202115-EIS-0001

DRAFT ENVIRONMENTAL IMPACT REPORT

Exxon Benicia Refinery Clean Fuels Project

Lead Agency:
City of Benicia
250 East L Street
Benicia, CA 94510

September 1993

Woodward-Clyde

Woodward-Clyde Consultants
500 12th Street
Suite 100
Oakland, California 94607-4014

93C0336A

THE CITY OF BENICIA CALIFORNIA

CITY HALL • 250 EAST L STREET • BENICIA, CA 94510 • (707) 746-4200

CITY OF BENICIA
PUBLIC NOTICE
AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT REPORT
CLEAN FUELS PROJECT AT THE EXXON BENICIA REFINERY

A Draft Environmental Impact Report (EIR) has been prepared for the Clean Fuels Project at the Exxon Benicia Refinery through the Planning Department of the City of Benicia as the Lead Agency, pursuant to the California Environmental Quality Act of 1970 (CEQA), the CEQA Guidelines and the City of Benicia's policies regarding implementation of CEQA.

The purpose of the Clean Fuels Project is to produce the clean-burning reformulated gasoline mandated by the Federal Clean Air Act Amendments of 1990 and the California Clean Air Act. The intent of the requirements is to reduce vehicle emissions of pollutants that are either toxic to human health, or lead to the formation of photochemical smog.

Exxon proposes to construct six new process units, three auxiliary facilities and to modify existing facilities. The proposed project would be constructed within the existing Benicia Refinery Complex, which occupies a 300-acre site within approximately 850 acres of land owned by Exxon Company, U.S.A. in Benicia, California. The refinery is located approximately 1.5 miles northeast of the downtown Benicia business district at 3400 East Second Street.

The Draft EIR addresses the following potential impacts that could occur when the project is implemented: air quality, public health risk, public safety, noise, surface water hydrology and quality, groundwater and hazardous materials contamination, geology and seismicity, traffic, socioeconomics, land use public services and utilities, visual resources, cultural resources, terrestrial biology.

Copies of the Draft EIR are available for public review at the following locations:

Planning Department
City Hall
250 East L Street
Benicia, CA 94510
707/746-4280

Reference Desk
Benicia Public Library
150 East L Street
Benicia, CA 94510
707/746-4343

All written comments on the Draft EIR should be directed to Kitty Hammer, Senior Planner or Joan Lamphier, Project Manager, and submitted to the Planning Department at the above address. All comments must be received by 5PM on Monday, October 18, 1993.

The public review period for the document will extend for 45-days from September 3 - October 18, 1992. The public hearing to receive oral comments on the Draft EIR has been scheduled for the Planning Commission meeting on Thursday, October 14, 1993 at 7PM in the Council Chambers of City Hall, 250 East L Street, Benicia, California.

DRAFT ENVIRONMENTAL IMPACT REPORT

Exxon Benicia Refinery Clean Fuels Project

Lead Agency:
City of Benicia
250 East L Street
Benicia, CA 94510

September 1993

Woodward-Clyde

Woodward-Clyde Consultants
500 12th Street
Suite 100
Oakland, California 94607-4014

93C0336A

TABLE OF CONTENTS

THE CITY OF BENICIA CALIFORNIA

CITY HALL • 250 EAST L STREET • BENICIA, CA 94510 • (707) 746-4200

CITY OF BENICIA
PUBLIC NOTICE
AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT REPORT
CLEAN FUELS PROJECT AT THE EXXON BENICIA REFINERY

A Draft Environmental Impact Report (EIR) has been prepared for the Clean Fuels Project at the Exxon Benicia Refinery through the Planning Department of the City of Benicia as the Lead Agency, pursuant to the California Environmental Quality Act of 1970 (CEQA), the CEQA Guidelines and the City of Benicia's policies regarding implementation of CEQA.

The purpose of the Clean Fuels Project is to produce the clean-burning reformulated gasoline mandated by the Federal Clean Air Act Amendments of 1990 and the California Clean Air Act. The intent of the requirements is to reduce vehicle emissions of pollutants that are either toxic to human health, or lead to the formation of photochemical smog.

Exxon proposes to construct six new process units, three auxiliary facilities and to modify existing facilities. The proposed project would be constructed within the existing Benicia Refinery Complex, which occupies a 300-acre site within approximately 850 acres of land owned by Exxon Company, U.S.A. in Benicia, California. The refinery is located approximately 1.5 miles northeast of the downtown Benicia business district at 3400 East Second Street.

The Draft EIR addresses the following potential impacts that could occur when the project is implemented: air quality, public health risk, public safety, noise, surface water hydrology and quality, groundwater and hazardous materials contamination, geology and seismicity, traffic, socioeconomics, land use public services and utilities, visual resources, cultural resources, terrestrial biology.

Copies of the Draft EIR are available for public review at the following locations:

Planning Department	Reference Desk
City Hall	Benicia Public Library
250 East L Street	150 East L Street
Benicia, CA 94510	Benicia, CA 94510
707/746-4280	707/746-4343

All written comments on the Draft EIR should be directed to Kitty Hammer, Senior Planner or Joan Lamphier, Project Manager, and submitted to the Planning Department at the above address. All comments must be received by 5PM on Monday, October 18, 1993.

The public review period for the document will extend for 45-days from September 3 - October 18, 1992. The public hearing to receive oral comments on the Draft EIR has been scheduled for the Planning Commission meeting on Thursday, October 14, 1993 at 7PM in the Council Chambers of City Hall, 250 East L Street, Benicia, California.

DRAFT ENVIRONMENTAL IMPACT REPORT

Exxon Benicia Refinery Clean Fuels Project

Lead Agency:
City of Benicia
250 East L Street
Benicia, CA 94510

September 1993

Woodward-Clyde

Woodward-Clyde Consultants
500 12th Street
Suite 100
Oakland, California 94607-4014

93C0336A

DRAFT ENVIRONMENTAL IMPACT REPORT

Exxon Benicia Refinery Clean Fuels Project

Lead Agency:
City of Benicia
250 East L Street
Benicia, CA 94510

September 1993

Woodward-Clyde

Woodward-Clyde Consultants
500 12th Street
Suite 100
Oakland, California 94607-4014

93C0336A

Section Page

LIST OF FIGURES

Section | Page

LIST OF APPENDIXES

PROJECT DESCRIPTION

Exxon Company, U.S.A. (Exxon) owns and operates a petroleum refinery located in the City of Benicia, California. The refinery imports crude oil and other petroleum feedstocks to produce a number of fuel products such as liquid petroleum gases, gasoline, diesel fuel, and jet fuel. In response to recent federal and state regulations that set new standards for the composition of fuels sold in California, particularly gasoline, Exxon has proposed modifications to their Benicia Refinery. The modifications would consist of additional processing equipment, several new auxiliary facilities including aqueous ammonia storage, a hot oil system, and three additional hydrocarbon storage tanks, as well as modifications of several existing facilities.

The additional equipment and modifications will enable the refinery to meet the Federal Clean Air Act Amendments of 1990 and California laws which require the use of reformulated, cleaner burning gasoline. California law requires that all gasoline sold in the state after March 1, 1996 be reformulated to meet the new state standards. The specifications for the reformulated fuels are designed to reduce emissions of criteria and toxic pollutants such as sulphur, benzene and other aromatic hydrocarbons from motor vehicle exhaust. These pollutants are either toxic to humans, or lead to the formation of photochemical oxidants (smog).

Proposed Facilities

The proposed new process facilities, new auxiliary facilities, and modifications to existing facilities are listed in Table S-1. The proposed facilities and modifications are designed for specific process streams at the Benicia Refinery that require additional treatment to allow Exxon to produce a marketable slate of refinery products that meet the reformulated fuels requirements. The facilities and modifications are for the following refining purposes:

TABLE S-1

CLEAN FUELS PROPOSED NEW AND MODIFIED FACILITIES

New Process Facilities	New Auxiliary Facilities	Modified Facilities
1. Heartcut Tower	1. Aqueous Ammonia Storage for NOx Control	1. Hydrocracker Unit
2. Heartcut Saturation Unit	2. Hot Oil System	2. Hydrogen Plant
3. Catalytic Reformer T90 Tower	3. Three hydrocarbon tanks	3. HCN Hydrotreater
4. Catalytic Naphtha T90 Tower		4. Virgin Light Ends
5. Light Catalytic Naphtha Hydrofiner		5. Alkylation Unit
6. C_5/C_6 Splitter		

Source: Exxon 1993b.

- The new **heartcut tower** is a fractionation unit that would be used to separate the refinery's light hydrocrackate and reformate streams into three products: a pentane and hexane stream, a "heartcut" stream, and a "bottom" stream.

- The heartcut stream would be processed in the new **heartcut saturation unit**, to reduce the benzene content of the gasoline produced by the refinery.

- The pentane and hexane stream would be processed in a new **C_5/C_6 splitter unit** to separate these hydrocarbons into two streams. The hexane would be added back into the gasoline produced by the refinery. The pentane would be used as a refinery fuel or sold as an industrial fuel. The removal of pentane from the gasoline produced by the refinery is necessary to meet the reformulated fuels requirement for a lower vapor pressure.

- The reformulated fuels specify a lower boiling point for gasoline blending stock. The "bottoms" stream from the new heartcut tower would be processed in new **T90 towers** which are designed to remove the heaviest hydrocarbons for further processing to reduce the boiling point.

- The reformulated fuel requirement of lower gasoline sulfur and olefin content would be met by processing the refinery's light naphtha stream through a new **light catalytic naphtha hydrofiner** which is designed to remove these two compounds.

Other proposed project facilities include storage tanks for aqueous ammonia and hydrocarbons, and a new hot oil system to produce heat for project process units. Project modifications in the refinery include an increase in the rate of firing of the existing hydrogen units and modifications of the hydrogen plant reformer furnaces for nitrogen oxide pollutant control, a new hydrogen compressor, expansion of the condenser unit in the existing hydrocracker, and replacement of catalyst in the heavy cat naphtha hydrofiner.

Air Emissions and Proposed Controls

New and modified process equipment installed would use Best Available Control Technology (BACT). Other air quality regulations and requirements stipulate emission controls for storage vessels, inspection and maintenance for valves and connectors, New Source Performance Standards, and other emission controls or performance standards. Sulfur dioxide would be controlled through treatment of the refinery fuel gases and a sulfur recovery plant. Nitrogen oxide controls include low nitrogen burners and thermal De-NO_x technology. Particulate emissions would be controlled through use of natural gas and treated refinery gas for the refinery's furnaces. Fugitive emissions would be controlled at the source (e.g., valves, flanges, etc.) and an inspection and maintenance program would be applied to all new facilities. All emissions of criteria pollutants that exceed the applicable standards established by the Bay Area Air Quality Management District would be offset by reductions at the refinery or through the emission offset banking program.

Utilities

The Clean Fuels project will increase the use of electricity at the refinery, which can be supplied by Pacific Gas & Electric through their existing transmission system. Exxon has proposed new electrical distribution and substation equipment to service the proposed and modified facilities.

The project will require an estimated 312,500 gallons per day of additional water from the City of Benicia. The refinery currently receives approximately 5 million gallons per day, and has an allocation of up to 11 million gallons per day by contract with the City. No modifications are required to the physical water supply system to meet the needs of the project.

Wastewater, Solid Waste, and Materials Shipments

The project will generate additional wastewater from cooling water systems, a new sour water stripper, and condensate from new compressors. The collective wastewater streams will increase flows to the refinery's existing wastewater treatment plant by 56 gallons per minute, which is about a 4 percent increase in total wastewater effluent.

An additional 373,000 pounds per year of solid waste will also result from the Clean Fuels project, which would represent about 0.4 percent of the refinery's total solid waste generation.

All of this waste represents spent catalyst which is recycled off-site, and sludge, which is returned to the refinery's coker unit for further refining.

The need for additional raw materials for the Clean Fuels process units will increase deliveries to the refinery by approximately 100 to 150 shipments per year. The proposed change to using anhydrous ammonia, however, will eliminate approximately 150 shipments.

Construction and Operation

Exxon proposes to construct the Clean Fuels facilities over an approximately 2-year time period, from early 1994 through 1995. An average of approximately 300 to 500 workers will be involved in the construction, with an estimated peak workforce of about 900 workers. Project operation is planned to begin in 1996, and would require an additional 15 to 30 permanent workers.

SUMMARY OF IMPACTS AND MITIGATION MEASURES

A summary of impacts and mitigation measure is provided in Table S-2. Impacts and mitigation measures are briefly summarized below.

Land Use

The Clean Fuels project is consistent with all adopted plans and land use policies, including the City of Benicia General Plan, City of Benicia Zoning Ordinance, Solano County General Plan, and the Suisun Marsh Local Protection Program. The proposed project would not impact other existing and future land uses.

Air Quality

Emissions of criteria air pollutants such as (e.g. nitrogen oxide, sulphur dioxide, carbon monoxide, volatile organic compounds, and particulates) and air toxics would be controlled and reduced by Best Available Control Technology (BACT) as determined by the Bay Area Air Quality Management District (BAAQMD). Concentrations of criteria pollutants emitted from the project equipment and tanks are not expected to exceed federal and state established

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES
(Page 1 of 13)

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
LAND USE				
1. The project would not conflict with any adopted plans and policies.	NS	None	--	--
2. The project would not affect existing and future land uses.	NS	None	--	--
AIR QUALITY				
1. Project construction activities would result in NO_x and PM_{10} emissions that would cause a short-term impact on air quality.	S	Emissions would be reduced through contract specifications and normal construction practices that would be included in the contract.	S	Short-term increases in nitrogen oxides and particulate matter.
2. The proposed project would result in a decrease of refinery emissions of NO_x, and would reduce these emissions on the local level.	NS	None	--	--
3. Operation of the proposed project would result in a potential increase in flaring. The flare is designed to handle pollutant emissions during upset conditions.	NS	None	--	--
4. Emissions from project equipment and tanks would result in local ambient concentrations of SO_x, PM_{10}, and CO.	NS	None	--	--
5. Project-related employee vehicles would increase emissions of NO_x, SO_x, VOCs and PM_{10}.	NS	None	--	--
6. Project-related employee trips would increase CO concentrations on roads in Benicia.	NS	None	--	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
7. The proposed project would result in a net decrease of criteria pollutants that cause regional air quality impacts.	NS	None	--	--
8. Normal operation of the project would not result in off-site ground level concentrations of odorous compounds that exceed odor thresholds.	NS	None	--	--
9. Project emissions of NO_x would not have a cumulative impact on air quality.	NS	None	--	--
10. Project emissions of CO, PM_{10}, and SO_x would have a cumulative impact on local air quality.	NS	None	--	--
HEALTH RISK				
1. An increase of 1.76 in a million in the incidence of cancer in the surrounding population would result from long-term exposure to chemicals emitted to the atmosphere from the proposed project.	NS	None	--	--
2. An incidence of chronic, non-cancer health effects in the surrounding population, resulting from long-term exposure to project-emitted chemicals, would be well below the hazard index criterion of 1.0.	NS	None	--	--
3. Acute non-cancer health effects in the surrounding population would increase slightly from combustion sources as a result of short-term exposure to chemicals emitted into the atmosphere from the proposed project.	NS	None	--	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES
(Page 3 of 13)

