SIMPLIFIED CALINE4 CARBON MONOXIDE ANALYSIS

Project Number: Lower Lagoon Valley
Project Title: 10794-00

Background Information

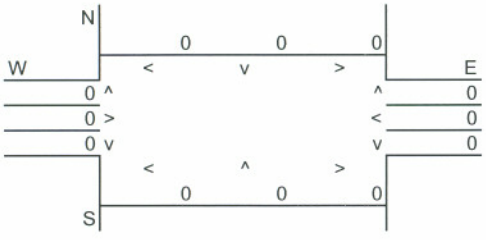
Nearest Air Monitoring Station measuring CO:	0
Background 1-hour CO Concentration (ppm):	3.0
Background 8-hour CO Concentration (ppm):	3.0
Persistence Factor:	0.6
Analysis Year:	2010

Roadway Data

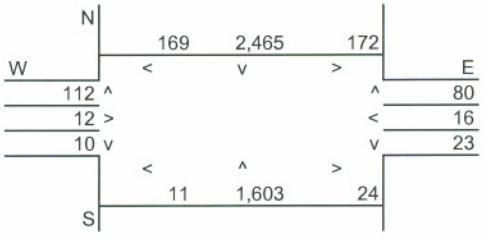
Intersection: Marshall Rd./Alamo Dr.
Analysis Condition: Existing Plus Project Traffic Volumes

		Roadway Type	No. of Lanes	Average Speed A.M.	Average Speed P.M.
North-South Roadway:	Marshall Road	At Grade	2	10	10
East-West Roadway:	Alamo Drive	At Grade	2	10	10

A.M. Peak Hour Traffic Volumes



P.M. Peak Hour Traffic Volumes



Highest Traffic Volumes (Vehicles per Hour)

N-S Road:	0	N-S Road:	4,601
E-W Road:	0	E-W Road:	330

Roadway CO Contributions and Concentrations

Emissions = (A x B x C) / 100,000[1]

Roadway	A_1 Reference CO Concentrations 25 Feet	A_2 50 Feet	A_3 100 Feet	B Traffic Volume	C Emission Factors[1]	Estimated CO Concentrations 25 Feet	50 Feet	100 Feet
A.M. Peak Traffic Hour								
North-South Road	7.6	5.7	4.0	0	10.78	0.00	0.00	0.00
East-West Road	2.7	2.2	1.7	0	10.78	0.00	0.00	0.00
P.M. Peak Traffic Hour								
North-South Road	7.6	5.7	4.0	4,601	10.78	3.77	2.83	1.98
East-West Road	2.7	2.2	1.7	330	10.78	0.10	0.08	0.06

[1] Methodology and emission factors from Bay Area Air Quality Management District *BAAQMD CEQA Guidelines* (1996).

Total Roadway CO Concentrations

Peak Hour Emissions = North-South Concentration + East-West Concentration + Background 1-hour Concentration[2]
8-Hour Emissions = ((Highest Peak Hour Concentration - Background 1-hour Concentration) x Persistence Factor) + Background 8-hour Concentration[2]

	A.M. Peak Hour	P.M. Peak Hour	8-Hour
25 Feet from Roadway Edge	3.0	6.9	5.3
50 Feet from Roadway Edge	3.0	5.9	4.7
100 Feet from Roadway Edge	3.0	5.0	4.2

[2] Methodology from Bay Area Air Quality Management District *BAAQMD CEQA Guidelines* (1996).

SIMPLIFIED CALINE4 CARBON MONOXIDE ANALYSIS

Project Number: Lower Lagoon Valley
Project Title: 10794-00

Background Information

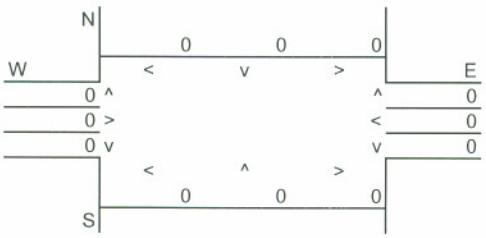
Nearest Air Monitoring Station measuring CO:	0
Background 1-hour CO Concentration (ppm):	3.0
Background 8-hour CO Concentration (ppm):	3.0
Persistence Factor:	0.6
Analysis Year:	2010

Roadway Data

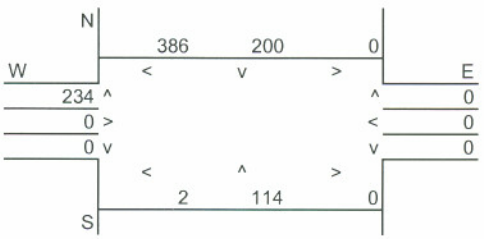
Intersection: Lagoon Valley Rd./Arterial #1
Analysis Condition: Existing Plus Project Traffic Volumes

		Roadway Type	No. of Lanes	Average Speed A.M.	Average Speed P.M.
North-South Roadway:	Arterial #1	At Grade	2	10	10
East-West Roadway:	Lagoon Valley Rd.	At Grade	2	10	10

A.M. Peak Hour Traffic Volumes



P.M. Peak Hour Traffic Volumes



Highest Traffic Volumes (Vehicles per Hour)

N-S Road:	0	N-S Road:	934
E-W Road:	0	E-W Road:	622

Roadway CO Contributions and Concentrations

Emissions = (A x B x C) / 100,000[1]

Roadway	A_1 Reference CO Concentrations 25 Feet	A_2 50 Feet	A_3 100 Feet	B Traffic Volume	C Emission Factors[1]	Estimated CO Concentrations 25 Feet	50 Feet	100 Feet
A.M. Peak Traffic Hour								
North-South Road	7.6	5.7	4.0	0	10.78	0.00	0.00	0.00
East-West Road	2.7	2.2	1.7	0	10.78	0.00	0.00	0.00
P.M. Peak Traffic Hour								
North-South Road	7.6	5.7	4.0	934	10.78	0.77	0.57	0.40
East-West Road	2.7	2.2	1.7	622	10.78	0.18	0.15	0.11

[1] Methodology and emission factors from Bay Area Air Quality Management District *BAAQMD CEQA Guidelines* (1996).

Total Roadway CO Concentrations

Peak Hour Emissions = North-South Concentration + East-West Concentration + Background 1-hour Concentration[2]
8-Hour Emissions = ((Highest Peak Hour Concentration - Background 1-hour Concentration) x Persistence Factor) + Background 8-hour Concentration[2]

	A.M. Peak Hour	P.M. Peak Hour	8-Hour
25 Feet from Roadway Edge	3.0	3.9	3.6
50 Feet from Roadway Edge	3.0	3.7	3.4
100 Feet from Roadway Edge	3.0	3.5	3.3

[2] Methodology from Bay Area Air Quality Management District *BAAQMD CEQA Guidelines* (1996).

SIMPLIFIED CALINE4 CARBON MONOXIDE ANALYSIS

Project Number: Lower Lagoon Valley
Project Title: 10794-00

Background Information

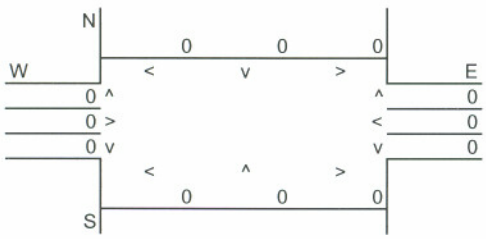
Nearest Air Monitoring Station measuring CO:	0
Background 1-hour CO Concentration (ppm):	3.0
Background 8-hour CO Concentration (ppm):	3.0
Persistence Factor:	0.6
Analysis Year:	2010

Roadway Data

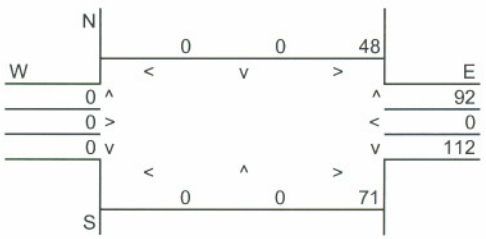
Intersection: Lagoon Valley Rd./Arterial #1
Analysis Condition: Existing Plus Project Traffic Volumes

		Roadway Type	No. of Lanes	Average Speed A.M.	Average Speed P.M.
North-South Roadway:	Arterial #1	At Grade	2	10	10
East-West Roadway:	Lagoon Valley Rd.	At Grade	2	10	10

A.M. Peak Hour Traffic Volumes



P.M. Peak Hour Traffic Volumes



Highest Traffic Volumes (Vehicles per Hour)

N-S Road:	0	N-S Road:	183
E-W Road:	0	E-W Road:	323

Roadway CO Contributions and Concentrations

Emissions = (A x B x C) / 100,000[1]

Roadway	A_1 Reference CO Concentrations 25 Feet	A_2 50 Feet	A_3 100 Feet	B Traffic Volume	C Emission Factors[1]	Estimated CO Concentrations 25 Feet	50 Feet	100 Feet
A.M. Peak Traffic Hour								
North-South Road	7.6	5.7	4.0	0	10.78	0.00	0.00	0.00
East-West Road	2.7	2.2	1.7	0	10.78	0.00	0.00	0.00
P.M. Peak Traffic Hour								
North-South Road	2.7	2.2	1.7	183	10.78	0.05	0.04	0.03
East-West Road	7.6	5.7	4.0	323	10.78	0.26	0.20	0.14

[1] Methodology and emission factors from Bay Area Air Quality Management District *BAAQMD CEQA Guidelines* (1996).

Total Roadway CO Concentrations

Peak Hour Emissions = North-South Concentration + East-West Concentration + Background 1-hour Concentration[2]
8-Hour Emissions = ((Highest Peak Hour Concentration - Background 1-hour Concentration) x Persistence Factor) + Background 8-hour Concentration[2]

	A.M. Peak Hour	P.M. Peak Hour	8-Hour
25 Feet from Roadway Edge	3.0	3.3	3.2
50 Feet from Roadway Edge	3.0	3.2	3.1
100 Feet from Roadway Edge	3.0	3.2	3.1

[2] Methodology from Bay Area Air Quality Management District *BAAQMD CEQA Guidelines* (1996).

TECHNICAL APPENDIX F

Noise Data Sheets

ON-SITE TRAFFIC NOISE LEVELS AND NOISE CONTOURS

Project Number: 10794-00
Project Name: Lower Lagoon

Background Information

Model Description:
Source of Traffic Volumes: Korve Engineering
Community Noise Descriptor: L_{dn}: X CNEL:

Assumed 24-Hour Traffic Distribution:	Day	Evening	Night
Total ADT Volumes	77.70%	12.70%	9.60%
Medium-Duty Trucks	87.43%	5.05%	7.52%
Heavy-Duty Trucks	89.10%	2.84%	8.06%

Analysis Condition Roadway, Segment	Lanes	Median Width	ADT Volume	Design Speed (mph)	Alpha Factor	Vehicle Mix Medium Trucks	Heavy Trucks	Distance from Centerline of Roadway Ldn at 100 Feet	Distance to Contour 70 Ldn	65 Ldn	60 Ldn
Existing Traffic Volumes											
I-80, North Texas to Lagoon Valley Rd.	4	25	95,200	65	0.5	5.0%	2.0%	76.4	269	580	1,249
Lagoon Valley Rd., east of Nelson/Rivera	2	0	744	45	0.5	1.8%	0.7%	49.3	-	-	-

[1] Distance is from the centerline of the roadway segment to the receptor location.
"-" = contour is located within the roadway right-of-way.

OFF-SITE TRAFFIC NOISE LEVELS

Project Number: 10659-00
Project Name: Lower Lagoon Valley Specific Plan

Background Information

Model Description: FHWA Highway Noise Prediction Model (FHWA-RD-77-108) with California Vehicle Noise (CALVENO) Emission Levels.
Analysis Scenario(s): Existing and Future Traffic Volumes
Source of Traffic Volumes: Korve Engineering
Community Noise Descriptor: L_{dn}: X CNEL:

Assumed 24-Hour Traffic Distribution:	Day	Evening	Night
Total ADT Volumes	77.70%	12.70%	9.60%
Medium-Duty Trucks	87.43%	5.05%	7.52%
Heavy-Duty Trucks	89.10%	2.84%	8.06%

Traffic Noise Levels

Analysis Condition / Roadway Name / Roadway Segment	Land Use	Lanes	Median Width	Peak Hour Volume	ADT Volume	Design Speed (mph)	Dist. from Center to Receptor	Alpha Factor	Barrier Attn. dB(A)	Vehicle Mix Medium Trucks	Vehicle Mix Heavy Trucks	Peak Hour dB(A) L_{eq}	24-Hour dB(A) Ldn
Existing (Scenario 1)Traffic Volumes													
I-80													
Alamo to E. of Alamo	Agricultural	4	25	10,420	83,360	65	100	0.5	0	5.0%	2.0%	79.1	75.9
Pena to Alamo/Cherry Glen	Commercial/Agricultural	4	25	11,770	94,160	65	100	0.5	0	5.0%	2.0%	79.6	76.4
Lagoon Valley to Pena	Residential	4	25	11,730	93,840	65	500	0.5	0	5.0%	2.0%	68.8	65.6
N. of Texas to Lagoon Valle	Agricultural	4	25	11,900	95,200	65	100	0.5	0	5.0%	2.0%	79.6	76.4
Cherry Glen to Alamo/Merc	Recreational/Agricultural	4	25	9,660	77,280	65	100	0.5	0	5.0%	2.0%	78.7	75.5
Cherry Glen Road													
Lyon Rd. to WB Ramp	Residential	2	0	213	1,704	35	50	0.5	0	1.8%	0.7%	58.8	55.0
Lyon Rd. to Pleasant Valley	Residential	2	0	228	1,824	35	50	0.5	0	1.8%	0.7%	59.1	55.3
Pleasant Valley Rd. to EB F	Residential	2	0	62	496	35	75	0.5	0	1.8%	0.7%	50.8	46.9
Pleasant Valley Road													
north of Cherry Glen Rd.	Residential	2	0	249	1,992	35	75	0.5	0	1.8%	0.7%	56.8	53.0
Alamo Drive													
Merchant St. to EB Ramps	Recreational/Agricultural	2	0	2,019	16,152	35	50	0.5	0	1.8%	0.7%	68.6	64.7
Existing Plus Approved Projects (Scenario 2)Traffic Volumes													
I-80													
Alamo to E. of Alamo	Agricultural	4	25	9,778	78,224	65	100	0.5	0	5.0%	2.0%	78.8	75.6
Pena to Alamo/Cherry Glen	Commercial/Agricultural	4	25	12,773	102,184	65	100	0.5	0	5.0%	2.0%	80.0	76.8
Lagoon Valley to Pena	Residential	4	25	12,639	101,112	65	500	0.5	0	5.0%	2.0%	69.1	65.9
N. of Texas to Lagoon Valle	Agricultural	4	25	13,724	109,792	65	100	0.5	0	5.0%	2.0%	80.3	77.1
Cherry Glen to Alamo/Merc	Recreational/Agricultural	4	25	10,422	83,376	65	100	0.5	0	5.0%	2.0%	79.1	75.9
Cherry Glen Road													
Lyon Rd. to WB Ramp	Residential	2	0	81	648	35	50	0.5	0	1.8%	0.7%	54.6	50.8
Lyon Rd. to Pleasant Valley	Residential	2	0	164	1,312	35	50	0.5	0	1.8%	0.7%	57.7	53.8
Pleasant Valley Rd. to EB F	Residential	2	0	33	264	35	75	0.5	0	1.8%	0.7%	48.0	44.2
Pleasant Valley Road													
north of Cherry Glen Rd.	Residential	2	0	139	1,112	35	75	0.5	0	1.8%	0.7%	54.3	50.4
Alamo Drive													
Merchant St. to EB Ramps	Recreational/Agricultural	2	0	2,661	21,288	35	50	0.5	0	1.8%	0.7%	69.8	65.9
Existing Plus Approved Projects with Proposed Project (Scenario 4)Traffic Volumes													
I-80													
Alamo to E. of Alamo	Agricultural	4	25	11,834	94,672	65	100	0.5	0	5.0%	2.0%	79.6	76.4
Pena to Alamo/Cherry Glen	Commercial/Agricultural	4	25	14,518	116,144	65	100	0.5	0	5.0%	2.0%	80.5	77.3
Lagoon Valley to Pena	Residential	4	25	13,130	105,040	65	500	0.5	0	5.0%	2.0%	69.3	66.1
N. of Texas to Lagoon Valle	Agricultural	4	25	13,326	106,608	65	100	0.5	0	5.0%	2.0%	80.1	76.9
Cherry Glen to Alamo/Merc	Recreational/Agricultural	4	25	13,776	110,208	65	100	0.5	0	5.0%	2.0%	80.3	77.1
Cherry Glen Road													
Lyon Rd. to WB Ramp	Residential	2	0	69	552	35	50	0.5	0	1.8%	0.7%	53.9	50.1
Lyon Rd. to Pleasant Valley	Residential	2	0	126	1,008	35	50	0.5	0	1.8%	0.7%	56.5	52.7
Pleasant Valley Rd. to EB F	Residential	2	0	47	376	35	75	0.5	0	1.8%	0.7%	49.6	45.7
Pleasant Valley Road													
north of Cherry Glen Rd.	Residential	2	0	119	952	35	75	0.5	0	1.8%	0.7%	53.6	49.8
Alamo Drive													
Merchant St. to EB Ramps	Recreational/Agricultural	2	0	1,983	15,864	35	50	0.5	0	1.8%	0.7%	68.5	64.6
2025 w/o Project (Existing Zoning) (Scenario 6)Traffic Volumes													
I-80													
Alamo to E. of Alamo	Agricultural	4	25	12,506	100,048	65	100	0.5	0	5.0%	2.0%	79.9	76.7
Pena to Alamo/Cherry Glen	Commercial/Agricultural	4	25	16,643	133,144	65	100	0.5	0	5.0%	2.0%	81.1	77.9
Lagoon Valley to Pena	Residential	4	25	15,002	120,016	65	500	0.5	0	5.0%	2.0%	69.9	66.7
N. of Texas to Lagoon Valle	Agricultural	4	25	14,877	119,016	65	100	0.5	0	5.0%	2.0%	80.6	77.4
Cherry Glen to Alamo/Merc	Recreational/Agricultural	4	25	14,095	112,760	65	100	0.5	0	5.0%	2.0%	80.4	77.2
Cherry Glen Road													
Lyon Rd. to WB Ramp	Residential	2	0	91	728	35	50	0.5	0	1.8%	0.7%	55.1	51.3
Lyon Rd. to Pleasant Valley	Residential	2	0	1,178	9,424	35	50	0.5	0	1.8%	0.7%	66.2	62.4
Pleasant Valley Rd. to EB F	Residential	2	0	331	2,648	35	75	0.5	0	1.8%	0.7%	58.0	54.2
Pleasant Valley Road													
north of Cherry Glen Rd.	Residential	2	0	1,439	11,512	35	75	0.5	0	1.8%	0.7%	64.4	60.6
Alamo Drive													
Merchant St. to EB Ramps	Recreational/Agricultural	2	0	3,705	29,640	35	50	0.5	0	1.8%	0.7%	71.2	67.4
2025 with Project (Scenario 8)Traffic Volumes													

I-80													
Alamo to E. of Alamo	Agricultural	4	25	12,120	96,960	65	100	0.5	0	5.0%	2.0%	79.7	76.5
Pena to Alamo/Cherry Glen	Commercial/Agricultural	4	25	16,199	129,592	65	100	0.5	0	5.0%	2.0%	81.0	77.8
Lagoon Valley to Pena	Residential	4	25	14,421	115,368	65	500	0.5	0	5.0%	2.0%	69.7	66.5
N. of Texas to Lagoon Valle	Agricultural	4	25	15,291	122,328	65	100	0.5	0	5.0%	2.0%	80.7	77.5
Cherry Glen to Alamo/Merc	Recreational/Agricultural	4	25	13,438	107,504	65	100	0.5	0	5.0%	2.0%	80.2	77.0
Cherry Glen Road													
Lyon Rd. to WB Ramp	Residential	2	0	101	808	35	50	0.5	0	1.8%	0.7%	55.6	51.7
Lyon Rd. to Pleasant Valley	Residential	2	0	602	4,816	35	50	0.5	0	1.8%	0.7%	63.3	59.5
Pleasant Valley Rd. to EB F	Residential	2	0	55	440	35	75	0.5	0	1.8%	0.7%	50.2	46.4
Pleasant Valley Road													
north of Cherry Glen Rd.	Residential	2	0	611	4,888	35	75	0.5	0	1.8%	0.7%	60.7	56.9
Alamo Drive													
Merchant St. to EB Ramps	Recreational/Agricultural	2	0	3,483	27,864	35	50	0.5	0	1.8%	0.7%	70.9	67.1

[1] Distance is from the centerline of the roadway segment to the receptor location.

ON-SITE TRAFFIC NOISE LEVELS

Project Number: 10659-00
Project Name: Lower Lagoon

Background Information

Model Description: FHWA Highway Noise Prediction Model (FHWA-RD-77-108) with California Vehicle Noise (CALVENO) Emission Levels.
Analysis Scenario(s): Existing and Future Traffic Volumes
Source of Traffic Volumes: Korve Engineering
Community Noise Descriptor: L_{dn}: X CNEL: _____

Assumed 24-Hour Traffic Distribution:	Day	Evening	Night
Total ADT Volumes	77.70%	12.70%	9.60%
Medium-Duty Trucks	87.43%	5.05%	7.52%
Heavy-Duty Trucks	89.10%	2.84%	8.06%

Traffic Noise Levels

Analysis Condition Roadway Name Roadway Segment	Land Use	Lanes	Median Width	Peak Hour Volume	ADT Volume	Design Speed (mph)	Dist. from Center to Receptor[1]	Alpha Factor	Barrier Attn. dB(A)	Vehicle Mix Medium Trucks	Vehicle Mix Heavy Trucks	Peak Hour dB(A) L_{eq}	24-Hour dB(A) Ldn
2025 with Project (Scenario 8) Traffic Volumes													
Residences Located Nearest I-80 Without Proposed Berm													
I-80 - N. Texas to Lagoon Valley	Residential	4	25	15,291	122,328	65	1,600	0.5	0	5.0%	2.0%	62.4	59.2
New Arterial #1 south of Lagoon Valley	Residential	4	16	622	4,976	45	85	0.5	0	1.8%	0.7%	63.0	58.9
											Total:	65.7	62.1
Residences Located Nearest I-80 With Proposed Berm													
N. of Texas to Lagoon Valley - no berm		4	25	15,291	122,328	65	1,600	0.5	-10	5.0%	2.0%	52.4	49.2
New Arterial #1 S. of south of Lagoon Va	Residential	4	16	622	4,976	45	85	0.5	0	1.8%	0.7%	63.0	58.9
											Total:	63.4	59.4
Lagoon Valley Road													
east of new Arterial #1		4	16	316	2,528	45	75	0.5	0	1.8%	0.7%	61.0	56.9
New Arterial #1													
south of Lagoon Valley Rd.		4	16	622	4,976	45	85	0.5	0	1.8%	0.7%	63.0	58.9

[1] Distance is from the centerline of the roadway segment to the receptor location.

TECHNICAL APPENDIX G

Wastewater Technical Memorandum

W E S T
Y O S T
& ASSOCIATES
Consulting Engineers

MEMORANDUM

DATE: February 13, 2004

Project No.: 207-03-03.02/1

TO: Deb Galway
City of Vacaville

CC: Cathy McEfee, EIP (mail)
Chris Gustin (email)
Fred Buderi (email)
Kevin Van Katwyk (email)
Rod Moresco (email)

FROM: Jeff Pelz JP

SUBJECT: Lower Lagoon Valley Offsite Wastewater Facilities

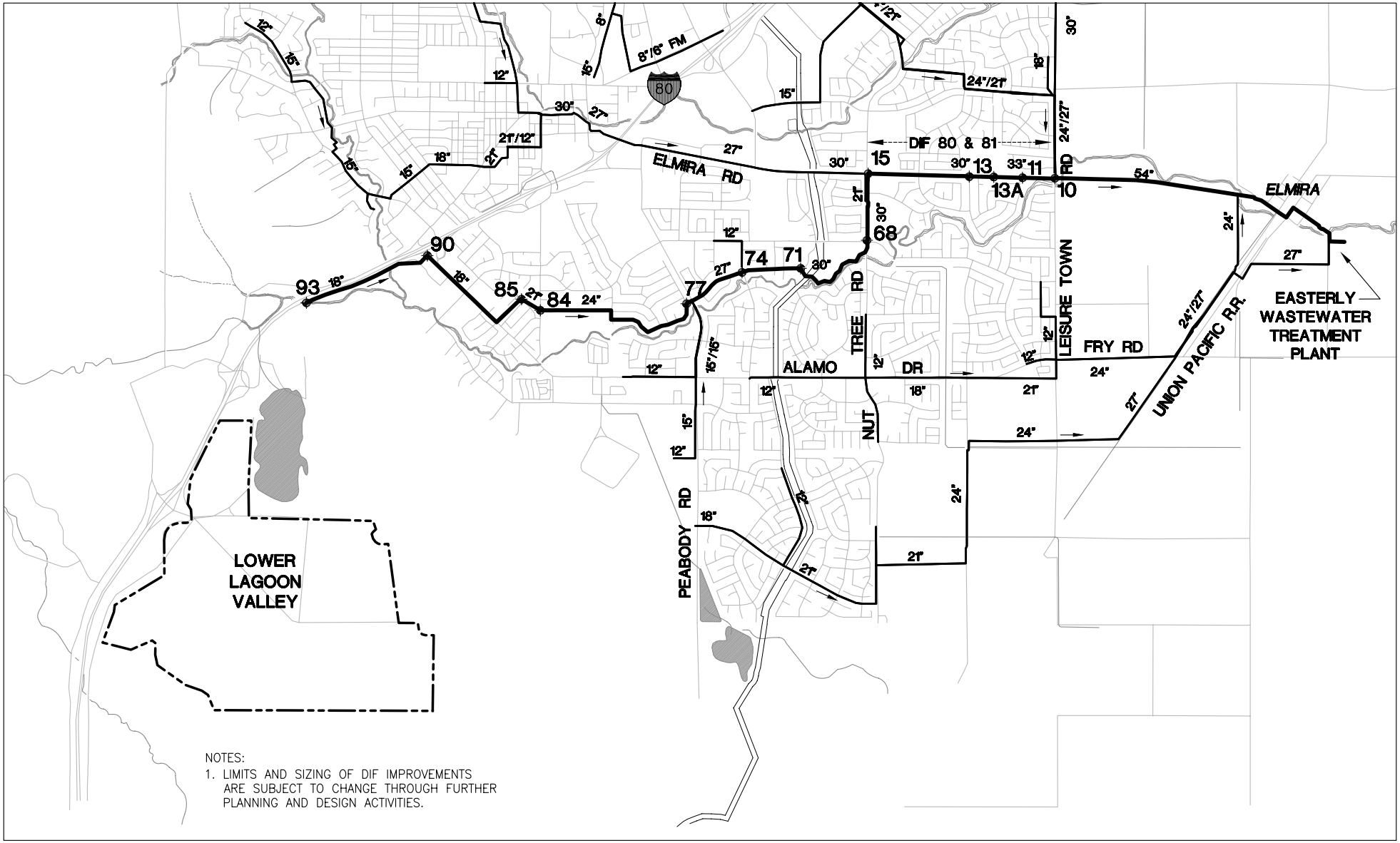
The purpose of this technical memorandum (TM) is to assess the advantages and disadvantages of offsite wastewater collection system options identified by the proponent of the proposed Lower Lagoon Valley project. The potential impacts of the options are described, and the options are compared on the basis of lifecycle costs. The results of this analysis will be used by the City of Vacaville (City) to determine which offsite sewer option has the least impact on the environment and the community. Available capacity in downstream sewers is also summarized.

The project proponent, Triad Properties, has proposed a residential and commercial development project for Lower Lagoon Valley[i]. Figure Y-1 shows the project area boundary and the existing trunk sewers that would convey wastewater from the project to the City's wastewater treatment plant. The project includes construction of onsite wastewater collection system facilities within the project area and offsite facilities to convey the flows from the project area to City's existing trunk sewer system. A hill separates the project area from the City's existing sewer system.

The project proponent identified two alternatives for the offsite wastewater collection system facilities: "Option 1 – Pump Station", and "Option 2 – Gravity Sewer". The first option would convey flows over the hill by pumping, and the second would convey flows around the hill by gravity. These alternatives are illustrated conceptually on Attachment 1, prepared by the project proponent. A third option, tunneling through the hill, was also considered. The project proponent identified Option 1 as the preferred alternative, for the City's consideration.

This TM compares Options 1 and 2 on the basis of life cycle costs and technical/environmental concerns. A tunneling option (Option 3) is also discussed.

1260 Lake Boulevard, Suite 240 Davis, California 95616 Phone 530 756-5905 Fax 530 756-5991 www.westyost.com



LEGEND

93	TRUNK SEWER AND MODEL NODE
	PROJECT AREA
DIF 80	DEVELOPMENT IMPACT FEE PROJECT NUMBER AND APPROXIMATE LIMITS

N

0 2000 4000
SCALE IN FEET

Figure Y-1

Lower Lagoon Valley EIR
EXISTING DOWNSTREAM TRUNK SEWERS

WEST YOST & ASSOCIATES

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WASTEWATER FLOW PROJECTIONS

Current development in Lagoon Valley is served by onsite wastewater disposal systems (septic tanks and leach fields). It has been assumed that any rural residences outside of the proposed project area will continue to be served by onsite systems and not connected to the new collection system constructed as part of the project. Capacity will be provided in the collection system to accommodate the existing commercial occupants that will remain after development of the project. City staff has indicated that a sewer stub will be provided to which a pipeline from the Lagoon Valley Park restrooms could be connected in the future, so a nominal flow allowance for the park is included in the wastewater flow projection.

Wastewater flows for Lagoon Valley were projected using the "Lagoon Valley Project Description" prepared by Triad Properties[1], and the City's flow generation factors for proposed land uses[ii]. A peaking factor of 2.11 and an infiltration and inflow (I&I) factor of 500 gallons per day per acre (gpd/acre) were used to estimate the peak wet weather flow at the downstream end of the proposed wastewater collection system. The peaking factor was predicted using a computer model developed by WYA simulating a conceptual wastewater collection system within the project area. The modeled conceptual collection system is shown in Figure Y-2. All pipeline sizes shown on the figure are preliminary. Revised calculations will be required for planning and design of actual facilities.

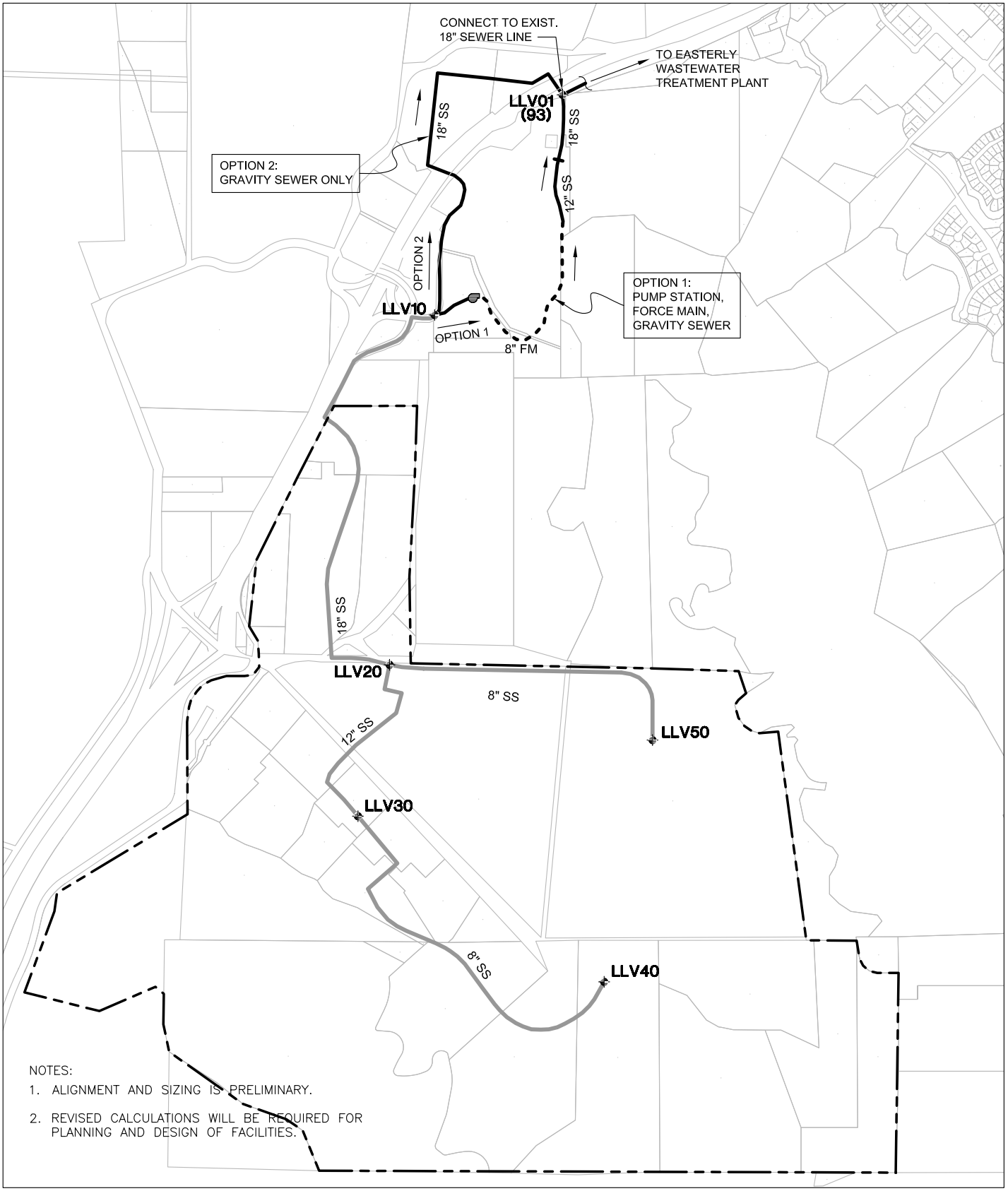
The land uses and wastewater flow generation factors used to project flows from the project and adjacent commercial parcels are summarized in Table 1. The projected average dry weather flow (ADWF) is 0.634 million gallons per day (mgd), and the projected hourly peak wet weather flow (PWWF) is 1.65 mgd.

