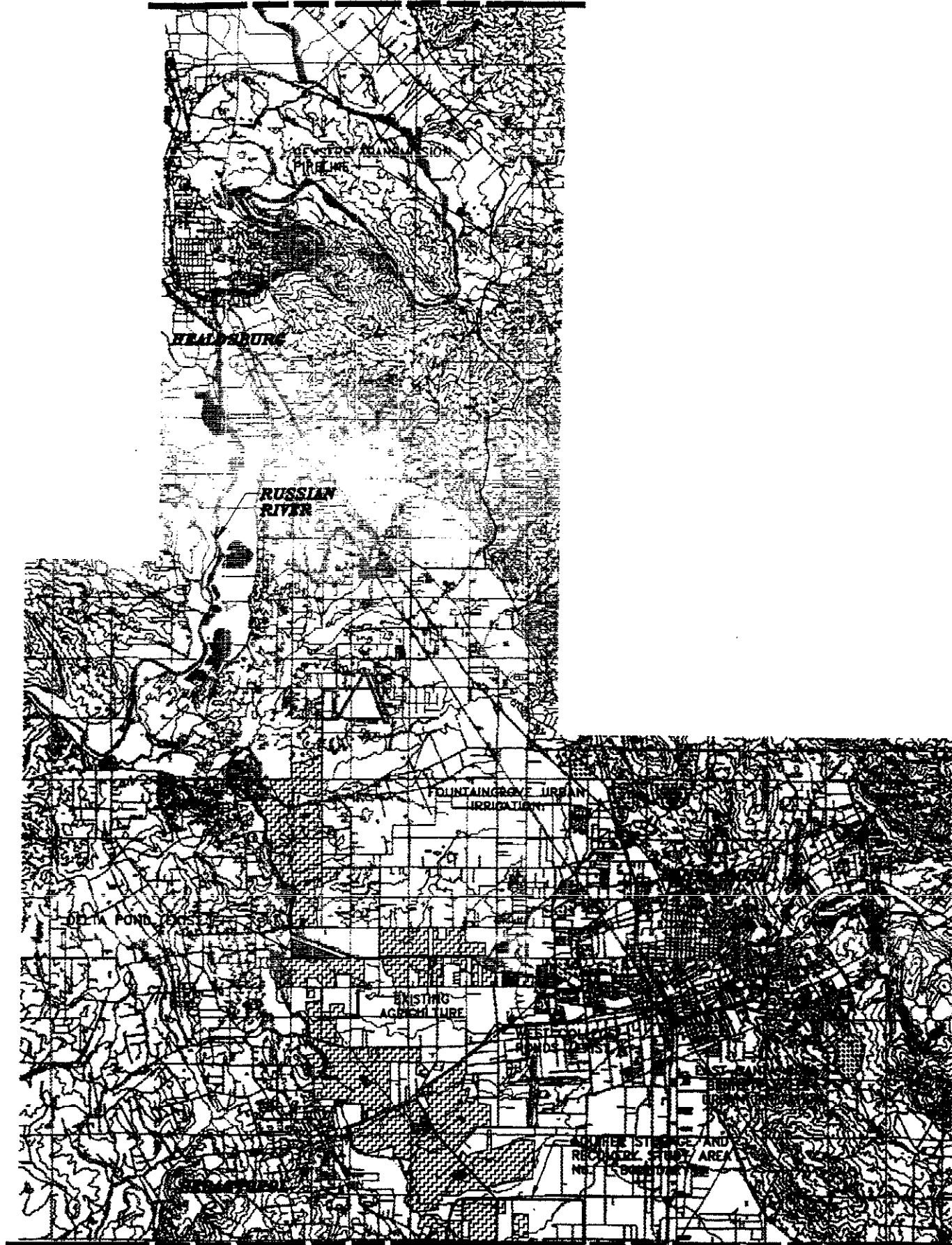
SCALE 1" = 8000'