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
PUBLIC SAFETY				
1. The proposed project includes equipment and operations that could have public risks related to fires, explosions, or release of hydrogen sulfide or sulphur dioxide. The probability and consequences of these risks would be less than significant.	NS	None	--	--
2. The proposed project would reduce risk of public safety impacts associated with use of ammonia at the Benicia Refinery.	NS	None	--	--
3. The proposed project would have a cumulative impact on potential rail car incidents in the San Francisco Bay Area.	NS	None	--	--
NOISE				
1. Operating equipment for the proposed project would result in a minor increase in community noise levels.	NS	None	--	--
2. Traffic generated by operation of the project would not result in increased noise levels.	NS	None	--	--
3. Construction traffic is calculated to generate less than a 3 dBA increase in traffic noise along East Second Street.	NS	None	--	--
4. Construction of processing units and other equipment would generate noise that would be audible but would not exceed significance criteria.	NS	Operate all construction equipment with properly fitted and well-maintained muffler.	NS	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES
(Page 4 of 13)

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
5. Project, in combination with other proposed industrial projects, would result in a potentially significant cumulative noise impact at sensitive receptors.	PS	All new equipment should meet 85 dBA worker noise exposure limit.	NS	--
6. Cumulative traffic noise impacts upon sensitive receptors in the area would not be significant.	NS	None	--	--
SURFACE WATER HYDROLOGY AND QUALITY				
1. Increased storm water runoff would result from the increase in the amount of paved surface of the Clean Fuels project.	NS	None	--	--
2. The Clean Fuels project would result in an increase of 0.04 lb/day of selenium discharged.	NS	None	--	--
3. The Clean Fuels process equipment would result in a minor increase in nitrogen and organic pollutant loads to the refinery's waste water treatment plant. The plant is capable of processing these increased pollutant loads.	NS	None	--	--
4. The Clean Fuels project would increase the total quantity of metals in the waste water discharge, but this increase is well below the refinery's effluent discharge limits.	NS	None	--	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES
(Page 5 of 13)

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
GROUNDWATER AND HAZARDOUS MATERIALS CONTAMINATION				
1. Excavation and construction of the Clean Fuels project would not measurably impact groundwater quality, flow, or direction.	NS	None	--	--
2. Construction and operation of the project would have a low potential to impact groundwater quality.	NS	None	--	--
3. Contaminated soils are present at project site. Contamination is below threshold levels for remediation, and removal of contaminated soils due to construction of proposed facilities would be subject to further investigation and proper disposal.	NS	None	--	--
4. There would be no effect on groundwater remediation activities due to construction.	NS	None	--	--
5. The proposed Clean Fuels project and other projects planned at the refinery would have no adverse individual or cumulative impacts to groundwater resources. Other projects in the regional area are too distant to contribute to any impacts to groundwater in the Benicia area.	NS	None	--	--
GEOLOGY AND SEISMICITY				
1. Seismically-induced ground shaking is not expected to substantially impact project equipment.	NS	Design all facilities to meet all applicable codes and specific geotechnical conditions at site.	NS	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES
(Page 6 of 13)

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
2. Project facilities would not be significantly impacted by adverse site or foundation conditions.	NS	Appropriate engineering design would minimize impacts.	NS	--
3. There are no unique or valuable geologic resources that could be affected by the project.	NS	None	--	--
4. Changes in runoff resulting from the proposed project are not expected to significantly increase erosion potential.	NS	None	--	--
5. The project would not contribute to any significant cumulative geologic or seismic impacts.	NS	None	--	--
TRAFFIC				
1. Construction workers will travel to and from the Benicia Refinery on local freeways, including the Benicia-Martinez Bridge, but these additional vehicles will be traveling in the off-peak direction.	NS	None	--	--
2. Project traffic at three I-780/East Second Street offramps will change by one level of service, but will not decline below level of service (LOS) E. At all eight ramp junctions of the I-780/Bayshore Road and I-780/Industrial Way interchanges, no junction would degrade below LOS D. LOS E is the minimum acceptable operating conditions in accordance with Solano County's CMP criteria.	NS	None	--	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
3. With the addition of project construction traffic, the westbound ramp merge from East Second Street to I-780 will change from LOS E to LOS F.	S	Exxon shall coordinate the construction process, including biweekly employment and truck activity projections to the city traffic engineer, to achieve a LOS of E. Projected traffic levels should be reduced by some or all of the following measures: • Stagger work hours to reduce traffic volumes during the peak daily periods. • Provide traffic control personnel at the affected intersection during the peak hours. • Provide temporary traffic control measures including signals, signing, striping, etc. • Use alternative Exxon access points to disperse project traffic.	NS	--
4. Traffic would increase at nine local intersections during construction, six of which would continue to function at acceptable levels of service, and three of which would degrade temporarily to LOS D.	NS	None	--	--
5. With project construction traffic, the intersection at East Second/I-780 eastbound ramps would operate at LOS F during the P.M. peak hour.	S	Same as for Impact No. 3 above.	NS	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES
(Page 8 of 13)

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
6. With project construction traffic, the intersection of East Second/I-780 westbound ramps would change from LOS D to E during A.M. peak hour and continue to function at LOS F during P.M. peak hour.	S	If City of Benicia does not install planned signal (as for Impact No. 3), the same mitigation should be used as for Impact No. 3 above.	NS	--
7. With project construction traffic, the intersection at East Second/Corporation Yard - Exxon Gate 8 would operate at LOS E during A.M. peak hour and LOS F during P.M. peak hour.	S	The corporation yard driveway should be widened to allow one inbound and one outbound lane plus a two-way left-turn lane. This center lane could be controlled to allow two inbound lanes during the A.M. peak hour and two outbound lanes during the P.M. peak hour. Exxon's Gate 8 should be opened by 7 A.M. to reduce queuing by inbound construction employees. To maintain LOS E conditions for the outbound driveway traffic at Gate 8, Exxon traffic would need to be limited to 25% of the levels described for the project. The mitigation measures specified in Mitigation Measure No. 3 should be applied, as necessary, as well as limiting outbound P.M. peak hour traffic at Gate 8 to right-turn only.	NS	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES
(Page 9 of 13)

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
8. An increase in project construction traffic along Park Road would increase the potential for train-related accidents at Southern Pacific's at-grade railroad crossing 130.	PS	Prior to project initiation, Exxon should coordinate with City of Benicia, Caltrans, Southern Pacific, and PUC regarding installation of warning lights in automatic crossing gates. In the event that the railroad crossing is not in place, Exxon should use flaggers at the crossing during working hours to stop traffic when trains approach the crossing.	NS	--
9. The delivery of construction material to/from the site could impact residential areas along East Second Street as well as add to the pedestrian and vehicle delays in the area.	S	Truck deliveries to the project site should use I-680, exit at Industrial Way and enter the refinery via Exxon Gate 4.	NS	--
10. Exxon has committed to minimizing the construction activities for the Clean Fuels project during a planned refinery maintenance turnaround. This commitment would avoid cumulative construction impacts.	NS	None	--	--
11. Traffic related to operation of the Clean Fuels project would not measurably change future traffic operations; there would be no long-term traffic impacts.	NS	None	--	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES
(Page 10 of 13)

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
SOCIOECONOMICS				
1. Construction of the project would, on average, result in 500 construction jobs for 2 years, and 880 jobs at its peak for six months in 1995.	NS	None	--	--
2. With adequate labor available within commuting distance of the project site, the project would not cause a significant impact of non-local population or create a demand for housing.	NS	None	--	--
3. Project operation would increase permanent employment at the refinery by 30 jobs. There would be no impact on population and housing in Benicia.	NS	None	--	--
4. The project, along with other proposed/planned projects, would create a total of about 10,000 construction jobs over a period of 2 years in 1994-1996. This magnitude of workforce is available and this would constitute a beneficial effect given the recent unemployment levels in the Bay Area.	NS	None	--	--
PUBLIC SERVICES AND UTILITIES				
1. The project would not impact the ability of emergency services to respond to an accident at the refinery, either for the proposed project or existing operations.	NS	None	--	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
2. The project would require additional water for process and cooling equipment. The increase in water use is within the refinery's allocated water supply.	NS	None	--	--
3. The project will result in a negligible increase in domestic waste water sent to the City's treatment plant.	NS	None	--	--
4. The project would increase the quantity of electricity used at the refinery. The required electricity can be supplied by PG&E to the refinery, and Exxon has proposed substation modifications to distribute power to the proposed new equipment.				
5. The project would generate additional solid waste, which could be recycled within the refinery and by outside vendors, thus avoiding sending additional waste to landfills.	NS	None	--	--
VISUAL RESOURCES				
1. The Clean Fuels project would add new equipment and facilities to the industrial portion of the facility. This change would not substantially alter the visual contrast or character of the setting.	NS	To ensure views do not contrast with existing refinery views, new equipment and facilities should be painted non-reflective colors using the existing yellow-gold and forest green color scheme.	--	--

[a]NS = Not Significant PS = Potentially Significant S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
2. Lighting for the Clean Fuels project would expand existing light and glare. The refinery is already illuminated, and the Clean Fuels project would not substantially change existing light and glare conditions.	NS	Direct light downward and shield where appropriate. Paint lamps with non-reflective paint.	NS	--
3. Construction of fabrication and storage areas associated with the Clean Fuels project and other refinery projects could potentially impact views of the refinery by encroaching upon the grassland buffer between residents and the refinery.	NS	Native plant border along west edge of laydown/ fabrication area.	--	--
4. New facilities would expand the industrial appearance of the overall complex. This change would not substantially impact visual resources.	NS	None	--	--
CULTURAL RESOURCES				
1. There is an unknown but low potential for buried resources to be encountered during project excavation, grading, or other subsurface construction activities.	PS	Construction activities that uncover buried resources will be stopped and the resources investigated, and properly inventoried.	NS	None
BIOLOGICAL RESOURCES				
1. Construction of the fabrication/laydown area associated with the Clean Fuels project could potentially degrade biological resources.	PS	Stake or fence a 20-foot setback from the drainage to sufficiently prevent construction within the creek. Plant native plant border along west edge of fabrication/laydown area.	NS	None

[a]NS = Not Significant   PS = Potentially Significant   S = Significant

TABLE S-2

POTENTIAL IMPACTS OF THE EXXON CLEAN FUELS PROJECT AND MITIGATION MEASURES
(Page 13 of 13)

Potential Impact	Significance of Impact Prior to Mitigation[a]	Recommended Mitigation	Significance Following Mitigation[a]	Residual/Secondary Impact
2. The estimated chemical exposure to target ecosystem species is well below the "no observed effect level."	NS	None	--	--
ENERGY				
1. Operation of the project would increase the rate of electricity consumption.	NS	None	--	--
2. Clean Fuels and other related projects will not have a net cumulative impact on electrical demand.	NS	None	--	--
GROWTH INDUCEMENT				
1. No Impacts	--	--	--	--

[a]NS = Not Significant   PS = Potentially Significant   S = Significant

air quality standards. The total project emissions, when considering on-site emission reductions and additional offsets, would result in a net regional decrease in emissions.

Operation of the project would result in a net decrease in NO_x emissions and emissions of SO_2, PM_{10}, and CO will not exceed state or federal standards. The project will therefore not have significant impacts on local air quality.

Project construction activities would result in relatively high NOx and PM_{10} emissions. This was judged to be a significant short-term impact. The construction-related emissions would be minimized by requiring contractors to use BACT to the extent feasible on construction equipment.

Public Health Risk

Cancer and non-cancer health effects attributed to the existing Benicia Refinery and the proposed Clean Fuels project were based on a health risk assessment conducted in accordance with guidelines established by the BAAQMD for implementation of AB2588. The maximum cancer risk (i.e., risk to the maximally exposed individual) for the surrounding population would be 1.76 in 1 million, which is well below the guideline of 10 in 1 million, established by the BAAQMD for this type of risk. The proposed project would not result in significant increases in the incidence of acute or chronic non-cancer health effects.

Public Safety

Refining crude oil involves working with flammable materials under heat and pressure. This type of operation creates inherent hazards for fire and explosion. Most of the fire and explosion hazards with a refinery involve process equipment. Statistics show that at an "average" refinery, the probability of an accident causing major offsite damage is 1 chance in 500 years, and the chance of causing offsite injury is approximately 1 in 6000 years. The Benicia Refinery is one of the newest refineries in the United States and the chances of a major accident are expected to be less than average. Risk to the public was calculated based upon two factors: 1) the likelihood of an accident to occur, and 2) the severity of the consequences of an accident. Several different accident scenarios were evaluated to determine the probability of occurrence and the severity of the likely consequences of the accident. Accident scenarios included fires in various process areas and accidents and fires occurring during rail car loading and transport. Consequence scenarios included various types of vapor cloud explosions, thermal radiation from pool fires, rail car explosions, and releases of toxic chemicals such as hydrogen sulfide and sulphur dioxide. The calculated probabilities of all of the accident scenarios was less than 1 chance in 500 years and are not considered significant.

Under the proposed project, Exxon would limit its use of anhydrous ammonia at the refinery and meet most of its ammonia requirements with aqueous ammonia. Anhydrous ammonia is 100 percent ammonia that is a gas at atmospheric temperatures. The aqueous ammonia that would be used contains only 29 percent ammonia. Accidental release of anhydrous ammonia could result in a concentrated plume of ammonia released to the atmosphere, while a release of aqueous ammonia would pool and could be cleaned up before it evaporated. The proposed project therefore reduces the public risk associated the use of ammonia at the Benicia Refinery.

Noise

The major contributors of noise in the vicinity of the refinery include the refinery operations and vehicular traffic on East Second Street. Noise sensitive land uses do not immediately adjoin the Benicia Refinery complex. Noise measurement conducted near the refinery and noise modelling indicate that operation of the Clean Fuels project would not increase noise levels above current levels. Traffic generated by construction and operation of the project would not increase noise levels more than 3 dBA and levels will be within the acceptable criteria established by the City of Benicia.

Noise generated by construction of the Clean Fuels project coincident with the refinery maintenance activities could cause a significant short-term increase in traffic related noise. This could be mitigated by scheduling major maintenance activities prior to construct of the Clean Fuels project or minimizing Clean Fuels project construction during the maintenance period.

Surface Water Hydrology and Quality

The proposed project will result in a slightly greater amount of storm water runoff due to a small increase in the amount of impermeable surface within the refinery. The refinery's current storm water drainage and storage facilities, which route runoff to the on-site wastewater treatment plant, have sufficient capacity to convey and retain the additional runoff prior to treatment and discharge to San Francisco Bay.

The Clean Fuels project would increase the refinery's treated wastewater discharge to San Francisco Bay by approximately 80,000 gallons per day. The proposed project would slightly increase concentrations and mass loadings of selenium, heavy metals, and nitrogen and organic pollutants discharged to the bay. These concentrations and mass loading will remain below current and proposed future discharge limitations for the refinery established by the Regional Water Quality Control Board (RWQCB). Consequently, the project would not have a significant impact on water quality.