OFFSITE COLLECTION SYSTEM ALTERNATIVES

Wastewater must be conveyed from the project area to the City's existing wastewater collection system. The proposed point of connection is located at the upstream end of an existing 18-inch gravity trunk sewer located along the Butcher Road pedestrian/bicycle trail and terminating on the north side of Laguna Creek. This point is identified as Model Node LLV01 on Figure Y-2. Flows will be conveyed to the point of connection through construction of the facilities described for one of the following offsite collection system alternatives.

Option 1 – Pump Station

Option 1 includes a pump station, force main and gravity sewer that would cross Laguna Creek in one location. As shown on Figure Y-2, the pump station would deliver flow to the top of the hill north of Lower Lagoon Valley via an 8-inch force main. A 12-inch gravity main would convey the flow downhill into an 18-inch gravity sewer. The gravity sewer would then cross Laguna Creek to the point of connection. Construction of the crossing would employ bore & jack or other suitable trenchless technology.



LEGEND

LLV40	MODEL NODE
	ONSITE GRAVITY SEWER
	OFFSITE GRAVITY SEWER
	OFFSITE FORCE MAIN
	PROJECT BOUNDARY

N

0 750 1500
SCALE IN FEET

Figure Y-2

LOWER LAGOON VALLEY EIR
WASTEWATER COLLECTION
SYSTEM ANALYSIS

WEST YOST & ASSOCIATES

CAD FILE: 1:/207/Lower Lagoon Valley Sewer Model.dwg DATE: 09-29-03 2:26pm

Table 1. Wastewater Flow Projection

Proposed Development	I&I Area, acres	Land Use			Flow Factor		ADWF, mgd	I&I Flow, mgd [a]	PWWF, mgd [b, c]
		Quantity	Units	Category	Value	Units			
Existing Development									
Area 1 – Commercial									
1A: CR (Blue Lagoon)	5.39	5.39	acres	CS	1,900	gpd/acre	0.010	0.003	0.024
1B: CG (Almond)	6.74	6.74	acres	CS	1,900	gpd/acre	0.013	0.003	0.030
1C: CG (Ranchotel)	9.23	9.23	acres	CS	1,900	gpd/acre	0.018	0.005	0.042
Area 5 – LV Regional Park	0	388	acres	PK	5,000	gpd [d]	0.005	--	0.011
Area 6 – Open Space/AH									
6A: OS East	0	385	acres	AG/OS	0	gpd/acre	0.000	0.000	0.000
6B: AH Southeast	0	356	acres	AG/OS	0	gpd/acre	0.000	0.000	0.000
6C: OS Southwest	0	325	acres	AG/OS	0	gpd/acre	0.000	0.000	0.000
Proposed Development									
Area 2 – Business Park [e]	89	89	acres	BP	1,900	gpd/acre	0.169	0.045	0.401
Area 3 – Residential									
3A: Village I	123	540	du	Residential	300	gpd/acre	0.162	0.062	0.403
Village Center (10,000 sf) [f]	0.77	0.77	acres	CS	1,900	gpd/acre	0.001	0.000	0.003
K thru 6 School Site	12	600	students	ESC	30	gpd/student	0.018	0.006	0.044
3B: Village II	142	402	du	Residential	300	gpd/acre	0.121	0.071	0.325
3C: Village III	222	365	du	Residential	300	gpd/acre	0.110	0.111	0.342
3D: Community Homes	22.73	18	du	Residential	300	gpd/acre	0.005	0.011	0.023
Area 4 – Golf Course	0.00	212	acres	PR	0	gpd/acre	0.000	0.000	0.000
Golf Course Services (17,000 sf) [f]	1.3	1.3	acres	CS	1,900	gpd/acre	0.002	0.001	0.006
Area 7 – Buffer									
7A: Nelson Road Berm	0	47	acres	OS	0	gpd/acre	0.000	0.000	0.000
7B: Rivera Road Berm	0	6	acres	OS	0	gpd/acre	0.000	0.000	0.000
Total Projected Flow							0.634	0.317	1.65

(a) Inflow/Infiltration (I&I) Factor = 500 (gpd/acre)

(b) Sanitary Flow Peaking Factor = 2.11 [g]

(c) Hourly Peak Wet Weather Flow (PWWF) = Average Dry Weather Flow (ADWF) x Peaking Factor + I&I Area x I&I Fact

(d) Sanitary sewer service for limited restroom facilities. I&I is expected to be insignificant.

(e) Area 2 includes some neighborhood service commercial and a fire station

(f) Acreage of Village Center and Golf Course Club House/Maintenance Building (Golf Course Services) based on 0.3 FAR.

(g) Based on modeling. This factor applies only at the downstream end of the collection system. The peaking factor in upstream sewers will tend to be higher. Where modeling has not been performed, a peaking factor of 2.5 should be used.

Land Use Legend: CS = Service Commercial, PK = Park, AG = Agricultural, OS = Open Space, BP = Business Park, ESC = Elementary School, PR = Private Recreation

The following configuration and major features would be required for the pump station, such that the facility would be comparable to other pump stations in Vacaville with a capacity greater that 1 mgd:

- Submersible pumps
- Two-chamber cast-in-place reinforced concrete wet well
- Variable speed drives
- Standby power
- Odor control
- Building to house the electrical controls, standby power, and odor control equipment
- Continuous flow metering on the force main
- Telemetry via the City wastewater SCADA system
- Protection of the facilities from flooding
- Pump-around fittings in accordance with current Utilities Division requirements

The City's three existing large pump stations are configured with five pumps each to accommodate initial low flows as well as the large anticipated flow increases in the future. However, for the proposed project, it is assumed that flows from Lower Lagoon Valley will be significant within a relatively short time frame. Therefore, a three pump configuration is expected to be adequate. Depending on available pump capacities and the anticipated frequency of pump starts predicted during design, a fourth pump may be determined to be necessary. For this reason, and to facilitate maintenance in either side of the two-chamber wet well, mounting rails, power connections, and discharge piping should be installed for four pumps (two in each wet well chamber) even if only three pumps are installed. The pump station would be sized to handle the projected build-out hourly peak wet weather flow with two units operating. The third pump would serve as standby. Use of liquid chlorine or ferric chloride for odor control would be based on City's approval, although ferric chloride would be the likely chemical of choice because it offers a longer lasting effect.

The following issues would need to be addressed with this option:

- Pump station wet well and force main solids deposition and odors: During the early life of the project, flows to the pump station and force main will be relatively low. A large volume of wastewater will be stored in the force main over significant periods of time, leading to potential accumulation of solids and maintenance problems. These conditions will also increase the potential for odors, and favor the use of odor control chemicals with residual effectiveness (e.g., ferric chloride). During design it will be important to identify pump station control programming and/or other methods of generating force main velocities and pumping volumes sufficient to periodically remobilize and flush solids from the force main. The force main design should also include provisions for the use of pressure pipeline cleaning tools (pigging) including minimum bend angles.

- Excessive velocities in the hillside gravity sewer: Due to the slope of the existing ground, a portion of the gravity sewer immediately downstream of the force main would need to be constructed at a significant slope, or alternatively, with several drop structures. Internal erosion caused by high velocities in the sewer is a potential concern for this portion of the pipeline. City design standards include a maximum velocity requirement of 10 feet per second (fps) to address this concern[iii].

- Odor generation and corrosion: Based on a preliminary analysis, about five drop manholes would be needed to reduce the slope of the hillside gravity sewer and meet the maximum velocity criterion. Drop structures dissipate energy through turbulence, which in turn can release hydrogen sulfide gas and other odor compounds in significant quantities. Drop structures would therefore require additional odor and corrosion control features. Odors are a particular concern because the proposed pipeline route follows an existing pedestrian/bicycle trail. The design of the drop structures should minimize the turbulence and odor generation to the extent possible. The manholes require all-weather access, and would therefore need to be located on the trail. Manholes should be sealed and vented via carbon filters or similar passive system approved by the City. Vortex drop manhole devices may be a viable odor control option if pilot testing or the experience of other agencies can confirm their effectiveness. Alternative manhole and pipeline materials (e.g., polyethylene) should be considered to minimize corrosion, subject to the City's approval during design.

  The City may elect to allow velocities greater than 10 fps to eliminate the need for drop structures and reduce the associated localized odor concerns. If allowed, a gravity sewer with a constant slope could be used to convey the flows downhill. However, for velocities greater than 10 fps, special consideration should be given to the pipe material, abrasive characteristics of wastewater, turbulence, and thrust at changes of direction[iv]. Additional maintenance of the high-velocity gravity sewer, and the potential need for a liner in the future would need to be included in collection system maintenance planning. Significant turbulence and odor potential will occur at the base of the hill where the sewer transitions from a steep slope to a flatter slope. Special energy dissipation, corrosion control, and manhole ventilation with carbon filtration or a similar passive system would be necessary at this location.

  Regardless of the pipeline configuration, the sewer should be designed to produce no detectable odors along the pedestrian/bicycle trail. The presence of slow moving pedestrian traffic and a relatively natural environment increase the risk of odor detection. As noted, all ventilation outlets should therefore be located well off the trail and incorporate carbon filtration. Manhole lids near the trail should be sealed against release of vapors.

- Proximity to existing and planned water lines: Two existing water mains are located within or near the pedestrian/bicycle trail leading to the Butcher Reservoirs at the top of the hill from the north. A small diameter pipeline flows down the hill to the south and west from the reservoirs. This line would be replaced with a larger diameter water line as part of the proposed project. At least 10 feet separation must be provided from the force main and gravity sewer to the existing and future water lines, in accordance with City standards and State Department of Health Services requirements. This is

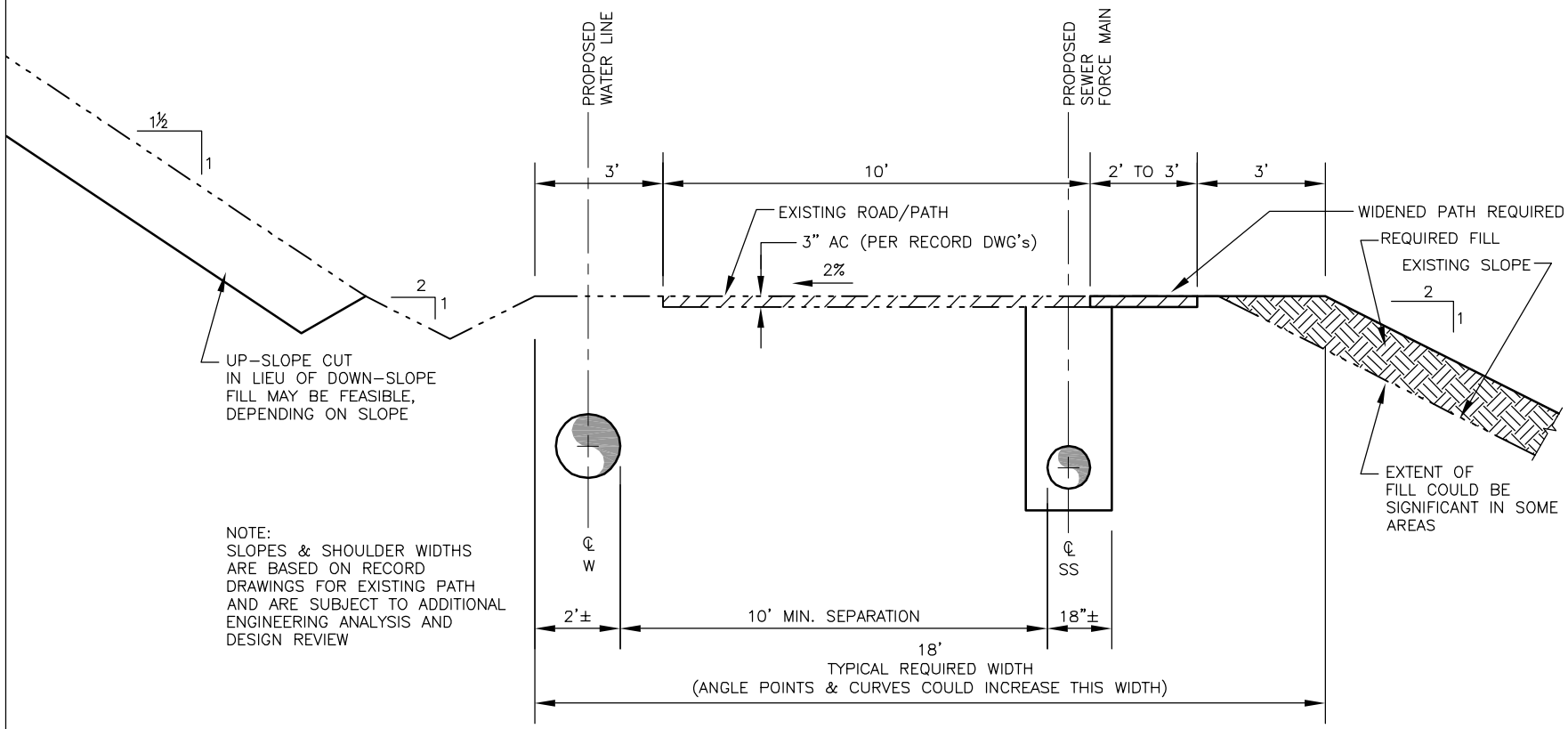
likely to preclude locating the sewer within the existing paved trail. The trail will therefore need to be widened to provide all-weather vehicle access to sewer manholes.

- Hillside earthwork: Widening the trail will require large amounts of cut or fill in some areas. These construction activities can be costly in the presence of steep slopes such as those that occur along substantial portions of the trail. Thorough geotechnical engineering as well as planning review and approval will be necessary for construction in these areas. Figure Y-3 illustrates this situation.
- Construction-related impacts: During trenching, there is a potential for cultural and biological impacts, especially in the vicinity of the creek where native American artifacts are known to exist at some locations. Special monitoring and possibly hand excavation could be necessary, and mitigation may be required if artifacts are discovered along the pipeline route.

Option 2 – Gravity Sewer

Option 2 is a gravity flow option and involves two crossings of I-80 and one crossing of Laguna Creek. The first crossing would be made under the freeway to the north of the Peña Adobe interchange. The initial conceptual plan (as shown on Attachment A) incorporated a route parallel to I-80. Project representatives have recently indicated a more northerly route is preferred, as shown on Figure Y-2. Once the gravity sewer crosses Laguna Creek, it would be routed east to a second freeway crossing, and then southeast to the point of connection. Construction of the freeway and creek crossing would employ boring and jacking or another suitable trenchless technology.

The City of Vacaville Utilities Division has developed a flow metering master plan (FMMP) which identifies flow metering objectives and installation criteria for wastewater collection system flow metering facilities[v]. The project area is identified as an area for which downstream flow metering should be installed if and when it develops. A flow metering manhole with telemetry should be installed at or near the point of connection at a location with suitable hydraulic characteristics, in accordance with the FMMP. Under the pump station option, flow metering would be provided at the pump station, so no metering flume is necessary.



SECTION

SCALE: 1/4"=1'-0"

Figure Y-3

Lower Lagoon Valley EIR
GENERALIZED TRAIL/UTILITY SECTION

WEST YOST & ASSOCIATES

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The following issues would need to be addressed with Option 2:

- Acquisition of property and easements northwest of I-80: The City will need permanent access along the entire route to maintain the gravity sewer. A significant portion of this alignment is not currently controlled by the project proponent or a public agency. A Caltrans encroachment permit would also be required, in addition to permits related to construction in the vicinity of creeks.
- Construction-related impacts: During trenching, there is a potential for cultural and biological impacts, especially in the vicinity of the creek where native American artifacts are known to exist at some locations. Special monitoring and possibly hand excavation could be necessary, and mitigation may be required if artifacts are discovered along the pipeline route.
- All weather access to the portion of the sewer system not located in a road: In accordance with City standards, access to the pipeline for routine and emergency maintenance must be provided in the form of a gravel or paved pathway along the pipeline route. Manholes should be flood protected to limit inflow during wet weather.

Option 3 – Tunneling Through the Hill

Option 3 was briefly considered by the project proponent and City staff. It includes a shorter 18-inch gravity sewer between the proposed project and the point of connection constructed by tunneling under the hill. This option would involve one crossing of the Laguna Creek, similar to Option 2. Construction of the crossings would employ bore & jack or other suitable trenchless technology.

The following issues need to be addressed with this option:

- Manhole spacing: Based on a preliminary inspection of available topographic data, it appears that the spacing between manholes at either end of the tunneling section would need to exceed the maximum spacing allowed by City standards. Routine inspection and cleaning is difficult or infeasible at distances greater than 800 to 1,000 ft. If a distance exceeding City standards is allowed, the manhole spacing should be limited to a maximum of 800 feet, which appears to be feasible based on available information.
- Construction-related impacts: During trenching (upstream and downstream of the tunneling section), there is a potential for cultural and biological impacts especially in the vicinity of the creek.
- The cost to the City for future replacement of the sewer would be excessive, relative to replacement costs for other sewers. Lining is a likely alternative that would be considered in lieu of replacement. The tunneled portion of the sewer should be oversized at least one standard gravity sewer diameter to accommodate future installation of a liner.

The tunneling option is not considered further due to the anticipated high cost of construction, and potential for difficult maintenance access.

Adequacy of Depth at Point Of Connection

The existing sewer at the proposed point of connection is approximately 10 feet deep. Detailed design is required to verify that this depth is adequate. It is possible that the creek or freeway crossings in either alternative could force the gravity sewer deeper than the point of connection. The project proponent has not indicated that any special design considerations (e.g., inverted siphons) will be necessary, so it is assumed that the depth of the existing sewer is adequate for either proposed alternative. The design engineer should complete and submit to the City an engineering analysis including detailed creek and freeway cross-sections with the first design review submittal or sooner to identify any impact on cost or feasibility of the selected option.

COMPARISON OF LIFE CYCLE COSTS

Life cycle costs include a capital cost component and an operation and maintenance component. Capital costs for Options 1 and 2 are presented in detail in Attachments 2 and 3. Predicted operation and maintenance costs, along with a net present value analysis of each option are detailed in Attachments 4 and 5. The estimated life cycle costs are summarized in Table 2.

Table 2. Estimated Life Cycle Costs, 2005 dollars

Description	Option 1	Option 2
Preliminary Engineer's Bid Estimate (2003$)	2,390,000	2,460,000
Inflation Allowance (2 years)	146,000	150,000
Other Project Costs and Contingencies	1,284,000	1,420,000
Subtotal, Preliminary Estimated Project Cost (2005$)	3,820,000	4,030,000
Net Present Value of Routine Equipment Replacements	1,371,000	0
Net Present Value of Operation and Maintenance	2,167,000	64,000
Total, Estimated Life Cycle Cost	7,358,000	4,094,000

Basis: 50-year life cycle, zero salvage value, 3 percent annual inflation, 4 percent discount rate. Note, the estimated cost for Option 1 does not reflect potentially substantial costs associated with hillside earthwork necessary to widen the existing bike/pedestrian trail.

Basis of the Life Cycle Cost Estimate

The estimates of life cycle cost rely on a series of assumptions, many of which are based on very limited information or predictions of future economic conditions. These assumptions are applied consistently to each option so the estimates represent a reasonable basis for comparison of the alternatives. Actual capital and operating costs will be affected by a number of factors and could be significantly different from the estimates. These estimates are therefore provided only for the purpose of comparing the two alternatives under consideration. As additional planning and design details become available, more accurate estimates can be developed for the purposes of evaluating project financing needs.

The major assumptions serving as a basis for the estimates are:

1. Facilities will be constructed in 2005
2. Annual inflation will be 3 percent
3. The net present value of future costs can be estimated using a discount rate of 4 percent
4. The useful life of pipelines is 50 years, and this is the period of the life cycle cost analysis, with zero residual value under either option
5. A major pump station equipment overhaul will be required in 15 years, and complete replacement of the pump station will be required in 25 years
6. The current Engineering New Record 20-cities construction cost index (ENR CCI) is 6741, for September 2003
7. Pump station construction costs can be estimate using published cost curves[vi]
8. A 12-foot paved path or street lane will be constructed (or restored) over the entire length of the Option 1 force main and gravity sewers and 25 percent of the Option 2 gravity sewer. No substantial cut or fill operations are included in the estimate, but may be required along portions of the path in areas of steep slope.
9. An all-weather gravel road requiring minimal fill or grading will be constructed over 75 percent of the Option 2 gravity sewer
10. Odor control at drop and energy dissipating manholes will approximately quadruple the cost of the manhole
11. Easement acquisition costs will be equal to $88,000 for Option 2 – Gravity Sewer, based an assumed 20-foot easement over 2,200 lineal feet at an assumed cost of $2 per square foot; no land appraisal was performed and actual costs could be substantially different
12. Boring and jacking costs will be equal to approximately $800 per foot of 36-inch casing, plus excavation and mobilization costs of approximately $104,000 per crossing (2003 dollars)
13. Potential cultural impacts will trigger additional construction costs that cannot be estimated at this time, but may be represented by an allowance of $50,000 for Option 1 and $100,000 for Option 2
14. Pipeline cleaning will occur after five years and every five years thereafter
15. Gravity pipeline inspections will occur after ten years and every five years thereafter
16. Power costs will be approximately $0.18 per kilowatt hour for electrical service to the pump station
17. Chemical, power, and pump station maintenance parts and materials costs will be approximately one half the future annual average cost during the first five years of pump station life

COMPARISON OF ALTERNATIVES

Table 3 provides a comparison of the two offsite wastewater alternatives under consideration. The alternatives are compared using the subjective criteria listed in the table and relative costs. Each option is assigned a score from 1 to 4 for each criterion. A score of "1" indicates the option is highly favored, having a relatively low impact, as compared to the other option. A score of "4" indicates the option is unfavorable, having a relatively significant impact on the environment and/or the general public, as compared to the other option. A score of "0" indicates the criterion is not applicable to the particular option.

Table 3. Comparison of Alternatives

Criterion	Option 1 – Pump Station	Option 2 – Gravity Sewer	Discussion Comments
Energy Consumption, Fuel and Chemical Use	4	0	Electrical energy use for the pump station at the predicted average flow will approach 100,000 kilowatt-hours per year, small amounts of fuel will be used to operate and maintain the standby generator, and odor control chemicals will be used; these uses create indirect impacts associated with production of the electricity, fuel, and chemicals
Air Emissions	4	0	Operation of the standby generator will produce exhaust emissions
Visual Impacts at Pump Station	4	0	The pump station site will include a building to house the generator, chemical feed equipment and controls; a concrete pad with grating over the valves; stainless steel hatches; outdoor lighting; and a fence
Visual Impacts Along Gravity Sewer	4	0	Small ventilation pipes may be incorporated in the odor control design for Option 1 and if present, would be visible at the surface near each manhole
Need for New Gravel Road	1	5	The Option 2 gravity sewer would require a significant amount of new gravel road for maintenance access
Noise when Exercising Generator	4	0	The standby generator at the pump station would require monthly operation for maintenance
Operational Noise at Pump Station	3	0	Minor operational noise may be noticeable near the pump station
Potential for Odor at Pump Station	4	0	Occasional odors may occur, even with odor control equipment installed
Potential for Odor along Pedestrian/ Bicycle Trail	4	0	It is not clear that available technology will adequately suppress odors from the sewer near the trail at all times

Table 3 Cont'd…

Criterion	Option 1 – Pump Station	Option 2 – Gravity Sewer	Discussion Comments
Disruption of Recreational Uses During Operation and Maintenance of Pump Station	3	0	Maintenance personal will be active at the pump station daily for routine operational monitoring, and for extended periods during maintenance activities
Disruption of Recreational Uses During Maintenance of Pipelines	3	1	Routine maintenance of the pipelines will be required, including cleaning (hydro jet equipment and personnel), and inspection (closed circuit television truck and personnel); minimum frequency is expected to be once every five years; these activities would block or restrict pedestrian and vehicle traffic on roads and trails
Risk of spills	4	1	Routine maintenance minimizes the risk of wastewater spills; however, the increased mechanical complexity of Option 1 increases the risk of spills relative to the risk under Option 2
Potential Construction Impacts along Roads and Trails	4	1	The gravity sewer is constructed almost exclusively outside of existing roads and trails; the pump station and pipelines for the pump station option would be constructed primarily within or adjacent to existing roads and trail, which would be disrupted during construction
Impacts of hillside construction on slopes exceeding 25%	4	0	Portions of the force main under Option 1 would require excavation and fill on relatively steep slopes increasing related environmental impacts
Potential Construction Impacts on Archeological Resources	2	4	Both options have the potential to disturb archeological resources during construction along the creek, with a greater potential under the gravity sewer option
Potential Schedule and Cost Impacts of Archeological Resources	2	4	The greater likelihood of archeological resources along the Option 2 gravity sewer introduces a greater risk of construction delays and cost escalation for Option 2
Schedule Impact of Easement Acquisition	0	4	Easements on private property required for Option 2 may significantly delay construction of the gravity sewer
Operation and Maintenance Staffing	4	1	The Option 1 pump station will increase demand for routine O&M activities as well as weekend and weeknight standby staffing

Table 3 Cont'd…

Criterion	Option 1 – Pump Station	Option 2 – Gravity Sewer	Discussion Comments
Maintenance Costs	4	1	The pump station will have a substantially higher cost for direct labor and materials, as well as related administrative costs that are not explicitly included in the life cycle cost analysis
Construction Costs	2	2	The Option 2 gravity sewer has a marginally higher initial cost (the cost of hillside earthwork has not been assessed).
Facility Replacement Costs	4	1	The pump station has a substantially shorter useful life, resulting in significant replacement costs over the useful life of the pipelines.
Summary Comparison	68	25	The most significant drawbacks of the Option 2 gravity sewer are the need to construct an all-weather access road and the increased potential for disruption of archeological resources and the associated delays. Option 1 has many other certain or potential negative impacts.

Based on the criteria included in Table 3, the gravity sewer option has significantly fewer potential impacts on the environment and general public both during and after construction.

ASSESSMENT OF DOWNSTREAM TRUNK SEWER CAPACITY

Existing wastewater collection system facilities will convey flow from the new sewers constructed with the project to Easterly Wastewater Treatment Plant (WWTP). These existing sewers have been the subject of previous master planning and preliminary design analyses that included preparation of a computer model. This previous modeling was used for the purpose of evaluating capacity available to the Lower Lagoon Valley project and the potential impact of the project on the existing sewers.

Predicted Flows and Pipeline Capacity

In general, existing sewers have sufficient capacity to accommodate build-out of the project. Downstream trunk sewer capacity and previously modeling results are summarized in Table 4. Previous modeling was based on the City's land use database for existing conditions as of 2000, and build-out of the 1990 General Plan. The build-out model included development in the project area that generated average and peak flows greater than those projected for the proposed project. Table 4 includes a column showing "Adjusted Hourly PWWF", which reflects an estimate of the build-out Hourly PWWF in downstream pipelines with the project developed as currently proposed.

Table 4. Downstream Trunk Sewer Capacity

Pipeline Reach			Capacity, mgd	Modeled Hourly PWWF[a], mgd		Adjusted Hourly PWWF[c]	Planned DIF Project
From Node	To Node	Length		2000[b]	Buildout[b]		
93	90	3,744	4.41	0.053	2.34	1.75	–
90	85	3,793	3.61	0.347	2.76	2.16	–
85	84	758	5.13	0.725	3.14	2.54	–
84	77	5,513	7.33	2.49	5.07	4.48	–
77	74	1,755	8.1 [d]	5.89	8.10	7.51	–
74	71	2,110	9.0 [d]	6.78	8.97	8.38	–
71	68	2,562	9.3 [d]	7.07	9.26	8.67	–
68	15	1,610	12.6	7.35	9.55	8.97	–
15	13	3,035	14.8	12.8	**16.8**	**16.3**	80
13	13A	645	11.8	**13.0**	**17.0**	**16.4**	80
13A	11	1,050	14.3	13.1	**17.1**	**16.5**	80
11	10	860	12.9	**13.2**	**17.1**	**16.5**	81
10	EWWTP	9,537	40.1	24.5	**45.6**	**45.1**	[e], [f]

(a) Bold values indicate modeled flows that exceed gravity flow pipeline capacity.
(b) Based on modeling from 2000 and 2001 prepared for the Beelard Trunk Sewer preliminary design, which included a higher buildout flow than currently projected from the project area.
(c) Estimated flow in mgd based on proposed Lower Lagoon Valley project. To be refined through updated modeling in conjunction with periodic master planning.
(d) Based on preliminary design of Beelard Trunk Sewer. (Construction was recently completed.)
(e) DIF 54A and other future projects are expected to divert a portion of the modeled buildout PWWF from this pipeline reach.
(f) Modeled flow is based on land use plans that may not reflect the current proposals for the Rice-McMurtry area.

As shown in Table 4, flows predicted for current conditions exceed the gravity flow capacity in two segments of the downstream sewers. These two segments are located on Elmira Road and comprise approximately 25 percent of the distance between Nut Tree Road and Leisure Town Road. Minor surcharging (less than two feet above the pipe crown and more than 12 feet below the rim elevation) was observed in the Elmira Road trunk sewer during the 2002/2003 wet season[vii]. At build-out of the 1990 General Plan, the predicted flow on Elmira Road from Nut Tree Road to Leisure Town Road are expected to exceed the gravity flow capacity of the pipeline. Modeled flows also exceed the capacity in this pipeline downstream of Leisure Town Road; however, other planned improvements are likely to relieve a portion of the excess flow before build-out is reached.

Planned Downstream Trunk Sewer Improvements

Two development impact fee (DIF) funded projects will provide additional capacity in the Elmira Road trunk sewer. These projects, sewer DIF 80 and 81, are shown on Figure Y-1. They will eventually be needed to accommodate the project and other planned growth. Given that minor surcharging was observed during the winter of 2002/2003, it is apparent that portions of one or both of these improvements may be needed in the near future. An updated wastewater collection system model reflecting current land use planning is currently being prepared for the Utilities Division. The updated model should be used in conjunction with ongoing flow monitoring to determine the appropriate timing of these improvements and any others identified through the normal trunk sewer planning process.

A third improvement, DIF 54A, will divert a portion of the flow entering the Elmira Road Trunk Sewer just west of Elmira. This improvement is expected to significantly reduce any long-term capacity limitations in the Elmira trunk sewer.

Available information indicates no other improvements are needed to accommodate the project.

CONCLUSIONS

The information presented above leads to the following conclusions regarding the offsite sewer alternatives under consideration for the Lower Lagoon Valley Project:

1. Sixteen of the twenty-one subjective ranking criteria favor the gravity pipeline option over the pump station option.
2. Both options have potential cultural and biological impacts associated with crossing Laguna Creek. More of the gravity sewer option (Option 2) would be constructed in the vicinity of the creek so this option would have a greater potential for impacts.
3. The pump station option (Option 1) would have the potential to generate odors in the vicinity of an existing pedestrian/bicycle trail, requiring design features that would be relatively unique within the Vacaville wastewater collection system and resulting in higher maintenance costs.
4. The greater complexity associated with the pump station (Option 1) produces a higher risk for operational problems and spills than Option 2.
5. Whether or not staffing costs increase, the pump station (Option 1) will increase the need for continuous standby availability from operation and maintenance staff, in addition to routine daily operation and maintenance activities on weekdays.
6. Estimated capital costs for Option 2 are about 10 percent higher than the estimated capital cost of Option 1; however, land acquisition costs could significantly increase from the amount included in the capital cost estimate. Hillside grading was not included in the cost estimate, but is likely to be required for Option 1 and could significantly increase its cost.
7. The gravity sewer option (Option 2) has the lowest life cycle cost (approximately 80 percent of the Option 1 life cycle cost).

8. DIF sewer project 81, and possibly a portion of 80 may be needed to accommodate the project. Ongoing sewer monitoring and planning activities will determine the appropriate extent and timing of these improvements.

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[i] Triad Properties (BKF Engineers), Lagoon Valley Project Description, April 10, 2003

[ii] West Yost & Associates, *Sewer Master Plan (Preliminary Draft)*, prepared for the City of Vacaville, June 12, 1992. Reprinted: February 1, 1995

[iii] City of Vacaville, Standard Specifications, Adopted September 11, 1990

[iv] Mohinder L. Nayyar, Piping Handbook, Sixth Edition

[v] West Yost & Associates, *2000 Sanitary Sewer Flow Metering Master Plan (Draft)*, prepared for the City of Vacaville, May 5, 2000.

[vi] Robert L. Sanks, *Pump Station Design*

[vii] West Yost & Associates, *2003 Annual Data Report – City of Vacaville Infiltration and Inflow Program*, prepared for the City of Vacaville, June 24, 2003.

ATTACHMENT 1

Date 04.09.03	No.	Revisions	
Scale 1"=800'			
Design TMA			
Drawn LVD			
Approved			
Job No 992623			

Sheet Number: FIG 4

LAGOON VALLEY
CONCEPTUAL PLAN
OFF-SITE SANITARY SEWER
VACAVILLE SOLANO COUNTY CALIFORNIA

BKF
ENGINEERS / SURVEYORS / PLANNERS
540 PRICE AVENUE
REDWOOD CITY, CA 94063
650/482-6300
650/482-6399 (FAX)

Attachment 2
Lower Lagoon Valley Offsite Sewer
Planning-Level Estimate Of Capital Cost
Option 1 -- Pump Station and Force Main

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Cost	Total Cost
1	Mobilization/Demobilization	Lump sum	1	$60,000	$60,000
2	Traffic control	Days	10	$1,000	$10,000
3	1.6 mgd Pump Station w/ standby power and odor control	Lump sum	1	$670,000	$670,000
4	18-inch sewer main by open-cut	Lin. feet	1,210	$319	$386,030
5	12-inch gravity sewer, steep slope	Lin. feet	780	$197	$153,540
6	8-inch force main	Lin. feet	2,190	$116	$254,050
7	48-inch sewer manhole	Each	8	$5,100	$40,800
8	Allowance for manhole odor control	Each	6	$16,000	$96,000
9	Construction Observation / Special Excavation (allowance)	Lump sum	1	$50,000	$50,000
10	Bore and jack crossings (1 location)	Lin. feet	100	$1,840	$184,000
11	Tie in at existing manhole	Lump sum	1	$5,000	$5,000
Subtotal (rounded)					**$1,909,000**
Estimating Contingency (25%)					$477,250
Subtotal, Preliminary Engineer's Bid Estimate - 2003 dollars (rounded)					**$2,390,000**
Inflation Allowance (3%/year, 2 years) (b)					$145,551
Subtotal, Preliminary Engineer's Bid Estimate - future dollars (rounded)					**$2,536,000**
Construction Contingency (7%)					$177,520
City Design Costs (5%)					$126,800
City Construction Period Costs, Including CM (12%)					$304,320
Design Services, Including Predesign, Geotechnical, and Surveying (14%)					$355,040
Construction Engineering Services (5%)					$126,800
Environmental Review (1%)					$25,360
Project Contingency (6%)					$152,160
Permitting (allowance - one location)					$10,000
Easement Acquisition Allowance (minor costs only, assumed)					$10,000
Total, Preliminary Estimated Project Cost (rounded)					**$3,820,000**

(a) Planning level unit costs for pipelines include allowances for dewatering, sheeting/shoring, minimal pavement restoration, sewage flow control, and as-builts.