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OV4-1

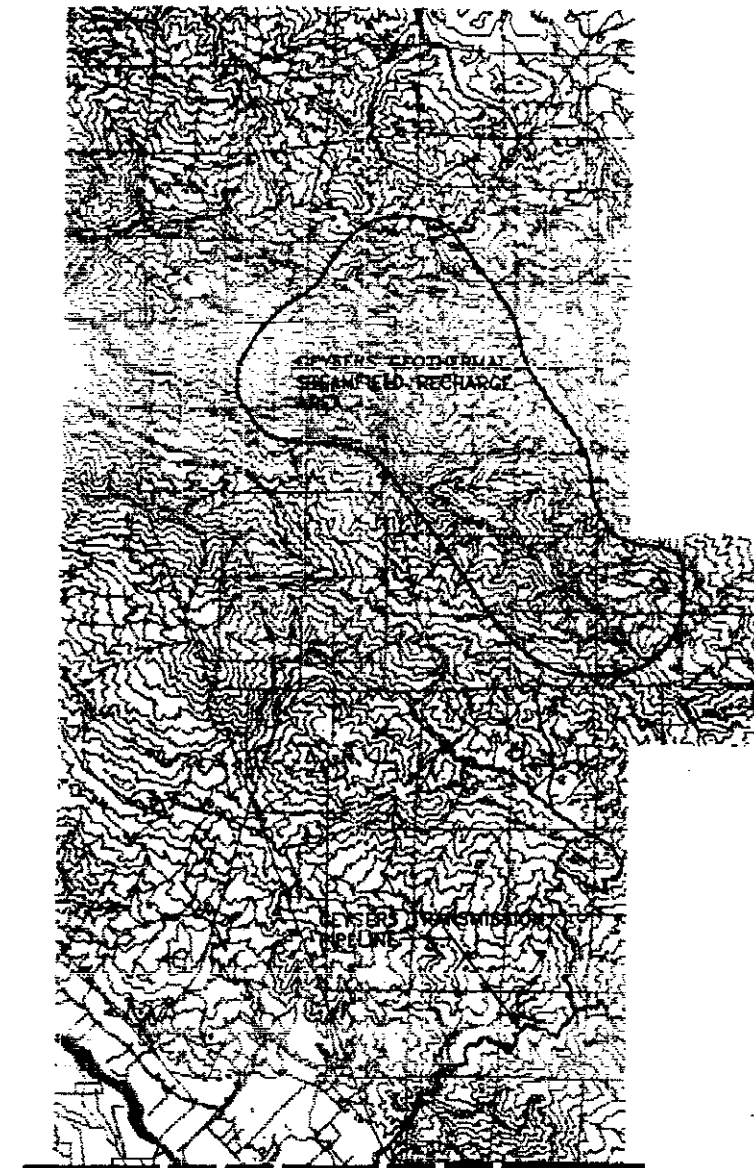
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SECTION B

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HARLAND BARTHOLOMEW AND ASSOCIATES