Groundwater and Hazardous Materials Contamination

Because of the small surface area of the proposed project, groundwater recharge would not be significantly impacted by the increased impervious surfaces added by the project. The depth to groundwater in the project area ranges from 15 to 35 feet. This is sufficient to allow remedial activities before any spilled material reaches and contaminates the groundwater. The area containing the new hydrocarbon storage tanks would be designed for secondary containment in the event of accidental release and would be underlain by a liner and leak detection system to prevent spills from infiltrating the ground. No significant impacts to groundwater are expected.

Geology and Seismicity

The refinery property, like the entire Bay Area, can be expected to undergo strong ground motion as a result of major earthquakes on the several faults in the region including the San Andreas. In addition, expansive soils in the area can cause damage to foundations, pavements and slabs. Impacts to the refinery due to ground shaking or expansive soils are not judged to be significant as facilities would be designed based upon specific geotechnical conditions at the site and would meet all applicable codes and building standards.

Traffic

Traffic associated with construction of the Clean Fuels project would not cause a significant impact to travel on local freeways, however, traffic during the construction period would cause significant congestion during peak AM and PM commute hours at several freeway (I-680 and I-780) ramps and intersections in the vicinity of the refinery. Most of these impacts can be minimized through mitigation measures to reduce traffic levels at the affected intersections or traffic control measures. Project-related construction traffic would significantly impact the intersection at East Second Street and the Corporation Yard/Exxon Gate 8 access road. These impacts can be mitigated to levels of insignificance by mitigation measures to improve traffic flow at Exxon Gate 8 and traffic control measures.

Operation of the Clean Fuels project will not result in any significant traffic impacts.

Socioeconomics

Construction of the Clean Fuels project would, on average, result in 500 construction jobs for two years, and 880 jobs during the peak period of construction in 1995. The project's requirements for a construction labor force could be adequately meet by local construction workers. Operation of the proposed project would create 30 new jobs.

Public Services and Utilities

No significant impacts to public services and utilities would occur due to the proposed project. The refinery has existing fire fighting capabilities, including trained fire fighters and equipment. There is an existing mutual aid agreement with the City and systems in place in the event of an emergency. Additional fire suppression facilities will be added for the new process equipment. Additional water will be required but total water use would not exceed the refinery's current water allocation. Increased electrical use can be adequately provided for by the Pacific Gas and Electric Company, and electrical distribution equipment will be added to the refinery by Exxon.

Visual Resources

The Clean Fuels project would not be visible from the Benicia-Martinez Bridge, Benicia's northeast gateway on I-680 near Lake Herman road; however, it may be visible from portions of the Hillcrest neighborhood near St. Dominic's cemetery to the eastern edge of the South Hampton Estates. From the residential areas to the east of the refinery, views are restricted to the first tier of homes because topography and other homes create a visual screening. Because the Clean Fuels project equipment will be located near other equipment within the refinery's main process block, the new facilities will not significantly alter the visual contrast, texture, or character of the existing view. Visual impacts for the project are not considered significant but will be minimized by painting the new process equipment in the same yellow-gold and forest green color scheme as other refinery equipment.

Cultural Resources

No cultural resources have been identified at the project site, although it is possible that historic activities or natural deposition of soils may have obscured evidence of them. There is therefore an unknown, but low potential for cultural resources to be encountered during project excavation, grading or other subsurface construction activities. This impact is considered potentially significant. If construction activities uncover buried resources, construction would be stopped so the resources could be investigated and properly inventoried.

Biological Resources

Most of the proposed project site is highly disturbed and consists of paved or graveled areas which do not support vegetation or wildlife habitat. Construction of one fabrication/laydown area, is located near a small drainage which has wetland characteristics. Construction activities could indirectly impact this area. Impacts would be avoided by maintaining a staked or fenced setback at least 20 feet from the drainage. The ground would be sloped or bermed to eliminate runoff from the construction area from entering the drainage.

Energy

The project will not require any significant new quantities of natural gas. Most process equipment will be fired by refinery gases. As discussed under Public Services and Utilities, increased electrical consumption would be adequately supplied by PG&E and no significant energy impacts are expected.

Growth Inducement

The proposed project would create the need for a construction work force of several hundred. It is expected that the majority of these workers would be local. Indirect employment triggered by the construction of the project is not anticipated to lead to an influx of non-local workers since these positions may be filled with unemployed or underemployed persons in the region. The proposed modifications will not result in the increased output of gasoline or other products. As a result, no new refinery-related industries are likely to be attracted to the region. The project would therefore have no growth inducing effects.

Cumulative Impacts

The Clean Fuels project was evaluated for each of the topic areas discussed above to determine potential cumulative impacts with other related and cumulative projects. The analysis determined that there would not be cumulative significant impacts.

1.0
INTRODUCTION

1.1 PURPOSE OF REPORT

This document is a Draft Environmental Impact Report (EIR) on the proposed Exxon Clean Fuels project at the Benicia Refinery. This EIR was prepared pursuant to the California Environmental Quality Act (CEQA) of 1970, as amended and in accordance with State and City of Benicia implementing guidelines, by providing full public disclosure of the proposed project's potential environmental effects. This EIR is an informational document that enables the general public and decision-makers to evaluate the potential significant effects of the proposed project. The EIR, in itself, does not determine whether a project will be approved, but aids in the local planning and decision-making process.

1.2 REPORT ORGANIZATION

This EIR is organized into the following major sections:

- **Project Description** describes the location and nature of the proposed Clean Fuels project.

- **Other Related Projects** identifies other ongoing or proposed projects at the Benicia Refinery and other related projects proposed in the region.

- **Environmental Setting, Impacts, and Mitigation** describes the existing environment at and near the project site, potential impacts of the project, cumulative impacts of this and related projects, and mitigation measures.

- **Alternatives** identifies and discusses alternatives considered in the development of Exxon Clean Fuels project and other project alternatives.

- **References Cited** lists the documents and sources used in preparing the EIR.

- **List of Preparers, and Organizations and Individuals Consulted** identifies the individuals who prepared the EIR and those who were consulted during its preparation.

- **Glossary** provides a list of terms and acronyms used in the EIR.

- **Appendices** include the following information:

  A. Notice of Preparation and Initial Study
  B. Responses to the Notice of Preparation and Initial Study

Technical documents prepared as part of the environmental analysis include the following:

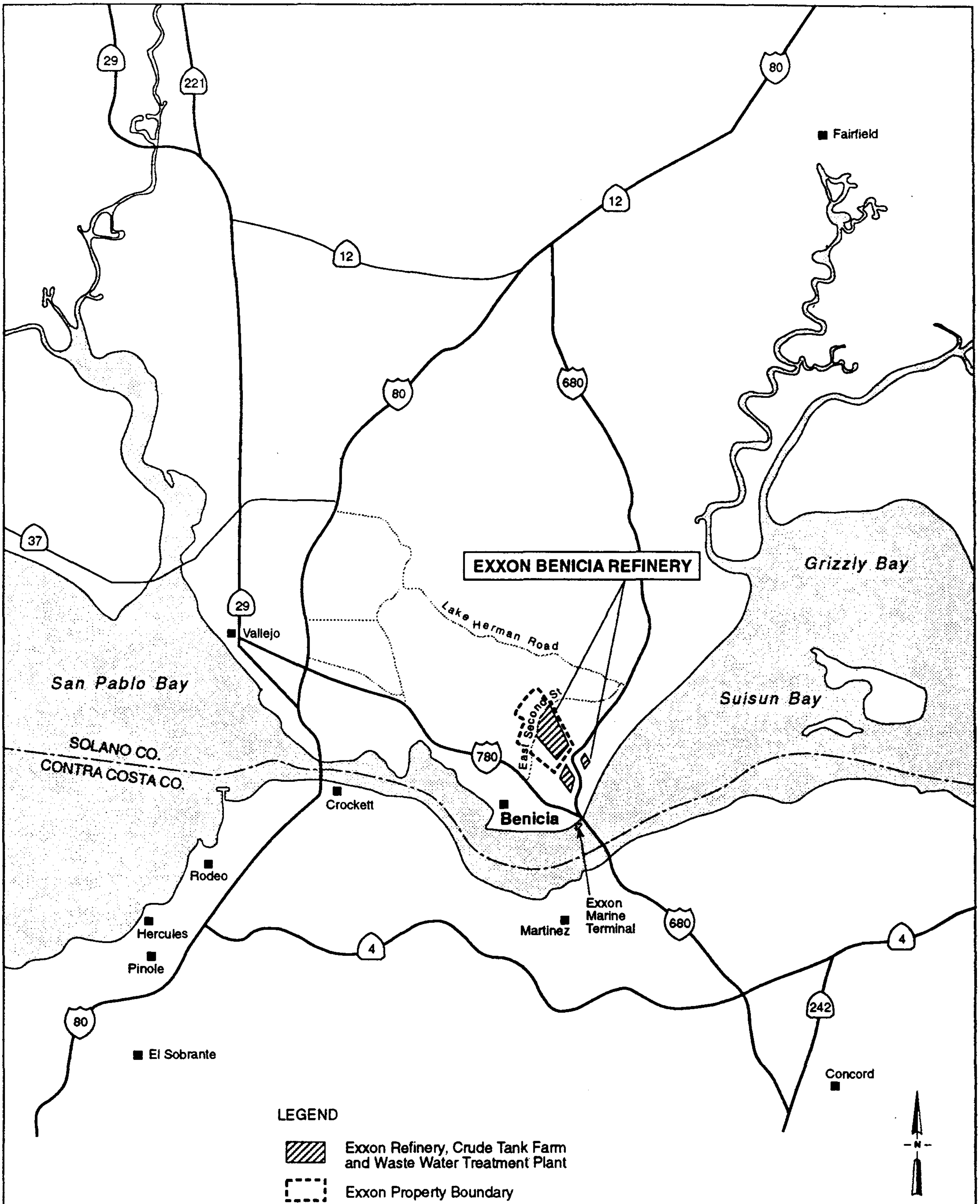
- Risk of Upset Review, by ENSR Consulting and Engineering

- Public Health Impacts of Air Emissions from the Exxon Clean Fuels Project, ENSR Consulting and Engineering

These technical documents are available for review at the City of Benicia Planning Department during normal business hours, 8:30 A.M. - 5:00 P.M., Monday through Friday.

1.3 SUMMARY OF THE PROPOSED PROJECT

Exxon Company, U.S.A. (Exxon) owns and operates a petroleum refinery in the City of Benicia, California (Figure 1-1). The refinery imports crude oil and other petroleum feedstocks to produce a number of fuel products such as liquid petroleum gases, gasoline, diesel fuel, and jet fuel. In response to recent federal and state regulations that set new standards for the composition of fuels, particularly gasoline, Exxon has proposed modifications to their Benicia Refinery. These modifications consist of additional processing facilities that will enable the refinery to manufacture gasoline that meets the new regulatory standards for cleaner burning fuels, and thus the project is referred to as the Exxon Clean Fuels project. The specifications for reformulated fuels are designed to reduce the emissions of criteria and toxic pollutants from motor vehicle exhaust by restricting the amount of components such as sulfur, olefins, benzene, and aromatics in motor gasoline.



Project No. 93C0336A	Exxon Clean Fuels Project	REGIONAL LOCATION MAP	Figure 1-1
Woodward-Clyde Consultants			

93C0336A-0600/083093

1.4 REQUIRED PERMITS

1.4.1 City of Benicia

The Benicia Refinery is an industrial use within the City of Benicia. The refinery was established prior to the enactment of the City's requirement that all refineries have an approved Use Permit. The City's current zoning ordinance stipulates that:

- A Use Permit is required for oil and gas refining.
- A Use Permit is required for the alteration or expansion of a pre-existing use that was established prior to the requirement of a Use Permit.
- A Use Permit is required for any project that requires a hazardous chemicals permit from the Benicia Fire Department.

A City Grading Permit will be required for site preparation. A use permit for outdoor storage may also be required if an offsite storage yard for construction materials is determined to be needed.

The Clean Fuels project is considered an alteration of a pre-existing refinery use that would also involve hazardous chemicals requiring a Fire Department permit. Therefore, a Use Permit must be approved by Benicia's Planning Commission to allow Exxon to construct and operate the project. Exxon has applied for a Use Permit, and the City's decision to approve or deny this application must be made in accordance with the provisions of CEQA. These provisions require that the City consider the potential significant environmental impacts of a project prior to determining whether to grant or deny the request for a Use Permit and other permits related to the project.

1.4.2 Other Required Permits and Review

The project would require the following permit:

- Bay Area Air Quality Management District (BAAQMD) - Authority to Construct and Permit to Operate. An application has been filed with BAAQMD, and the BAAQMD is expected to make a decision on this permit shortly after the EIR has been certified.

Other required review would include:

- California Regional Water Quality Control Board (San Francisco Bay Region): Review of existing National Pollutant Discharge Elimination System (NPDES) Permit and issuance of General Construction Activity Stormwater Permit. An application (Notice of Intent) is expected to be filed by Exxon in late 1993.

- Solano County: Revision of Risk Management and Prevention Plan (RMPP). Revisions to the RMPP, if required, would be made in 1995.

1.5 LEAD AND RESPONSIBLE AGENCIES

The City of Benicia is the designated lead agency for CEQA review and for this EIR. As the lead agency, the City has the principal responsibility for review and approval of the proposed project. Distinct from the lead agency are responsible agencies, i.e., other public agencies that have discretionary approval over the project. Responsible agencies for this project include the BAAQMD and the Regional Water Quality Control Board.

1.6 DECISION TO PREPARE AN EIR

The CEQA review process was initiated when Exxon submitted a Use Permit application to the City of Benicia in January 1993. The City determined that a focused EIR must be prepared and issued a Notice of Preparation (NOP) of an EIR and an Initial Study of Environmental Impacts on May 21, 1993. The NOP announced the City's receipt of Exxon's application, the City's intent to prepare an EIR, and a request for comments that should be considered during the preparation of the EIR.

The Initial Study (Appendix A) set forth the preliminary discussion of potential environmental impacts that could occur with project implementation, in order to focus the EIR analysis.

Two public agencies responded to the NOP and their comments are included in Appendix B. The City also held a public scoping meeting on June 3, 1993 to receive comments on the project and the EIR process. No substantive comments were received at the scoping meeting.

1.7 SCOPE OF THE EIR

The Initial Study determined those environmental areas which could involve significant impacts from the project, or where substantial concerns have been raised by the public. Areas identified as having potentially significant impacts due to the proposed Clean Fuels project are analyzed further in this Draft EIR. They include the 17 study areas presented in Chapter 4.0 of this report.

1.8 EIR REVIEW PROCESS

The Draft EIR was circulated for a 45-day public review period beginning on September 3, 1993. The public and agency review for the Draft EIR will run from September 3, 1993 to October 18, 1993, during which comments and information can be submitted to the City of Benicia. Readers may submit written comments to:

Ms. Kitty Hammer, Senior Planner
Benicia Planning Department
250 East L Street
Benicia, California 94510

A public hearing on the Draft EIR will be held during the review period. All written and oral comments concerning project-related impacts will be included and addressed in a Final EIR. A public hearing will also be held on the Final EIR, during which public testimony and comments may be made regarding the contents and conclusions of the document.