(b) Inflation allowance is based on an assumed inflation rate of 3%/year. Actual inflation may be higher or lower, and other factors (e.g., bidding climate) may further influence construction costs. Current costs correspond to an ENR 20-cities average Construction Cost Index of 6741 (September 2003).

Attachment 3
Lower Lagoon Valley Offsite Sewer
Planning-Level Estimate Of Capital Cost
Option 2 -- Gravity Trunk Sewer

Item No.	Item Description	Unit of Measure	Estimated Quantity	Unit Cost	Total Cost
1	Mobilization/Demobilization	Lump sum	1	$60,000	$60,000
2	Traffic control	Days	2	$1,000	$2,000
3	18-inch sewer main by open-cut	Lin. feet	3,900	$200	$778,200
4	48-inch sewer manhole	Each	16	$5,100	$81,600
5	Construction Observation / Special Excavation (allowance)	Lump sum	1	$100,000	$100,000
6	Bore and jack crossings (3 locations)	Lin. feet	680	$1,270	$863,600
7	Flow Metering Manhole and Telemetry	Lump sum	1	$31,600	$31,600
8	Tie in at existing manhole	Lump sum	1	$5,000	$5,000
9	Access road	Lin. feet	2,930	$15	$43,950
Subtotal (rounded)					**$1,966,000**
Estimating Contingency (25%)					$491,500
Subtotal, Preliminary Engineer's Bid Estimate - 2003 dollars (rounded)					**$2,460,000**
Inflation Allowance (3%/year, 2 years) (b)					$149,814
Subtotal, Preliminary Engineer's Bid Estimate - future dollars (rounded)					**$2,610,000**
Construction Contingency (7%)					$182,700
City Design Costs (5%)					$130,500
City Construction Period Costs, Including CM (12%)					$313,200
Design Services, Including Predesign, Geotechnical, and Surveying (14%)					$365,400
Construction Engineering Services (5%)					$130,500
Environmental Review (1%)					$26,100
Project Contingency (6%)					$156,600
Permitting (allowance - three locations)					$30,000
Easement Acquisition Allowance (44,000 sf @ $2/sf, assumed)					$88,000
Total, Preliminary Estimated Project Cost (rounded)					**$4,030,000**

(a) Planning level unit costs for pipelines include allowances for dewatering, sheeting/shoring, minimal pavement restoration, sewage flow control, and as-builts.

(b) Inflation allowance is based on an assumed inflation rate of 3%/year. Actual inflation may be higher or lower, and other factors (e.g., bidding climate) may further influence construction costs. Current costs correspond to an ENR 20-cities average Construction Cost Index of 6741 (September 2003).

Lower Lagoon Valley EIR - Life Cycle Costs
for New Offsite Wastewater Facilities

OPTION 1: PUMP STATION AND FORCE MAIN

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Capital (2005$)				
Pump Station and Pipelines (Opt. 1)				$1,909,000
Estimating Contingencies	25%		$ 477,250	$ 2,386,250
Inflation to 2005	6.09%		$ 145,323	$ 2,531,573
Construction Contingency	7%		$ 177,210	
Engineering, Admin & Project Cont.	43%		$ 1,088,576	
Permitting (allowance - one location)			$ 10,000	
Easement Acquisition Allowance			$ 10,000	
Total Capital (rounded)	-			$ 3,820,000

O & M				**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Assumed Annual Inflation	3%		(2005$)																	
Pipeline Cleaning	4,180	LF	$ 1.50						$ 7,269					$ 8,426					$ 9,768	
CCTV Inspection (add to cleaning)	1,990	LF	$ 0.50											$ 1,337					$ 1,550	
Pump Station Maintenance, Labor	425	hr	$ 55.00	$ 23,364	$ 24,065	$ 24,787	$ 25,530	$ 26,296	$ 27,085	$ 27,898	$ 28,735	$ 29,597	$ 30,485	$ 31,399	$ 32,341	$ 33,311	$ 34,311	$ 35,340	$ 36,400	$ 37,492
Pump Station Maintenance, Parts/Supplies	varies	ls		$ 2,500	$ 2,575	$ 2,652	$ 2,732	$ 2,814	$ 5,796	$ 5,970	$ 6,149	$ 6,334	$ 6,524	$ 6,720	$ 6,921	$ 7,129	$ 7,343	$ 7,563	$ 7,790	$ 8,024
Power, 1 cfs, 8760 hrs, 91 ft, 70% eff	96,140	kwh	$ 0.18	$ 8,653	$ 8,912	$ 9,180	$ 9,455	$ 9,739	$ 20,061	$ 20,663	$ 21,283	$ 21,922	$ 22,579	$ 23,257	$ 23,954	$ 24,673	$ 25,413	$ 26,176	$ 26,961	$ 27,770
Odor Control Chemicals, 10 mg/L ferric	4.1	dry tons	$ 323.00	$ 660	$ 679	$ 700	$ 721	$ 742	$ 1,529	$ 1,575	$ 1,622	$ 1,671	$ 1,721	$ 1,773	$ 1,826	$ 1,881	$ 1,937	$ 1,995	$ 2,055	$ 2,117
Pipeline Vent Filters (allow, installed)	6	each	$ 300.00	$ -	$ 1,854	$ 1,910	$ 1,967	$ 2,026	$ 2,087	$ 2,149	$ 2,214	$ 2,280	$ 2,349	$ 2,419	$ 2,492	$ 2,566	$ 2,643	$ 2,723	$ 2,804	$ 2,888
Subtotal O & M				$ 35,176	$ 38,085	$ 39,228	$ 40,405	$ 41,617	$ 63,828	$ 58,256	$ 60,003	$ 61,804	$ 63,658	$ 75,331	$ 67,534	$ 69,560	$ 71,647	$ 73,797	$ 87,329	$ 78,291
O & M Contingencies	10%			$ 3,518	$ 3,809	$ 3,923	$ 4,040	$ 4,162	$ 6,383	$ 5,826	$ 6,000	$ 6,180	$ 6,366	$ 7,533	$ 6,753	$ 6,956	$ 7,165	$ 7,380	$ 8,733	$ 7,829
O & M Cash Flow				$ 38,694	$ 41,894	$ 43,151	$ 44,445	$ 45,779	$ 70,210	$ 64,081	$ 66,004	$ 67,984	$ 70,023	$ 82,864	$ 74,288	$ 76,516	$ 78,812	$ 81,176	$ 96,062	$ 86,120

Project Cash Flow				**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Capital Costs				$ 3,820,000										$ 70,000					$ 240,000	
O & M				$ 38,694	$ 41,894	$ 43,151	$ 44,445	$ 45,779	$ 70,210	$ 64,081	$ 66,004	$ 67,984	$ 70,023	$ 82,864	$ 74,288	$ 76,516	$ 78,812	$ 81,176	$ 96,062	$ 86,120
Discount Rate		Total	4%																	
Net Present Value - Capital + Replacements		$ 5,190,954		$ 3,820,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 47,289	$ -	$ -	$ -	$ -	$ 133,263	$ -
Net Present Value - O & M (rounded)		$ 2,167,000		$ 38,694	$ 40,283	$ 39,895	$ 39,512	$ 39,132	$ 57,708	$ 50,644	$ 50,157	$ 49,675	$ 49,198	$ 55,980	$ 48,256	$ 47,792	$ 47,332	$ 46,877	$ 53,340	$ 45,980
Net Present Value		$ 7,357,954																		

Notes
Assessment District alignment used for the lengths

Lower Lagoon Valley EIR - Life Cycle Costs
for New Offsite Wastewater Facilities

OPTION 1: PUMP STATION AND FORCE MAIN

ITEM	QUANTITY	UNIT	UNIT COST
Capital (2005$)			
Pump Station and Pipelines (Opt. 1)			
Estimating Contingencies	25%		$ 477,250
Inflation to 2005	6.09%		$ 145,323
Construction Contingency	7%		$ 177,210
Engineering, Admin & Project Cont.	43%		$ 1,088,576
Permitting (allowance - one location)			$ 10,000
Easement Acquisition Allowance			$ 10,000
Total Capital (rounded)	-		

O & M				**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Assumed Annual Inflation	3%		(2005$)																			
Pipeline Cleaning	4,180	LF	$ 1.50				$ 11,324					$ 13,128					$ 15,219					$ 17,643
CCTV Inspection (add to cleaning)	1,990	LF	$ 0.50				$ 1,797					$ 2,083					$ 2,415					$ 2,800
Pump Station Maintenance, Labor	425	hr	$ 55.00	$ 38,617	$ 39,776	$ 40,969	$ 42,198	$ 43,464	$ 44,768	$ 46,111	$ 47,494	$ 48,919	$ 50,387	$ 51,898	$ 53,455	$ 55,059	$ 56,711	$ 58,412	$ 60,164	$ 61,969	$ 63,828	$ 65,743
Pump Station Maintenance, Parts/Supplies	varies	ls		$ 8,264	$ 8,512	$ 8,768	$ 9,031	$ 9,301	$ 9,581	$ 9,868	$ 10,164	$ 10,469	$ 10,783	$ 11,106	$ 11,440	$ 11,783	$ 12,136	$ 12,500	$ 12,875	$ 13,262	$ 13,660	$ 14,069
Power, 1 cfs, 8760 hrs, 91 ft, 70% eff	96,140	kwh	$ 0.18	$ 28,603	$ 29,461	$ 30,345	$ 31,255	$ 32,193	$ 33,159	$ 34,153	$ 35,178	$ 36,233	$ 37,320	$ 38,440	$ 39,593	$ 40,781	$ 42,004	$ 43,264	$ 44,562	$ 45,899	$ 47,276	$ 48,694
Odor Control Chemicals, 10 mg/L ferric	4.1	dry tons	$ 323.00	$ 2,180	$ 2,246	$ 2,313	$ 2,382	$ 2,454	$ 2,528	$ 2,603	$ 2,682	$ 2,762	$ 2,845	$ 2,930	$ 3,018	$ 3,109	$ 3,202	$ 3,298	$ 3,397	$ 3,499	$ 3,604	$ 3,712
Pipeline Vent Filters (allow, installed)	6	each	$ 300.00	$ 2,975	$ 3,064	$ 3,156	$ 3,251	$ 3,349	$ 3,449	$ 3,552	$ 3,659	$ 3,769	$ 3,882	$ 3,998	$ 4,118	$ 4,242	$ 4,369	$ 4,500	$ 4,635	$ 4,774	$ 4,917	$ 5,065
Subtotal O & M				$ 80,640	$ 83,059	$ 85,551	$ 101,238	$ 90,761	$ 93,483	$ 96,288	$ 99,177	$ 117,363	$ 105,216	$ 108,373	$ 111,624	$ 114,973	$ 136,056	$ 121,975	$ 125,634	$ 129,403	$ 133,285	$ 157,726
O & M Contingencies	10%			$ 8,064	$ 8,306	$ 8,555	$ 10,124	$ 9,076	$ 9,348	$ 9,629	$ 9,918	$ 11,736	$ 10,522	$ 10,837	$ 11,162	$ 11,497	$ 13,606	$ 12,197	$ 12,563	$ 12,940	$ 13,329	$ 15,773
O & M Cash Flow				$ 88,704	$ 91,365	$ 94,106	$ 111,362	$ 99,837	$ 102,832	$ 105,917	$ 109,094	$ 129,099	$ 115,738	$ 119,210	$ 122,787	$ 126,470	$ 149,662	$ 134,172	$ 138,197	$ 142,343	$ 146,614	$ 173,499

Project Cash Flow				**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Capital Costs												$ 2,800,000										$ 150,000
O & M				$ 88,704	$ 91,365	$ 94,106	$ 111,362	$ 99,837	$ 102,832	$ 105,917	$ 109,094	$ 129,099	$ 115,738	$ 119,210	$ 122,787	$ 126,470	$ 149,662	$ 134,172	$ 138,197	$ 142,343	$ 146,614	$ 173,499
Discount Rate		Total	4%																			
Net Present Value - Capital + Replacements		$ 5,190,954		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,050,327	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 38,012
Net Present Value - O & M (rounded)		$ 2,167,000		$ 45,538	$ 45,100	$ 44,667	$ 50,824	$ 43,812	$ 43,390	$ 42,973	$ 42,560	$ 48,427	$ 41,745	$ 41,344	$ 40,947	$ 40,553	$ 46,143	$ 39,777	$ 39,394	$ 39,015	$ 38,640	$ 43,967
Net Present Value		$ 7,357,954																				

Notes
Assessment District alignment used for the lengths

Lower Lagoon Valley EIR - Life Cycle Costs
for New Offsite Wastewater Facilities

OPTION 1: PUMP STATION AND FORCE MAIN

ITEM	QUANTITY	UNIT	UNIT COST
Capital (2005$)			
Pump Station and Pipelines (Opt. 1)			
Estimating Contingencies	25%		$ 477,250
Inflation to 2005	6.09%		$ 145,323
Construction Contingency	7%		$ 177,210
Engineering, Admin & Project Cont.	43%		$ 1,088,576
Permitting (allowance - one location)			$ 10,000
Easement Acquisition Allowance			$ 10,000
Total Capital (rounded)	-		

O & M				**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**
Assumed Annual Inflation	3%		(2005$)															
Pipeline Cleaning	4,180	LF	$ 1.50					$ 20,453					$ 23,711					$ 27,487
CCTV Inspection (add to cleaning)	1,990	LF	$ 0.50					$ 3,246					$ 3,763					$ 4,362
Pump Station Maintenance, Labor	425	hr	$ 55.00	$ 67,715	$ 69,747	$ 71,839	$ 73,994	$ 76,214	$ 78,501	$ 80,856	$ 83,281	$ 85,780	$ 88,353	$ 91,004	$ 93,734	$ 96,546	$ 99,442	$ 102,426
Pump Station Maintenance, Parts/Supplies	varies	ls		$ 14,491	$ 14,926	$ 15,374	$ 15,835	$ 16,310	$ 16,799	$ 17,303	$ 17,823	$ 18,357	$ 18,908	$ 19,475	$ 20,059	$ 20,661	$ 21,281	$ 21,920
Power, 1 cfs, 8760 hrs, 91 ft, 70% eff	96,140	kwh	$ 0.18	$ 50,155	$ 51,660	$ 53,210	$ 54,806	$ 56,450	$ 58,144	$ 59,888	$ 61,685	$ 63,535	$ 65,441	$ 67,404	$ 69,427	$ 71,509	$ 73,655	$ 75,864
Odor Control Chemicals, 10 mg/L ferric	4.1	dry tons	$ 323.00	$ 3,823	$ 3,938	$ 4,056	$ 4,178	$ 4,303	$ 4,432	$ 4,565	$ 4,702	$ 4,843	$ 4,988	$ 5,138	$ 5,292	$ 5,451	$ 5,614	$ 5,783
Pipeline Vent Filters (allow, installed)	6	each	$ 300.00	$ 5,217	$ 5,373	$ 5,535	$ 5,701	$ 5,872	$ 6,048	$ 6,229	$ 6,416	$ 6,609	$ 6,807	$ 7,011	$ 7,221	$ 7,438	$ 7,661	$ 7,891
Subtotal O & M				$ 141,402	$ 145,644	$ 150,013	$ 154,514	$ 182,848	$ 163,924	$ 168,841	$ 173,907	$ 179,124	$ 211,971	$ 190,033	$ 195,734	$ 201,606	$ 207,654	$ 245,732
O & M Contingencies	10%			$ 14,140	$ 14,564	$ 15,001	$ 15,451	$ 18,285	$ 16,392	$ 16,884	$ 17,391	$ 17,912	$ 21,197	$ 19,003	$ 19,573	$ 20,161	$ 20,765	$ 24,573
O & M Cash Flow				$ 155,542	$ 160,209	$ 165,015	$ 169,965	$ 201,133	$ 180,316	$ 185,726	$ 191,297	$ 197,036	$ 233,168	$ 209,036	$ 215,307	$ 221,766	$ 228,419	$ 270,306

Project Cash Flow				**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**
Capital Costs								$ 490,000										
O & M				$ 155,542	$ 160,209	$ 165,015	$ 169,965	$ 201,133	$ 180,316	$ 185,726	$ 191,297	$ 197,036	$ 233,168	$ 209,036	$ 215,307	$ 221,766	$ 228,419	$ 270,306
Discount Rate		Total	4%															
Net Present Value - Capital + Replacements		$ 5,190,954		$ -	$ -	$ -	$ -	$ 102,062	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Present Value - O & M (rounded)		$ 2,167,000		$ 37,901	$ 37,536	$ 37,175	$ 36,818	$ 41,894	$ 36,113	$ 35,766	$ 35,422	$ 35,082	$ 39,918	$ 34,410	$ 34,079	$ 33,752	$ 33,427	$ 38,035
Net Present Value		$ 7,357,954																

Notes
Assessment District alignment used for the lengths

Lower Lagoon Valley EIR - Life Cycle Costs
for New Offsite Wastewater Facilities

OPTION 2: GRAVITY SEWER

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
Capital (2005$)				
18" gravity sewer (Option 2)	3,900	LF	$ 504.10	$ 1,966,000
Estimating Contingencies	25%		$ 491,500	$ 2,457,500
Inflation to 2005	6.09%		$ 149,662	$ 2,607,162
Construction Contingency	7%		$ 182,501	
Engineering, Admin & Project Cont.	43%		$ 1,121,080	
Permitting (allowance - three locations)			$ 30,000	
Easement Acquisition Allowance			$ 88,000	
Total Capital (rounded)	-			$ 4,030,000

O & M (2005$)				2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Assumed Annual Inflation	3%		(2005$)																			
Cleaning	3,900	LF	$ 1.50						$ 6,782					$ 7,862					$ 9,114			
CCTV Inspection (add to cleaning)	3,900	LF	$ 0.50											$ 2,621					$ 3,038			
Subtotal O & M				$ -	$ -	$ -	$ -	$ -	$ 6,782	$ -	$ -	$ -	$ -	$ 10,483	$ -	$ -	$ -	$ -	$ 12,152	$ -	$ -	$ -
O & M Contingencies	10%			$ -	$ -	$ -	$ -	$ -	$ 678	$ -	$ -	$ -	$ -	$ 1,048	$ -	$ -	$ -	$ -	$ 1,215	$ -	$ -	$ -
O & M Cash Flow				$ -	$ -	$ -	$ -	$ -	$ 7,460	$ -	$ -	$ -	$ -	$ 11,531	$ -	$ -	$ -	$ -	$ 13,367	$ -	$ -	$ -

Project Cash Flow			2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Capital Costs			$ 4,030,000																		
O & M			$ -	$ -	$ -	$ -	$ -	$ 7,460	$ -	$ -	$ -	$ -	$ 11,531	$ -	$ -	$ -	$ -	$ 13,367	$ -	$ -	$ -
Discount Rate		Total	4%																		
Net Present Value - Capital + Replacments		$ 4,030,000	$ 4,030,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Present Value - O & M (rounded)		$ 64,000	$ -	$ -	$ -	$ -	$ -	$ 6,132	$ -	$ -	$ -	$ -	$ 7,790	$ -	$ -	$ -	$ -	$ 7,422	$ -	$ -	$ -
Net Present Value		$ 4,094,000																			

Notes
Assessment District alignment used for the lengths

Lower Lagoon Valley EIR - Life Cycle Costs
for New Offsite Wastewater Facilities

OPTION 2: GRAVITY SEWER

ITEM	QUANTITY	UNIT	UNIT COST
Capital (2005$)			
18" gravity sewer (Option 2)	3,900	LF	$ 504.10
Estimating Contingencies	25%		$ 491,500
Inflation to 2005	6.09%		$ 149,662
Construction Contingency	7%		$ 182,501
Engineering, Admin & Project Cont.	43%		$ 1,121,080
Permitting (allowance - three locations)			$ 30,000
Easement Acquisition Allowance			$ 88,000
Total Capital (rounded)	-		

O & M (2005$)				**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**
Assumed Annual Inflation	3%		(2005$)																				
Cleaning	3,900	LF	$ 1.50		$ 10,566					$ 12,249					$ 14,199					$ 16,461			
CCTV Inspection (add to cleaning)	3,900	LF	$ 0.50		$ 3,522					$ 4,083					$ 4,733					$ 5,487			
Subtotal O & M				$ -	$ 14,088	$ -	$ -	$ -	$ -	$ 16,331	$ -	$ -	$ -	$ -	$ 18,933	$ -	$ -	$ -	$ -	$ 21,948	$ -	$ -	$ -
O & M Contingencies	10%			$ -	$ 1,409	$ -	$ -	$ -	$ -	$ 1,633	$ -	$ -	$ -	$ -	$ 1,893	$ -	$ -	$ -	$ -	$ 2,195	$ -	$ -	$ -
O & M Cash Flow				$ -	$ 15,496	$ -	$ -	$ -	$ -	$ 17,965	$ -	$ -	$ -	$ -	$ 20,826	$ -	$ -	$ -	$ -	$ 24,143	$ -	$ -	$ -

Project Cash Flow			**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**
Capital Costs																						
O & M			$ -	$ 15,496	$ -	$ -	$ -	$ -	$ 17,965	$ -	$ -	$ -	$ -	$ 20,826	$ -	$ -	$ -	$ -	$ 24,143	$ -	$ -	$ -
Discount Rate		Total	4%																			
Net Present Value - Capital + Replacments		$ 4,030,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Present Value - O & M (rounded)		$ 64,000	$ -	$ 7,072	$ -	$ -	$ -	$ -	$ 6,739	$ -	$ -	$ -	$ -	$ 6,421	$ -	$ -	$ -	$ -	$ 6,118	$ -	$ -	$ -
Net Present Value		$ 4,094,000																				

Notes
Assessment District alignment used for the lengths

Lower Lagoon Valley EIR - Life Cycle Costs
for New Offsite Wastewater Facilities

OPTION 2: GRAVITY SEWER

ITEM	QUANTITY	UNIT	UNIT COST												
Capital (2005$)															
18" gravity sewer (Option 2)	3,900	LF	$ 504.10												
Estimating Contingencies	25%		$ 491,500												
Inflation to 2005	6.09%		$ 149,662												
Construction Contingency	7%		$ 182,501												
Engineering, Admin & Project Cont.	43%		$ 1,121,080												
Permitting (allowance - three locations)			$ 30,000												
Easement Acquisition Allowance			$ 88,000												
Total Capital (rounded)	-														
O & M (2005$)				**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**
Assumed Annual Inflation	3%		(2005$)												
Cleaning	3,900	LF	$ 1.50		$ 19,083					$ 22,122					$ 25,646
CCTV Inspection (add to cleaning)	3,900	LF	$ 0.50		$ 6,361					$ 7,374					$ 8,549
Subtotal O & M				$ -	$ 25,444	$ -	$ -	$ -	$ -	$ 29,496	$ -	$ -	$ -	$ -	$ 34,194
O & M Contingencies	10%			$ -	$ 2,544	$ -	$ -	$ -	$ -	$ 2,950	$ -	$ -	$ -	$ -	$ 3,419
O & M Cash Flow				$ -	$ 27,988	$ -	$ -	$ -	$ -	$ 32,446	$ -	$ -	$ -	$ -	$ 37,614
Project Cash Flow				**2044**	**2045**	**2046**	**2047**	**2048**	**2049**	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**
Capital Costs															
O & M				$ -	$ 27,988	$ -	$ -	$ -	$ -	$ 32,446	$ -	$ -	$ -	$ -	$ 37,614
Discount Rate		Total	4%												
Net Present Value - Capital + Replacments		$ 4,030,000		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Present Value - O & M (rounded)		$ 64,000		$ -	$ 5,830	$ -	$ -	$ -	$ -	$ 5,555	$ -	$ -	$ -	$ -	$ 5,293
Net Present Value		$ 4,094,000													

Notes
Assessment District alignment used for the lengths

TECHNICAL APPENDIX H

Technical Memorandum

Water Supply Investigation
Lower Lagoon Valley Project

CITY OF VACAVILLE

TECHNICAL MEMORANDUM

WATER SUPPLY INVESTIGATION
LOWER LAGOON VALLEY PROJECT

NOLTE

BEYOND ENGINEERING

JANUARY 2004

CITY OF VACAVILLE

TECHNICAL MEMORANDUM

WATER SUPPLY INVESTIGATION
LOWER LAGOON VALLEY PROJECT

January 2004

Submitted to:
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Utilities Division
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TECHNICAL MEMORANDUM

WATER SUPPLY INVESTIGATION
LOWER LAGOON VALLEY PROJECT

January 2004

This technical memorandum summarizes a water supply investigation for the proposed Lower Lagoon Valley (LLV) project. This investigation represents an analysis of potential impacts of serving the LLV project on the overall water supply and distribution system for the City of Vacaville (City). Recommended supply and distribution system improvements are identified, including non-potable water system components managed by the Solano Irrigation District (SID). The technical memorandum consists of: 1) a discussion of existing water supply and distribution system components (setting); 2) an analysis of LLV project impacts; and, 3) a summary of recommended facilities to mitigate impacts to the potable water and non-potable water systems.

SETTING

Setting is divided into the following elements: 1) a description of the LLV project; 2) a discussion of existing and planned water sources; and, 3) an inventory of local water production and distribution systems.

Lower Lagoon Valley (LLV) Project Description

The development would be located in the Lower Lagoon Valley area on the southeast side of Interstate 80 (I-80) from Lagoon Valley Road to the City limits. The project site is surrounded by a range of hills to the south and the east, the Lagoon Valley Lake to the north, and I-80 to the west (see Figure 1). Current land uses include residential, grazing and agricultural, the Hines Nursery facility, and City-owned open space.

The LLV project is a 1,325-unit home development, including an 18-hole championship-style golf course (approximately 213 acres), neighborhood commercial uses, and open space areas. The golf course would include a clubhouse facility. The total project area is approximately 879 acres, including 88 acres of business-park area with one-million square feet of commercial/office space and 50,000 square feet of Town Center retail space.

Figure 1

The residential portion of the LLV project would be divided into three community villages. Village I would include 517 small to moderate-sized parcels for attached townhouses and single family homes about 7,000 ft^2 in size. An elementary school with approximately 600 students encompassing 11 acres is also included within Village I, as well as a small park and a village center with small retail services. The village center is about 10,000 ft^2 (2.0 acres) of temporary development office to be converted to a community center. Village II would be separated from Village I by a portion of the proposed golf course and would include 398 single family homes on 7,000 ft^2 to 13,000 ft^2 lots. The total number of units for Village II includes 18 lots planned for Community Homes. Village III is planned to include 410 larger-size single family homes on parcels ranging from approximately 10,000 ft^2 to one acre in size. A summary of the LLV project land uses and surrounding areas is presented in Table 1 and illustrated in Figure 2. As reflected in the tables, of the approximately 2,354 acres within the study area only 879 acres are proposed for development by the LLV project.

As suggested above, there are land uses presented in Table 1 which are outside the proposed LLV project, yet fall within the study area and as such may impact the overall system requirements. Some of the areas include existing development (i.e. Area 1, Area 5 and Area 6), while other areas are specific to new development as proposed by the LLV project.

Sources of Water Supply

This section contains a description of the existing and planned groundwater, surface water, and water conveyance facilities. The water utility system is a self-supporting City enterprise. The water utility is responsible for operation, maintenance, and repair of the City's water treatment and distribution system, as well as water quality and recycled water distribution. Vacaville's water utility system was purchased from Pacific Gas and Electric (PG&E) Company in 1959 by issuing voter-approved water revenue bonds. Since purchasing the system, the City has systematically improved and upgraded this infrastructure.

Description of Existing Facilities

The Vacaville water system consists of surface water treatment facilities, wells, pumping facilities, distribution and transmission pipelines, and storage reservoirs. The system receives water from several sources, including Solano Project water from the Lake Berryessa reservoir, State Water Project water from the North Bay Aqueduct (NBA) through the North Bay Regional (NBR) water treatment plant (WTP), and groundwater from local city wells. Within Vacaville's water entitlements, the percentage of water used from each supply source varies due to conjunctive use. If any one source has limited water availability or poor water quality, use from other sources can increase. Likewise, if unscheduled water becomes available, it can be utilized to the City's advantage.

TABLE 1
LOWER LAGOON VALLEY PROJECT
SUMMARY OF PROPOSED LAND USES

Area	Land Use	Quantity	Unit	Notes
EXISTING DEVELOPMENT				
Area 1 - Commercial				
1A	Commercial Recreation	5.4	acres	Use growth factors
1B	Commercial Highway	6.8	acres	Use growth factors
1C	Commercial Highway	9.2	acres	Use growth factors
	Total - Area 1	**21.4**	**acres**	
Area 5 - Lower Lagoon Valley Regional Park				
5A	Park	40	acres	Irrigation only
5AA	Lake	105	acres	No water demand
5AAA	Open Space	243	acres	No water demand
	Total - Area 5	**388**	**acres**	
Area 6 - Open Space/Agricultural Hillside				
6A	Open Space East	385	acres	No water demand
6B	Agricultural Hillside Southeast	356	acres	No water demand
6C	Open Space Southwest	325	acres	No water demand
	Total - Area 6	**1,066**	**acres**	
PROPOSED DEVELOPMENT				
Area 2 - Business Park/Town Center/Fire Station				
2A	Business Park	85.2	acres	
2B	Fire Station	1	acres	Assumed public medium
2C	Town Center	3.8	acres	50,000 ft^2 at FAR = 0.3
	Total - Area 2	**90**	**acres**	
Area 3 - Residential				
3A	Village I - Residential	123	acres	517 dwelling units
3AA	Village I - School/Park	11	acres	600 students
3AAA	Village I - Village Center	2	acres	10,000 ft^2 at FAR = 0.3
3B	Village II - Residential	137	acres	380 dwelling units
3BB	Village II - Park "spine"	5	acres	Assumed 2% of total area
3C	Village III - Residential	217	acres	410 dwelling units
3CC	Village III - Parks	5	acres	Assumed 2% of total area
3D	Community Homes	22.7	acres	18 dwelling units
	Total - Area 3	**522.7**	**acres**	
Area 4 - Golf Course/Club House				
4A	Golf Course	211.7	acres	Irrigation only
4B	Club House/Restaurant/Offices	0.8	acres	10,000 ft^2 at FAR = 0.3
4C	Maintenance Facility	0.5	acres	7,000 ft^2 at FAR = 0.3
	Total - Area 4	**213**	**acres**	
Area 7 - Buffer				
7A	Nelson Road Berm	47	acres	Assumed open space
7B	Rivera Road Berm	6	acres	Assumed landscape park
	Total - Area 7	**53**	**acres**	
Total - Lower Lagoon Valley Area		**2,354**	**acres**	

Figure 2

Surface water from Lake Berryessa is provided by contract between the U.S. Bureau of Reclamation (BuRec) and the Solano County Water Agency (SCWA), delivered by the SID. This water is treated at either the NBR WTP or at the City's 10 million gallons per day (mgd) diatomaceous earth filter water treatment plant (DE WTP), in which the treated water empties into a ground-level chlorine contact basin.

Wells 1, 6, and 13 also supply water directly to this contact basin. From the contact basin, a booster pump station lifts the water into the distribution system. The remaining wells (2, 3, 5, 7, 8, 9, 14, and De Mello) supply water directly to the distribution system. A new production well (15) now drilled will be equipped and brought into production in 2004. De Mello, a low-capacity well, was brought into production in March 2003 to provide fresh water at a distribution system "dead-end" located on the outskirts of town. The locations of the existing City wells and DE WTP are shown in Figure 3.

The NBR WTP provides a capacity of 13.0 mgd for Vacaville and supplies water directly to the City's distribution system. The NBR WTP draws water from the Sacramento River Delta via the NBA, as well as Solano Project water from the Putah South Canal. The location of the NBA and Putah South Canal can be seen in Figure 4.

Groundwater

As noted earlier, one source of supply for the City is groundwater. Currently, groundwater is provided through eleven wells, ten of which withdraw water from the deep aquifer in the basal zone of the Tehama Formation. Historic groundwater pumping is summarized in Table 2. Most City wells are located in the Elmira well field. However, new wells are being sited further north, near Interstate 80 (I-80). Currently, approximately 6,600 acre-feet per year (ac-ft/yr) are withdrawn. Vacaville continues to explore well field expansion as a means of maintaining adequate water supply.

Figure 3

Figure 4

TABLE 2
HISTORICAL GROUNDWATER PUMPING FOR THE CITY OF VACAVILLE

Year	ac-ft/yr	Year	ac-ft/yr
1968	2,862	1986	5,829
1969	3,046	1987	6,267
1970	2,871	1988	5,420
1971	3,198	1989	6,073
1972	3,255	1990	5,626
1973	3,125	1991	5,447
1974	3,316	1992	5,531
1975	3,970	1993	4,395
1976	4,965	1994	3,892
1977	5,076	1995	3,885
1978	5,707	1996	3,230
1979	6,236	1997	3,386
1980	7,043	1998	3,905
1981	7,740	1999	4,096
1982	7,684	2000	5,141
1983	8,156	2001	6,211
1984	6,063	2002	6,638
1985	5,863		

Surface Water

The City has three separate sources for surface water. Each source has a different level of reliability. This section describes the City's surface water sources.