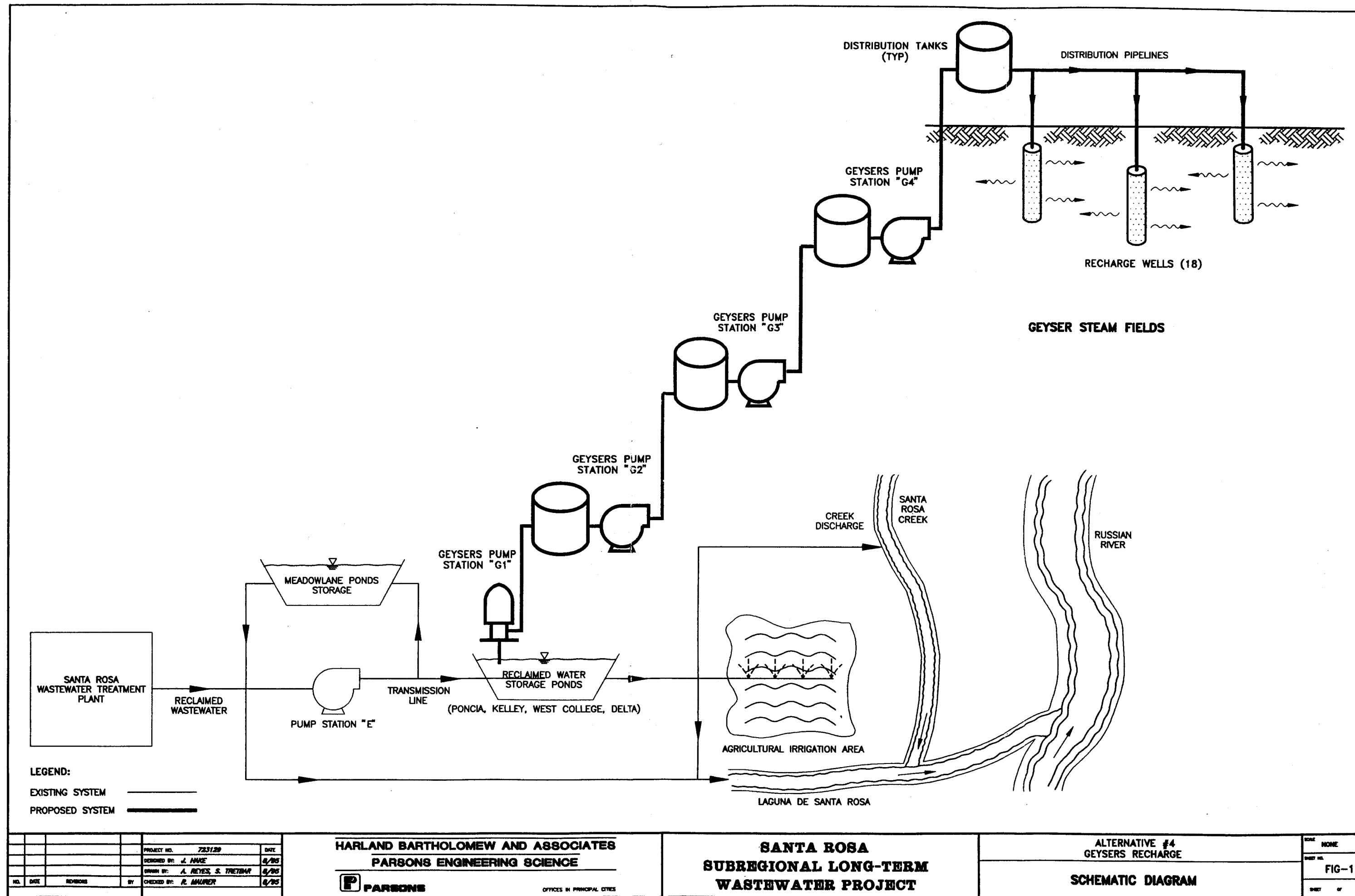
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**SANTA ROSA
SUBREGIONAL LONG-TERM
WASTEWATER PROJECT**

PROJECT ALTERNATIVE No.4: GEYSERS STEAMFIELD RECHARGE	SCALE 1" = 8000'
PROJECT OVERVIEW MAP NORTH	SHEET NO. OV4-2
	SHEET OF



PROJECT NO.	723129	DATE	6/95
DESIGNED BY:	J. HAYE	DATE	6/95
DRAWN BY:	A. REYES, S. TRETAK	DATE	6/95
CHECKED BY:	R. AMARER	DATE	6/95

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WASTEWATER PROJECT

ALTERNATIVE #4
GEYSERS RECHARGE

SCHEMATIC DIAGRAM

SCALE: NONE
 SHEET NO. FIG-1
 SHEET OF