The Final EIR must be certified as adequately complying with CEQA before the City can approve the project. The City will use the EIR in considering the Use Permit; to support any necessary findings regarding the impacts and mitigation for the project; to determine if adoption of a statement of overriding considerations will be necessary in the event that there are significant impacts that cannot be mitigated; and to establish any mitigation monitoring required or other conditions of approval.

2.0
PROJECT DESCRIPTION

2.1 ORGANIZATION

This chapter of the EIR provides a detailed description of Exxon's proposed Clean Fuels project. It is organized into the following major subsections:

- **Project Location** describes the location of the Benicia Refinery, the existing major refinery processing equipment, and the location of the proposed Clean Fuels equipment within the refinery.

- **Chemistry of Petroleum Refining** provides a brief summary of fundamental refining processes for readers unfamiliar with this industry. This discussion is intended to provide a context for understanding why refineries operate as they do, and how the Clean Fuels facilities would interrelate with Exxon's existing equipment and processes.

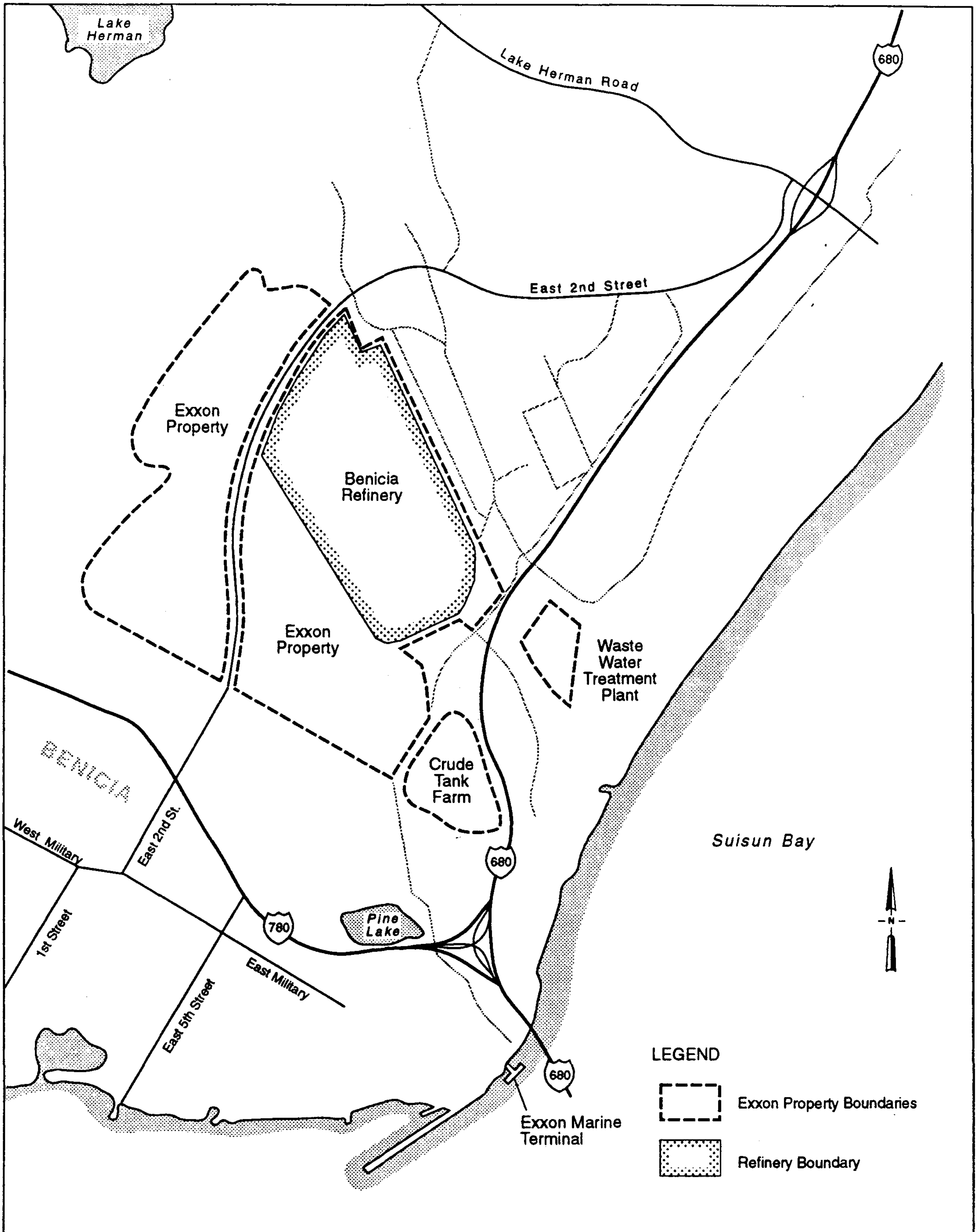
- **Existing Refining Processes at the Benicia Refinery** describes the major existing refinery processes and equipment.

- **Purpose and Objectives of the Project** describes the regulatory requirements for Clean Fuels specifications that have created a requirement for the project.

- **Clean Fuels Project** discusses the proposed project, including equipment additions and modifications, utility requirements, effluent and emission controls, waste generation and disposal, construction procedures and schedule, and workforce requirements.

2.2 PROJECT LOCATION

Exxon owns approximately 800 acres of land within the City of Benicia, located approximately ½ mile north of I-780 and immediately west of I-680 (Figure 2-1). Exxon's



Project No. 93C0336A	Exxon Clean Fuels Project	LOCATION OF EXXON'S BENICIA PROPERTY AND REFINERY	Figure 2-1
Woodward-Clyde Consultants			

93C0336A-0600/082593

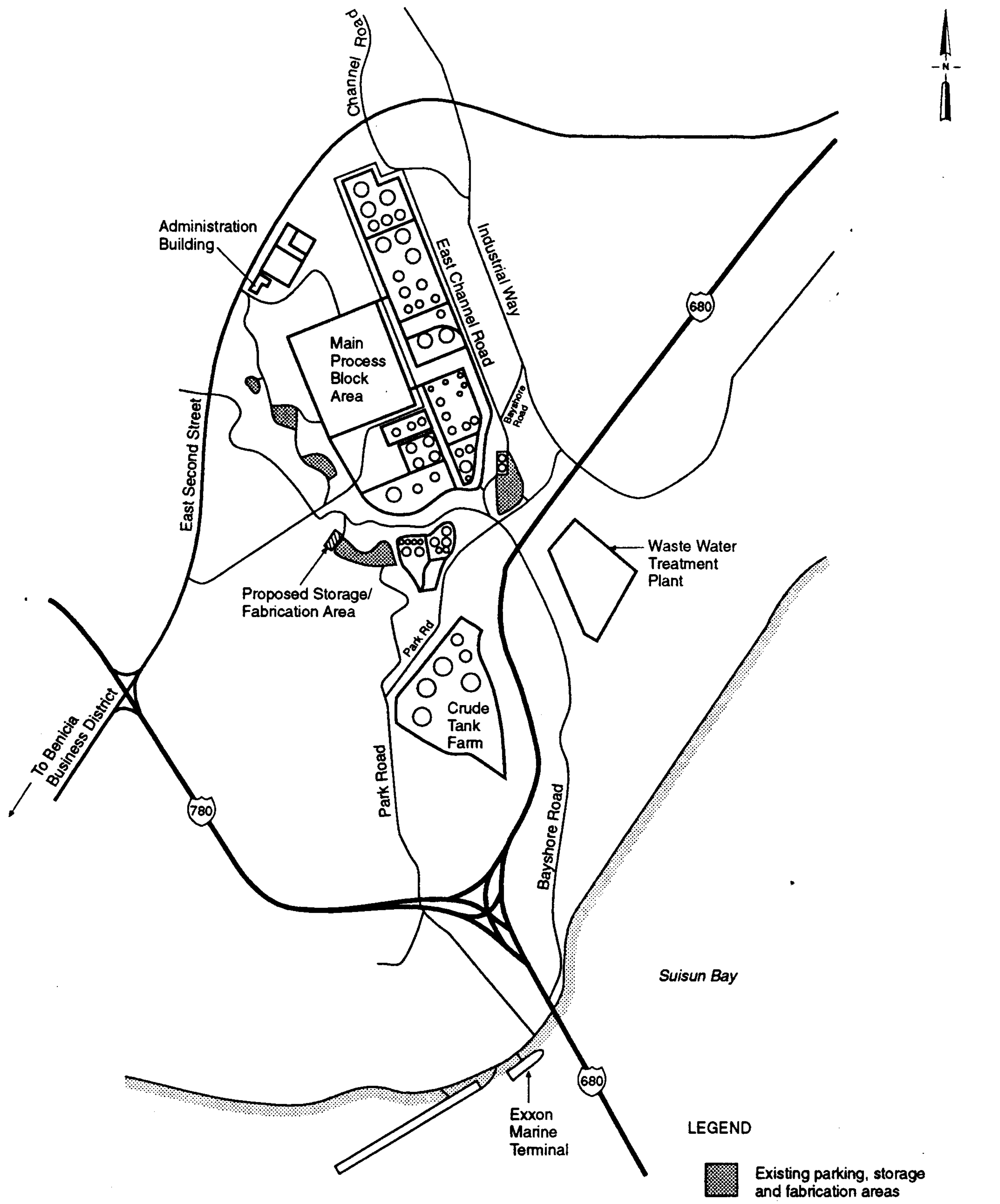
property is bisected in a north-south direction by East Second Street, and is bounded on the north by residential development and open space, on the east by an industrial park and I-680, on the south by industrial development, and on the west by residential development.

Within the 800-acre Exxon property, approximately 331 acres are used for the refinery. The refinery is located on the northeast side of the property, between East Second Street and I-680 (Figure 2-2). Within the refinery, the main block of processing equipment covers about 46 acres. The processing facilities proposed for the clean fuels project would occupy about three acres of this main process block. The project would also add three new petroleum storage tanks to the existing tank farms, an aqueous ammonia storage tank, and modifications to existing refinery process and support equipment. Figure 2-3 shows the location of the Clean Fuels project and associated facilities.

The proposed new tanks will be located at an area that contains no existing facilities and the hydrogen facilities will not require relocation of equipment or structures. A graded area for project equipment fabrication will be added next to the Gate 5 parking lot. This area is also shown on Figures 2-2 and 2-3. Other areas will be used for equipment storage and staging within the refinery. These areas either already exist, or will be developed as part of a separate Use Permit; these other related projects are described in Section 3.0.

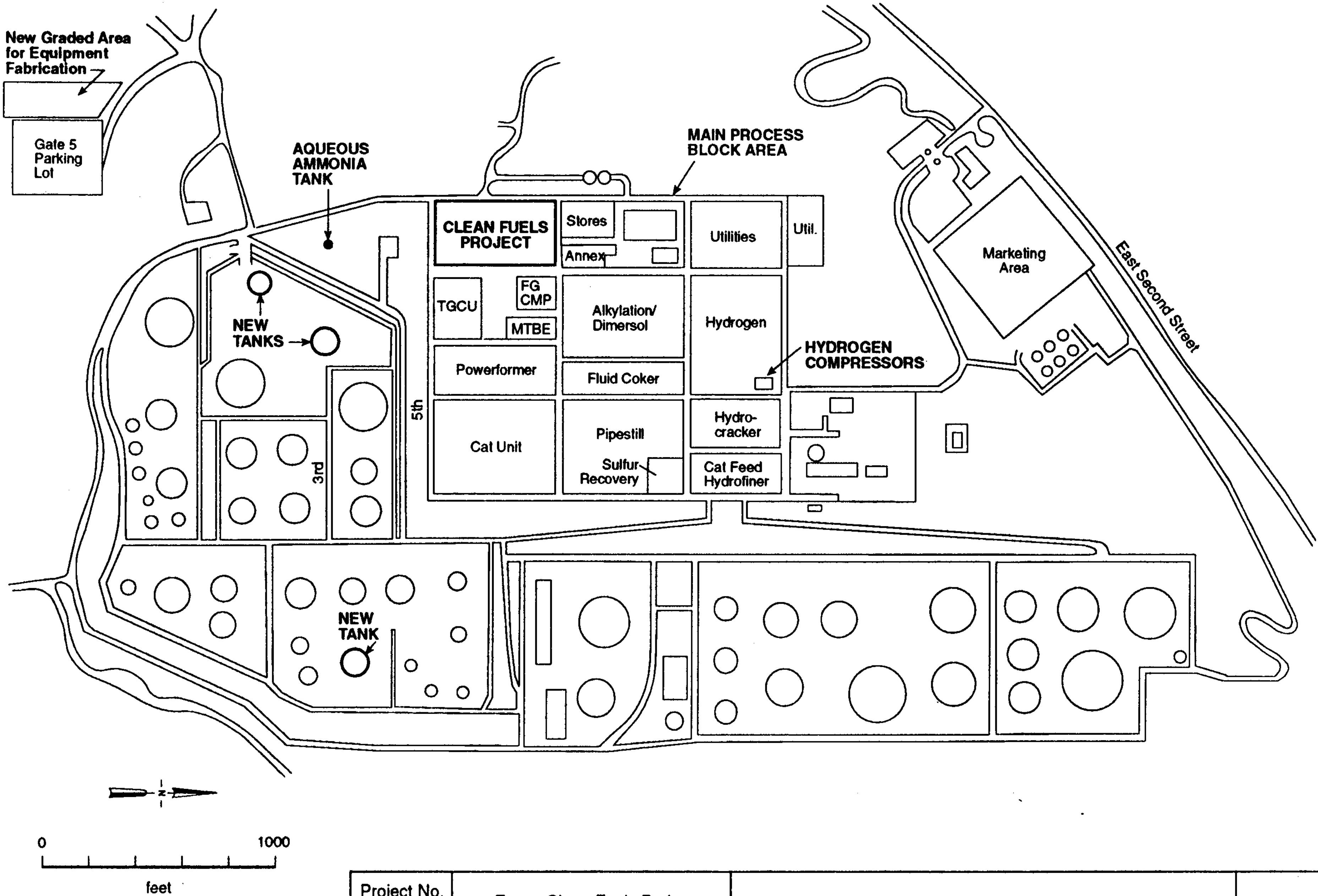
2.3 CHEMISTRY OF PETROLEUM REFINING

The purpose of a petroleum refinery is to make useful products from crude oil. Regardless of its source, all crude oil is a mixture of organic compounds consisting primarily of hydrocarbons, inorganic salts, and water. Hydrocarbons are chemical compounds made up of hydrogen and carbon atoms which are combined into molecules of different sizes, shapes, and degrees of complexity. The smallest hydrocarbon molecules, containing only a few atoms of hydrogen and carbon, are gases such as methane and propane. Somewhat larger hydrocarbon molecules are liquids such as gasoline and diesel fuel. Very large hydrocarbon molecules are solids such as asphalt and tar. Examples of hydrocarbon groups important to petroleum refining are provided on Figure 2-4. Other organic compounds in crude oil can contain sulfur, nitrogen, and metals. These elements along with the inorganic salts and water in the crude oil are impurities removed during the refining process.