Solano Project (Vacaville Entitlement, SID Agreement)

The Solano Project was constructed by the BuRec in 1958. The Solano Project is not part of the Federal Central Valley Project, but the BuRec is the owner of the facility and holds the water rights. Unlike most federal water projects, the water rights to the Solano Project "belong" to the Solano water users. The main feature of the Solano Project is Monticello Dam, which provides for storage of 1.6 million ac-ft of water in Lake Berryessa (Lake). Water from the Lake is diverted through the Solano Diversion Dam to the 32-mile Putah South Canal, which transports water to the eight SCWA-member unit contractors for Solano Project water.

SCWA has entered into agreements with cities, districts, and state agencies to provide water from the Solano Project. The Solano Project contracting agencies are: Fairfield, Suisun City, Vacaville, Vallejo, SID, Maine Prairie Water District, University of California at Davis, and California State Prison - Solano. The annual entitlement for each agency is described in Table 3.

TABLE 3
SUMMARY OF SOLANO PROJECT WATER CONTRACTS [1]

Agency	Annual Entitlement (ac-ft/yr)
Fairfield	9,200
Suisun City	1,600
Vacaville	5,750
Vallejo	14,600
SID	141,000
Maine Prairie Water District	15,000
UC Davis	4,000
California State Prison – Solano	1,200
Project Operating Loss (average estimated)	15,000
Total	207,350 [a]

[a] Value approximates a firm yield during the driest hydrologic period on record (1916-1934).

The contracts with the public entities that use Solano Project water provide for the sale and distribution of water made available by the BuRec each year. The BuRec is contractually committed to delivering the full contract amount of water supply from the Solano Project unless the water supply does not physically exist (e.g. an empty reservoir). All Solano Project contractors, whether they are municipal or agricultural, are impacted by water supply reductions on an equal basis.

In addition to its entitlement from SCWA, Vacaville entered into a 1995 Master Water Agreement with SID, pursuant to which Vacaville receives an increasing water supply from SID through the year 2016 and a consistent supply thereafter until the year 2045. A summary of the annual water schedule of SID water available to Vacaville is contained in Table 4.

TABLE 4
ANNUAL WATER SCHEDULE FOR THE SID WATER AGREEMENT [2]

Year	Annual Entitlement (ac-ft/yr)	Year	Annual Entitlement (ac-ft/yr)
2001	2,500	2009	3,000
2002	2,500	2010	8,000
2003	2,500	2011	8,000
2004	2,500	2012	9,000
2005	3,000	2013	9,000
2006	3,000	2014	10,000
2007	3,000	2015	10,000
2008	3,000	2016 through 2045	10,050

State Water Project (North Bay Aqueduct)

Vacaville receives water allocations from the State Water Project (SWP) through the SCWA and water from a Year 2000 purchase agreement from Kern County Water Agency (KCWA). Surface water received pursuant to these agreements is delivered though the North Bay Aqueduct (NBA), a SWP facility. The City supply from the State Water Project is 6,100 ac-ft/yr, while KCWA Agreement water totals 2,878 ac-ft/yr. The Solano County branch of the NBA was completed in 1988. The North Bay Aqueduct is 28 miles long starting from Barker Slough in the Delta and ending in Napa County. The location of the NBA can be seen in Figure 5. The California Department of Water Resources (DWR) is the owner and operator of the NBA.

The water supply for the NBA is less reliable than the Solano Project. Supply from the NBA comes from the State Water Project which provides water to a total of 29 contractors. Because the NBA is part of the entire State Water Project, any shortages occurring in the State Water Project impact the NBA.

There are currently seven agencies with NBA water allocations. These include Benicia, Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo. The annual increase in SCWA's contract is described in Table 5. Member units using the NBA and their allocations are described in Table 6. Shortages during dry years are proportional to their share of the overall contract with DWR.

TABLE 5
SUMMARY OF STATE WATER PROJECT ALLOCATIONS TO THE SOLANO COUNTY WATER AGENCY THROUGH THE NORTH BAY AQUEDUCT [1]

Year	Annual Entitlement (ac-ft/yr)	Year	Annual Entitlement (ac-ft/yr)
2001	45,836	2009	47,456
2002	46,296	2010	47,506
2003	46,756	2011	47,556
2004	47,206	2012	47,606
2005	47,256	2013	47,656
2006	47,306	2014	47,706
2007	47,356	2015[a]	47,756
2008	47,406		

[a] Each year thereafter will have an annual allocation of 47,756 ac-ft/yr.

TABLE 6
STATE WATER PROJECT
ALLOCATION TO SOLANO COUNTY CITIES SERVED BY THE NORTH BAY AQUEDUCT [1]

City	Annual Entitlement (ac-ft/yr)
Benicia	17,200
Dixon	0[a]
Fairfield	14,678
Rio Vista	0[a]
Suisun City	1,300
Vacaville	8,978[b]
Vallejo	5,600
Total	47,756

[a] Dixon and Rio Vista currently do not use their individual entitlement of 1,500 ac-ft/yr. If Dixon and/or Rio Vista decide to use the NBA water supply, supplies to Benicia, Fairfield and Vallejo are reduced commensurately.
[b] Vacaville entitlement to State Water Project and transfers from Kern County Water Agency.

Settlement Water (DWR Agreement)

Settlement water consists of surface water from the Sacramento River and Sacramento-San Joaquin Delta Estuary. Settlement water is diverted under water rights held by DWR, but is not considered State Water Project (SWP) water. The water is made available by DWR in settlement of area-of-origin water right applications by the cities of Fairfield, Benicia, and Vacaville. The Settlement Agreement provides an entitlement to each of those three cities as shown in Table 7 which is based on critical dry year deliveries.

TABLE 7
SUMMARY OF SETTLEMENT WATER FOR THE CITIES OF FAIRFIELD, BENICIA, AND VACAVILLE [1]

Agency	Annual Entitlement (ac-ft/yr)
Fairfield	11,800
Benicia	10,500
Vacaville	9,320
Total	**31,620**

Recycled Water

In 2003, the City began developing a Recycled Water Master Plan. Preliminary planning estimates indicate tertiary treated recycled water available for delivery, with the appropriate infrastructure in place, by 2015. Potential irrigation customers have been identified and a stakeholder's workshop was held in July 2003 to review preliminary planning with affected community members. At present, delivery estimates for 2015 total 1,175 ac-ft/yr. Knowing that this drought-proof resource will require user contracts and possible retrofit costs on the user's behalf, for planning purposes 75 percent of the total delivery figure or 880 ac-ft/yr is assumed [3].

Summary of Water Supply Sources

For the City, at buildout, the total water supply available from groundwater, surface water, and recycled water will be 42,978 ac-ft/yr. A summary of the respective supply sources previously discussed is presented in Table 8.

TABLE 8
CITY OF VACAVILLE
TOTAL WATER SUPPLY AT BUILDOUT

Sources of Supply	**Entitlement (ac-ft/yr)**
Solano Project	
Vacaville Entitlement	5,750[a]
SID Agreement	10,050[b]
State Water Project	
Vacaville (Table A)	6,100
KCWA Agreement	2,878
Settlement Water[c]	9,320
Groundwater Pumping[d]	8,000
Recycled Water	880
Total	**42,978**

[a] See Table 3
[b] See Table 4
[c] See Table 7
[d] Reference 4

Water Production and Distribution Facilities

This section contains a description of the water production facilities, including surface water treatment plants and wells, along with water distribution facilities.

Potable Water Production Facilities

Potable water production facilities include wells and surface water treatment plants (see Figure 3). A summary of the existing and near-term water production facilities available to the City is presented in Table 9. For reference, near-term is defined as the initial 5 year period (Year 2008). As noted earlier, the City participates in two water treatment facilities: (1) the DE WTP; and, (2) the NBR WTP. The City owns 11 municipal groundwater wells generally located along the Elmira Road corridor, east of I-80 and west of Leisure Town Road. Water from Wells 1, 6, and 13 are chlorinated at the DE WTP and then pumped to the City distribution system. The remaining wells (2, 3, 5, 7, 8, 9, and 14) supply water directly to the distribution system. A low capacity well (0.22 mgd) located at the intersection of Midway Road and I-80, the De Mello Well, was brought into production in March 2003 to provide fresh water at a distribution system "dead-end" located on the outskirts of town. The well was designed to provide re-circulation and improve water quality at the existing water main in the area (currently a long dead-end water main from Leisure Town Road).

TABLE 9
CITY OF VACAVILLE
SUMMARY OF EXISTING AND NEAR-TERM WATER PRODUCTION FACILITIES

Production Facility	Capacity, mgd
Existing Potable Water Wells	
Well 1	0.33
Well 2	1.58
Well 3	2.20
Well 5	1.87
Well 6	1.64
Well 7	1.60
Well 8	2.20
Well 9	2.02
Well 13	2.00
Well 14	2.50
DeMello Well	0.22
Subtotal - Existing Wells	**18.16**
Near-Term Potable Water Wells	
Well 15 (expected on line in 2004)	2.50
Well 16 (expected on line in 2006)	2.50
Well 17 (expected on line in 2008)	2.50
Subtotal – Near-Term Wells	**7.50**
All Wells (Existing and Near-Term)	**25.66**
Less 5.0 mgd from Wells [a]	- 5.00
Subtotal – Wells Maximum Production Capacity	**20.66**
Existing Water Treatment Plants	
DE WTP [b]	6.89
NBR WTP (allocation) [c]	13.00
Subtotal – Existing WTP Maximum Production	**19.89**
Total Maximum Production Capacity	**40.55**
Firm Production Capacity [d]	**36.49**

[a] 5.0 mgd of groundwater wells are assumed out of service (OOS) due to well interference and distribution system impacts.
[b] The DE WTP is nominally rated at 8,200 gpm, maximum production is based on 15 hours of operation per day (14 hours of production and 1 hours for startup/backwash) for a total of 6.89 mgd.
[c] City allocation
[d] Firm production capacity is defined as 90% of the maximum production capacity (40.55 x 0.9 = 36.49 mgd)

The City has plans to replace or rehabilitate existing wells and to construct three new wells in the near-term to more fully develop the groundwater supply. A new well (Well 15), located near the intersection of Vaca Valley Parkway and Leisure Town Road, is expected to be in service in 2004. Similar plans are underway for Wells 16 and 17.

Potable Water Distribution System Facilities

Existing and planned water distribution system facilities are described below.

- Existing

The City's potable water distribution system consists of one main pressure zone (main zone) plus several higher elevation pressure zones (upper pressure zones) in various areas of the City. The main zone serves elevations up to 222 feet. All of the water production facilities are located within the main zone. The main zone currently has four water storage reservoirs and one (or two) water storage reservoirs at each upper pressure zone for a combined capacity of 13.8 million gallons (MG). The nearest reservoirs to the LLV project are the Butcher Road Reservoirs. The Butcher Reservoirs are part of the City's main zone. The City's reservoir locations and upper pressure zones are illustrated in Figure 5.

Reservoirs are required to provide operational, fire, and emergency storage. The water mains in the existing water distribution system form a network throughout the City. Large-diameter water transmission mains form the backbone of the system and convey water from the water production facilities to the major sectors of the City. The largest water transmission mains are 30 inches in size. One 30-inch water transmission main originates at the NBR WTP and follows Peabody Road northward to Elmira Road. At Elmira Road, this water transmission main joins with another 30-inch water transmission main that ties into the DE WTP. The next largest water transmission main in the system is a 24-inch water transmission main that originates at the intersection of Peabody Road and Elmira Road and extends north on Browns Valley Road to provide service to the northern sectors of the City. The 24-inch water transmission main extends from Browns Valley Road to Vaca Valley Parkway. Elsewhere, the distribution system has several 18-inch water transmission mains and many 12-inch and smaller water distribution mains. Existing water transmission and distribution (12-inch and larger) mains in the vicinity of the LLV project are shown in Figure 6.

Currently, areas near the LLV project area are served by a single 8-inch water line which originates at the Butcher Road Reservoirs and extends to the north end of the valley. This existing water main from the main zone will not be sufficient to provide adequate water distribution to the proposed LLV project.

Figure 5

Figure 6

- Planned

Specific onsite water system improvements to serve the LLV project were not included in the 1990 *Water System Master Plan* [5] for the City. However, onsite and offsite transmission main improvements were identified in the City's 1992 *Development Impact Fee Study (DIF)* [6]. When development in this area occurs, major water system infrastructure will be needed from the perimeter of the existing system to and throughout the LLV area. Furthermore, the water demand from these developments will necessitate augmenting the pipelines in the existing system. Such improvements may include a new transmission main beginning at Peabody Road and Alamo Drive that then follows Alamo Drive to Buck Avenue. Figure 8 illustrates the planned potable water distribution system facilities in the vicinity of the LLV project. The proposed improvements were identified previously in the referenced *DIF Study* [6]. A description of each of the scheduled improvements depicted in Figure 7 is provided below.

- ***DIF 10 – Alamo Drive Pipeline – Peabody to I-80***: A new pipeline within the main zone will be required to allow water to be withdrawn from the main zone at the Butcher Reservoirs for Lower Lagoon Valley. This pipeline will originate at Peabody Road and California Drive and run west on California Drive, north on Davis Street, and northwest on Alamo Drive to the south side of I-80. An 18-inch pipeline is proposed if only the Lower Lagoon Valley development is considered, however to accommodate future development and provide a stronger link between storage and distribution facilities, a larger 24-inch pipeline is recommended. This pipeline was scheduled for construction in 1992 but the lack of development in Lower Lagoon Valley has deferred the need for this improvement. The City installed a portion of this project from Peabody Road to Alamo Lane (along California Drive) in the year 2000 as part of a slurry seal program for the existing street. This project will be funded by development impact fees.

- ***DIF 60 – Peabody Road Pipeline***: When the City's allocation in the NBR WTP increases beyond 13.0 mgd, a parallel pipeline from the NBR WTP is proposed from the plant to California Drive. The pipeline will include 36-inch and 30-inch segments parallel to the existing 30-inch and 24-inch pipeline from the NBR WTP. This project will be funded by development impact fees.

Non-Potable Water Distribution System Facilities

- Existing

Currently, non-potable water for the Lower Lagoon Valley area (for irrigation uses in Lagoon Valley Regional Park and the Hines Nursery) is supplied by SID. The existing non-potable water system includes the Paradise Valley Pumping Plant with a capacity of

Figure 7

6,200 gpm, located near the intersection of the Putah South Canal and Grover Avenue in the City of Fairfield [7]. The supply for this pump station is the Putah South Canal and water is pumped to a 600,000 gallon non-potable water storage reservoir (Paradise Valley Tank). The pump station, reservoir and non-potable piping network serve the irrigation demand from the Hines Nursery, Paradise Valley Golf Course, Lagoon Valley Regional Park, and other park/landscape and agricultural uses. The pipeline from the Paradise Valley Tank is 18-inch for approximately 1,800 feet reducing to 12-inch for approximately 1,700 feet before the existing Hines Nursery turnout. The design capacity of this pipeline is 1,500 gpm [7]. A schematic representation of the existing non-potable water distribution system is presented in Figure 8.

ANALYSIS OF PROJECT IMPACTS

To determine project impacts, water demands were estimated for the LLV project along with other proposed developments citywide. Total water demands were then compared to available water supply. In addition, the existing City water distribution system was evaluated to identify any potential impacts from the proposed project. The results of the impacts analysis are presented as follows.

Water Demand Factors

A summary of the potable and irrigation water demand factors for both existing and future development currently used by the City for planning purposes is presented in Table 10. All of the water demand factors, with the exception of Residential Low Density (RLD), Residential Estate (RE), Residential Low Medium Density (RLMD), and Commercial Highway (CH), were presented in a 1994 technical memorandum, *Water and Sewer Planning Factors Reconciliation – Final Draft* [8]. The water demand factors for RLMD, RLD, RE, and CH were recently updated as a result of actual water metering data obtained and analyzed for the City in preparation for the *SB610 Water Supply Assessment Report for Lagoon Valley, Southtown, and Rice McMurtry* [9]. The difference between the two sets of demand factors (existing versus future) includes a contingency to reflect uncertainties in projecting future land use. These factors also reflect increase in water demand for new development versus existing within a given land use category.

Figure 8

TABLE 10
CITY OF VACAVILLE
SUMMARY OF WATER DEMAND FACTORS
EXISTING AND FUTURE DEVELOPMENT[a]

			Existing Development		Future Development	
Land Use	**Designation**	**Unit**	**Potable gpd/unit**	**Irrigation gpd/unit**	**Potable gpd/unit**	**Irrigation gpd/unit**
Residential Low Medium Density	RLMD	du	340	0	420	0
Residential Low Density	RLD	du	380	0	520	0
Residential Estates	RE	du	680	0	600	0
Rural Residential	RR	du	850	0	1,000	0
Residential Medium Density	RMD	du	300	0	350	0
Residential High Density	RHD	du	260	0	300	0
Residential Urban High Density	RUHD	du	210	0	250	0
Manufactured Homes	MH	du	260	0	300	0
Retirement Residential	RetRes	du	300	0	350	0
Office	O	ac	1,000	500	1,600	450
Business Park	BP	ac	1,000	400	1,600	450
Industrial	IND	ac	1,200	400	2,000	450
Retail Sales	RS	ac	1,000	400	1,600	450
Downtown	D	ac	3,900	100	3,900	100
Commercial Highway	CH	ac	1,700	400	4,750	450
Commercial Service	CS	ac	1,000	400	1,600	450
Public	P	ac	1,000	400	1,600	450
Park	PK	ac	0	1,300	0	2,100
Park Regional	PR	ac	100	1,500	170	2,500
Elementary School[b]	ESC	stu/ac	25	900	30	1,500
High School[b]	HSC	stu/ac	35	900	40	1,500
Open Space	OS	ac	0	0	0	0
Hospital	HOS	ac	1,400	500	2,300	450
Agricultural	AG	ac	0	0	0	0

[a] Includes updated future development factors for RLMD, RE, RLD, and CH per *SB 610 Water Supply Assessment Report for Lagoon Valley, Southtown, and Rice/McMurtry* [9].
[b] Potable demand for schools is per student basis while irrigation demand is per acre basis.

Projected Water Demands

Water demands are divided into potable and non-potable components. The non-potable water demands will be supplied by SID. Each demand is analyzed below.

Potable

A summary of the total (potable and non-potable) water demand for the LLV project is presented in Table 11. The water demand estimate is based on land use totals (dwelling units and acreage) and the water demand factors summarized in Table 10. As summarized in

TABLE 11

LOWER LAGOON VALLEY PROJECT

SUMMARY OF ESTIMATED TOTAL (POTABLE AND NON-POTABLE) WATER DEMANDS

						Demand Factors		Demand			
						Potable	Non-Potable	Potable	Non-Potable	Total	
Area	Land Use	Designation	Quantity	Unit	Notes	gpd/unit	gpd/unit	gpd	gpd	gpd	ac-ft/yr
EXISTING DEVELOPMENT											
Area 1 - Commercial											
1A	Commercial Recreation	CS	5.4	acres	Use growth factors	1,600	450	8,640	2,430	11,070	
1B	Commercial Highway	CH	6.8	acres	Use growth factors	4,750	450	32,300	3,060	35,360	
1C	Commercial Highway	CH	9.2	acres	Use growth factors	4,750	450	43,700	4,140	47,840	
	Total - Area 1		21.4	acres				84,640	9,630	94,270	106
Area 5 - Lower Lagoon Valley Regional Park											
	Park	PK	40	acres	Irrigation only	0	1,300	0	52,000	52,000	
	Lake	OS	105	acres	No water demand	0	0	0	0	0	
	Open Space	OS	243	acres	No water demand	0	0	0	0	0	
	Total - Area 5		388	acres				0	52,000	52,000	58
Area 6 - Open Space/Agricultural Hillside											
6A	Open Space East	OS	385	acres	No water demand	0	0	0	0	0	
6B	Ag. Hillside Southeast	AG	356	acres	No water demand	0	0	0	0	0	
6C	Open Space Southwest	OS	325	acres	No water demand	0	0	0	0	0	
	Total - Area 6		1,066	acres				0	0	0	0
PROPOSED DEVELOPMENT											
Area 2 - Business Park/Town Center/Fire Station											
2A	Business Park	BP	85.2	acres		1,600	450	136,320	38,340	174,660	
2B	Fire Station	PM	1	acres	Public medium use	1,600	450	1,600	450	2,050	
2C	Town Center	CS	3.8	acres	50,000 ft^2 at FAR = 0.3	1,600	450	6,080	1,710	7,790	
	Total - Area 2		90	acres				144,000	40,500	184,500	207

(Continued)

TABLE 11

LOWER LAGOON VALLEY PROJECT

SUMMARY OF ESTIMATED TOTAL (POTABLE AND NON-POTABLE) WATER DEMANDS (CONTINUED)

						Demand Factors		Demand			
						Potable	Non-Potable	Potable	Non-Potable	Total	
Area	Land Use	Designation	Quantity	Unit	Notes	gpd/unit	gpd/unit	gpd	gpd	gpd	ac-ft/yr
Area 3 - Residential											
3A	Village I - Residential	RLD	123	acres	517 dwelling units	520[a]	0	268,840	0	264,840	
	Village I - School/Park	ESC	11	acres	600 students	30[b]	1,500	18,000	16,500	34,500	
	Village I - Village Center	RS	2	acres	10,000 ft^2 at FAR = 0.3	1,600	450	3,200	900	4,100	
3B	Village II - Residential	RLD	137	acres	380 dwelling units	520[a]	0	197,600	0	197,600	
	Village II - Park "spine"	PK	5	acres	2% of total area	0	2,100	0	10,500	10,500	
3C	Village III - Residential	RLD	217	acres	410 dwelling units	520[a]	0	213,200	0	213,200	
	Village III - Parks	PK	5	acres	2% of total area	0	2,100	0	10,500	10,500	
3D	Community Homes	RLD	22.7	acres	18 dwelling units	520[a]	0	9,360	0	9,360	
	Arterial Landscape	CS	26	acres	5% of Area 3	0	450	0	11,700	11,700	
	Total - Area 3		522.7	acres	(neglect arterial landscape)			710,200	50,100	760,300	852
Area 4 - Golf Course/Club House											
4A	Golf Course	PK	211.7	acres	Irrigation only	0	2,100	0	444,570	444,570	
4B	Club House/Rest./Offices	CS	0.8	acres	10,000 ft^2 at FAR = 0.3	1,600	450	1,280	360	1,640	
4C	Maintenance Facility	CS	0.5	acres	7,000 ft^2 at FAR = 0.3	1,600	450	800	225	1,025	
	Total - Area 4		213	acres				2,080	445,155	447,235	501
Area 7 - Buffer											
7A	Nelson Road Berm	OS	47	acres	No water demand	0	0	0	0	0	
7B	Rivera Road Berm	PK	6	acres	Landscape park	0	2,100	0	12,600	12,600	
	Total - Area 7		53	acres				0	12,600	12,600	14
Total - Lower Lagoon Valley Project			**2,354**	**acres**				**940,920**	**609,985**	**1,550,905**	**1,738**

[a] Demand factor is per dwelling unit not per acre.
[b] Demand factor is per student not per acre.

Table 11, the total water demand requirements for LLV are estimated at 1.55 mgd (1,738 ac-ft/yr).

SID Non-Potable

Non-potable water from SID must be used to irrigate the proposed golf course and landscaping within the school, business park, Lagoon Valley Regional Park, buffer area, and commercial land uses of the area. Irrigation areas and estimated irrigation demand based on the factors described above are summarized in Table 12.

Effect of Demand Management Practices

Under drought conditions the City has the ability to reduce water demand. As drought or emergency conditions are declared by the City Council, additional water rate tiers are added to the existing rate structure to promote conservation. The City is also committed to implementing water conservation programs by means of various Demand Management Measures (DMMs). In past years demand management practices have been effective in reducing water demand and based on historical experience, the City has the ability to reduce demand by 10 percent during a single-dry year and by 20 percent during a multi-dry year. Reduced water demands will be considered in subsequent analyses of water supply availability during drought conditions.

Water Supply Considerations

The existing City water demand is estimated at approximately 15.6 mgd (17,524 ac-ft/yr) based on the 2003 monthly water production (including projection for December 2003) as reported by the City. Including the proposed LLV project, the water demand will increase to about 17.2 mgd (19,262 ac-ft/yr). The City Year 2025 water demand including Lower Lagoon Valley, Southtown, and Rice McMurtry projects will increase to about 28.0 mgd (31,331 ac-ft/yr) as shown in Table 13.

TABLE 12
LOWER LAGOON VALLEY PROJECT
SUMMARY OF NON-POTABLE WATER DEMAND TO BE SUPPLIED BY SID

Land Use	Designation	Quantity	Units	Demand Factor, gpd/unit	Irrigation Demand gpd	Irrigation Demand ac-ft/yr
Area 1 – Commercial						
Commercial Recreation	CS	5.4	ac	450	2,430	
Commercial Highway	CH	16.0	ac	450	7,200	
Subtotal – Area 1		21.4	ac		9,630	11
Area 2 – Business Park						
Business Park	BP	85.2	ac	450	38,340	
Fire Station	PM	1.0	ac	450	450	
Town Center	CS	3.8	ac	450	1,710	
Subtotal – Area 2		90.0	ac		40,500	45
Area 3 – Residential						
Village I – School/Park	ESC	11	ac	1,500	16,500	
Village I – Village Center	RS	2	ac	450	900	
Village II – Park "spine"	PK	5	ac	2,100	10,500	
Village III – Parks	PK	5	ac	2,100	10,500	
Arterial Landscape	CS	26.0	ac	450	11,700	
Subtotal – Area 3		49.0	ac		50,100	56
Area 4 – Golf Course						
Golf Course	PK	211.7	ac	2,100	444,570	
Club House	CS	0.8	ac	450	360	
Maintenance Facility	CS	0.5	ac	450	225	
Subtotal – Area 4		213	ac		445,155	499
Area 5 – Lower Lagoon Valley Regional Park						
Park	PK	40	ac	1,300	52,000	
Lake	PK	105	ac	0	0	
Open Space	OS	243	ac	0	0	
Subtotal – Area 5		388	ac		52,000	58
Area 6 – Open Space						
Open Space	OS	710	ac	0	0	
Agricultural Hillside	AG	356	ac	0	0	
Subtotal – Area 6		1,056	ac		0	0
Area 7 – Buffer						
Nelson Road Berm	OS	47	ac	0	0	
Rivera Road Berm	PK	6.0	ac	2,100	12,600	
Subtotal – Area 7		53.0	ac		12,600	14
Total – Non-Potable Water Demand for LLV Area [a]					**609,985**	**683**

[a] This total was also included in Table 11.

TABLE 13
CITY OF VACAVILLE
SUMMARY OF YEAR 2025
NORMAL YEAR ANNUAL WATER DEMAND

	Demand (ac-ft/yr)
Existing City (2003)	17,524
Lower Lagoon Valley Project	1,738
Southtown Project	831
Rice McMurtry Project	194
Other Future Growth in the City	11,044
Total Demand	**31,331**

An analysis of available water supplies was prepared as part of an *SB 610 Water Supply Assessment Report* for the City [9]. As summarized in Table 14, the Year 2005 available normal year water supply for the City is 33,060 ac-ft/yr. Normal year water supply available for Vacaville in Year 2025 is approximately 41,990 ac-ft/yr while the estimated normal water demand (including the proposed LLV project) is 31,331 ac-ft/yr. As shown in Table 14, sufficiency of water supply can be demonstrated under a variety of delivery conditions.

TABLE 14
CITY OF VACAVILLE
SUMMARY OF PROJECTED WATER DEMAND VERSUS SUPPLY
DURING NORMAL, SINGLE-DRY, AND MULTIPLE DRY YEARS [9]

	Normal Year(ac-ft/yr)		Single-Dry Year (ac-ft/yr)		Multiple Dry Years (ac-ft/yr)	
Year	Projected Demand	Available Supply	Projected Demand	Available Supply	Projected Demand	Available Supply
2005	18,780	33,060	16,902	32,216	15,024	29,990
2010	21,917	38,560	19,726	37,816	17,533	36,290
2015	25,055	41,440	22,549	40,696	20,043	39,170
2020	28,193	41,990	25,374	41,346	22,554	39,820
2025	31,331	41,990	28,197	41,346	25,065	39,820

City-Wide Storage Considerations

The *Water System Master Plan* for the City specifies requirements for total water storage in the City's distribution system [5]. As noted previously, there are three components to total storage: operational, emergency, and fire. Operational and emergency storage are established as 25 percent and 50 percent of maximum day demand, respectively. Storage for fire fighting purposes is based upon a demand of 4,500 gpm sustained for 4 hours. This is the highest fire flow

requirement (industrial, commercial, and high density residential land uses) described in the *Water System Master Plan*.

As presented in the City of Vacaville, *Infrastructure, Facilities and Services, Status Report 2003 Update* [11], Table 16 summarizes the total system storage requirements for the City based on the actual maximum day demand in 2001-2003 and projected maximum day demand in 2004-2007. The current shortfall in planned water storage is about 5.2 MG. The City Council has authorized design of a new 5.1 MG capacity reservoir (McMurtry Reservoir) withinr the Rice McMurtry project area. The construction of the McMurtry Reservoir will help eliminate the current storage deficit. With time, however, additional storage will be necessary as detailed in Table 15. The City is currently evaluating sites for additional storage beyond the McMurtry Reservoir.

TABLE 15
CITY OF VACAVILLE
ACTUAL AND PROJECTED WATER STORAGE REQUIREMENTS

Year	Maximum Day Demand [a] (MGD)	Water Storage Requirements (MG)				Existing Storage [e] (MG)	Shortfall Storage [f] (MG)
		Operational Storage [b]	Fire Storage [c]	Emergency Storage [d]	Total Requirement		
2001	26.1	6.5	1.1	10.0	17.6	13.8	3.8
2002	27.4	6.9	1.1	10.6	18.6	13.8	4.8
2003	28.0	7.0	1.1	10.9	19.0	13.8	5.2
2004	29.7	7.4	1.1	11.8	20.3	13.8	6.5
2005	31.4	7.9	1.1	12.6	21.6	13.8	7.8
2006[g]	33.1	8.3	1.1	13.5	22.9	18.9	4.0
2007[h]	34.8	8.7	1.1	14.3	24.1	22.6	1.5
2008	36.3	9.1	1.1	15.1	25.3	22.6	2.7

[a] Based on actual maximum day demand for year 2001, 2002, and 2003. Subsequent future demands are projected at increase of 1.7 mgd/year.
[b] Operational Storage = 25% of maximum day demand.
[c] Fire Storage = 4,500 gpm for 240 minutes (4 hours).
[d] Emergency storage assumes a 12 hour loss of power, or approximately 50% of maximum day demand. As a mitigation factor, however the DE WTP has backup power for half its capacity (5 MGD) and Well 8 has backup power for its full capacity (2 MGD). Assuming the DE WTP can produce water for 10 hours out of the 12 hour loss of power period results in a total production of 2.1 MG. Similarly, Well 8 operating for 12 hours can produce a total of 1 MG of water. Thus, the total available production during the 12 hour loss of power period is (2.1 MG from the DE WTP and 1.0 MG from Well 8) 3.1 MG. Therefore, the emergency storage requirement is actually 50% of maximum day demand minus 3.1 MG.
[e] Includes the total capacities of all existing City water storage reservoirs and planned water storage reservoirs.
[f] Shortfall storage is estimated as the difference between the total requirement and existing storage.
[g] Existing storage is increased by 5.1 MG in 2006 with the planned completion of the McMurtry Reservoir.
[h] Storage is increased in 2007 by 3.68 MG for the Lower Lagoon Valley reservoirs (Zone 2 - 2.9 MG, Zone 3 – 0.25 MG) and Rice McMurtry Reservoir (0.53 MG).

Service Area Requirements

Pad elevations for residential and commercial developments within the LLV project will range from 210 ft to 340 ft. The maximum service elevation within the main zone is 222 ft. The design

criteria contained in the City's *Water System Master Plan* [5] limits the maximum elevation differential for any new service zone to 100 ft. Therefore, two upper pressure zones (Zone 2 and Zone 3) will be necessary to serve all planned development within the LLV project. Zone 2 will provide onsite potable water service to development between elevations 210 ft and 310 ft including the office/commercial (business park land use) areas at elevation 210 ft. Zone 3 would serve elevations higher than 310 ft.

Configuring Zone 2 and Zone 3 as a single pressure zone and incorporating pressure reducing valves is technically possible. However, this concept has several drawbacks as discussed below.

- Pumping to a higher elevation and then reducing the pressure for most of the service area would result in wasted pumping energy.
- The pressure reducing stations must be well maintained to prevent failure and possible over pressurization of the lower system.
- Compatibility with any future water system facilities in the Lower Lagoon Valley would be limited.

Considering these factors, two upper pressure zones (Zone 2 and Zone 3) are recommended for the LLV project. Performance criteria which apply to this distribution system expansion include the following:

1. Within a street, only distribution system piping for one service zone may be constructed.

2. All water mains shall be looped such that no dead-end exceeds 600 ft in length.

3. Water will be delivered under average day and maximum day demand conditions at a residual pressure ranging from 35 to 88 psi.

4. Water will be delivered under maximum day plus fire flow demands at a minimum residual pressure of 20 psi.

5. Storage capacity in upper service zone reservoir(s) will be determined in accordance with the City's *Water System Master Plan* criteria.

By serving all the development of the LLV project and surrounding parcels between 210 ft and 340 ft using at least two new upper service zones will satisfy the referenced *Water Master Plan* criteria.

Figure 9

Main Zone Water System Improvements

In terms of main zone improvements, the previously described DIF 10 project (24-inch water transmission main) will be required to strengthen the existing transmission main network (see Figure 9). Without including DIF 10 as a water system improvement, serving the LLV project will impact filling operations at the existing Butcher Reservoirs within the main zone based on preliminary computer simulations. The computer modeling was conducted at near-term conditions (Year 2008) with an estimated main zone maximum day demand of 36.3 mgd. Citywide buildout conditions should be modeled prior to project approval (tentative map phase) to verify that DIF 10 does not need to be upsized to ensure adequate water supply to the LLV area.