Project No. 93C0336A	Exxon Clean Fuels Project	EXXON BENICIA REFINERY	Figure 2-2
Woodward-Clyde Consultants			

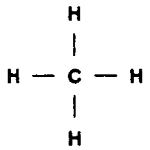
93C0336A-0600/083093



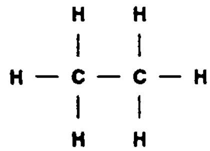
Project No. 93C0336A	Exxon Clean Fuels Project	LOCATION OF PROPOSED CLEAN FUELS FACILITIES	Figure 2-3
Woodward-Clyde Consultants			

93C0336A-0600/082593

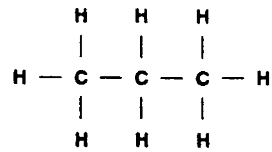
PARAFFINS



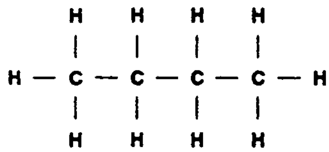
Methane
(CH_4)



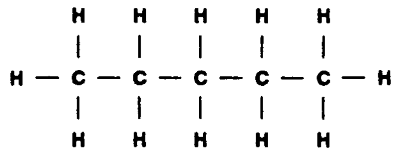
Ethane
(C_2H_6)



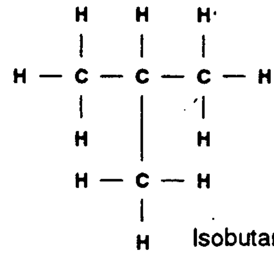
Propane
(C_3H_8)



Normal Butane
(C_4H_{10})

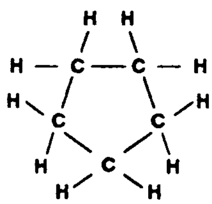


Normal Pentane
(C_5H_{12})

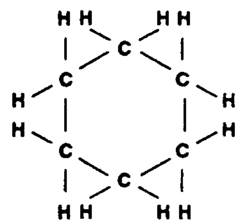


Isobutane
(C_4H_{10})

NAPHTHENES

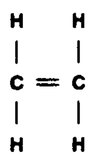


Cyclopentane
(C_5H_{10})

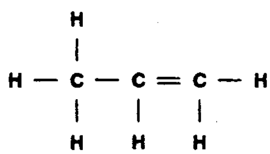


Cyclohexane
(C_6H_{12})

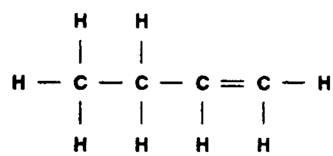
OLEFINS



Ethylene
(C_2H_4)

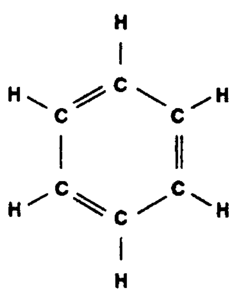


Propylene
(C_3H_6)

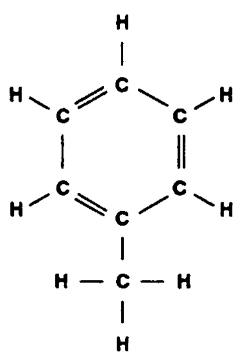


Butylene
(C_4H_8)

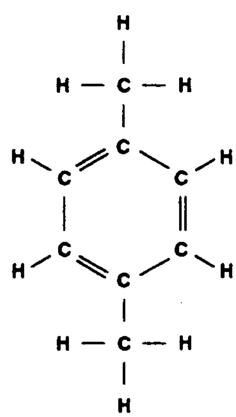
AROMATICS



Benzene
(C_6H_6)



Toluene
(C_7H_8)



Xylene
(C_8H_{10})

Project No. 93C0336A	Exxon Clean Fuels Project	HYDROCARBON MOLECULES COMMON TO PETROLEUM REFINING	Figure 2-4
Woodward-Clyde Consultants			

93C0336A-0600/082593

Crude oil contains many different hydrocarbon molecules representing many potential products such as propane, butane, gasoline, jet fuel, diesel oil, fuel oil, wax, and asphalt. Each product can be thought of as a part of the whole crude oil. In early refineries built and operated prior to the 1940s, most of the process equipment was designed solely to separate groups of hydrocarbon molecules into these different products. Much of the process equipment in modern refineries is still designed to separate groups of hydrocarbon molecules.

This separating process is called fractionation. To carry out the process of fractionation (separation of hydrocarbons), the refinery takes advantage of the fact that hydrocarbons boil at different temperatures according to the size of their molecules. For example, gasoline, with molecules containing 6 to 10 carbon atoms, boils at temperatures between approximately 150°F and 350°F[1]. Smaller hydrocarbon molecules, such as methane and propane, are gases at atmospheric temperatures and pressures, and have very low boiling points. At the other extreme, heavy oils with large molecules have to be heated to 600° F or higher to turn them into gases.

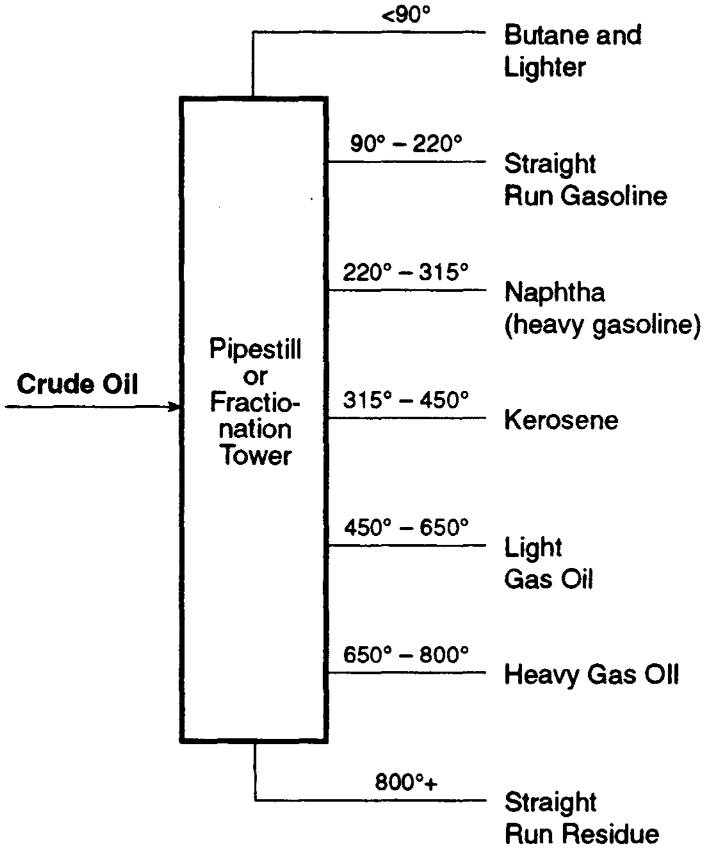
In the fractionation process, crude oil and other process hydrocarbon streams are first vaporized. As this gas cools, each hydrocarbon fraction, or cut, is collected as it condenses back into a liquid over a specific temperature range. Figure 2-5 shows a typical range of hydrocarbon fractions, or cuts, and the boiling points the refining industry typically uses to define these cuts.

Crude oil does not naturally contain a very large volume of high-demand fuel products such as gasoline, diesel fuel, or jet fuel. For example, a barrel of crude oil may contain 20 percent or less of the hydrocarbon molecules that make up gasoline. As the use of the internal combustion engine increased, the demand for the fuels used by them drove the development of methods to chemically rearrange hydrocarbon molecules in crude oil to produce more fuel, particularly gasoline, from each barrel of crude.

Changing demands for fuel quality is another major factor that has driven the development of petroleum processing methods. Gasoline quality was not an important concern to the performance of early internal combustion engines, such as the engine of the Model T Ford.

---

[1] Water boils at 212° F.



Source: Leffler 1979

Project No. 93C0336A	Exxon Clean Fuels Project	RANGE OF HYDROCARBON FRACTIONS PRODUCED FROM FRACTIONATION TOWER	Figure 2-5
Woodward-Clyde Consultants			

93C0336A-0600/082593

As the demand for engine performance and reliability increased with time, performance specifications for fuel became increasingly important. Two of the most important gasoline performance characteristics that influence the types of hydrocarbon fuels produced at a refinery are octane number and Reid vapor pressure.

Octane number is a system to rate a fuel's ability to prevent "knocking" or "pinging" in an engine. A fuel made up entirely of "iso-octane," a branched-chain hydrocarbon with 8 carbons in each molecule, has a research octane number of 100. This is the standard against which all gasoline produced for sale is measured. Gasoline containing all straight-chain hydrocarbons may have an octane rating as low as 40. "Heptane," a straight-chain hydrocarbon with 7 carbons in each molecule, has an octane rating of zero. Production of gasoline with a desired octane rating involves blending various gasoline stocks produced by different refining processes in proportions to make the final product meet the customer's requirements and government regulations. For example, regular unleaded gasoline typically has an octane rating[2] in the range of 87 to 89, while super unleaded gasoline generally has a higher octane rating of about 92.

The Reid vapor pressure of fuel is important to the proper functioning of a modern engine over a wide range of temperatures and pressures. Reid vapor pressure is a measure of the ability of a material to vaporize. In a combustion engine, air and vaporized fuel are drawn into the cylinder where they are compressed by a piston and ignited with a spark plug. The exploding gas mixture expands, pushing the piston down and providing the power that runs the engine. When an engine is warm, it generates sufficient heat to vaporize 100 percent of the gasoline. When the engine is cold, the gasoline must contain enough volatile hydrocarbons to obtain a vapor-air mixture that will ignite in the cylinder. Vapor pressure is a function of temperature. Therefore, in cold climates gasoline must contain a higher proportion of volatile hydrocarbons (higher Reid vapor pressure) than gasoline used in warm climates (lower Reid vapor pressure). The gasoline cannot contain too large a proportion of volatile hydrocarbons because the gasoline may then vaporize in the fuel line leading to the engine. This causes a vapor lock which stops the flow of fuel into the engine making it quit until the temperature of the gasoline is lowered.

---

[2] Octane rating is expressed as Research + Motor ÷ 2 or R+M/2 as shown on gasoline pumps.

One of the most common chemical processes used in a refinery to produce more gasoline from each barrel of crude oil and meet engine performance specifications is called cracking. When hydrocarbons are heated to about 900°F they begin to break into pieces, or crack. Cracking converts some of the long-chained molecules of heavy oils into shorter-chained molecules and ring-shaped molecules (such as naphthenes and aromatics shown on Figure 2-4 that make up fuel products such as gasoline. Refineries use a variety of cracking methods to produce high-value fuel products. The specific method used depends on the characteristics of the crude oil processed at a refinery and product demands.

Because they are relatively resistant to chemical change, most hydrocarbon molecules are not easy to crack without applying high heat and pressure. As indicated above, cracking typically requires temperatures above 900°F. Although some molecules crack near atmospheric pressure, pressures as great as 2000 to 3000 pounds per square inch are necessary to crack many hydrocarbon molecules. Catalytic cracking (or cat cracking) uses heat and pressure in the presence of a catalyst[3] to crack long-chained hydrocarbon molecules. The catalyst used in this process allows the cracking reaction to take place under lower pressures, about 12 pounds per square inch, making the process easier to control.

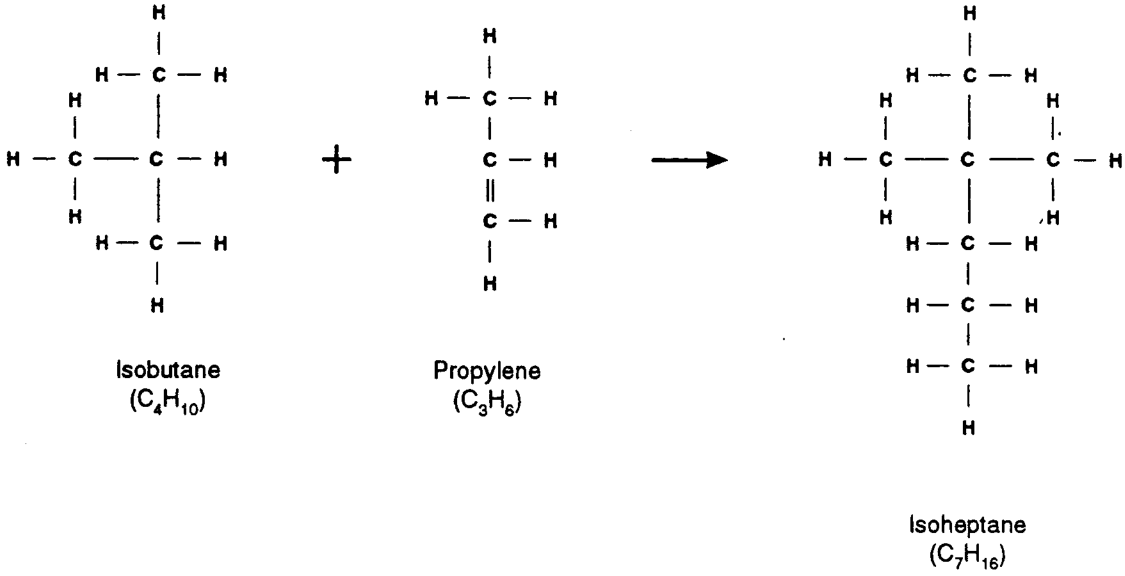
Catalytic reforming changes paraffins which have a low octane number into naphthenes, iso-paraffins, and aromatics (Figure 2-4) with much higher octane numbers. This is done by removing hydrogen atoms from the molecules and creating more carbon-to-carbon bonds.