On-Site Potable Water System Improvements - Zone 2

The LLV project boundary will be served by two new upper service zones (Zone 2 and Zone 3). The estimated average day water demand for the proposed Zone 2 service area boundary is approximately 906,080 gpd.

To supply this new upper zone (Zone 2) for the LLV project, a water storage tank, a booster pump station (near the Butcher Reservoirs), and a supply pipeline from the main zone to the booster pump station must be constructed. The pump station would be sited near the Butcher Road Reservoirs. Location of the booster pump station along the northerly perimeter of the project area will facilitate water circulation through the new upper zone while minimizing dead ends. A pump station siting study must be conducted to identify which area near the Butcher Reservoirs is best suited for this new facility. The siting study will also identify how the piping should be configured to maintain water quality and reservoir turnover. Zone 2 will also include a water storage reservoir located above the service area southwest of the Village III development and a network of distribution system pipelines.

A reservoir siting study is also necessary and must be conducted to identify potential reservoir sites for the construction of the upper zone (Zone 2) water storage tank. The reservoir will have a nominal capacity of approximately 2.9 MG. The total storage includes fire storage, operational storage, and emergency storage. A summary of the storage components is presented in Table 16. Fire storage includes satisfying a worst-case condition of a 4,500 gpm fire demand for a total of 4 hours. Operational storage is defined as 25 percent of the maximum day demand. Emergency storage is defined as 75 percent of the maximum day demand. The Zone 2 booster pump station firm capacity would be approximately 2,690 gpm to ensure the proposed reservoir is filled in a period of 18 hours.

TABLE 16
LOWER LAGOON VALLEY PROJECT
SUMMARY OF STORAGE COMPONENTS FOR PROPOSED ZONE 2 RESERVOIR

Maximum Day Demand [a] (mgd)	Water Storage Requirements (MG)			
	Operational Storage [b]	Fire Storage [c]	Emergency Storage [d]	Total Requirement
1.82	0.46	1.08	1.36	2.9

[a] Maximum day demand is 2 times the average day "potable" demand for the LLV Zone 2 (940,920 gpd less 67 RLD units at 520 gpd/unit).
[b] Operational storage is estimated as 25% of the maximum day demand.
[c] Fire storage = 4,500 gpm for 240 minutes (4 hours).
[d] Emergency storage is estimated as 75% of the maximum day demand.

The suggested location of the Zone 2 tank (southwest of the Village III development) is shown in Figure 10. As noted above, a tank siting study is required to verify the location of the proposed partially buried reinforced concrete storage tank. However based on the service area elevation range the tank base should be at approximately 380 – 390 ft. Major pipelines in the Zone 2 system will include 18-inch, 12-inch, and 8-inch water mains. Proposed pipe sizes and alignments are depicted in Figure 11. Operationally, the booster pump station will draw water from the main zone water mains near the Butcher Reservoirs and convey water to the new reservoir via an 18-inch transmission water main and a 12-inch/18-inch water main loop within the proposed development streets.

On-Site Potable Water System Improvements - Zone 3

The developable land above elevation 310 ft is generally located in the southeast residential portion of Village III. Therefore, Zone 3 will be limited to this region. It will also be limited to residential development so that the greater fire flows associated with commercial development need not be provided in Zone 3. Specifically, it is assumed that 67 low density residential dwelling units above elevation 310 ft proposed for Village III will be served by the proposed Zone 3 water system and have an average day water demand of 34,840 gpd.

Figure 10

Within the Zone 3 water system, two alternatives are proposed by the project proponent to serve elevations higher than 310 ft. The first alternative is to provide elevated storage above the service area, a pumping station to transfer water from Zone 2 to Zone 3, and distribution system pipelines. With this alternative, fire and emergency storage would be provided in the reservoir per City standards creating a very reliable system. The reservoir would have a nominal capacity of approximately 0.25 MG. A summary of the storage components is presented in Table 17. The total storage is calculated including fire storage, emergency storage, and operational storage. Fire storage includes the worst-case condition of a 1,500 gpm fire flow for a total of 2 hours. Emergency storage is defined as 75 percent of the maximum day demand, and operational storage as 25 percent of the maximum day demand. The firm pump station capacity would be approximately 230 gpm to fill the proposed reservoir in a period of 18 hours.

TABLE 18
LOWER LAGOON VALLEY PROJECT
SUMMARY OF STORAGE COMPONENTS FOR PROPOSED ZONE 3 RESERVOIR

Maximum Day Demand [a] (mgd)	Water Storage Requirements (MG)			
	Operational Storage [b]	Fire Storage [c]	Emergency Storage [d]	Total Requirement
0.07	0.0175	0.18	0.0525	0.25

[a] Assume all 67 dwelling units above the 310 ft elevation within Village III development at 520 gpd/du. Total average day demand is 0.035 mgd. Maximum day demand is 2 times the average day demand.
[b] Operational storage is estimated as 25% of the maximum day demand.
[c] Fire storage = 1,500 gpm for 120 minutes (2 hours).
[d] Emergency storage is estimated as 75% of the maximum day demand.

The second alternative proposed by the project proponent does not include elevated storage and therefore does not meet City standards. It is considered less reliable especially in a hillside development adjacent to open space. With this option, a hydropneumatic tank system would be provided to allow the pumps to cycle ON and OFF. The firm pump station capacity would be approximately 1,630 gpm. Fire and emergency water requirements would be dependent upon the pump station, so emergency power at the site would be required. This alternative does not provide redundancy for electrical or mechanical equipment failures.

It will be necessary to conduct a reservoir and booster pump station siting study to determine the feasibility of alternative reservoir sites and optimum locations for these new facilities.

One other requirement to note is as follows: the Zone 3 distribution system must avoid long dead-end water mains greater than 600 ft to provide adequate water quality and satisfy City standards. The water main layout proposed by the project proponent in this Zone 3 does not meet these criteria and must be modified.

On-Site Non-Potable Water System Improvements

The existing SID non-potable irrigation water system in the Lower Lagoon Valley area reflects recommended improvements suggested in the *Lagoon Valley Draft Environmental Impact Report Facilities Plan Potable and Irrigation Water Systems* [12]. This earlier analysis of the LLV included a golf course which represents the highest non-potable irrigation water demand. As such, the existing system should be adequate to supply current project requirements. The estimated maximum hour non-potable flow for the proposed LLV project is approximately 1,314 gpm. The capacity of the existing Hines Pipeline (1,500 gpm) should be capable of meeting the peak irrigation demands for the proposed project [7]. However, a detailed review of the golf course irrigation demands will be necessary to confirm the demands can be met by the proposed project improvements. A schematic of the proposed on-site (and off-site) non-potable water system improvements to the existing SID water system to support the LLV project are presented in Figure 11.

RECOMMENDED MITIGATION

Based on the analysis presented in the previous section, the LLV project is expected to create impacts to the existing water supply and distribution system. These impacts may be mitigated through the following:

- Creation of an upper zone (Zone 2) to serve part of the project (elevation range from approximately 210 to 310 feet). The water distribution system for this new upper pressure zone (Zone 2) will include a 2,600 gpm booster pump station and a 2.9 MG partially buried concrete water storage reservoir.
- Creation of another upper zone (Zone 3) to serve the remainder of the project (elevation approximately 310 to 340 feet). The water distribution system for this upper pressure zone (Zone 3) will include a 230 gpm booster pump station and a 0.25 MG partially buried concrete water storage reservoir.
- Constructing the 24-inch water transmission pipeline (DIF 10) from Alamo Lane to Butcher Road. The water transmission main will convey water from Peabody Road to the existing water transmission mains on Butcher Road that will serve the LLV project and mitigate the filling operations impact to the existing Butcher Reservoirs. (City responsibility)
- Conducting a water service area master plan and pump station/reservoir siting study to determine the limits of the Zone 2 and Zone 3 service area boundaries as well as the optimum locations for the booster pump stations and water storage reservoirs. The service area master plan will include modeling simulations to confirm that the planned 24-inch (DIF 10) water transmission main is adequate at buildout conditions. The master plan will also determine whether any additional upsizing is required. (Service area master plan and water model simulations are City responsibility).

Figure 11

- Dedicating (if necessary) one residential lot within the development to the City for the construction of the Zone 3 booster pump station. It is assumed that the Zone 2 booster pump station can be properly located within open space near the existing Butcher Road Reservoirs.
- Dedicating the proposed reservoir sites and access roads as identified by the water service area master plan and siting study. The sites shall be dedicated to the City for construction of the upper zone(s) partially buried concrete water storage reservoirs.
- Conduct a detailed review of the proposed golf course irrigation demands to confirm the demand (including other non-potable uses) can be met by the proposed project improvements and existing SID non-potable water system.

NOTE: Focused project level Environmental Impact Report (EIR) is required for the proposed facilities.

REFERENCES

[1] Solano County Water Agency, *SCWA Briefing Book,* January 2002.

[2] Nolte Associates, Inc., *2000 Urban Water Management Plan Update,* December 2001.

[3] Carollo Engineers, *City of Vacaville Recycled Water Master Plan (Draft),* July 2003.

[4] Luhdorff and Scalmanini, Consulting Engineers, *SB 610 Water Supply Assessment Ground-Water Source Sufficiency, Administrative Draft 2,* July 2003.

[5] Nolte and Associates, Inc., *Water System Master Plan, City of Vacaville,* May 1990.

[6] City of Vacaville, *Development Impact Fee Study,* February 1992.

[7] Summers Engineering, Inc., Correspondence to Jim Daniels, Solano Irrigation District, regarding Lower Lagoon Valley Project, September 23, 2003.

[8] West Yost & Associates, *Water and Sewer Planning Factors Reconciliation – Final Draft,* April 1994.

[9] Nolte Associates, Inc., *SB610 Water Supply Assessment Report for Lagoon Valley, Southtown, and Rice McMurtry,* January 2004.

[10] Nolte Associates, Inc., *2000 Urban Water Management Plan Update, City of Vacaville*, December 2001.

[11] City of Vacaville, *Infrastructure, Facilities and Services Report 2003 Update - Water Supply Section,* January 2003.

[12] West Yost & Associates, *Lagoon Valley Draft Environmental Impact Report Facilities Plan Potable and Irrigation Water Systems,* April 1990.

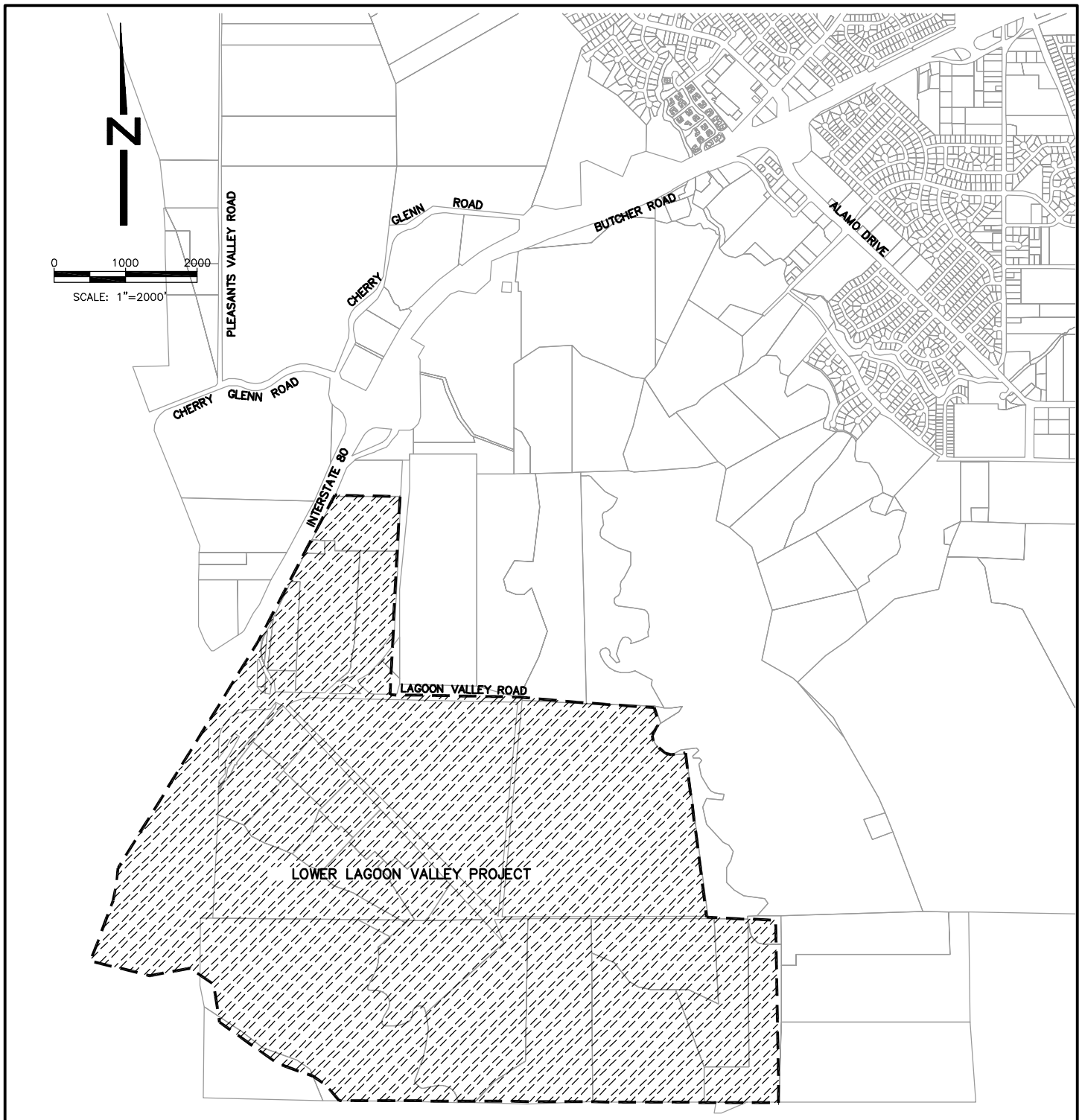


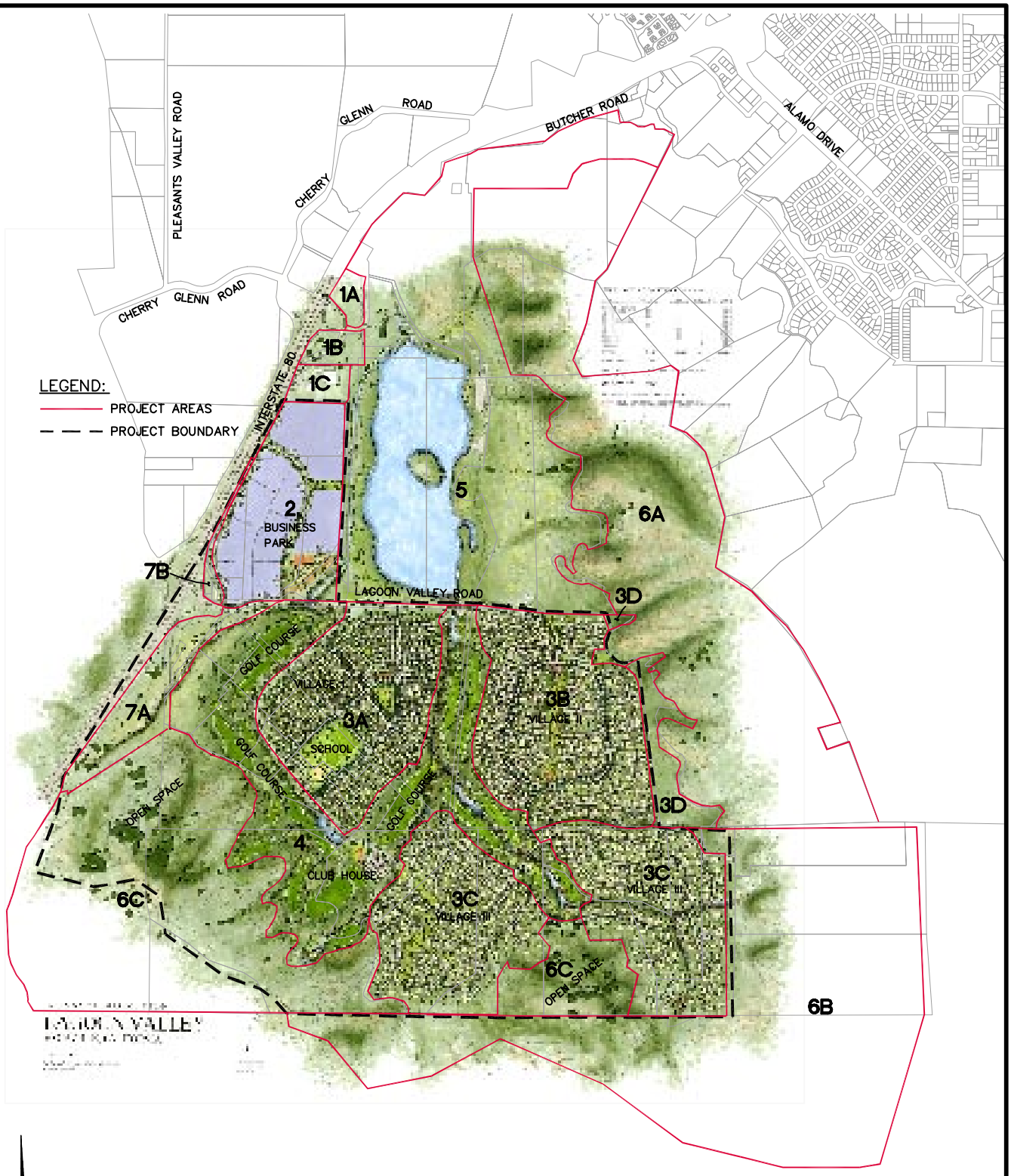
FIGURE 1

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

PROJECT SITE LOCATION

NOLTE
BEYOND ENGINEERING

N:\SAB010500\CADD\FIGURE1-ADEIR.DWG VMA 1-14-2004



N

0 1,000 2,000

SCALE: 1"=2000'

FIGURE 2

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

PROPOSED PROJECT AREAS AND LAND USE

NOLTE
BEYOND ENGINEERING

N:\SAB010500\CADD\FIGURE2-ADEIR.DWG VMA 1-14-2004

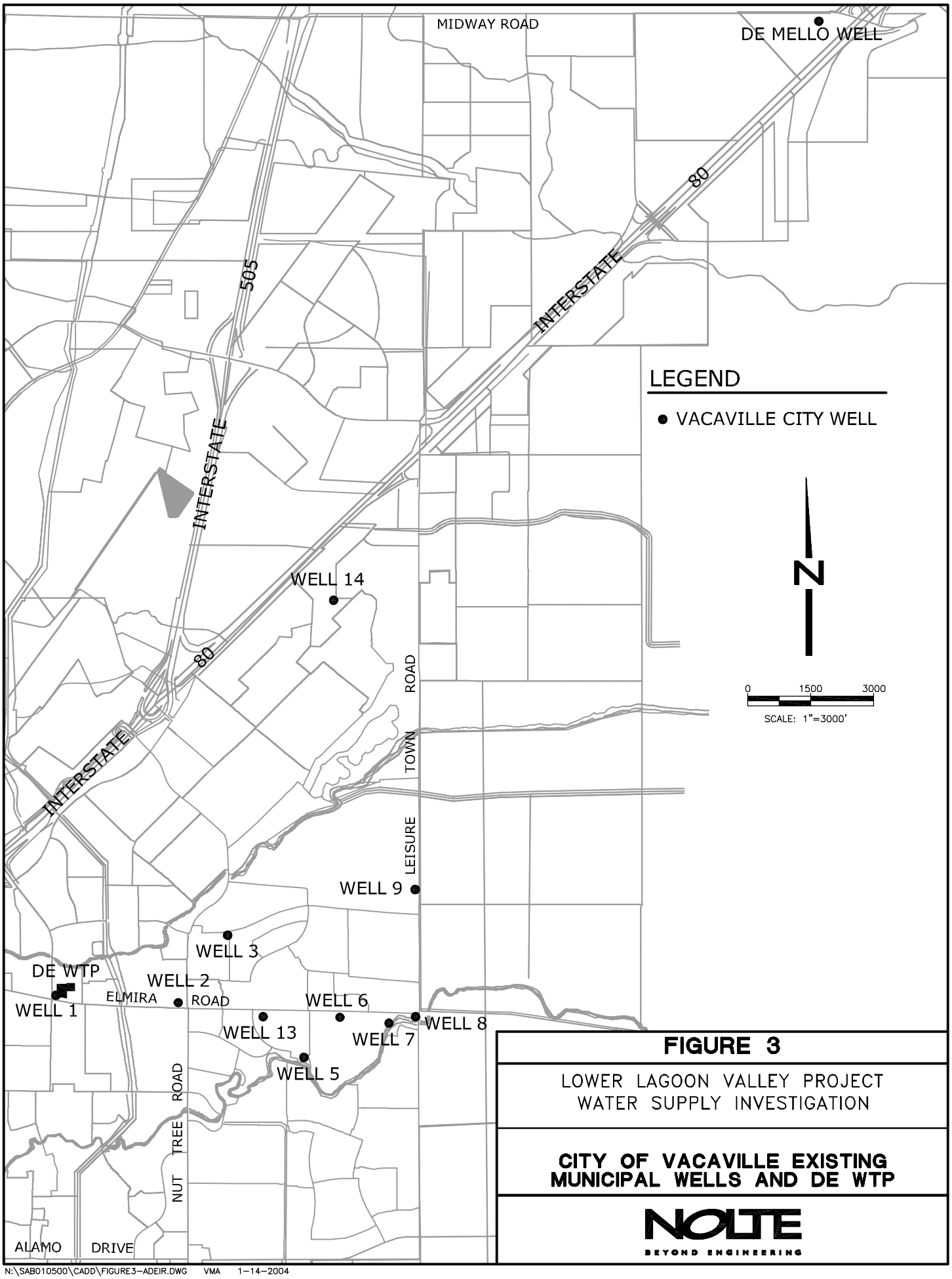


FIGURE 3

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

CITY OF VACAVILLE EXISTING MUNICIPAL WELLS AND DE WTP

NOLTE
BEYOND ENGINEERING

N:\SAB010500\CADD\FIGURE3-ADEIR.DWG VMA 1-14-2004

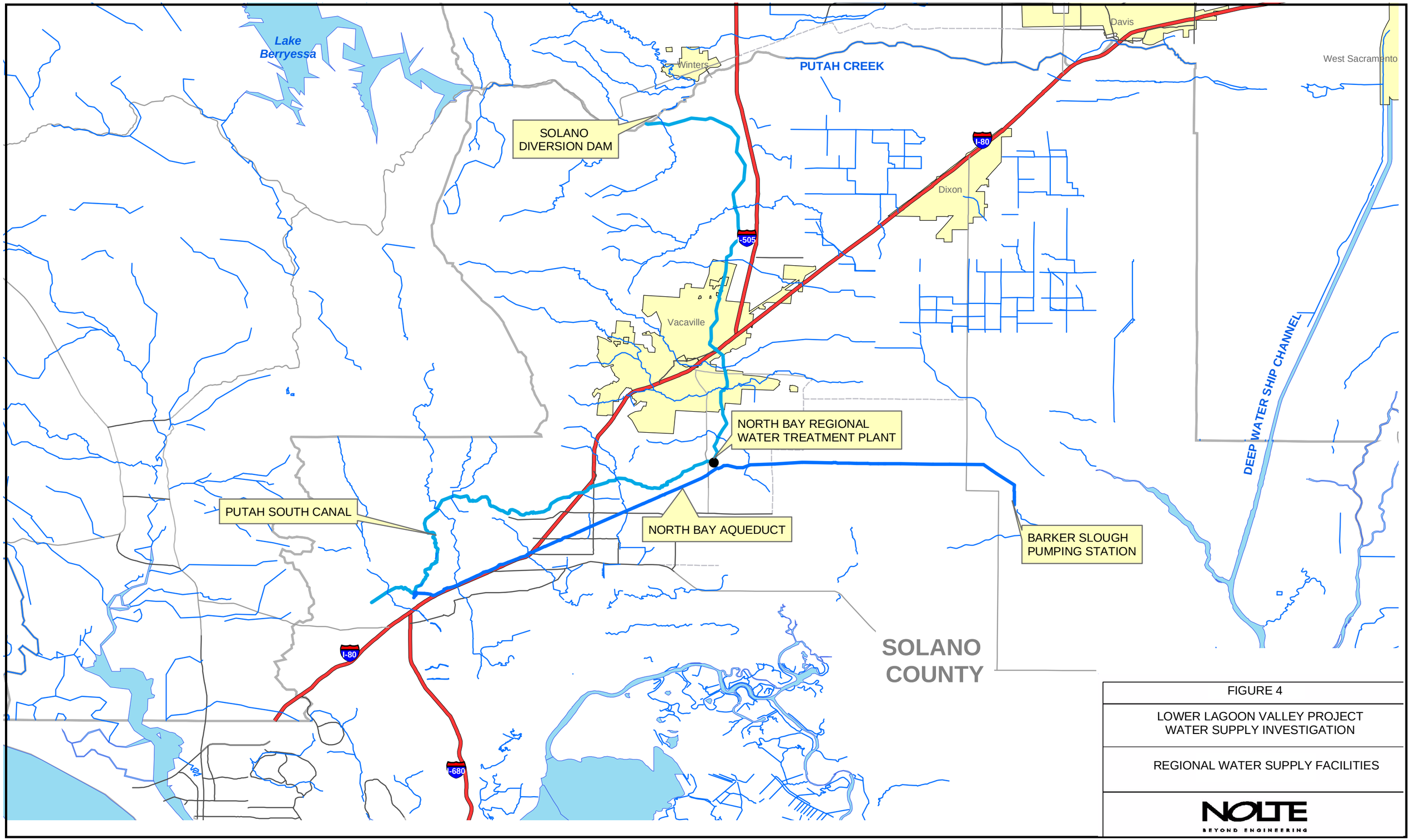


FIGURE 4

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

REGIONAL WATER SUPPLY FACILITIES

NOLTE
BEYOND ENGINEERING

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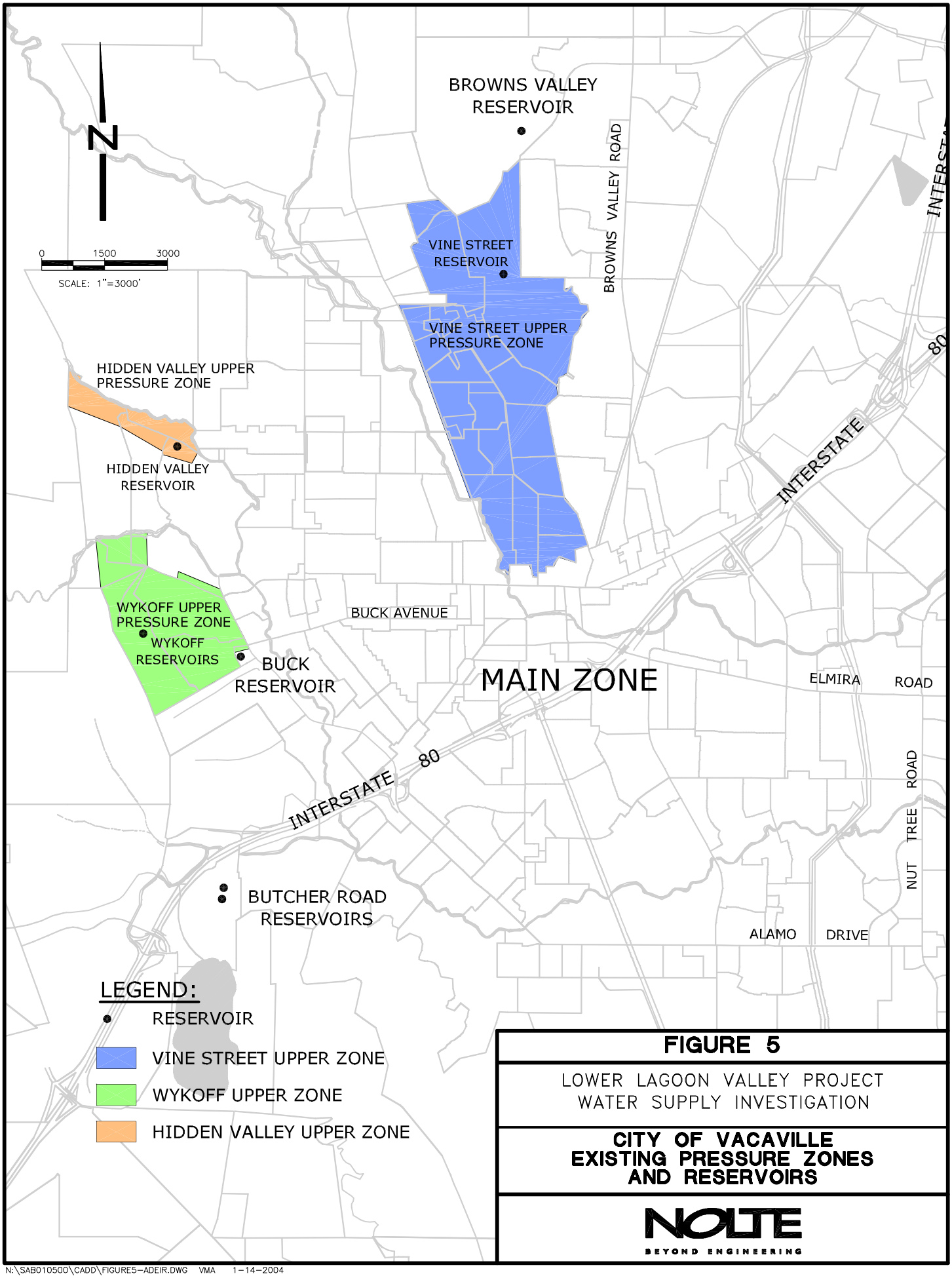