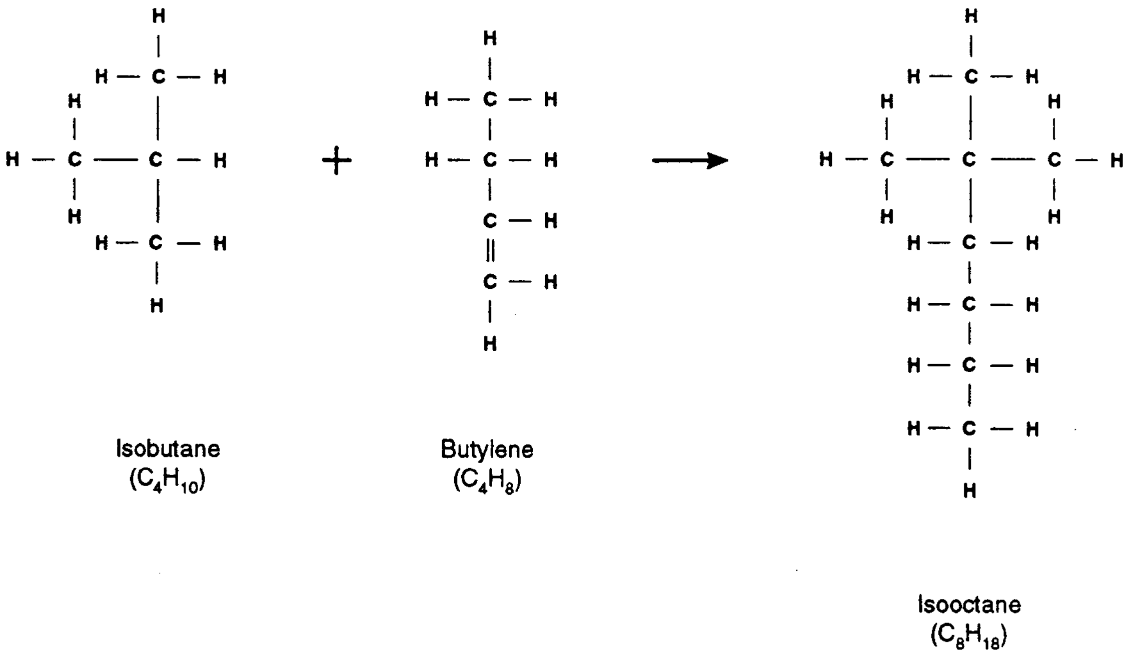
Alkylation is a process where isobutane is combined with olefins to produce iso-paraffins called alkylate (Figure 2-6). Alkylate has a high octane number and, as discussed in Section 2.4, it is an ideal gasoline blending stock to meet the new federal and state specifications for cleaner burning fuel.

As mentioned above, crude oil contains water, inorganic salts, and sulfur, nitrogen, and metal compounds. All of these impurities, if not properly controlled, can corrode process equipment, interfere with refinery processes, lower product quality, pollute the environment,

---

[3] A substance that speeds up the chemical reaction between other substances without being used up in the chemical reaction. Catalysts gradually accumulate impurities which interfere with their action and must be regenerated or replaced when they become inefficient.





Project No. 93C0336A	Exxon Clean Fuels Project	CHEMICAL REACTION THAT TAKES PLACE BETWEEN ISOBUTANE AND OLEFINS IN AN ALKYLATION UNIT	Figure 2-6
Woodward-Clyde Consultants			

93C0336A-0600/082593

and cause odors. Water and inorganic salts are physically separated from the crude oil during initial processing. The sulfur, nitrogen, and metal compounds are chemically removed during process operations. This is done by reacting hydrogen with hydrocarbons under heat and pressure. The sulfur and nitrogen combine with the hydrogen forming hydrogen sulfide gas and ammonia. In further processing, the hydrogen sulfide is converted to elemental sulfur which can be sold, and the ammonia is converted to nitrogen and water.

Hydrotreating is the primary process used in a refinery to remove sulfur and nitrogen from crude oil. In this process, hydrocarbons are combined with hydrogen in the presence of a catalyst. This results in the following reactions:

- Hydrogen combines with sulfur in the hydrocarbon molecules to produce hydrogen sulfide gas
- Hydrogen combines with some of the nitrogen in the hydrocarbon molecules to produce ammonia
- Some of the carbon-to-carbon bonds of the naphthenes, aromatics, and olefins in the petroleum are broken and new bonds are made with hydrogen atoms, creating different hydrocarbon molecules
- Some of the hydrocarbon molecules are cracked, creating some butanes and lighter gases

2.3.1 Process Variability

Process equipment in a refinery is integrated; products and by-products from one group of equipment (termed a process unit) serve as raw material, or feedstock, for another. To save energy, heating and cooling equipment is also integrated between various process streams and units. Because the operations of the process units are intertwined, it is necessary to balance the throughput of all units in a refinery.

Because crude oil is a naturally occurring substance, there can be substantial variability in its chemical and physical properties. Different crudes contain different percentages of the hydrocarbon fractions that feed refinery process equipment. Because there are few crudes with a perfect proportion of hydrocarbon fractions, refining a single type of crude or even crude blends results in too low a feed rate for some portion of the plant. For example, Alaskan North Slope oil, which is processed at the Benicia refinery, is rich in naphtha but contains relatively low amounts of gas oil, the primary feedstock for the fluidized catalytic cracking unit at the refinery. Refineries overcome this problem by bringing in partially refined materials from other refineries (i.e., feedstocks) containing hydrocarbon fractions that supplement the deficiencies of the crude oils they are processing.

Market forces also influence the balanced operation of a refinery. The desired product mix from a refinery varies seasonally. In general, the demand for gasoline is highest during the summer. To meet that demand, most refineries balance their operations to maximize gasoline production during that time of year. The composition of gasoline also varies seasonally. For example, the Reid vapor pressure of gasoline is generally increased during winter and decreased in summer. Government regulations can change the required composition of fuel products. For example, regulations have phased out the use of leaded gasoline over the past 20 years. The addition of oxygen to gasoline sold in California and many other states was mandated by federal law in November 1992.

In summary, a refinery separates hydrocarbon molecules into groups of similar size, cracks the larger molecules into smaller ones of more useful sizes and shapes, recombines some molecules into more useful sizes and shapes, rearranges the molecular structure of others, and removes impurities. A refinery is integrated and balanced to maximize the production of high-demand products that meet required specifications and minimize the production of low-value products. A refinery must also have operating flexibility[4] to meet long-term and seasonally changing market and regulatory demands, as well as variability in crude oil properties.

[4] Flexibility is used here to mean the ability to vary process operations within the design parameters of the equipment.

2.4 THE BENICIA REFINERY AND EXISTING REFINING PROCESSES

2.4.1 Overview of Benicia Refinery

The Benicia Refinery was established in 1969, and is a modern industrial complex that consists of the refining process block, tank farms and storage areas, a marine terminal, railroad shipping facilities, a wastewater treatment plant, and support and service facilities such as an office building, laboratory, control building, electrical substations, and fire station. The core of the refinery is the main process block, located on a level graded terrace above Suisun Bay. As described in detail in Section 2.4.2, the main process block contains the primary refining equipment and process facilities, such as reaction vessels, fractionation towers, storage vessels, combustion heaters, heat exchangers, cooling towers, and other equipment. The process block is laid out in units relating to the major refining stages, as well as smaller support units. The process equipment is interconnected with a substantial system of pipes, pumps, and storage vessels used to transfer the oils and products within the refinery complex. On the west-central edge of the main process block are several support facilities, including a control house (housing the refinery's computer process control equipment), a fire house (containing fire trucks and equipment), office facilities for the process operating personnel, and a materials storage/warehouse.

South and east of the process block, on lower graded terraces, are the tanks used for storing refinery products. This area contains approximately 60 major storage tanks. South and east of the tank storage areas are the refinery's product shipping facilities.

Below East Second Street and above the main process block are rolling hills and graded areas that contain storage facilities and employee and contractor parking. This area also contains the main gate to the refinery (Gate No. 1 off East Second Street; there are a total of nine entrance gates that surround the facility and provide access to specific areas) and the administration building, which provides office facilities for refinery staff.

South of the main refinery area is the crude oil storage facility and marine terminal. The marine terminal contains a dock facility where crude oil and products are shipped and received. The crude oil storage facility consists of several large tanks, where crude oil that has been unloaded at the marine terminal is stored prior to transfer to the refinery for processing.

Southeast of the main refinery is the wastewater treatment plant, which consists of several tanks, vessels, and retention ponds. This facility treats the refinery's wastewater prior to its discharge to Suisun Bay.

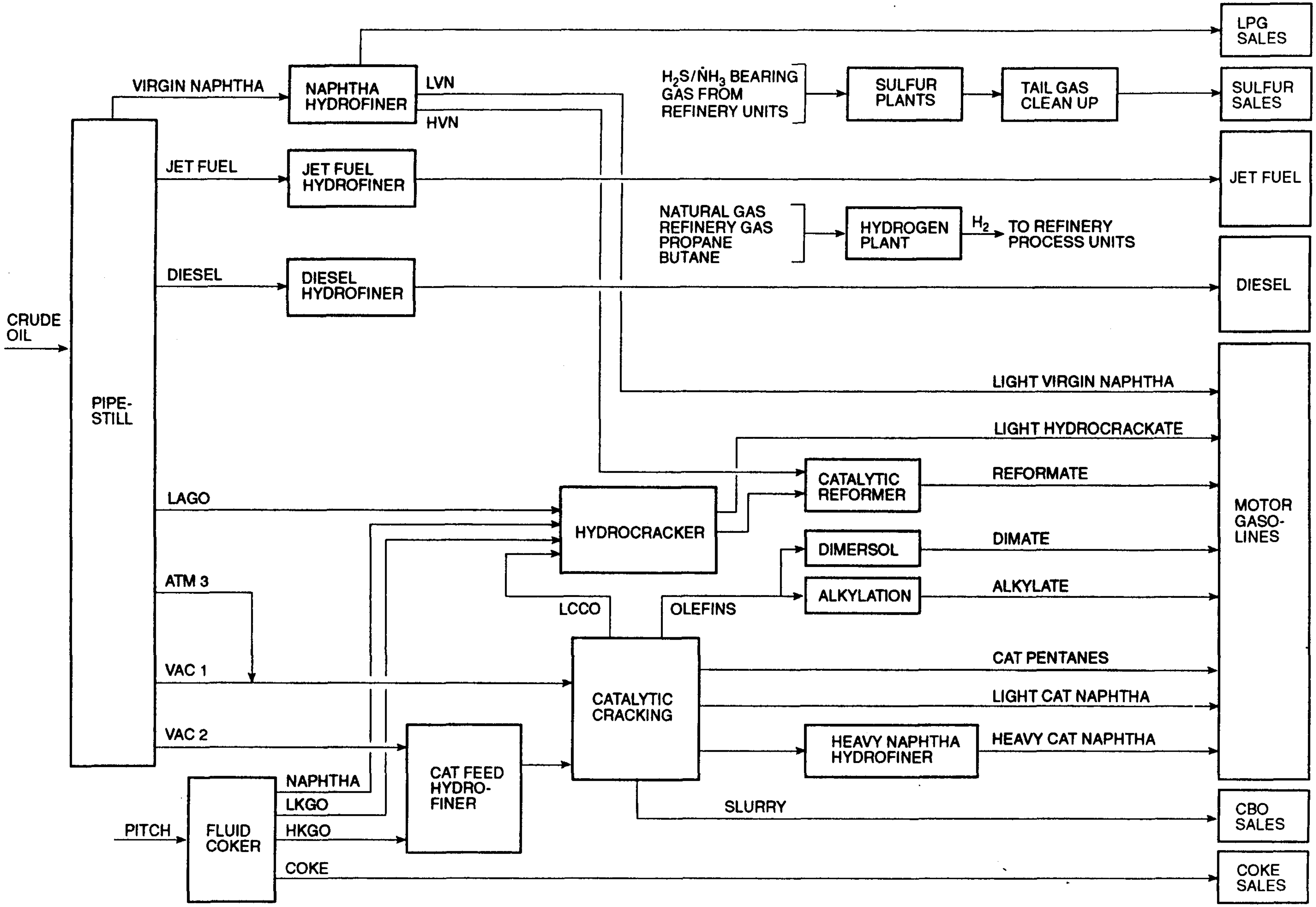
2.4.2 Process Block

All of the process equipment at the refinery is located in the 46-acre process block (Figure 2-3). Figure 2-7 is a simplified flow diagram of the existing refining processes at Exxon's Benicia Refinery. This diagram and the following discussion focuses on those processes upstream and downstream of the equipment that constitutes the proposed project. Other refining processes, such as the Stretford unit, are not shown or discussed here because they would have no relationship to the proposed project.

The discussion provided here on refining is organized by process units. Each process unit in a refinery consists of a number of independent pieces of equipment grouped to accomplish a primary process function such as catalytic cracking, reforming, and alkylation. The key equipment in most process units includes the following:

- <u>Reaction vessel</u>. These are closed steel vessels designed to contain the chemical reactions used to modify hydrocarbon molecules. The vessels typically contain a catalyst to facilitate the reaction. The catalyst may be "fluidized" or "fixed" in the vessel depending on the specific reaction the vessel is designed to accomplish. A fluidized catalyst often consists of silica and aluminum compounds in the form of tiny spheres which mingle with the hot gases inside the vessel, and flow with the gases like a liquid. A fixed catalyst is stationary in the vessel, much like the catalytic converter in the muffler of a modern automobile.

- <u>Fractionation or distillation column</u>. This piece of equipment consists of a cylindrical steel tower designed to separate the products from the reaction vessel into its various components through distillation.



Source: ENSR 1993

Project No. 93C0336A	Exxon Clean Fuels Project	EXISTING BENICIA REFINERY FLOW DIAGRAM	Figure 2-7
Woodward-Clyde Consultants			

93C0336A-0600/082593

- Pots, accumulators, and separators. These are steel vessels often used in a process unit to store hydrocarbons that will feed other reaction vessels or fractionation columns.

- Support equipment. Reaction vessels and fractionation columns have associated heaters and heat exchangers to control temperatures, equipment to control pressure, and pumps and compressors to move materials.

Existing Process Units

The Benicia Refinery processes approximately 135,000 barrels per day of crude oil. At present, approximately 80 percent of this crude is delivered by tanker from Alaska, and the remaining 20 percent is delivered by pipeline from the San Joaquin Valley of California. The specific supply of crude oil to the refinery will change over time based on crude supplies and market conditions.

Crude oil is first separated into its basic fractions or cuts in a fractionation unit called a pipestill (Figure 2-7). To separate the hydrocarbon fractions, crude oil is heated until it is partially vaporized. The vapors are piped into the bottom portion of a large cylindrical vessel called a pipestill. The pipestill has a number of horizontal trays stacked one above another. These trays are perforated to allow the hot hydrocarbon vapors to rise freely through them to the top of the vessel. As the vapors rise they cool and condense back into liquid at different heights in the vessel. The temperature at the bottom of the vessel is greater than at the top, so that heavy hydrocarbons with high boiling points condense on the lower trays and lighter hydrocarbons with lower boiling points, such as gasoline, condense on trays near the top. The condensed liquid hydrocarbon fractions from the trays run out through pipes in the side of the vessel, and are separately collected into the following six fractions or cuts:

- Virgin naphtha
- Jet fuel
- Diesel
- Light gas oil[5]

[5] Gas oil is a group of hydrocarbons with medium-length carbon chains.

- Atmospheric gas oil
- Residual oil[6]

The residual oil from the pipestill is further processed in a vacuum distillation column to remove the relatively light hydrocarbon molecules remaining in this heavy oil. This is done by introducing heated residual oil to a vacuum. Reducing the pressure on the liquid has much the same effect as increasing the temperature, causing the lighter hydrocarbons to vaporize. The products from the vacuum flasher are light and heavy vacuum gas oils and pitch.