FIGURE 5

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

CITY OF VACAVILLE
EXISTING PRESSURE ZONES AND RESERVOIRS

NOLTE
BEYOND ENGINEERING

N:\SAB010500\CADD\FIGURE5-ADEIR.DWG VMA 1-14-2004

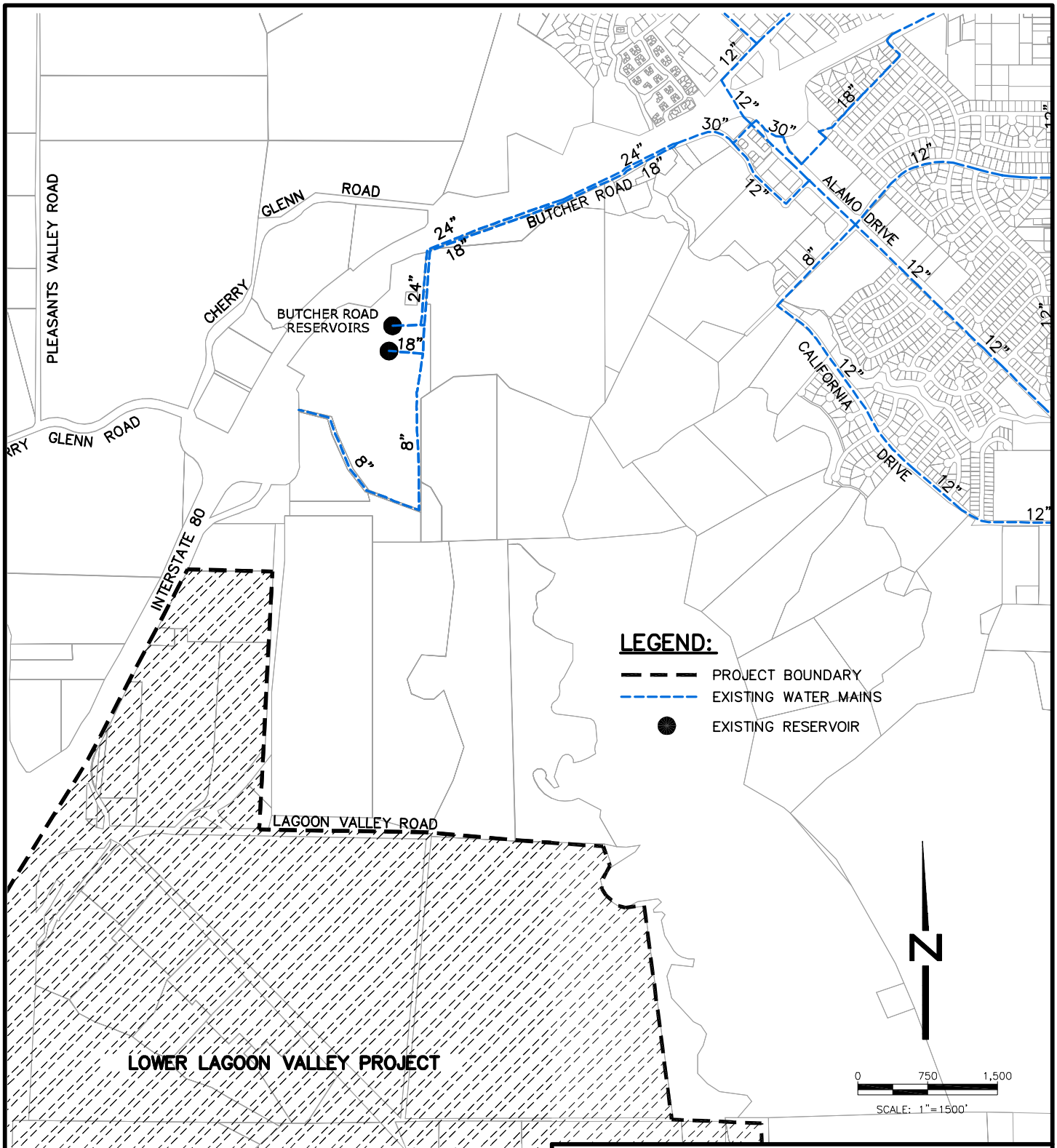


FIGURE 6

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

EXISTING WATER MAINS NEAR LOWER LAGOON VALLEY

NOLTE
BEYOND ENGINEERING

N:\SAB010500\CADD\FIGURE6-ADEIR.DWG VMA 1-14-2004

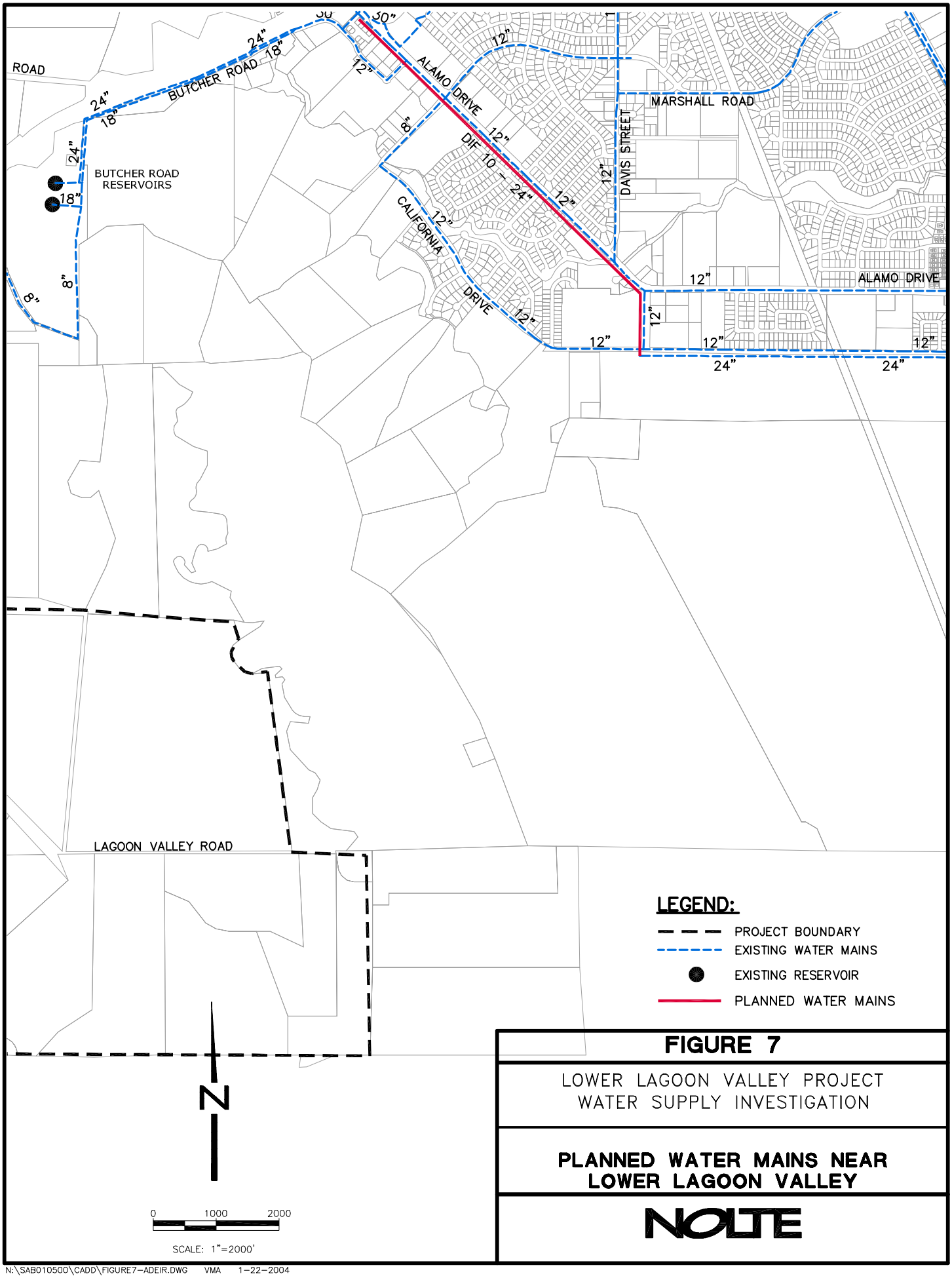


FIGURE 7

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

PLANNED WATER MAINS NEAR LOWER LAGOON VALLEY

NOLTE

N:\SAB010500\CADD\FIGURE7–ADEIR.DWG VMA 1–22–2004

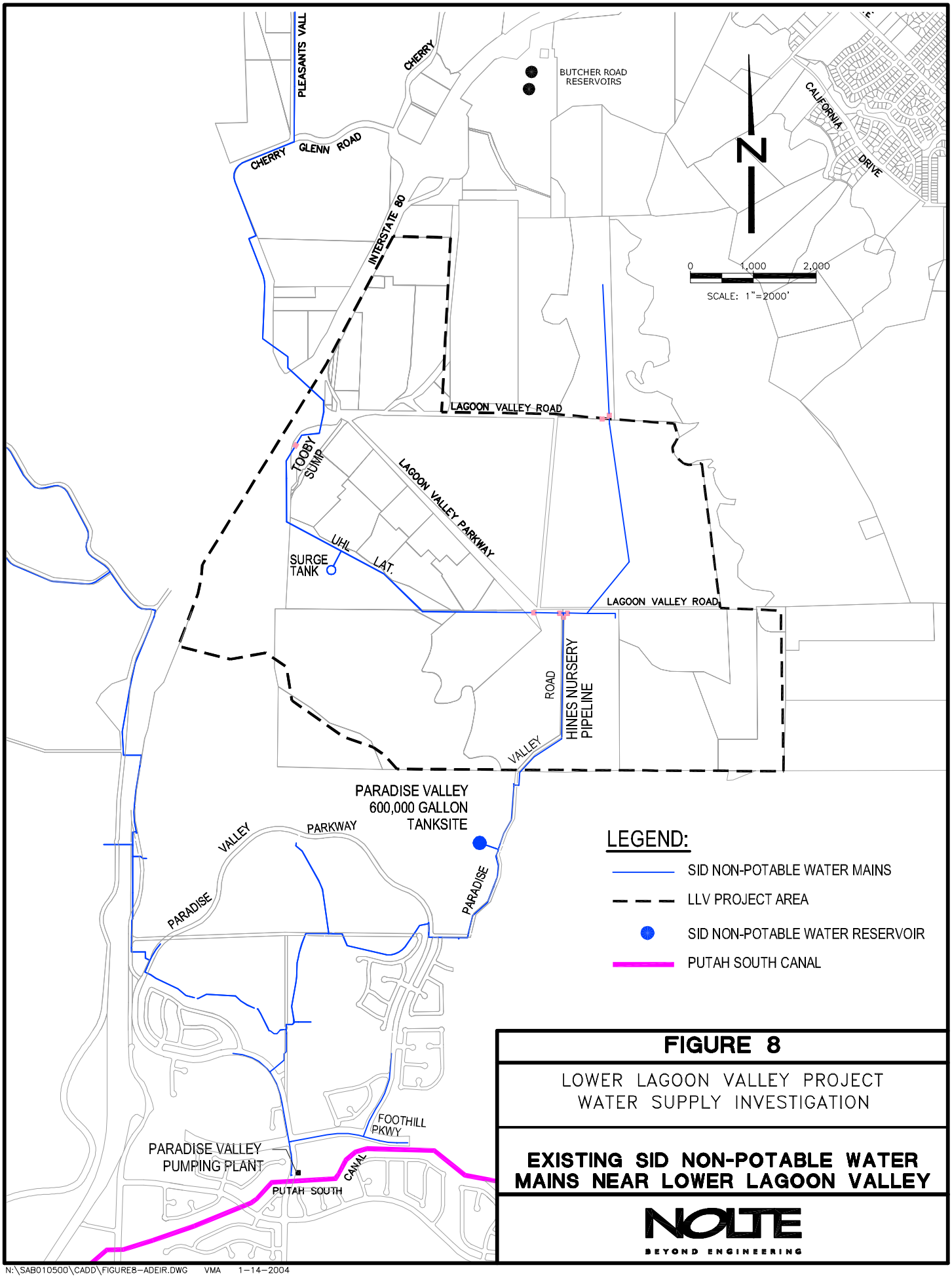


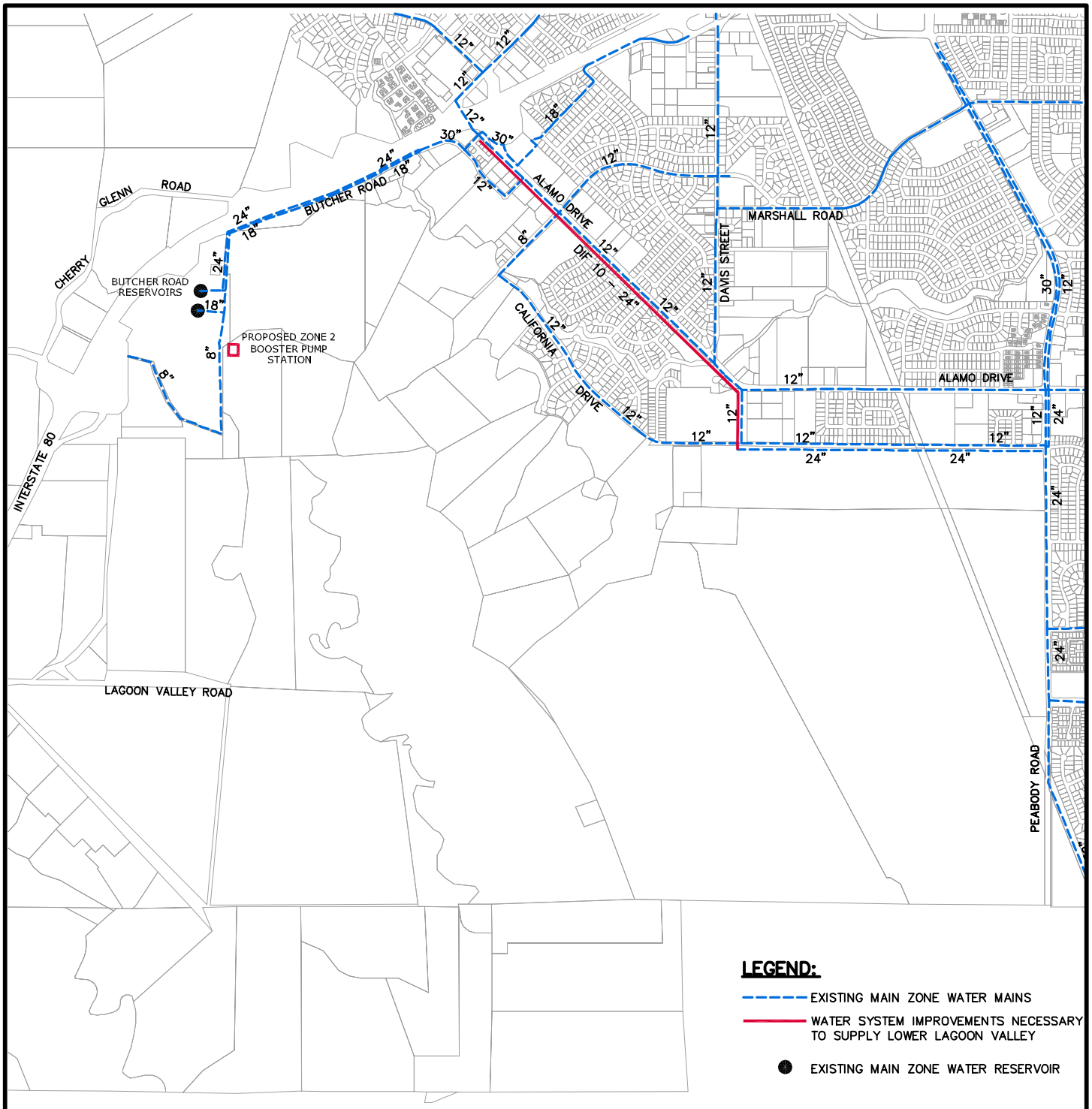
FIGURE 8

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

EXISTING SID NON-POTABLE WATER MAINS NEAR LOWER LAGOON VALLEY

NOLTE
BEYOND ENGINEERING

N:\SAB010500\CADD\FIGURE8-ADEIR.DWG VMA 1-14-2004



N

0 1000 2000

SCALE: 1"=2000'

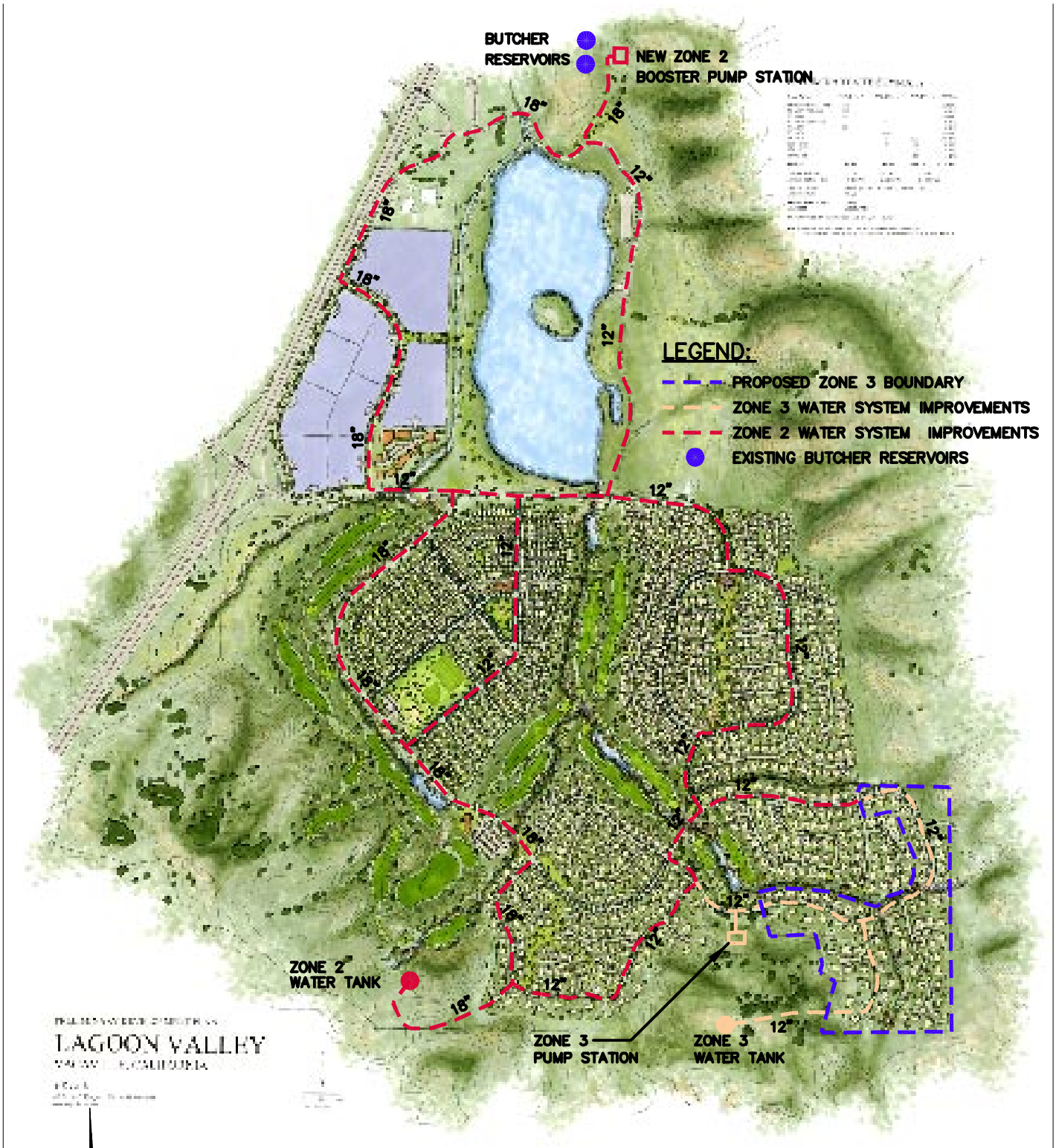
FIGURE 9

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

MAIN ZONE WATER SYSTEM IMPROVEMENTS TO SUPPLY LOWER LAGOON VALLEY

NOLTE
BEYOND ENGINEERING

N:\SAB010500\CADD\FIGURE9-ADEIR.DWG VMA 1-22-2004



N

0 650 1300

SCALE: 1"=1300'

FIGURE 10

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

PROPOSED WATER SYSTEM IMPROVEMENTS FOR ZONE 2 AND ZONE 3

NOLTE
BEYOND ENGINEERING

N:\SAB010500\CADD\FIGURE10-ADEIR.DWG VMA 1-22-2004

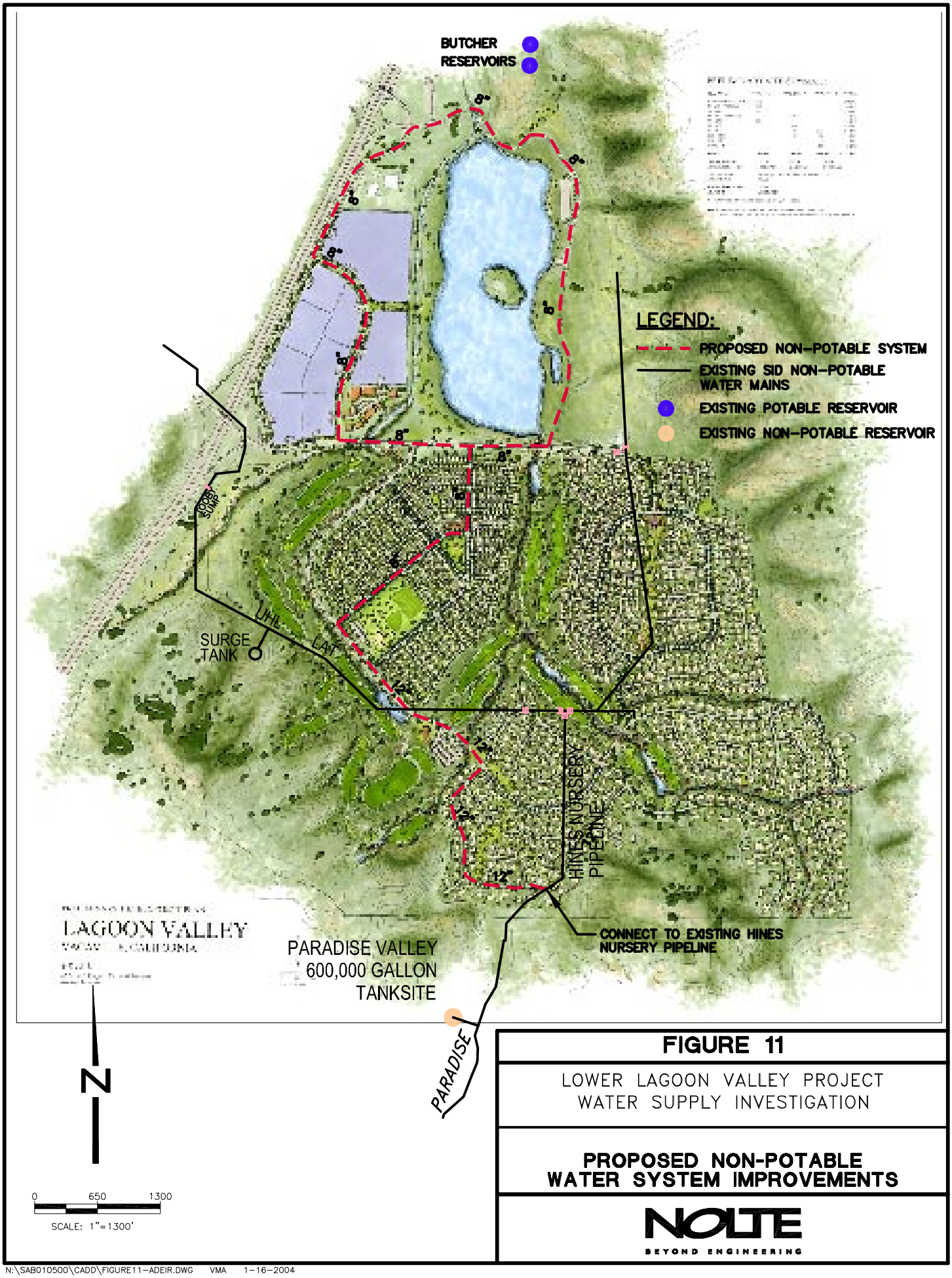


FIGURE 11

LOWER LAGOON VALLEY PROJECT
WATER SUPPLY INVESTIGATION

PROPOSED NON-POTABLE WATER SYSTEM IMPROVEMENTS

NOLTE
BEYOND ENGINEERING

N:\SAB010500\CADD\FIGURE11-ADEIR.DWG VMA 1-16-2004

TECHNICAL APPENDIX I

Impacts of the Proposed Lower Lagoon Valley Development on the Drainage, Flooding, and Storm Water Quality Within the City of Vacaville

WEST
YOST
& ASSOCIATES
Consulting Engineers

TECHNICAL MEMORANDUM

DATE: February 13, 2004

Project No.: 207-03-03.01

TO: Rod Moresco
City of Vacaville

CC: Cathy McEfee, EIP
Kevin VanKatwyk
Tom Basye
Fred Buderi

FROM: Jeffrey Wanlass
Steve Dalymple

SUBJECT: Impacts of the Proposed Lower Lagoon Valley Development on the Drainage, Flooding, and Storm Water Quality within the City of Vacaville

The purpose of this technical memorandum (TM) is to assess the impacts of the proposed Lower Lagoon Valley Development (proposed project) on the drainage flooding, and storm water quality within the City of Vacaville (City).

ENVIRONMENTAL SETTING

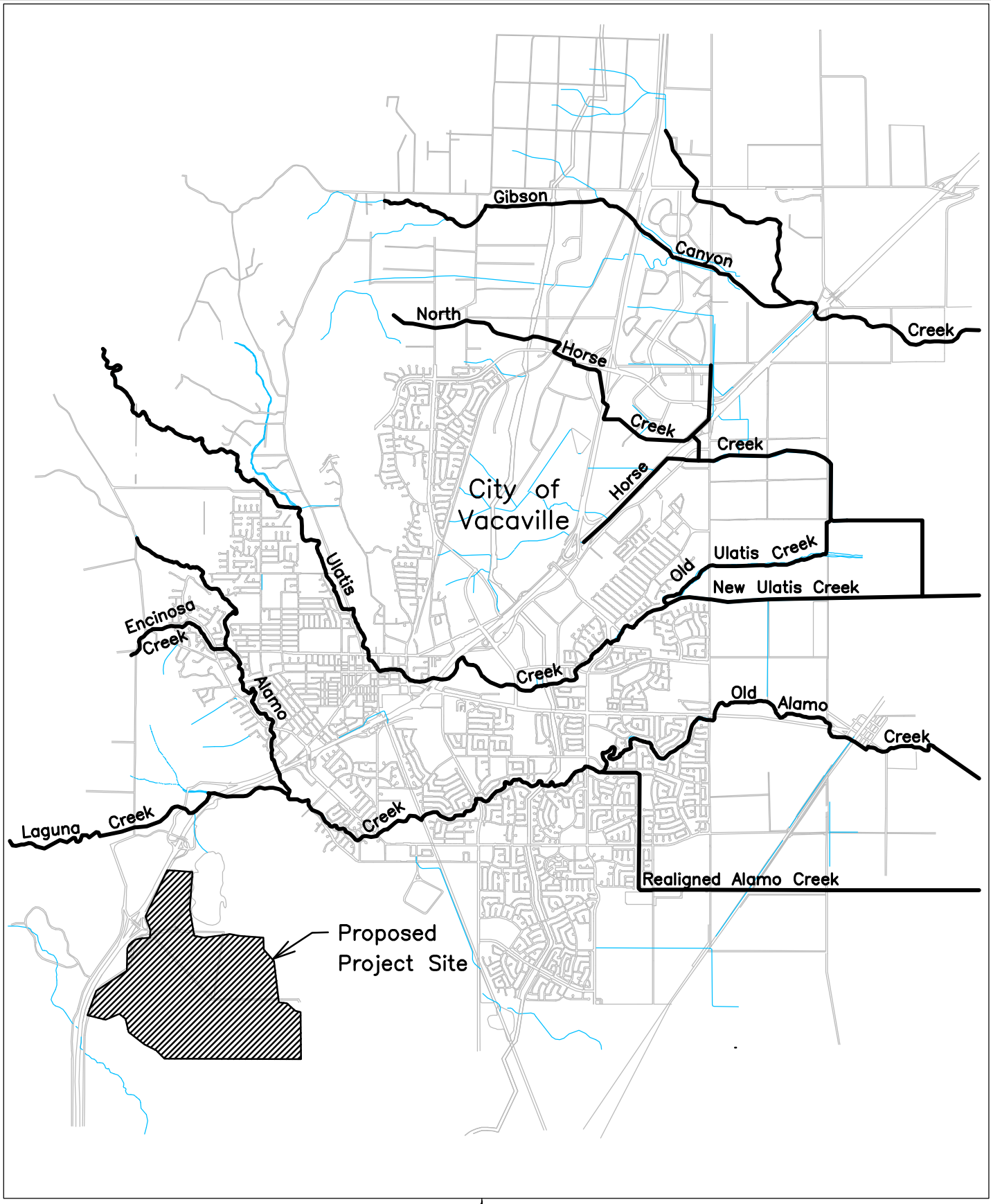
Surface Water Resources

The proposed project site is located in the lower southwest area of the 150 square mile Ulatis Creek Watershed. Mountains and flat alluvial valleys characterize the terrain of the Ulatis Creek Watershed. The Vaca Mountains are part of the Coastal Ranges and lie along the western border of the watershed. The English Hills lie east of the Vaca Mountains, separated by the Vaca Valley. The remainder of the watershed is characterized by flat terrain, which gradually slopes to the southeast.

The Ulatis Creek Watershed is drained by a series of major stream courses that discharge into the Cache Slough and ultimately into the Sacramento River. The major stream courses, which drain to the Cache Slough, include Alamo Creek, Ulatis Creek, Horse Creek, Gibson Canyon Creek, Sweeny Creek, and McCune Creek. The location of the project site and the major stream courses within the City of Vacaville are illustrated on Figure 1.

The project site lies within the Lower Lagoon Valley watershed. This watershed is about 4 square miles and is a tributary to Laguna Creek, which is a tributary to Alamo Creek.

1260 Lake Boulevard, Suite 240 Davis, California 95616 Phone 530 756-5905 Fax 530 756-5991 www.westyost.com



LEGEND

MAJOR CREEKS

PROPOSED PROJECT AREA

N

0 3000 6000

SCALE IN FEET

Figure 1

MAJOR CREEK SYSTEMS

WEST YOST & ASSOCIATES

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Topography and Soils

The topography of the project site is flat and slopes to the northwest. The Laguna Creek watershed lies within a valley with runoff ultimately draining to the Cherry Glen/I-80 area and then draining to the east and discharging into Alamo Creek. The topography within the Laguna Creek watershed varies from steep to flat. Soils in the watershed range from shallow loams overlaying sandstone bedrock in the mountainous area to moderately deep layers of sands, silts, and clays in the valley floor. The majority of soils in the Vaca Mountains and English Hills consist of Maymen-Los Gatos loam, Millsholm loam, and Dibble-Los Osos loam. These soils range in permeability from moderate to high, with very high erosion potential. Soils in the Vaca Valley floor and into the Sacramento Valley consist of Brentwood clay loam, Altamont clay, Capay clay and silty clay loams, which have permeabilities in the moderate to low range.[1]

A majority of the project site consists of Hydrologic Soil Groups C and D, which have very low permeability and very high runoff rates. There is an area west of the lake that consists of Group B, which has moderate to low permeability with moderate runoff rates.[2]

Climatic Conditions and Precipitation

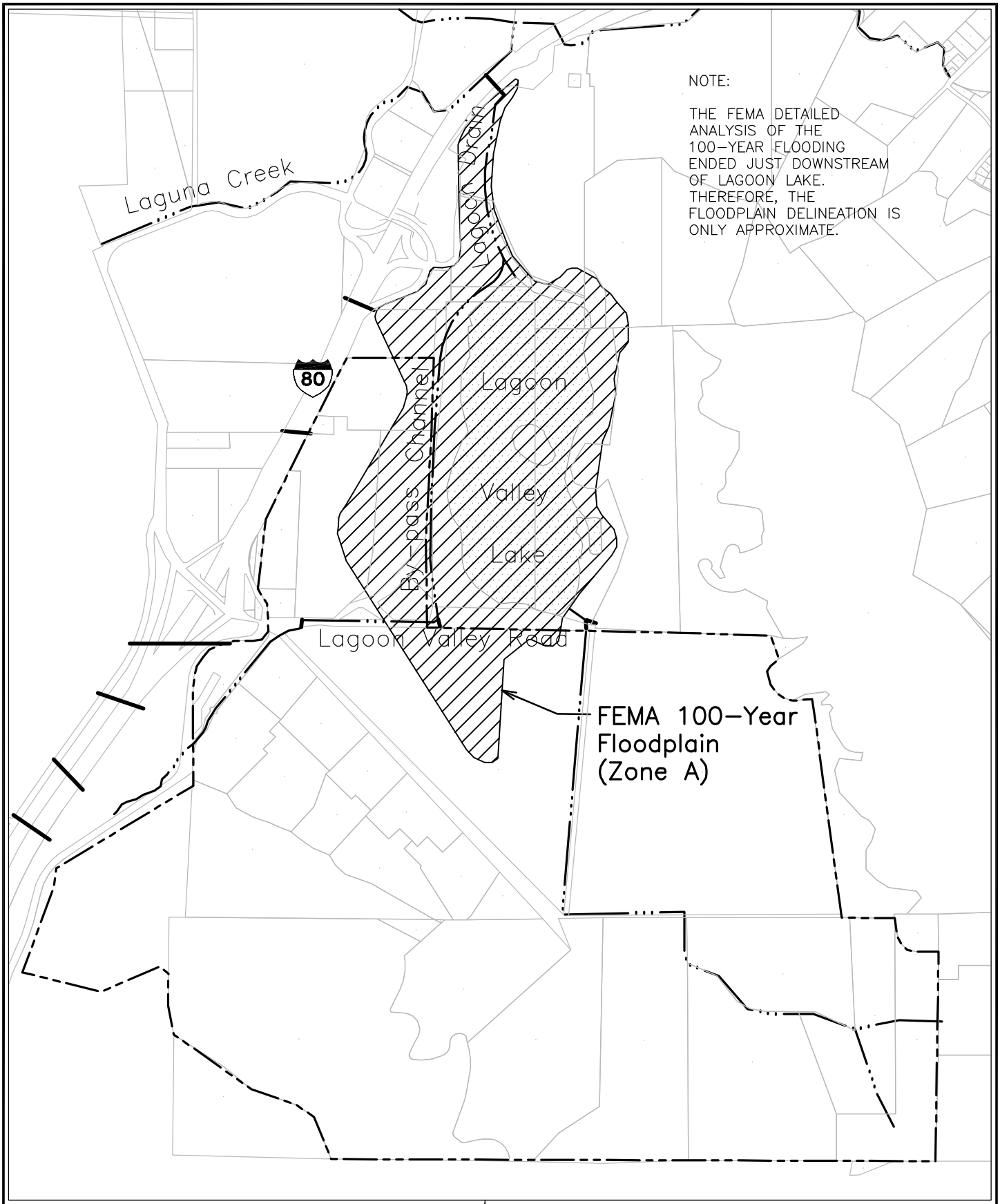
Climatic conditions for the area are consistent with the temperature conditions predominant in the Sacramento Valley. The summers are hot and dry, and the winters are cool and moist. Average monthly temperatures range from lows in the 40s and highs in the 50s during the winter months, to lows in the 60s and highs in the 100s during the summer months.

The predominant rainfall season is from November through April, with the heaviest storms of record occurring from December through February. Spatial rainfall distribution over the Vacaville area consists of higher intensities and volumes in the upper elevations of the Vaca Mountains and lower intensities and volumes to the east. Mean annual precipitation varies from 45 inches along the ridgeline of the Vaca Mountains to 23 inches in the flat southeastern portions of the watershed near Elmira. The mean annual precipitation for the project area is about 28 inches.[3]

The total precipitation depth within the project area for the 10-year, 24-hour design storm is 4.8 inches, and 6.7 inches for the 100-year, 24-hour design storm.[4]

100-Year Floodplain

The 1997 revised Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for the City of Vacaville shows that about 25 acres of the proposed residential development and 50 acres of the proposed commercial development are within the FEMA 100-year floodplain (see Figure 2).[5] The detailed FEMA analysis of the Lower Lagoon Valley ended just downstream of the Lagoon Valley Lake outfall; consequently, the floodplain boundary is approximate.



LEGEND

PROJECT BOUNDARY

CREEKS

FEMA 100-YEAR ZONE B FLOODPLAIN

N

0 700 1400

SCALE IN FEET

Figure 2

100-YEAR FEMA FLOODPLAIN

WEST YOST & ASSOCIATES

CAD FILE: I:\207\Drainage - Fig2.dwg DATE: Feb. 2004 PROJECT NO.: 207-03-03

Drainage

Regional Drainage

The major stream courses, which flow through the City of Vacaville, are generally in their natural state and alignment. Under existing conditions, channel capacities are exceeded in isolated locations and localized flooding occurs during moderate storm events. In the 1960s, some reaches of the creeks located within the City were modified by the U.S. Soil Conservation Service (SCS-now the Nature Resource Conservation Service) to provide a 10-year level of protection and maintain a minimum freeboard of 1.5 to 3.5 feet (with the exception of the few reaches along Horse Creek and Ulatis Creek that were designed for a 50-year level of protection). However, under current conditions many of the modified channels do not have capacity to convey the estimated 10-year peak flows. The channel modifications consisted of realigning and widening along Ulatis, Lower Old Alamo, Horse Gibson Canyon, Sweeney, and McCune Creeks; the modification extended from Cache Slough to I-80. A new diversion channel was constructed on Alamo Creek downstream of Nut Tree Road. Other improvements included stabilization structures on Ulatis, Alamo, and Horse Creeks; and levees along lower Ulatis Creek and Old Alamo Creek.

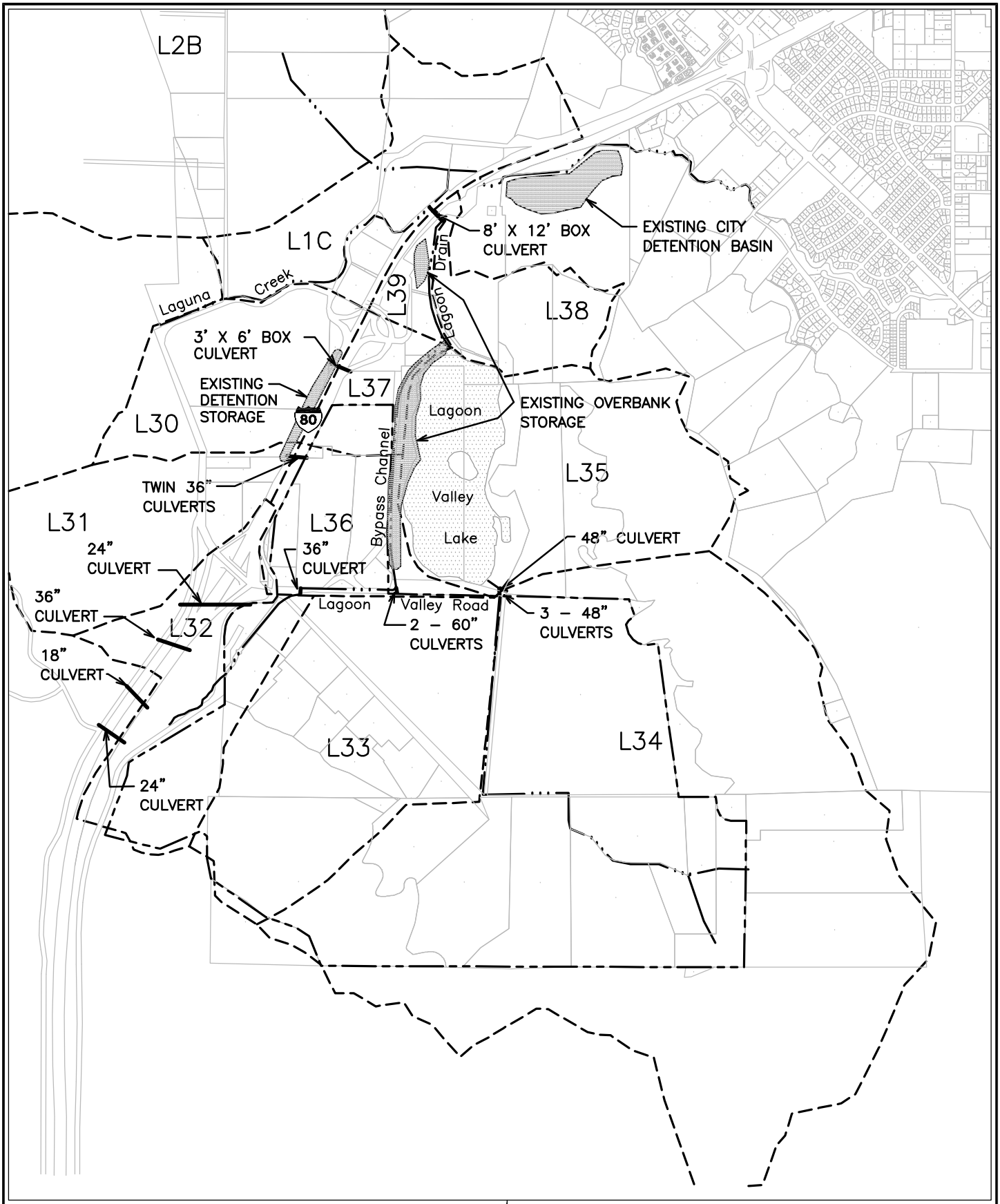
A majority of the natural streams in the City are maintained by the adjacent property owners to the channel centerline. The City maintains only the channel reaches they have access to, keeping the channel flowlines free from debris and vegetation. The Solano County Water Agency (SCWA) is responsible for maintenance of the modified channels.

On-site Drainage

As mentioned previously the project site is within the Lower Lagoon Valley watershed, which is a tributary to Laguna Creek. A majority of the runoff in Laguna Creek is from the area upstream of I-80 (the area west and north of I-80). The Lower Lagoon Valley watershed consists mostly of the area east and south of I-80, with about 400 acres from the west of I-80.

The existing land uses include grazing, open space, parkland, commercial, and agricultural (nursery). The project site and existing drainage facilities area shown on Figure 3. Existing drainage facilities consist of creeks and drainage ditches with culverts generally conveying runoff from the surround subsheds to either the Lagoon Valley Lake or a bypass channel located just west of the lake. The majority of the project site drains by overland flow to a few defined creeks and drainage ditches. The ground slope varies from relatively steep in the surrounding hills to an average slope in the valley of about 20 feet per 1,000 feet.

The runoff from the Lower Lagoon Valley watershed area conveyed to Laguna Creek via the Lagoon Drain and a box culvert under I-80 south of the Cherry Glen Road. About 1,500 acres drain directly to the Lagoon Valley Lake and about 1,100 acres bypass the lake in a channel constructed along the west side of the lake. The bypass channel was constructed to convey runoff that could not drain into the lake because the high water levels in the lake and the berm along the western side of the lake is higher than the existing ground surface west of the lake. Runoff from the west of I-80 cross I-80 via two sets of culverts; a 3’ X 6’ box culvert south Cherry Glen freeway exit, and twin 36” culverts north of the Lagoon Valley Road freeway exist. Runoff from west of I-80 discharges into the bypass channel. The discharge from the lake and bypass channel



LEGEND

PROJECT BOUNDARY

CREEKS

WATERSHED SUBBASIN BOUNDARY

L34 WATERSHED SUBBASIN NAME

N

0 1000 2000

SCALE IN FEET

Figure 3

EXISTING DRAINAGE FACILITIES

WEST YOST & ASSOCIATES

CAD FILE: I:\207\Drainage - Fig2.dwg DATE: Feb. 2004 PROJECT NO.: 207-03-03

combine at the confluence with the Lagoon Drain, flow continues north to the confluence with Laguna Creek.

During moderate storm events the bypass channel and the Lagoon Drainage experience ponding and overflows causing flooding. One of the reasons for the flooding is obstruction in the Lagoon Drain, which limits the discharge from the lake and the bypass channel. The City of Vacaville is in the process of implementing improvements to remove the obstructions in the Lagoon Drain.

Lagoon Valley Lake is one of the major drainage features in the Lower Lagoon Valley watershed. The lake was construction in the early 1980s and covers an area of about 105 acres. The western and southern boundaries of the lake are created by an earthen berm, with the top of the berm at an elevation of 217.5 feet. The lake discharges through a spillway and low flow outlet located on the north side of the lake. The crest of the spillway is at elevation 213 feet. The average depth of the lake is about six to seven feet. According to the Lagoon Valley Lake Management Plan, about three feet of sediment accumulation has occurred in the lake since its construction in the early 80s.[6] Although sediment deposition is a normal occurrence in a man-made lake, the deposition has significantly reduced the storage volume in the lake.

Surface Water Quality

The Sacramento River is classified as having numerous beneficial uses, including municipal water supply, agriculture, recreation, and fisheries. Water quality within the river is classified as "good" to "impaired" in the reach from Red Bluff to the Delta. Upstream water management and use can affect the quality of water in the river. Regulation of stream flows by the federal and state flood control and storage facilities reduce high water flows and increases summer and fall flows, substantially lessening water quality variations. Extensive irrigated agriculture in upstream reaches of the river tends to degrade water quality. During the spring and fall, irrigation return flows are discharged to drainage canals that flow into the river. During the winter, local runoff also flows over agriculture lands, increasing the turbidity in the river and introducing herbicides and pesticides. The Sacramento River has historically been highly turbid and naturally carries high sediment loads. During peak regional storm events, the river's total sediment load can increase by several times its average levels.[7]

Local Water Quality

Water quality within the watershed is primarily characterized by surrounding land uses. In the proposed project area, the water quality of the Lagoon Valley Lake is influenced by both the sediment laden runoff from the surrounding hills, and nutrient laden flows from the Hines Nursery located southeast of the lake. Downstream of the proposed project site, water quality in the existing watercourses is dominated by urban land uses. Possible constituents associated with urban land uses, the surrounding hill sides, and the nursery include: sediment, heavy metals, petroleum hydrocarbons, fertilizers, and pesticides.

Urban Runoff Water Quality

Constituents found in urban runoff vary during a storm event, from event to event within a given area, and from area to area within a given watershed. Variances can be the result of differences in

rainfall intensity and occurrence, geographic features, and the land use of the area, as well as vehicle traffic and the percentage of impervious surface. Furthermore, sediment runoff from construction sites without adequate erosion control measures can contribute sediments, pesticides, fertilizers, and other pollutants to receiving waters.

In the Vacaville area, the natural weather pattern consists of a long dry period from May to October, and a wet season from November to April. During the seasonal dry period, pollutants contributed by vehicle exhaust, vehicle and tire wear, spills, and atmospheric fallout accumulates within the watershed. Precipitation during the early portion of the wet season displaces these pollutants into the storm water runoff that can result in elevated pollutant concentrations in the initial wet weather runoff.

Concentrations of heavy metals present in dry weather runoff (runoff during the dry season generated by landscape irrigation, street washing, etc.) are typically higher than concentrations measured in wet weather runoff (runoff generated during the rainy season primarily by precipitation). Some sources of dry weather runoff constituent pollutants include commercial and domestic irrigation, general wash-off, groundwater infiltration, and other illicit discharges.

REGULATORY SETTING

Federal

EPA Storm Water Discharge Permitting Regulations

The CWA prohibits the discharge of pollutants to navigable waters from a point source unless authorized by a NPDES permit. With respects to pollutants in storm water discharge, the CWA is currently implementing Phase II permits. Phase II requires municipalities with under 100,000 to obtain permit coverage (previously permit coverage was only required for municipalities of population greater than 100,000). Consequently, the City is in the process of developing and implementing a storm water quality management plan. The management plan could contain specific requirements for new development to reduce pollutants entering existing stream courses.

Clean Water Act Section 404 Permit

The U.S. Army Corps of Engineer has jurisdiction over dredging and filling in the "waters of the United States," and including many wetlands.[8] The proposed project may be required to obtain a Clean Water Act Section 404 permit. If a 404 permit is required, the project proponent would be required to prepare a wetland delineation that would include avoidance and minimization measures, Best Management Practices, and potential impacts. A mitigation and monitoring program will also be required.

FEMA Floodplain Regulations

The National Flood Insurance Act of 1968 made flood insurance available to property owners who are within communities that participated in the National Flood Insurance Program (NFIP). Communities are required to adopt minimum floodplain management regulations established by FEMA to be included in the NFIP. The minimum requirement are set forth in 44 Code of Federal

Regulations Part 60. The City's Floodplain Management Code outlines the requirements for construction within a designated 100-year floodplain or areas prone to flooding.

State

NPDES Permit and 401 Water Quality Certification

Any construction activity that disturbs one acre or more of land must obtain a Construction Activities Storm Water General Permit (General Permit). The project applicant must prepare and submit a NOI and develop and implement a Storm Water Pollution Prevention Plan (SWPPP) prior to the beginning of construction activities. The NOI, General Permit, and SWPPP are administered and enforced by the Regional Water Quality Control Board (RWQCB).[9]

Lake or Streambed Alteration Agreement (LSAA) permit

The California State Department of Fish and Game is responsible for protecting, conserving, and managing the state's fish, wildlife, and plant resources. If the proposed project will if the project will "Divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake designated by the department in which there is at any time an existing fish or wildlife resource or from which these resources derive benefit, use material from the streambeds designated by the department, or result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake designated by the department" [10] may require a LSAA permit.

Local

The Solano County General Plan, Health and Safety Element, contains the following flood control policy that is applicable to the proposed project:

- The County and Cities should implement those flood control and drainage improvement recommendations included in locally-formulated plans and should give due consideration to those recommendations made by the COE and the California Reclamation Board, which do not conflict with locally adopted open space and conservation policies regarding natural water course preservation.

City of Vacaville

General Plan

The following goals and policies from the City of Vacaville General Plan are relevant to drainage and flood control:

Guiding Policy

Policy 3.5-G1: Maintain open spaces needed to retain storm water and prevent flooding of urban or agricultural land.

Policy 9.2-G1: Locate development outside mapped flood-prone area unless mitigation of flood risks is assured.

Policy 9.2-G2: Continue to develop a comprehensive system of drainage improvements to minimize flood hazards.

Policy 9.2-G3: The additional runoff caused by development shall be mitigated.

Implementing Policies

Policy 2.3-I14: Detention of floodwaters shall provide for all lost floodwater storage and incremental increases in runoff, and total retention shall reduce downstream flows during peak storm conditions to not more than 90 percent of existing conditions.

Policy 3.5-I6: Reserve stream-channel setbacks necessary for flood control.

Policy 9.2-I2: Evaluate storm drainage needs for each project in the context of demand and capacity when the drainage area if fully developed. Require on-site detention until upstream reservoirs are constructed and/or other mitigation of the project's impacts on the storm drainage system appropriate to the project's share of cumulative effect is implemented. In the Alamo Creek watershed upstream of Peabody Road, which includes Alamo, Laguna, and Encinosa Creeks, require post-development 10-year and 100-year peak flows to be reduced to 90 percent of predevelopment levels. For the remainder of the study area, for development involving new construction to the creeks, peak flows shall not exceed predevelopment levels for a 10- and 100-year peak flow. *This is required to reduce downstream flood hazard.*

Policy 9.2-I4: Assure through a Master Drainage Plan and development ordinances that proposed new development adequately provides for development of onsite and downstream offsite mitigation of potential flood hazards and drainage problems and require development fees to fund the required improvements.

Drainage Design Standards

Standard 4-01: The design of a new storm drain system shall include consideration of the downstream creek or storm drain. The Engineer will need to show that existing creeks (or pipes) can handle the new drainage or that the downstream facilities are being improved to the point where they can.

Floodplain Management

Section 14.18.228.010 (C.1) Residential construction, new or substantial improvement, shall have the lowest floor, including basement, in Zone A, elevated to or above the base flood elevation. Upon the completion of the structure, the elevation of the lowest floor shall be certified by a registered professional engineer or surveyor, and verified by the community building inspector to be properly elevated.

Section 14.18.228.010 (C.2) Nonresidential construction, new or substantial improvement, shall either be elevated to conform with Section 14.18.228.010 C.1 or be

floodproofed below the elevation recommended under Section 14.18.228.010 C.1 so that the structure is watertight with wall substantially impermeable to the passage of water; have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy; and certified by a registered engineer or architect that the standards of this section are satisfied.

Section 14.18.228.030

(A) All preliminary subdivision proposals shall identify the special flood hazard area and the elevation of the base flood.
(B) All subdivision plans will provide the elevation of the proposed structure(s) and pad(s). If the site is filled above the base flood elevation, the lowest floor and pad elevations shall be certified by a registered professional engineer or surveyor.
(C) All subdivision proposals shall be consistent with the need to minimize flood damage.
(D) All subdivision proposals shall have public utilities and facilities located and constructed to minimize flood damage.
(E) All subdivisions shall provide adequate drainage to reduce exposure to flood hazards.

Section 14.18.228.060

Located within areas of special flood hazard are areas designated as floodways. Encroachments within the designated floodways shall be prohibited; including fill, new construction, substantial improvement, and other new development unless certification by a registered professional engineer is provided demonstrating that encroachments shall not result in any increase in the base flood elevation during the occurrence of the base flood discharge.

IMPACTS AND MITIGATION MEASURES

Method of Analysis

The proposed project changes the land use in the project area from agriculture and open space to single family residential and commercial. The changes in land use will cause a change in the runoff from a storm event through changes in infiltration of incident rainfall and concentration of runoff into efficient conveyance facilities such as gutters and pipes. For example, more impervious area from a change in land use results in higher runoff that flows faster in gutters and drain pipes than as overland flow from undeveloped land.

The proposed project has been evaluated through the use of a hydrologic computer model using the HEC-1 computer program. The computer model methodology is consistent with the approach used in the City's Draft Strom Drainage Master Plan study, except that the rainfall data was updated based on the rainfall data contained in the Solano County Water Agency Hydrology Manual. The analysis is based on approximate assumed acreages for the different land uses in the proposed project area. BKF Engineers (BKF) performed the hydrologic analysis to determine the detention storage volume required as mitigation for the proposed project. BKF also conducted a hydraulic analysis of the bypass channel and Lagoon Drain using the HEC-RAS computer model.

Their analyses is summarized in the document titled *Lower Lagoon Valley Preliminary Storm Drainage Study* (February 12, 2004), which is provided as Attachment A. Evaluation of the impacts of the proposed project was based this study.

Impacts to water quality were evaluated qualitatively by comparing existing versus future land uses and assessing the increase in flows to the receiving waters. The proposed project might result in degradation of storm water quality during and after construction. However, the potential degradation can be addressed by the implementation of suitable mitigation measures.

Standards of Significance

For the purpose of this EIR, impacts to storm drainage and water quality are considered significant if the proposed project would:

- Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.
- Violate any water quality standards, waste discharge requirements, or otherwise substantially degrade water quality.
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge.
- Substantially alter the existing drainage pattern in a manner that would either result in substantial erosion or siltation on- or off-site, or increase the rate or amount of surface runoff resulting in flooding on- or off-site.
- Create or contribute runoff that would exceed the capacity of existing or planned storm water drainage systems.
- Place within a 100-year flood hazard area structures that would impede or redirect flood flows.
- Expose people or structures to a significant risk of loss, injury or death involving flooding.

Project Impact and Mitigation Measures

Impact 1 Development of the proposed project would produce increased peak runoff flows from the project area, which could exceed the capacity of downstream drainage facilities and increase the downstream flooding hazard. This impact is considered *significant*.

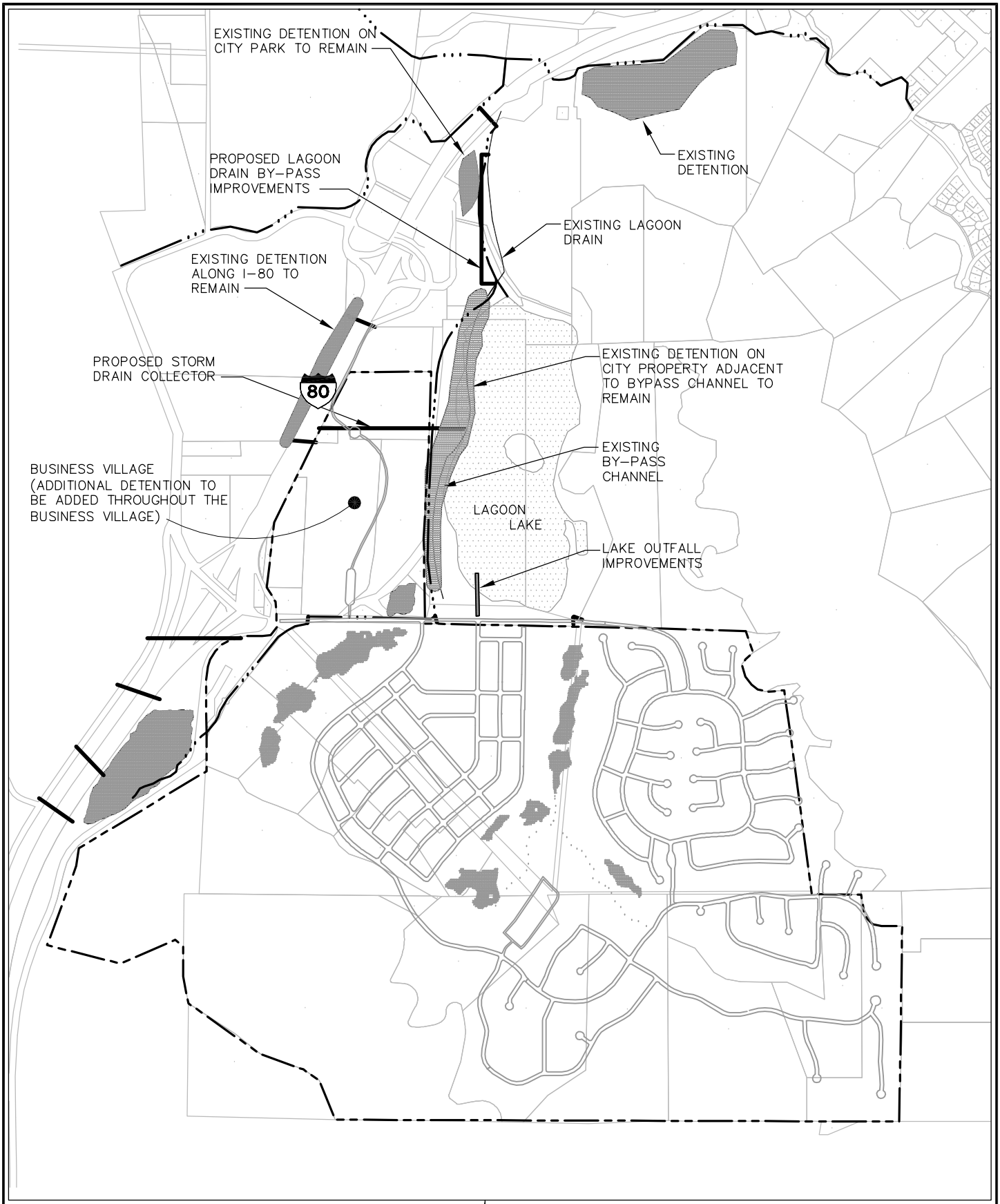
The area of the proposed project is primarily undeveloped, with some agricultural uses. The proposed project is underlain by clay soils that have low infiltration rates; therefore, it could be anticipated that the construction of impervious surface area would not generate significant increases in the volume of surface runoff. Nevertheless, with the project development, runoff would be collected on streets and in pipe systems that would concentrate and convey the runoff more efficiently and would alter existing drainage patterns. This would generate higher peak flow

than the peak flows from the existing undeveloped conditions. The results of the HEC-1 model analysis indicated that the peak flows would be about 1.5 times higher than the peak flows under the existing conditions.

The Lagoon Drain channel does not have sufficient capacity to convey the 100-year design flows. As a result, a backwater condition is created, which results in over topping of the Lagoon Drain and the Bypass channel. This causes frequent flooding of the Pena Adobe Park and the Ranchotel area during moderate storm events.

The proposed project includes construction of detention basins and related drainage facilities to mitigate for the increase in runoff resulting from development of the proposed project and to reduce the 10- and 100-year peak flows from the watershed to 90 percent of existing peak flow at the I-80 box culvert (located at the north end of the valley). Preliminary analysis using HEC-1 methodology indicates that the total detention storage necessary to reduce the 10- and 100-year peak flow to 90 percent of existing flows is between 110 and 135 acre-feet. Of this amount, only 40 to 60 acre-feet are required to mitigate for the increased runoff resulting from the development the proposed project area. Figure 4 shows the approximate location of the proposed detention basins.

The estimated 100-year peak flow for the Lower Lagoon Valley watershed is about 2,600 cfs, which includes the existing detention within Lagoon Lake; however, this flow does not include the overbank storage that occurs adjacent to the bypass channel and the Lagoon Drain. The box culvert under I-80 has a capacity of about 1,400 cfs. Nevertheless, the capacity of the bypass channel and the Lagoon Drain is less than 1,400 cfs. Consequently, during the moderate to large storm events these channels overtop resulting in flooding in the valley. The overbank losses and resulting flooding reduce the peak flow in the bypass channel and the Lagoon Drain. As a result, the estimated existing peak flow at the I-80 box culvert is about 1,280 cfs. Therefore, the required 100-year peak flow at the I-80 culvert is 1,150 cfs in order to reduce the 100-year peak flow to 90 percent of existing flows. Table 1 provides a comparison of the existing and proposed conditions 100-year peak flows at critical locations.



LEGEND

PROPOSED & EXISTING DETENTION BASINS

N

0 750 1500

SCALE IN FEET

Figure 4

PROPOSED ON-SITE DRAINAGE FACILITIES

WEST YOST & ASSOCIATES

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Table 1. Comparison of Existing and Proposed Conditions 100-year Peak Flows

Location	Node Designation [b]	100-Year Modeled Peak Flows [a], cfs	
		Existing Conditions	Proposed Conditions
Discharge into Lagoon Valley Lake [c,d]	C(L34)	2,566	1,616
Discharge into the Bypass Channel [c,d]	C(L32+33)	1,014	229
Combined Runoff from Area West of Bypass Channel [e]	C(L36+37)	788	587
Discharge at Downstream End of Bypass Channel [d]	C(BYPASS)	1,775	811
Discharge at the I-80 Box Culvert [f]	C(ND3)	1,277	1,147

(a) Based on the HEC-1 models developed by BKF Engineers
(b) Node designation per HEC-1 models
(c) Runoff from the proposed residential and golf course development (located immediately south of Lagoon Valley Lake), and the undeveloped areas surrounding the proposed project.
(d) The proposed project plans to divert some of the area that currently drains to the Bypass Channel to Lagoon Valley Lake because of the limited capacity of the Bypass Channel.
(e) Runoff from the proposed Business Park development, located west of Lagoon Valley Lake and areas west of I-80.
(f) Discharge from the Lower Lagoon Valley watershed at the I-80 box culvert, includes existing overbank detention storage.

The Lagoon Drain, as discussed previously, does not have sufficient capacity to convey the 100-year design flows. This results from a restriction in the channel created by a rock ledge. To increase the capacity of the Lagoon Drain the addition of up to two 72-inch bypass pipes are proposed to direct flow around the channel restriction. The proposed bypass pipes would lower the water surface elevation in the Lagoon Drain and subsequently the bypass channel west of Lagoon Lake. The lower water surface elevation would significantly reduce flooding in the Lower Lagoon Valley.

The business park area will be raised to approximately one foot above the estimated 100-year water level in the bypass channel. The proposed residential area immediately south of the lake will be approximately four feet higher than the estimated 100-year water surface elevation in Lagoon Lake.

The proposed storm drainage conveyance system is anticipated to generally consist of catch basins, manholes, and gravity flow pipes within the project site. The runoff collected within the proposed residential development (the area south of Lagoon Valley Lake) would be routed to the proposed golf course. As the runoff is conveyed through the golf course, the flows would pass through several small detention basins. The detention basins would attenuate the 10- and 100-year peak flows prior to discharge into the bypass channel or Lagoon Valley Lake. The runoff

collected within the proposed Business Park development area would be routed to an on-site detention basin prior to discharging into the Bypass Channel. An additional detention basin would be constructed within the City's open space area adjacent to I-80.

Stormwater runoff would be collected on streets and in pipe systems that would concentrate and convey the runoff more efficiently. The storm drain pipelines would be designed to convey the 10-year peak flows in accordance with City design standards and would generally follow the proposed street alignments, and open channels would be designed to convey the 100-year peak flows with freeboard.

The proposed project increases and reroutes surface runoff, which could increase the potential for on-site flooding. A preliminary drainage study has been prepared by the project proponent (*Lower Lagoon Valley Storm Drainage Study,* see Attachment A*)*, which provides a conceptual plan that identifies the approximate storage requirements to reduce the 10- and 100-year peak flows within the Lower Lagoon Valley to 90 percent of existing flows. A Master Drainage Plan that identifies specific improvements consistent with Implementing Policy 9.2-I4 of the General Plan has not been developed, but will be required as part of more detailed engineering studies that will be prepared during the tentative map process. The Master Drainage Plan shall completed and approved prior to approval of the first Tentative Map.

<u>Mitigation Measures</u>

Implementation of the following mitigation measures would reduce this impact to a *less-than-significant level.*

(a) *A Storm Drain Master Plan (SDMP) shall be prepared by a registered civil engineer that identifies specific design improvements that would mitigate for the increased runoff resulting from development of the proposed project. The SDMP shall demonstrate that the proposed drainage facilities adequately convey the design runoff and that the increased runoff will be mitigated through implementation of the proposed drainage facilities (see Figure 4). The SDMP shall be completed prior to approval of the first Tentative Map, and shall include the following:*

- *Maps showing the location of existing and proposed drainage facilities, the watershed boundaries, location of analysis points, and overland release paths;*
- *Preliminary pipe sizes and/or typical channel geometry with hydraulic grade lines, invert, and proposed ground elevations at analysis points;*
- *Design flows (10- and 100-year) at key analysis points;*
- *Preliminary grading plan and layout of proposed detention basins;*
- *Stage, storage, and discharge information for detention basins for selected design storms;*
- *Description of storage requirements, operation, and maintenance of detention facilities; and*
- *Description and analysis of any necessary water quality features.*

(b) *The project applicant shall include drainage improvements and detention basins designed to accommodate 10- and 100-year flows. Detention facilities shall be adequate to limit discharges from the Lower Lagoon Valley watershed such that the 10- and 100-year peak flows are reduced to 90 percent of the estimated existing peak flows. The detention facilities shall be designed to the City's Design Standards and will include provisions to ensure draining during high flows in the main channels and to prevent increased flows downstream due to the occurrence of simultaneous peak flows from upstream. All necessary detention storage shall be accommodated within the project site.*

(c) *The proposed project shall be designed such that the building pads are raised and overland flows can be safely conveyed through the project site to an existing receiving channel (such as the Bypass channel or Lagoon Valley Lake), to the proposed golf course, and/or to the proposed detention facilities.*

Impact 2 The northern portion of the proposed residential development and most of the proposed business park development is within the FEMA 100-year Floodplain. This impact in considered *significant*.

The proposed project would develop residential and business park land uses within the 100-year floodplain as defined by FEMA for Laguna Creek (see Figure 2). The detailed FEMA analysis of the floodplain within the Lower Lagoon Valley was limited to the Lagoon Drain downstream of Lagoon Valley Lake. As a result, the delineation of the 100-year floodplain indicated on the FEMA FIRM maps is only approximate. Development of proposed land uses in the floodplain could expose people and property to increased risk of flooding. In addition, development of structures within the floodplain could impede or redirect flood flows, such that additional areas could be inundated.

The proposed project includes construction of several detention basins and related drainage facilities that would reduce the water surface elevations within the Lower Lagoon watershed, thus decrease the potential for flooding. In addition, the business park area will be raised to approximately one foot above the estimated 100-year water levels in the bypass channel. The residential area will be approximately four feet higher than the estimated 100-year water surface elevation in Lagoon Lake.

Further detailed studies would need to be performed to further define the 100-year floodplain. The project applicant would need to submit the new floodplain study and request a Flood Insurance Rate Map revision from FEMA to reflect the new floodplain conditions. Until the 100-year floodplain is verified and/or modified so that it does not affect the proposed development, there is a risk of exposure to flooding during the 100-year storm event.

Development in the 100-year floodplain must comply with the regulatory requirements established by FEMA and the City of Vacaville. In general, these requirements ensure the proposed project would not increase flooding downstream of the proposed project or create flooding hazards within the project boundaries.

<u>Mitigation Measures</u>

Implementation of the following mitigation measures would reduce this impact to a *less-than-significant level.*

(a) *Prior to the first residential Final Map and commercial building permit, a detailed floodplain study for the proposed residential and commercial projects shall be conducted by a registered civil engineer to determine the boundaries of the 100-year floodplain within the Lower Lagoon Valley.*

(b) *Prior to issuance of the first building permit, the floodplain study shall be submitted to and approved by FEMA in accordance with all FEMA requirements for the floodplain map revision process.*

(c) *Until a revised floodplain map is adopted, prior to any development within the 100-year floodplain as currently designated by the City of Vacaville FIRM, the City shall require as a condition of building permit issuance that the proposed project complies with the City's Floodplain Management ordinance for residential and non-residential floodproofing. When the revised floodplain map is adopted, any areas in the revised floodplain shall comply with the City's Floodplain Management Ordinance.*

Impact 3 Increased rates of surface runoff generated by the project development or dewatering for construction activities could result in sedimentation and increased levels of urban contaminants, which could affect receiving water quality. This impact in considered *significant*.

Implementation of the proposed project would increase the peak runoff rates compared to existing conditions, which could potentially result in increased erosion and level of sedimentation. Conversion of agricultural uses and open space to urban land uses will likely increase the concentration of contaminants associated with urban areas in the runoff.

There would be a corresponding increase in roadway contaminants (i.e. oil, grease, and heavy metals) due to increased vehicular traffic in parking areas and on surrounding roadways. Other urban contaminants, such as fertilizers and pesticides, would be discharged from landscaped areas. These urban contaminants would be carried along with the runoff discharged into the Lagoon Valley Lake and the Bypass channel, thereby adversely affecting receiving water quality. Some runoff pollutants could be removed through sedimentation and biological removal in the detention basins, depending on the design of these facilities.

Construction Activities

Construction activities could expose bare soil and potentially generate other water quality pollutants that could be exposed to rainfall and subsequent erosion caused by surface runoff. Construction activities involving soil disturbance, excavation, cutting/filling, stockpiling, and grading activities could result in increased erosion and sedimentation in surface waters. Construction materials such as asphalt, concrete, and equipment fluids could be exposed to rainfall and subsequent surface runoff. If precautions are not taken to contain contaminants, construction could produce contaminated storm water runoff (nonpoint source pollution), a potential major contributor to the degradation of water quality.

Any significant construction in the State of California requires preparation of a Storm Water Pollution Prevention Plan (SWPPP) to comply with the requirements of the SWRCB NPDES General Permit. The best management practices identified in the SWPPP would help mitigate for the impact of construction activities on storm water quality. In addition, under the NPDES Phase

II rule, the City is required to develop a Storm Water Quality Management Program to protect surface waters from adverse water quality associated with runoff. The Storm Water Quality Management Program would minimize any impact of development on storm water quality.

Lagoon Valley Lake Water Quality

The water quality of Lagoon Valley Lake has deteriorated over the past several years. The impaired water quality results from sedimentation, excessive nutrient loading, and waterfowl fecal loadings. The primary source of the nutrient loading is the Hines Nursery, located just south the Lagoon Valley Lake. The primary source of the high levels of fecal coliform bacteria is domestic waterfowl.[11]

The proposed project could adversely impact the water quality of Lagoon Valley Lake through contaminants typically contained in urban runoff, such as sediment, oil, grease, and heavy metals. In addition to these contaminants, runoff from landscaped areas and the golf course contain fertilizers and pesticides.