The light hydrocarbon cuts from the pipestill (virgin naphtha, jet fuel, and diesel) are processed through three different hydrotreating units (called hydrofiners) to remove sulfur from the petroleum in the form of hydrogen sulfide. The jet fuel and diesel produced by the hydrofiners is pumped to storage tanks outside the process block and sold. The treated virgin naphtha from the hydrofiner is divided into two cuts in a fractionation column. The light hydrocarbon cut (light virgin naphtha) is pumped to storage tanks outside the process block and used as a gasoline blending stock. The octane of the heavy hydrocarbon cut from the hydrofiner (heavy virgin naphtha) is boosted in the catalytic reformer by reshaping some of the long-chained hydrocarbon molecules into aromatics and naphthenes. Hydrogen sulfide from the hydrofiners is collected in an amine and water solution and pumped to one of the refinery sulfur plants. The hydrogen sulfide is stripped from the amine with steam and converted to elemental sulfur which is stored outside the process block in heated tanks and sold as a product of the refinery. The stripped amine solution (lean amine) is recirculated back to the process units.

The heavy hydrocarbon cuts (light gas oil, atmospheric gas oil, light and heavy vacuum gas oils, and pitch) from the pipestill are processed in several units to maximize the production of gasoline. The light gas oil cut from the pipestill is used as feedstock for the hydrocracker. The gas oil is mixed with hydrogen in a reactor vessel in this unit and cracked in the presence of a catalyst. The products of this process are divided into two streams in a fractionation column. The lightest hydrocarbon cut (light hydrocrackate) is pumped to storage

---

[6] Residual oil consists of long-chain and complex hydrocarbon molecules generally with boiling points above 800°F.

tanks outside the process block and used as a gasoline blending stock. The heavy hydrocarbon cut from the unit is processed further in the catalytic reformer to increase its octane number so that it can be used as a gasoline blending stock.

The atmospheric gas oil and vacuum gas oil cuts from the pipestill are used as feedstock for the catalytic cracking unit (or cat cracker). The heaviest of these oils, the heavy vacuum gas oil cut, is processed in a hydrofiner to remove sulfur before it is fed into the cat cracker.

The cat cracker uses heat and pressure in the presence of a catalyst to crack long-chained hydrocarbon molecules in a specific way that maximizes the conversion of heavy oils into gasoline. The catalyst used in this unit is made up of silica and aluminum compounds in the form of tiny spheres which mingle with the hot gases inside the reaction chamber, and flow with the gases like a liquid. Because of this phenomenon, the process is called fluidized catalytic cracking. The products of the cat cracker are divided into five cuts:

- Pentanes
- Light cat naphtha
- Heavy cat naphtha
- Light gas oil
- Olefins

The pentane (straight-chained hydrocarbons containing five carbons) and light cat naphtha from the unit are pumped to storage tanks outside of the process block and used as gasoline blending stocks. The heavy cat naphtha is further processed in a hydrofiner to remove sulfur before it is pumped to storage tanks and used as a gasoline blending stock. The light gas oil is used as a feedstock for the hydrocracker. Olefins produced in the unit are used as feedstocks to the alkylation unit and dimersol unit.

The alkylation unit reacts olefins with isobutane in the presence of a catalyst to produce a high-quality gasoline blending stock called alkylate. Alkylate is an essential blending stock for reformulated gasoline because of its relatively high research octane number of 92, its zero benzene, aromatic hydrocarbon, and olefin content, and its relatively low Reid vapor pressure.

Some of the olefins from the cat cracker that contain three carbon atoms, termed propylene, are reacted in the dimersol unit to form an iso-olefin called isohexene. This hydrocarbon is a high-octane gasoline blending stock called diamate.

The bottom cut from the vacuum distillation column of the pipestill consists of the largest hydrocarbon molecules in the crude oil. This bottom cut, termed pitch, is used as feedstock to the fluid coker. The fluid coker is a cracking unit that converts extremely heavy vacuum bottoms into lighter hydrocarbon streams and coke, a carbon by product that is sold by the refinery for fuel and other industrial applications. The naphtha and light gas oil produced from the fluid coker is used as a feedstock for the hydrocracker. The heavy gas oil from the unit is first treated in a hydrofiner to remove sulfur and nitrogen and is then fed into the cat cracker.

There are currently five hydrofiners at the Benicia refinery (Figure 2-7). Hydrogen is an essential ingredient for this process. While the catalytic reformer produces some hydrogen that is used in these hydrotreating units, more is needed. High purity hydrogen is produced in two hydrogen plants by reacting natural gas (methane) and other light hydrocarbons with steam and catalyst in a reformer.

In summary, Exxon's existing facilities produce a range of petroleum products through the refining of crude oil. Although the refinery's equipment and operations are oriented at producing primarily gasoline, which is the most marketable product for a refinery, other products include liquid petroleum gas, sulfur, jet fuel, diesel, and other products.

2.5 PURPOSE AND OBJECTIVES OF THE PROJECT

The purpose of the Clean Fuels project is to produce the clean-burning reformulated gasoline mandated by the Federal Clean Air Act Amendments of 1990 and the California Clean Air Act. These requirements are summarized below, along with the objectives of the reformulated fuel standards.

2.5.1 Federal and State Reformulated Fuel Requirements

The Federal Clean Air Act Amendments require that all gasoline sold in "non-attainment" areas[7] of the country must be reformulated in accordance with mandated specifications that are being implemented in four phases. Those specifications require oxygenation of gasoline, reduction in benzene and other aromatic hydrocarbon content, and reduction in Reid vapor pressure.

The California Air Resources Board (CARB) adopted rules (California Code of Regulations, Title 13) in response to the California Clean Air Act. These rules require gasoline sold in California after January 1, 1992, to have a maximum Reid vapor pressure of 7.8 psia during the summer months and contain deposit-control additives. The rules also restrict lead and phosphorous content. By March 1, 1996, gasoline sold in the entire state must meet the specifications listed in Table 2-1. Table 2-1 also lists the composition of typical gasoline sold in 1992 in comparison to the required content of reformulated gasoline that will be sold in the state in 1996.

2.5.2 Purpose of the Reformulated Fuels Regulations

The purpose of the federal and state reformulated fuels requirements is to reduce vehicle emissions of pollutants that are either toxic to human health, or lead to the formation of photochemical smog. Smog is the result of a photochemical reaction between nitrogen oxides and volatile organic compounds that occurs in the atmosphere in the presence of sunlight. Vehicle emissions are a major source of these compounds, and reduction of these emissions would help reduce the formation of smog. Motor vehicle emissions are also a major source of carbon monoxide in the atmosphere. Carbon monoxide can impact human health when ground-level concentrations are high. Benzene and 1,3-butadiene emitted in vehicle exhaust are known carcinogens. Reduction of these emissions would reduce the risk of cancer throughout California. The reformulated fuels specifications will help to control vehicle emissions of nitrogen oxide, volatile organic compounds, and carbon monoxide, as well as other pollutants in the following ways:

---

[7] A non-attainment area is a region where monitored air quality concentrations have exceeded one or more air quality standards.

TABLE 2-1

CALIFORNIA AIR RESOURCES BOARD SPECIFICATIONS FOR REFORMULATED GASOLINE

Property	Typical Summer 1992 California Gasoline Values	CARB 1996 Specifications California Gasoline (Flat Limits)
Reid Vapor Pressure, psia	7.8	7.0
Sulfur, wppm	150	40
Olefins, vol. %	9.9	6
Benzene, vol. %	2.0	1.0
T-90, deg. F	330	300
T-50, deg. F	220	210
Aromatics, vol. %	32	25
Oxygen, wt. %	0	2.0

Source: Exxon 1993b

- Volatile organic compounds are emitted from gasoline through evaporation, from both uncombusted gasoline emitted from an engine, or directly through the evaporation of gasoline exposed to the air. Reducing the Reid vapor pressure standard for gasoline will lower the emissions of uncombusted volatile organic compounds. The volatility of reformulated gasoline will be about 40 percent lower than gasoline manufactured today.

- Sulfur in gasoline reduces the efficiency of automobile catalytic converters, which are a major component of the pollution control equipment in modern automobiles. Sulfur in gasoline is also emitted in vehicle exhaust as sulfur oxides, an unwanted air pollutant. The sulfur content requirement for reformulated gasoline is significantly reduced, which will help prolong and enhance the performance of catalytic converters (thereby reducing automobile emissions of volatile organic compounds, nitrogen oxides, and carbon monoxide), and reduce emissions of sulfur oxides.

- Limiting the olefin content of gasoline will reduce automobile emissions of nitrogen oxides. The olefin content of reformulated gasoline is limited to 6 percent, which is estimated by CARB to result in a 1 to 2 percent reduction in automobile emissions of nitrogen oxides.

- "T-50" and "T-90" are the temperatures at which 50 percent and 90 percent, respectively, of a gasoline sample will boil in a standard distillation test. Reformulated fuel specifications limit the T-50 and T-90 component of gasoline. By limiting T-50, the lighter components of gasoline must be removed at the refinery, which reduces emissions of carbon monoxide and volatile organic compounds. By limiting T-90, refineries must remove the heavier compounds from gasoline blending stocks, which will reduce emissions of volatile organic compounds.

- Reformulated gasolines must have a reduced aromatic hydrocarbon content which will, in conjunction with other reformulated fuel specifications, reduce automobile emissions of volatile organic compounds, carbon monoxide, and nitrogen oxides.

- The addition of oxygen to gasoline reduces the emissions of carbon monoxide, as well as volatile organic compounds, from automobiles. As of November 1992, oxygenate is a required gasoline additive during the winter months when carbon monoxide concentration levels are typically at their highest. CARB's reformulated gasoline specifications require that oxygenates be blended into gasoline year round beginning in 1996.

- Reformulated fuels specifications require a reduced benzene and 1,3 butadiene content in gasoline. The reductions in vehicle emissions of these compounds is predicted to achieve a reduction of 35 cancer cases per year over a 15-year period in California.

As noted in Section 2.5.1, Exxon currently complies with the reformulated fuel specifications implemented in 1992 through manufacturing gasoline with a reduced Reid vapor pressure, and importing MTBE to the Benicia Refinery for blending with gasoline products. The refinery will be able to meet a portion of the oxygenate requirement on-site once the MTBE process facility is completed and on-line, estimated for mid-1994. The proposed Clean Fuels project described and evaluated in this EIR will provide the necessary process and support facilities for the Benicia Refinery to comply with the remainder of the reformulated fuel requirements by 1996.

2.6 CLEAN FUELS PROJECT

Table 2-2 lists the proposed new process and auxiliary facilities that would be added to the Benicia Refinery by the Clean Fuels project, and the existing facilities that would be modified by the project. A flow diagram showing how the proposed new process equipment fits into the existing refinery processes is provided on Figure 2-8. Schematic diagrams of each new and modified process unit and operating system are provided in Appendix A. The location of new equipment is provided on Figures 2-3 and 2-9.

2.6.1 New Process Equipment

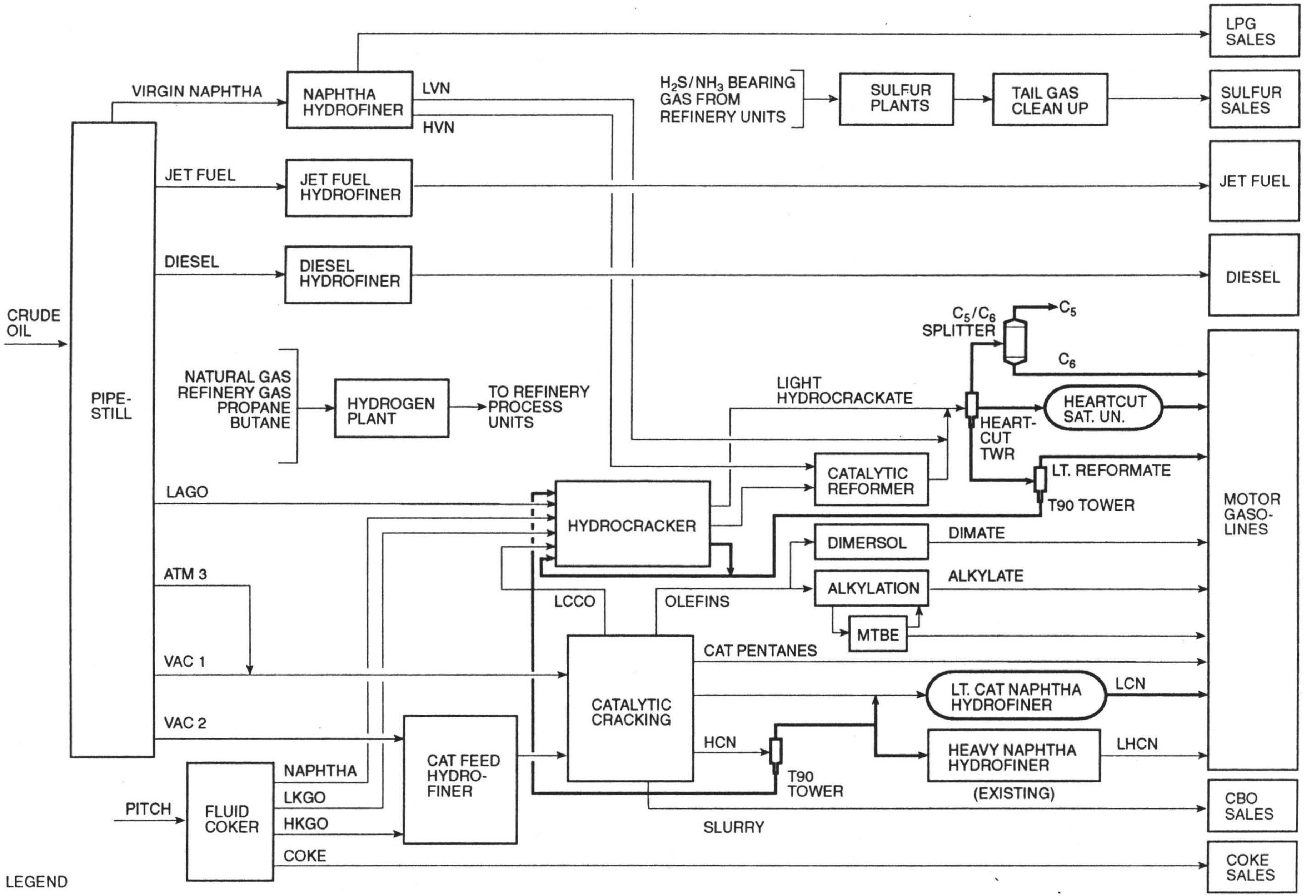
The gasoline blending stock currently produced by the Benicia Refinery contains a higher percentage of olefins and sulfur than allowed under the new federal and state requirements

TABLE 2-2

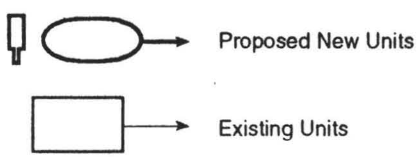
CLEAN FUELS PROPOSED NEW AND MODIFIED FACILITIES

New Process Facilities	New Auxiliary Facilities	Modified Facilities
1. Heartcut Tower	1. Aqueous Ammonia Storage for NOx Control	1. Hydrocracker Unit
2. Heartcut Saturation Unit	2. Hot Oil System	2. Hydrogen Plant
3. Catalytic Reformer T90 Tower	3. Three hydrocarbon tanks	3. HCN Hydrotreater
4. Catalytic Naphtha T90 Tower		4. Virgin Light Ends
5. Light Catalytic Naphtha Hydrofiner		5. Alkylation Unit
6. C_5/C_6 Splitter		