The project proponent plans to utilize vegetative swales within portions for the residential development and through the proposed golf course to provide on-site runoff treatment. In areas where vegetative swales are not feasible, treatment control devices, such as Vortex type separators, will be used to treat storm water. All storm flows from the residential development will be routed to the golf course and through a series of vegetative swales and wet ponds to provide further treatment.

It is anticipated that the proposed project will improve the current Lagoon Valley Lake water quality through both the elimination the nutrient load from the Hines Nursery and the proposed water quality improvements planned as part of the proposed project.

<u>Mitigation Measures</u>

Implementation of the following mitigation measures would reduce this impact to a less-than-significant level.

(a) *A comprehensive storm water management plan shall be prepared by a registered civil engineer or registered professional hydrologist for approval by the City prior to submittal of local improvements plans. The management plan shall be designed to protect water resources from water quality impacts of runoff generated by the project to the maximum extent practicable, identifying construction and programmatic Best Management Practices (BMP) as required to achieve this goal.*

(b) *Since the proposed project will disturb more than one acre of soil, preparation of a Storm Water Pollution Prevention Plan (SWPPP) will be required by the Regional Board under the NPDES General Permit for Discharges of Storm Water Associated with Construction Activity. Prior to the start of construction, a SWPPP shall be prepared to address water quality impacts associated with construction of project facilities and roadways. The Project Proponent shall incorporate into the construction contract specifications the requirement that all contractors comply with and implement the provisions of the SWPPP. The objectives of the SWPPP are to identify pollutant sources that could affect the quality of stormwater discharge, to implement control practices to reduce pollutants in stormwater discharges, and to protect receiving water quality.*

The City shall require preparation of a Storm Water Pollution Prevention Plan for construction activities, and shall comply with requirements adopted by the SWRCB that are shown to be necessary to mitigate project specific and cumulative water quality impacts of runoff.

Impact 4 Runoff from the surrounding hillsides is laden with sediment that could plug drainage facilities resulting in increased maintenance and increases the potential for flooding within the proposed project. This impact in considered *significant.*

Since completion of the current configuration of the Lagoon Valley Lake in the late 1970s, the lake has been slowly filling with sediment. Recent studies undertaken by the City of Vacaville have estimated that over three feet of sediment has accumulated at the bottom of the lake. The sediment accumulation has resulted in loss of several hundred acre-feet of potential detention storage, promotes excess algae and aquatic growth, and has depleted the fisheries.[12]

Sediment laden runoff also increases storm drain facility maintenance. If the sediment loadings are significant then there is the potential for failure of the storm drain system to convey the design storm, ultimately resulting in flooding within the project.

According to recent studies, the sediment load in the runoff results from erosion of the upper watershed. The erosion is caused by unstable channels, over-grazing, and possible erosion of existing trails and fire roads.[13] Possible erosion control measures include construction of sediment basins upstream of the proposed project, development of a grazing management plan, and stabilization of existing drainage courses upstream of the project.[14]

Mitigation Measure

Implementation of the following mitigation measures would reduce this impact to a less-than-significant level.

(a) A comprehensive erosion control management plan shall be prepared by a registered civil engineer, registered geotechnical engineer, or registered geologist for approval by the City prior to submittal of local improvements plans. The management plan shall be designed to reduce sediment entering the proposed project, develop a maintenance plan for the proposed drainage facilities and/or erosion control measures, and protect the water quality of Lagoon Valley Lake.

Cumulative Impacts and Mitigation Measures

Impact 5 Cumulative development, including the proposed project, could increase runoff that could exceed the capacity of existing drainage facilities resulting in localized flooding. This impact is considered *significant.*

Cumulative development within the City would result in increased peak flows within the existing creeks, which could result in increased flooding within and downstream of the City. As presented in Table 1, the proposed project, with implementation of the proposed detention basins and related drainage facilities identified in the preliminary drainage study, would decrease peak flows

discharging from the Lower Lagoon Valley watershed. Although a preliminary drainage study has been completed, the project proponent is required to complete a Drainage Master Plan that identifies specific improvements consistent with City General Plan policies. Until a Master Drainage Plan is completed and approved by the City the project's contribution to this cumulative impact is ***considerable***.

Mitigation Measures

Preparation of a drainage master plan prior to Tentative Map approval would ensure that the proposed project includes sufficient detention storage to reduce the 10- and 100-year peak flows from the Lower Lagoon Valley watershed to 90 percent of existing peak flows, as required by General Plan Policy 2.3-I 14 for development in the watershed. This would reduce the risk of flooding and would ensure consistency with General Plan policies, thus reducing the project contribution to *less than considerable*.

Implement Mitigation Measures 1(a) through 1(c)

Impact 6 Increased runoff generated by cumulative development, including the proposed project, could result in sedimentation and increased levels of urban contaminants, which could affect receiving water quality in the Ulatis Creek Watershed. This impact is considered *significant.*

Increased peak runoff rates would be generated with cumulative development within the City compared to those under existing conditions due to new impervious surfaces. There could be a potentially increase in erosion and the level of sedimentation. Conversion of undeveloped land to urban land uses will likely increase the concentration of contaminants associated with urban areas in the runoff.

There would be a corresponding increase in roadway contaminants (i.e. oil, grease, and heavy metals) due to increased vehicular traffic in parking areas and on surrounding roadways. Other urban contaminants, such as fertilizers and pesticides, would be discharged from landscaped areas. These urban contaminants would be carried along with the runoff into local creeks and streams, and ultimately discharging into the delta.

Construction activities could expose bare soil and potentially generate other water quality pollutants that could be exposed to rainfall and subsequent erosion caused by surface runoff. Construction activities involving soil disturbance, excavation, cutting/filling, stockpiling, and grading activities could result in increased erosion and sedimentation in surface waters. Construction materials such as asphalt, concrete, and equipment fluids could be exposed to rainfall and subsequent surface runoff. If precautions are not taken to contain contaminants, construction could produce contaminated storm water runoff (nonpoint source pollution), a potential major contributor to the degradation of water quality.

Any significant construction project in the State of California requires preparation of a Storm Water Pollution Prevention Plan (SWPPP) to comply with the requirements of the SWRCB NPDES General Permit. The best management practices identified in the project SWPPP would help mitigate for the impact on storm water quality from construction activities within the City. In

addition, under the NPDES Phase II rule, the City is required to develop a Storm Water Quality Management Program to protect surface waters from adverse water quality associated with runoff. The Storm Water Quality Management Program would minimize any impact on storm water quality from the cumulative development within the City.

Mitigation Measures

While a City wide programmatic plan for water quality protection has not been developed, project-specific requirements will address water quality impacts (see Mitigation Measures 3(a) and 3(b)). Therefore, these individual mitigation measures will result in a cumulative decrease in the significance of the impact.

Implement Mitigation Measures 3(a) and 3(b)

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[1] United States Department of Agriculture Soil Conservation Service, *Soil Survey of Solano County, California*, May 1977.

[2] Ibid, Map 21.

[3] West Yost & Associates, *Solano County Water Agency Hydrology Manual*, June 1999, Figure 2-2.

[4] Ibid, Table 3-4B.

[5] FEMA Flood Insurance Rate Map, *City of Vacaville, California, Solano County*, January 17, 1997, Panel 060373-0013 C & 060373-0011 C.

[6] LSA Associates, Inc., *City of Vacaville Proposed Lagoon Valley Lake Management Plan*, October 13, 1999.

[7] City of West Sacramento, *City of West Sacramento General Plan, Background Report*, May 3, 1990.

[8] U.S. Army Corp of Engineers, Wetlands and Waterways Regulation and Permitting website (http://www.usace.army.mil/public.html#Regulatory), accessed July 21, 2003.

[9] State Water Resources Control Board – Water Quality, Storm Water Program – Construction Frequently Asked Questions, SWRCB website (http://www.swrcb.ca.gov/stormwtr/constfaq.html), accessed June 23, 2003.

[10] California Department of Fish and Game, Lake or Streambed Alteration Program (aka 1600) website, (http://www.dfg.ca.gov/1600/1600code.shtml), accessed July 21, 2003.

[11] LSA 1999, p. viii

[12] Ibid, p.42-43

[13] LSA Associates, Inc., *Watershed Restoration Plan – Lagoon Valley Lake,* June 1, 2003, p. 2

[14] LSA 1999, p. 54-58

ATTACHMENT 1

Preliminary Storm Drainage Study

LOWER LAGOON VALLEY

ENVIRONMENTAL IMPACT REPORT LOWER LAGOON VALLEY
TECHNICAL MEMORANDUM
PRELIMINARY STORM DRAINAGE STUDY

PREPARED FOR TRIAD
1095 HIDDENBROOKE PARKWAY
VALLEJO, CA 94591

PREPARED BY **BKF ENGINEERS**
540 PRICE AVENUE
REDWOOD CITY, CA 94063

Job No. 20020223
Date: February 12, 2004

Lower Lagoon Valley Preliminary Storm Drainage Study
Hydrograph Modification of 100-year Flows
Existing and Proposed Conditions

Introduction

This report provides both general and specific guidelines for the development of future storm drainage detention facilities necessary to serve Lower Lagoon Valley. The Lower Lagoon Valley drainage area currently generates about 2,600 cfs peak flow during the 100-year storm event, including intentional detention storage that occurs within Lagoon Valley Lake. This flow does not include unintentionally storage in overbanks adjacent to the Bypass Channel and in the area upstream of the I-80 culvert.

Based on preliminary survey information, observed downstream flows and previous studies of the Lagoon Valley drainage area, the 100-year event peak flow through the I-80 culvert is about 915 cfs for the 10-year storm event and 1,280 cfs for the 100-year storm event. This flow rate is based on a total of about 440 acre-feet of, (1) intentional in Lagoon Valley Lake and (2) unintentional storage in areas adjacent to the Bypass Channel.

For proposed conditions, development will occur that will increase storm water runoff. More critically, portions of areas of unintentional storm water detention will be raised above the 100-year water level, reducing storage. To compensate for this lost storage, detention basins are proposed that will reduce peak flows to approximately 90 percent of the existing peak flow rate. The current analysis shows flows reduced to about 810 cfs for the 10-year storm event and 1,150 cfs for the 100-year storm event.

Site Description

The proposed project site is located in the Laguna Creek drainage area. A majority of the runoff in Laguna Creek is from the area upstream of I-80 (the area west and north of I-80). The Lower Lagoon Valley drainage area consists mostly of the area east and south of I-80, with about 400 acres from the west of I-80. The existing land uses within the Lower Lagoon Valley include grazing, open space, parkland, commercial, and agricultural (Hines Nursery). The project site and existing drainage facilities are shown on Figure 4.10-3 of the EIR. The ground slope varies from relatively steep in the surrounding hills to an average slope in the valley of about 20 feet per 1,000 feet.

The runoff from the Lower Lagoon Valley drainage area is conveyed to Laguna Creek via the Lagoon Drain and a box culvert under I-80 at the north end of the Valley. About 1,500 acres drain directly to the Lagoon Valley Lake and about 1,100 acres drain to the Bypass Channel constructed along the west side of the Lake. The Bypass Channel was constructed to convey runoff that could not drain into the Lake because the high water levels in the Lake. The berm along the western side of the Lake is higher than the existing ground surface west of the Lake. The 1,100 acre drainage area to the Bypass Channel includes drainage area west of I-80 that

flows across I-80 toward the Bypass Channel via two sets of culverts; a 6 by 3-foot box culvert south Cherry Glen freeway exit, and twin 36-inch culverts north of the Lagoon Valley Road freeway exit. The runoff from west of I-80 currently flows overland through the Business Village area and discharges into the Bypass Channel. The discharge from the Lake and Bypass Channel combine at the confluence with the Lagoon Drain, and continue north, through the I-80 box culvert, and connect to Laguna Creek.

Lagoon Valley Lake is one of the major drainage features in the Lower Lagoon Valley drainage area. The Lake was construction in the 1970's and covers an area of about 105 acres. The western and southern boundaries of the Lake are created by an earthen berm (dam), with the top of the berm at an elevation of 217.5 feet (NGVD 1929). The Lake discharges through a spillway and low flow outlet located on the north side of the Lake. The crest of the spillway is at elevation 213 feet (NGVD 1929). The average depth of the Lake is about six to seven feet.

The earthen dam at Lagoon Valley Lake is under the jurisdiction of the California Division of Safety of Dams (DSOD). The DSOD perform periodic inspections of the structure to evaluate physical integrity. The earthen dam is generally in good condition with no evidence of significant erosion or destabilization. However, DSOD noted some items that should be addressed by the City to help maintain the integrity of the dam. These include: 1) removal of vegetation on the west side of the berm that has the potential to undermine the dam berm through the growth of roots and by creating locations for rodent burrows; 2) improvements to the outlet works so that the dam will not be over-topped during storm events in excess of the 100-year storm; 3) removal of constrictions in Lagoon Drain caused by vegetation that could impede design flows. The City's Lagoon Valley Lake Proposed Management Plan identifies specific management actions to address these issues.

Existing Storm Water Flows

The existing 100-year peak storm water flow through the Valley is approximately 2,600 cfs, including intentional storage in the Lake, and excluding unintentional storage that results when low-lying areas are flooded. All of the storm water flows exit the Lower Lagoon Valley area through an existing box culvert under I-80 at the north end of the Valley. The maximum flow capacity of the box culvert, with no flow overtopping I-80, is approximately 1,400 cfs. The flow capacity of the Bypass Channel and Lagoon Drain are less than 1,400 cfs. Therefore, during large events, portions of the Lower Lagoon Valley flood. The flooding reduces the 100-year flow through the Bypass Channel and Lagoon Drain and therefore the peak 100-year peak flow rate to the I-80 box culvert is approximately 1,280 cfs.

Existing 100-Year Storm Water Level

The existing 100-Year water levels are evaluated using a HEC-RAS analysis with a maximum water elevation of 206.0 ft (NGVD 29) at the confluence of Lagoon Drain and Laguna Creek. This confluence of the two water stream is located at the east side of the culvert under I-80 downstream of the Lower Lagoon Valley.

The 100-Year water elevation along the Lagoon Drain varies from 210.9 ft at the I-80 box culvert to 214.5 ft (NGVD 29) at the confluence of the Lake Spillway and Bypass Channel. Much of the differential in water surface elevation is caused by constrictions in the Lagoon Drain at bridges crossings.

The Bypass Channel conveys flows around Lagoon Valley Lake and is located immediately west of the Lake. There is a low-lying overbank area adjacent to the Bypass Channel that is susceptible to flooding. The overbank detains and conveys significant flow. Therefore, the Bypass Channel water level has little variation from its downstream point to its upstream end with a maximum 100-year water level of about 214.6 ft (NGVD 29).

The existing 100-Year water level of the Lagoon Valley Lake is approximately 216.3 ft (NGVD 29). The maximum 100-Year level in the Lake is higher than the maximum 100-year water level in the Bypass Channel.

Existing Flood Zone

Based on the EIR analyses, the existing area inundated during a 100-year storm event includes a large portion of the proposed Business Village, including the Ranch Hotel, the other private properties along the Bypass Channel and the City Pena Adobe Park area. Based on preliminary HEC-RAS analysis, the elevation of the existing 100-year flood is approximate 214-215 (NGVD 29).

On-Site Storm Drainage Improvements, Residential Site and Business Village

The areas where the Residential and Business Village portions of the Specific Plan area are proposed are primarily undeveloped. Development of buildings, roadways, parking lots, and landscape hardscaping in these areas would increase the amount of impervious surfaces over that which currently exists, and would alter the natural drainage patterns across the project area. The rate and amount of stormwater runoff would change as a result of these improvements. Because the proposed project site is underlain by clay soils that have low infiltration rates, the development of new impervious surfaces area would not generate significant increases in the volume of stormwater runoff. However, it is expected that without mitigation, the runoff generated from development of the proposed project would be conveyed more efficiently to the outlet, producing higher stormwater peak flow rates than would occur with the existing undeveloped conditions. The results of the preliminary HEC-1 analyses indicate that the peak flows would be about 1.5 times higher than the peak flows that occur with existing conditions.

The project is required by the City to construct detention basins and related drainage facilities to provide for all lost stormwater storage and incremental increases in runoff, and total retention to reduce downstream flows during peak-storm conditions to not more than 90 percent of existing conditions. To achieve this required reduction in peak flows, the proposed project will need to reduce the flows through the box culvert to about 1,150 cfs. To accomplish this, the project will need to provide storage to replace the volume of existing flooding that will be raised to above the 100-year flood level, detain an additional approximately 200 cfs throughout the Lower Lagoon Valley development, and change the timing of peak flows to the Lake to more effectively use

the existing peak storage capacity within the Lake. The results of preliminary HEC-1 analyses indicate this will require approximately 110 – 135 acre-feet of on-site detention and improvements to the Laguna Drain.

Stormwater Detention in Residential Area

To achieve the required 110-135 acre-feet of detention for the Lower Lagoon Valley area, the residential development will construct approximately 80-90 acre-ft of detention within the golf course area (Land Use Area 4) and an additional 20 acre-feet within the City's open space adjacent to I-80 (Land Use Area 7A). The additional area required will be accommodated within the Business Village. Refer to Figure A3 for the approximate detention areas.

The detention on the golf course will be accomplished by constructing approximately 20 to 30 acres of pond features throughout the course. These ponds will be constructed with a depth of approximately 8 to 10-feet including 3 to 5-feet of freeboard above the normal water elevation. During the rainy seasons the 3 to 5-feet will be used to detain the larger storms. During the dry season the ponds will be left at the normal operating depth of approximately 5-feet and will act as an amenity for the golf course. The depth of the ponds will be controlled through the use of weirs and pipe sizing to detain the appropriate amount of runoff through the winter months. During the dry season, the water surface elevation will be maintained by the Solano Irrigation District (SID) water. This water will then be drawn out of the ponds for irrigation of the course.

The detention within the open space adjacent to I-80 will be accommodated by a combination of excavated stormwater detention areas and over-sized storm drainage improvements. This open space area currently receives storm flow from west of I-80 through several culverts under I-80. This flow collects in the open space and flows in open drainage ditches along Nelson Road and Lower Lagoon Valley Road until it reaches the Bypass Channel. The project will construct a storm drain system to collect this flow and route it to the Bypass Channel in pipes rather than as overland flow. The storm drainage system will be sized to detain the 100-year flows within the open space area. The open space adjacent will be graded to accommodate approximately 20 acre-feet of storage during the 100-year events.

In addition to the golf course and open space pond storage, additional detention may be accommodated with storm drainage pipes within the residential streets. The detention within the street storm systems will be accommodated by sizing the pipes larger than required for the 10-year design storms with smaller pipes on the down stream side of the manholes and catch basin structures. This will allow water to back up within the pipe and be released at a slower rate than normal.

The outfall structure that conveys flows into Lagoon Valley Lake will be improved to accommodate the anticipated flows from the residential area. The proposed flows into the Lake will not be greater than the existing flows.

Stormwater Detention in Business Village

The storm water detention within the Business Village will be created within the southeast corner of the Town Center area, within the existing Bypass Channel area, and within the City's existing Pena Adobe Park area. Refer to Figure A3.

The detention within the southeast corner of the Town Center area will be accomplished by grading to create a water/wetland amenity for the site. Drainage from a portion of the Business Village will be routed to this area and detained during the larger rainfall events. The smaller rainfall events will pass through the area and discharge into the Bypass Channel. Approximately 12-acre feet of detention will be created within this area.

The detention within the existing Bypass Channel and Pena Adobe areas will match the existing detention within these areas. During large events, the Bypass Channel currently overflows and the Pena Adobe Park area and adjacent private properties flood. The proposed project will construct storm drainage and detention improvements to reduce the flooding within these areas during large rainfall events. Along the Business Village, the Bypass Channel detention area will be reduced to include only the City's property between the project boundary and the western edge of Lagoon Lake. The flooding of the downstream adjacent private properties will be reduced and limited to large events. Within the Pena Adobe area, the flooding will be reduced to include only the open space/park site area. These areas will only detain water during the largest of rainfall events.

In addition to the Town Center pond feature, the Business Village area will utilize pipe sizing to create additional detention volume below ground and lowered parking areas to store runoff above ground. The underground detention will be accommodated by sizing the pipes larger than required for the 10-year design storms with smaller pipes on the down stream side of the manholes and catch basin structures. This will allow water to back up within the pipe and be released at a slower rate than normal. Parking lot storage would be provided with a maximum depth of 9-inches at the peak of the 100-year storm event.

The Business Village area currently receives flows from west of I-80 through several existing culverts under I-80. The flows from these culverts discharge on the east side of I-80 and flow overland to the Bypass Channel. The project will collect these flows as they discharge from under I-80 and construct a new piping system that discharges to the Bypass Channel.

Up to two 72-inch bypass pipes are proposed to direct flow around an existing high point in the Lagoon Drain downstream of the Business Village area and Lake Spillway discharge point. Refer to Figure A3 for approximate location.

Proposed Site Elevation

The proposed storm drain system improvements will lower the Bypass Channel 100-Year water level to 213.5 ft (NGVD 29). Therefore, the Business Village area will be filled to accommodate

building finished floor elevations of 215 ft (NGVD 29) and higher. This elevation will provide the protection required to remove the proposed site from the 100-Year storm event flood area.

The adjacent Ranch Hotel and other private properties will have a reduced flooding elevation of approximately 1 foot during a 100-year storm event. The existing flooding elevation is estimated to be about 214.5 ft (NGVD 29) along those properties. After the implementation of the proposed storm system, the water level is anticipated to be approximately 213.5 ft (NGVD 29).

The residential area along the Lagoon Valley road will be filled to provide a minimum building finish floor elevation of 220.0 ft. This elevation will raise the area at least one foot above the 100-year water level of the Lagoon Valley Lake of 216.3 ft (NGVD 29) and will provide for headloss in lines from the Residential area to the Lake.

RESULTS

The existing analyses are based on available topography for the anticipated areas of inundation and show a peak detained flow from the Valley of about 1,280 cfs and 915 cfs for 100 and 10-year storm events, respectively. This flow is affected by overland flow and unintentional storage.

For proposed conditions, the analyses show a peak flow of 1,150 cfs and 810 cfs for the 100 and 10-year storm events, respectively, with about 135 acre-feet of storage on the site. There is a significant reduction in unintentional storage in the area downstream of the Lake spillway because of proposed improvements to direct flow around a high point in the existing Bypass Channel and because portions of the site will be raised to above the 100-year water surface elevation.

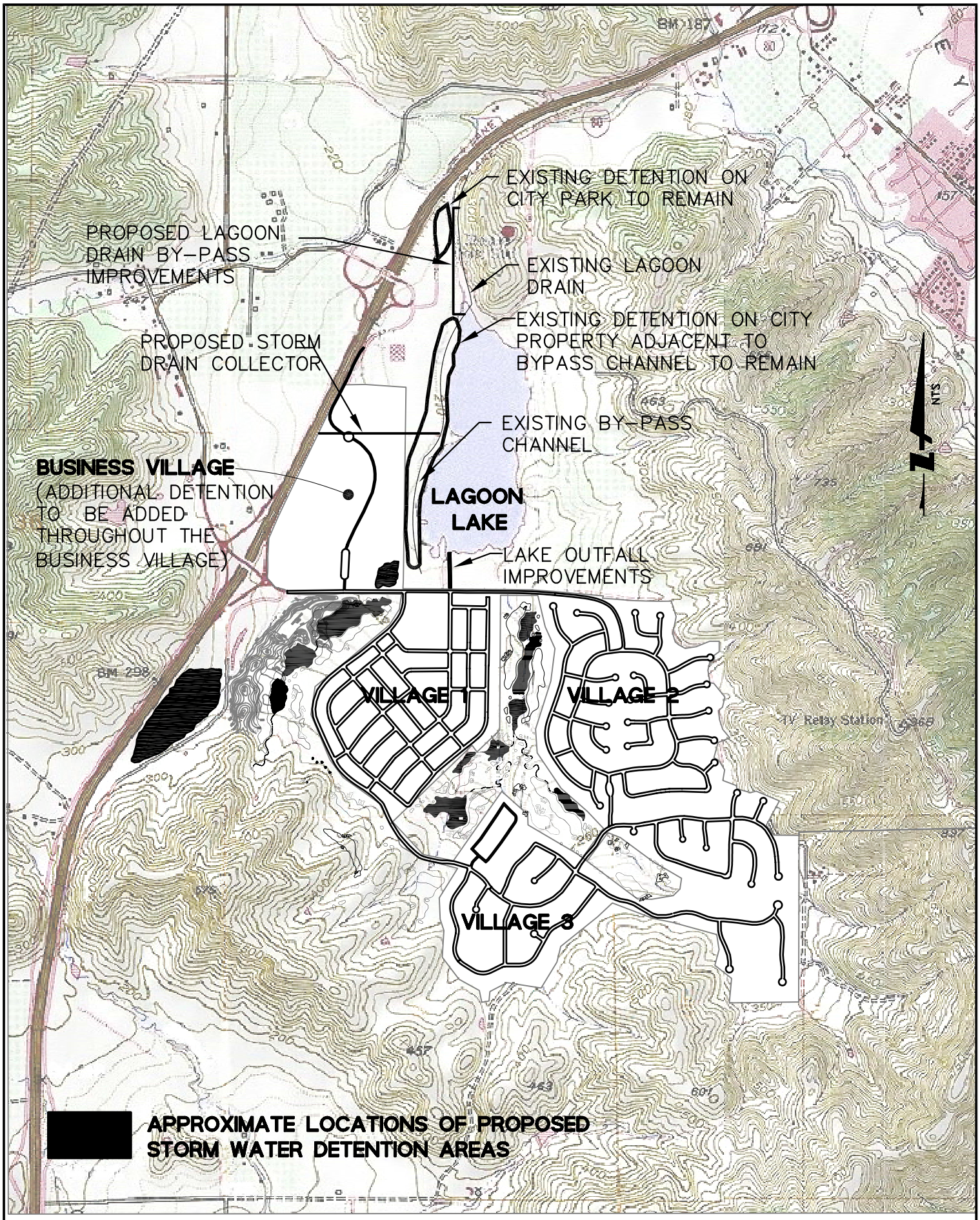

FIGURE A3 – STORM DRAINAGE IMPROVEMENTS AND DETENTION

TECHNICAL APPENDIX J

Addendum to Preliminary Geotechnical Exploration –
Seismic Refraction Survey

Preliminary Geotechnical Exploration –
Lagoon Valley

Preliminary Geotechnical Exploration –
Commercial Development, Lagoon Valley

ENGEO INCORPORATED

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Project No.
5489.2.003.01

August 29, 2003

Mr. Tom Egidio
Triad Development
1095 Hiddenbrooke Parkway
Vallejo, CA 94591

Subject: Commercial Development
Lagoon Valley
Vacaville, California

ADDENDUM TO PRELIMINARY GEOTECHNICAL EXPLORATION – SEISMIC REFRACTION SURVEY

Reference: ENGEO Incorporated, Preliminary Geotechnical Exploration, Commercial Development, Lagoon Valley, Vacaville, California, August 14, 2003

Dear Mr. Egidio:

This letter is an addendum to our preliminary geotechnical exploration for the planned commercial development at Lagoon Valley in Vacaville, California, dated August 14, 2003. As noted in our above-referenced report, ENGEO Incorporated has performed an additional seismic refraction survey at the commercial site for suggested evidence of anomalies in the alluvium possibly related to a concealed fault that would warrant further exploration.

The findings of the seismic refraction survey by Norcal at this site showed no evidence of possible concealed fault-related anomalies in the alluvium at this site. This finding supports our previous conclusions as presented in the above-referenced report. The accompanying report by Norcal contains the details, findings, and conclusions of their geophysical evaluation.

Based on this work and previous exploratory studies along the suspected fault trace, we conclude that there are no indications of active or potentially active fault traces traversing the planned commercial development.

We are pleased to provide our services to you on this project and look forward to consulting further with you and your design team.

Very truly yours,

ENGEO INCORPORATED

Eric Bowman
for Robert Boeche, RG
Project Geologist
sp/rb/kd:addendum

Reviewed by:

Theodore P. Bayham, GE, CEG
Principal

Attachment: Seismic Refraction Survey by NORCAL dated August 28, 2003

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E-mail: engstaff@engeo.com • www.engeo.com

NORCAL GEOPHYSICAL CONSULTANTS, INC.

August 28, 2003

ENGEO, Inc.
Quarters N. 522 Walnut Avenue
Mare Island, Vallejo, California 94582

Subject: Seismic Refraction Survey
Lagoon Valley
Vacaville, California

Attention: Mr. Robert Boeche

Gentlemen:

This letter presents the findings of a seismic refraction survey performed by NORCAL Geophysical Consultants in Vacaville, California. The seismic refraction survey is supplemental to a survey we performed in May of 2003, described in our report dated June 4, 2003. The supplemental seismic refraction survey was performed on August 19, 2003 by NORCAL Geophysicists William E. Black with the assistance of Geophysical Technician Michael Zinsley. Mr. Jason Bariel of ENGEO provided background information and site logistical support.

SITE DESCRIPTION

The supplemental seismic refraction survey was performed at the north end of Lagoon Valley, just east of Interstate 80, in Vacaville, CA. The area of investigation is bordered by Rivera Road on the west and north, by Lagoon Valley Regional Park on the east, and by private property on the south. The seismic refraction survey consisted of one line, Line 02, as shown on Plate 4. The line was oriented perpendicular to the suspected trace of the north-northwest trending Lagoon Valley fault. The terrain in the area of investigation is relatively flat with elevations ranging from about 212 to 220 ft above mean sea level (MSL). Ground cover consisted of high grass and reeds among scattered trees. Information provided by ENGEO indicates that the study area is probably underlain by alluvium which in turn overlies undifferentiated sedimentary rocks of the Great Valley Sequence.

PURPOSE

The purpose of the supplemental seismic refraction survey is to add to the information previously provided in our June 4, 2003 report regarding the location of the Lagoon Valley fault. We understand that this information will be used by ENGEO, along with surface geologic mapping and air photo interpretation, to help determine the optimum location of exploratory trenches, and to minimize their lateral extent.

DATA ACQUISITION AND ANALYSIS

Our data acquisition and analysis procedures for the supplemental seismic refraction survey were essentially the same as those used for the initial survey. The seismic refraction profile, Labeled Line 02 on Plate 4, consisted of two overlapping spreads. Each spread consisted of 24 geophones

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www.norcalgeophysical.com

distributed at 20-ft intervals in a collinear array. Shot points were placed at the center of each array, and 10-ft beyond the end geophone at both ends of the array. Additional shot points were offset 250-ft beyond both ends of each array, except at the west end of the west array. An offset shot point could not be used at that location because the spread was too close to Rivera Road. The two seismic spreads overlapped each other by a distance of 160-ft, resulting in a total profile length (end shot point to end shot point) of 800-ft.

RESULTS

The results of the seismic refraction survey are represented by the seismic velocity cross-section shown on Plate 5. Our interpretation of the seismic refraction data resolves the subsurface into two seismic velocity layers. The layers are designated, according to increasing depth and velocity, as V1 and V2. The velocity, depth range, and assumed lithology of the two seismic layers are listed in the following table:

Layer	Vp (ft/sec)	Depth Range* (ft)	Assumed Lithology
V1	750 - 1100	surface	loose, dry surficial deposits (alluvium).
V2	5400 - 5600	4 - 10	more compacted, more moist alluvium; deeply to deeply weathered rock

*to top of layer

SEISMIC VELOCITIES

The velocity range represented by the two seismic layers (V1 - V2) are color coded on Plate 5. Variations in velocity within each layer are represented by variations in the shade of the assigned color. The higher the velocity, the lighter the shade. The average velocities of the two layers are as follows:

V1 = 900 ft/sec
V2 = 5500 ft/sec

Seismic Refraction Line 01, which was performed during the previous survey at the south end of Lagoon Valley, resolved three seismic layers. The upper two layers, V1 and V2, have velocities similar to the V1 and V2 values listed above. However, Line 01 also resolved a third layer (V3) underlying the V2 layer. That layer, with velocities of 7600 - 7750 ft/sec, probably represents moderately weathered rock. A V3 (bedrock) layer was not resolved by Line 02. However, we can estimate a minimum depth to V3 using the V1 and V2 velocities resolved by Line 02, and the V3

(7700 ft/sec) velocity resolved by Line 01. If we assume that the top of bedrock (V3) is relatively horizontal, and that confident resolution of V3 would require the identification of arrivals from that layer over the last 100-ft of the spread, the V3 layer would have to be more than 200-ft deep to go undetected.

INTERPRETATION

Fault traces can be manifest in seismic refraction data in a variety of ways. If a fault causes a vertical offset in a geologic layer (e.g. bedrock) there may be a similar offset in the corresponding seismic interface. If a fault produces a lateral change in geologic properties, or juxtaposes two different rock types, there may be a lateral change in seismic velocity. In either case, the offset or lateral velocity change may result in a travel-time anomaly.

The fault characteristics described above are most pronounced in bedrock. Any vertical offsets or lateral velocity changes caused by faulting in an alluvial sequence would probably be too subtle to detect using the seismic refraction method. Therefore, since Line 02 did not encounter bedrock, it is not surprising that the resulting profile, as shown on Plate 5, does not indicate any vertically offset refractors or significant lateral variations in velocity. To the contrary, the velocities are very uniform along the entire length of the seismic line.

STANDARD CARE AND WARRANTY

The scope of services for this project consisted of using the seismic refraction method to define subsurface seismic velocities and depths. The accuracy of our findings is subject to specific site conditions and limitations inherent to the seismic refraction technique. We performed our services in a manner consistent with the level of skill ordinarily exercised by members of the profession currently employing similar methods. No warranty, with respect to the performance of services or products delivered under this agreement, expressed or implied, is made by NORCAL.

We appreciate the opportunity to provide our services to ENGEO, Inc. for this project. Should you require additional geophysical services or have questions regarding this survey, please do not hesitate to call.

Sincerely,

NORCAL Geophysical Consultants, Inc.

William E. Black
Geophysicist GP-843

REGISTERED GEOPHYSICIST
WILLIAM E. BLACK
2004
NO. 843
STATE OF CALIFORNIA

WEB/jm

Enclosures: Plates 4 - 5