Source: Exxon 1993b

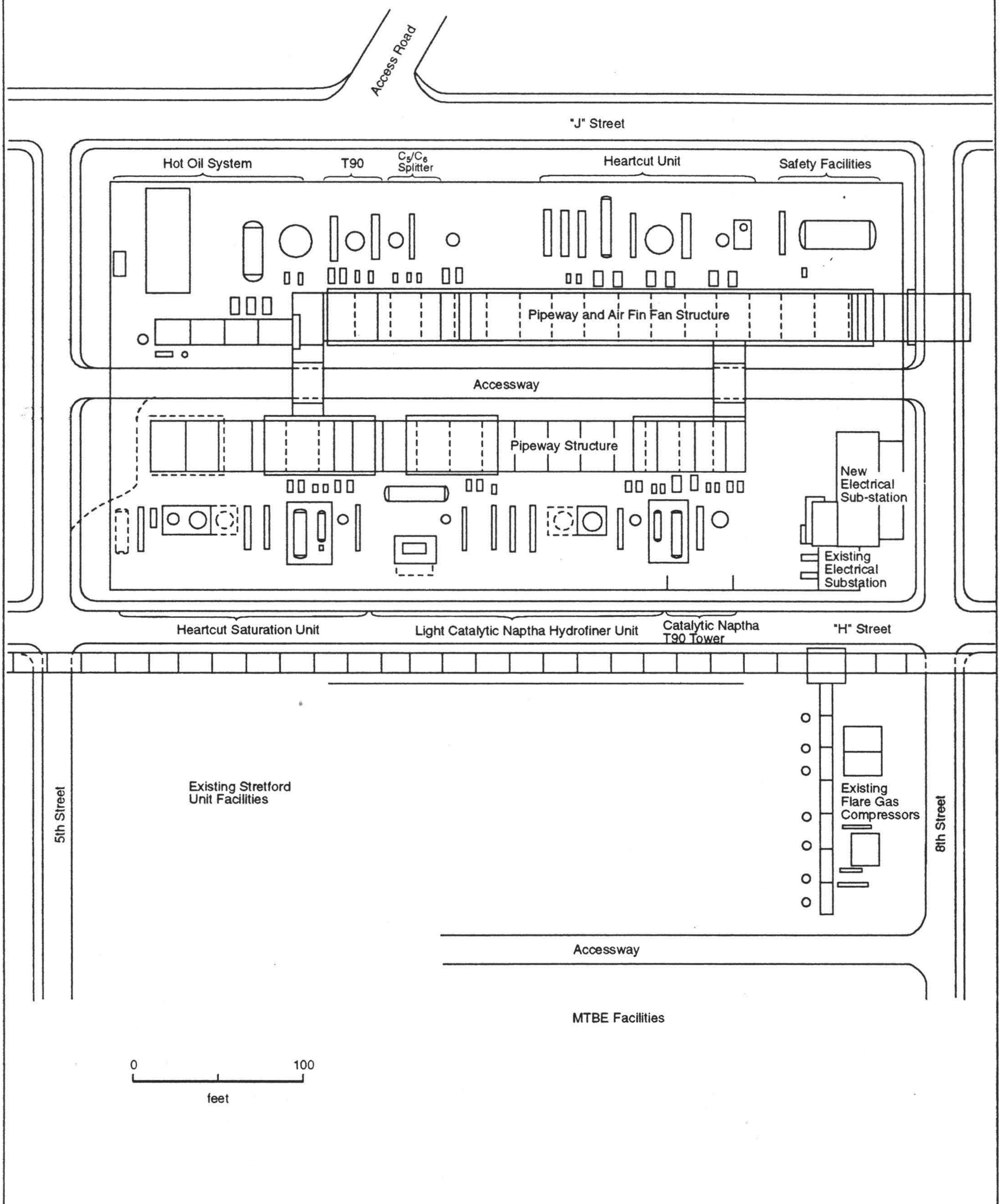


LEGEND



Source: Exxon 1993b

Project No. 93C0336A	Exxon Clean Fuels Project	REFINERY FLOW DIAGRAM WITH EXISTING AND PROPOSED PROCESS FACILITIES	Figure 2-8
Woodward-Clyde Consultants			



Project No. 93C0336A	Exxon Clean Fuels Project	CLEAN FUELS PROCESS FACILITIES PLOT PLAN	Figure 2-9
Woodward-Clyde Consultants			

93C0336A-0600/083093

for gasoline. The major contributor of olefins and sulfur to the refinery's gasoline blending stocks is the light cat naphtha produced from the existing catalytic cracking unit (Figure 2-8). The project would add a new hydrofiner to treat light cat naphtha, converting the sulfur to hydrogen sulfide and saturating the olefins to produce naphthenes and paraffins.

As shown on Figure 2-4, olefins are hydrocarbon molecules that have one double bond between two carbons. By introducing these compounds to hydrogen under heat and pressure, the double bond is broken and hydrogen is added to the molecule producing naphthenes and paraffins. This process is called saturation because the bonding sites of the carbon atoms tend to become saturated with hydrogen atoms.

The gasoline blending stocks produced by the Benicia Refinery contain more benzene than allowed under the reformulated fuel standards. The mid-boiling point fraction (heart cut) of reformate from the existing catalytic reformer and the light petroleum cut (light hydrocrackate) from the hydrocracker contain the highest amount of benzene of all the refinery's gasoline blending stocks. The project would add a fractionation unit called a heartcut tower to further separate the light hydrocrackate and the reformate into three cuts:

- Pentanes and hexanes (hydrocarbons with five and six carbons, respectively)
- Heartcut
- Bottoms

The heartcut stream, which would contain most of the benzene, would be processed in a proposed new saturation unit. In this process, the heartcut would be reacted with hydrogen, saturating the benzene to produce a naphthene (Figure 2-4) called cyclohexane. This would be pumped to storage tanks outside the process block and used as a gasoline blending stock.

Gasoline produced at the Benicia Refinery has a higher Reid vapor pressure than stipulated under the reformulated fuel requirements. To decrease the Reid vapor pressure, much of the light liquid hydrocarbon (pentane) and all of the butanes need to be removed from the gasoline blending stocks. Pentane from the pentane/hexane fraction of the heartcut tower would be separated from hexane in a new fractionation unit called a pentane/hexane or C_5/C_6 splitter. The pentane from the splitter would be stored in tanks outside the process block and either sold as an industrial fuel, used for fuel in the refinery, or used for gasoline. The hexane from the splitter would be used as a gasoline blending stock.

The T90 temperature (i.e., temperature at which 90 percent of the material boils) of the Benicia Refinery gasoline blending stock is higher than the reformulated fuel standard. This temperature would be reduced by removing a fraction of the heavier hydrocarbons in the blending stocks and reprocessing that cut to produce lighter hydrocarbons. The bottoms from the heartcut tower would be processed through a new fractionation unit called a T90 tower to remove the heaviest hydrocarbons in this bottom cut. The heavy hydrocarbon stream from the T90 tower would be fed back into the hydrocracker to break these hydrocarbons into smaller molecules with a lower boiling point.

The heavy cat naphtha from the cat cracker also contributes to the high boiling point of gasoline produced by the Benicia Refinery. This heavy naphtha would also be processed in a new T90 tower to remove the heavy hydrocarbons. The light naphtha cut from this tower would be further processed in an existing modified hydrofiner to remove sulfur before it is used as a gasoline blending stock. The heavy cut from the second T90 tower would also be recycled to the hydrocracker for further processing.

Approximately 30 percent of the petroleum products from the existing hydrocracker are too heavy to use as gasoline blending stock. In the existing refinery, this fraction is recycled back to the front of the hydrocracker to increase the production of light products. As discussed above, the Clean Fuels project also calls for processing the heavy cuts from the two proposed T90 towers in the hydrocracker. Some minor modifications to the hydrocracker unit would allow processing of the additional material.

2.6.2 New Auxiliary Facilities

The proposed project would include auxiliary facilities to support the new process equipment. Those facilities would include nitrogen oxides (NO_x) controls, a hot oil system, three hydrocarbon storage tanks, and a modification of the hydrogen plant.

Aqueous Ammonia Storage for Emission Controls

The proposed project would include selective catalytic reduction (SCR) units to reduce nitrogen oxides (NO_x) emissions from the new furnace for the hot oil system. These emissions control units use ammonia (NH_3) to convert NO_x to elemental nitrogen (N_2) and water (H_20) from the furnace exhaust gas. Ammonia is currently used at the refinery in the electrostatic precipitators on the pipestill to reduce particulate emissions from the exhaust of this unit. This emission control device puts an electric charge on particles in the exhaust and collects them on a substrate with the opposite charge. Ammonia is also used in the Dimersol process.

The electrostatic precipitators and Dimersol unit currently use anhydrous ammonia which is a gas. The project would replace the anhydrous ammonia used for the precipitators with aqueous ammonia, and the new NO_x control units would use aqueous ammonia. The use of aqueous ammonia instead of anhydrous ammonia in these emission control systems would improve refinery safety. Failure of an anhydrous ammonia storage system could lead to the release of a toxic cloud of ammonia gas. Failure of an aqueous ammonia system would result in a much smaller release of ammonia to the atmosphere.

The project would include facilities to store and transport aqueous ammonia. These facilities would consist of a 1600-barrel storage tank and a piping system to convey the ammonia to the electrostatic precipitator and NO_x control units. The storage tank will store ammonia under pressure in an enclosed system. It would be surrounded with an earth dike capable of containing at least 100 percent of the volume of the tank. The aqueous ammonia tank would be located at the current site of the catalyst fines storage area outside the process block. Aqueous ammonia would be transported via pipelines to the point of use, and would then be vaporized for use in the precipitator and NO_x control units.

Hot Oil System

As mentioned in Sections 2.3 and 2.4, to fractionate crude oil or petroleum cuts the material must first be vaporized. This requires substantial heat which is typically provided in a refinery by steam. The new fractionation columns added by the proposed project (heartcut tower, T90 towers, and C_5/C_6 splitter) would require additional heat. To conserve water, the heat for this new equipment would be provided by a hot oil system instead of steam. The hot oil system would consist of a 330 million Btu/hour furnace, hot oil circulation system, and a 1,100-barrel storage tank for the oil. The hot oil circulation lines and storage tank are a closed system. The heat transfer oil is heated in the furnace, the hot oil is pumped to the fractionation columns, and the petroleum feed to these columns is heated by the oil in heat exchangers. These heat exchangers are like the radiator in a car. The relatively cool petroleum feedstock passes around tubes containing the hot oil and is heated up. The cooled oil is recirculated back to the furnace. The hot oil system would be located adjacent to the project process equipment in the process block.

Hydrocarbon Storage Tanks

The project would include two new hydrocarbon storage tanks in the existing tank farm south of the process block (Figure 2-3). Those tanks would be 175,000-barrels each in size. A third 71,000-barrel tank would be located in the existing tankage area, southeast of the process block. Tanks would have fixed roofs and vapor recovery systems. The tanks would be located within the existing tank farm spill containment area. The new tanks are required primarily to store the pentane cut produced by the proposed new process equipment. They may also be used from time-to-time to store the greater number of gasoline blending stocks produced by the refinery after the project is completed.

2.6.3 Modification of Existing Equipment

As discussed in Section 2.6.1, the proposed project would modify the feedstocks to the existing hydrocracker unit to include the heavy cuts from the new T90 towers. The different feedstocks would require adjustments in several fractionation towers in the unit including piping changes and control valve changes.

Hydrogen is a necessary feedstock to the proposed new heartcut saturation unit, and light cat naphtha hydrofiner. The hydrocracker is also a major consumer of hydrogen. The additional hydrogen that would be required for these units would be obtained by increasing the firing rate of the two existing hydrogen plants.

The project would include several other ancillary changes to the hydrogen plants. A new compressor would be installed to pump the larger volume of hydrogen produced in these plants to the process equipment. A new absorbent (Flexsorb HP or equivalent) would be used to remove carbon dioxide from the hydrogen produced in the plants.

The existing reformer furnaces in the hydrogen plants would be equipped with low-NO_x burners and/or thermal de-NO_x equipment to reduce NO_x emissions resulting from increasing the design firing rate of the furnaces from 1,005 to 1,210 million Btu/hour (annual average).

The change in the feedstocks to the hydrocracker that would be implemented by the project would result in the production of slightly more light hydrocarbons (virgin light ends) from this unit. Condenser capacity in the hydrocracker unit would be expanded to collect these light ends. This would be accomplished by adding condenser area to one tower and increasing cooling water flow in two towers.

The project would install a different catalyst in the heavy cat naphtha hydrofiner (Figures 2-8 and 2-9) to reduce olefin and sulfur content. This modification would also require a bypass controller on the feed and effluent exchangers in the unit, replacement of a vapor condenser tube bundle, and the addition of a larger unit pressure control valve.

A minor modification will be made to the alkylation unit, with the addition of a new pump to convey light ends produced at the unit to the hydrogen unit as feed.

2.6.4 Electric and Gas Utility Requirements

Exxon estimates that the proposed project will have a capacity to use approximately 910 million Btu[8]/hour of additional heat. This heat use rate represents the maximum annual average capacity of the new and modified facilities, including a combination of new combustion sources, increased combustion rates at existing modified sources, and increased combustion rates at existing non-modified sources. Typical operations will require an

---

[8] A Btu (British thermal unit) is a common measure of energy content. One Btu represents the energy required to raise the temperature of one pound of water by one degree Fahrenheit.

estimated 810 million Btu/hour. The increase represents about a 29 percent increase in fuel gas firing over a "base year," calculated from February 1991 through January 1992.

The proposed project energy requirements will be met through a combination of refinery fuel gas, refinery pentane, and electricity. Refining crude oils produces hydrocarbon gases such as methane, butane, and propane. These gases are used as fuel at the Benicia Refinery to fire gas turbines, furnaces, and boilers. The refinery fuel gas system is supplemented when needed with natural gas. In general, Exxon minimizes the use of natural gas at the refinery, as it is less expensive to use refinery fuel gas to fire combustion units. However, natural gas is required whenever sufficient refinery fuel gas is unavailable. With the proposed project, the refinery will produce more pentane, which can no longer be used in large amounts as a gasoline blending stock. Enough of this pentane will be used as a refinery fuel that Exxon does not expect to increase the use of natural gas.

Exxon estimates the increased electricity requirements for the project at 13 megawatts (MW), which is approximately a 25 percent increase over the existing base refinery operations load. This increase will bring the total electrical demand for the refinery to 65 MW. The additional electricity is needed to power air fin heat exchangers (fin fans), which are cooling units, a new fourth hydrogen compressor, and pumps, lighting, and other Clean Fuels project electrical equipment. All of the electricity used at the Benicia Refinery is supplied by Pacific Gas & Electric Company (PG&E). In the last year, Exxon converted from electrical supply from PG&E's distribution system to direct supply from the utility's transmission system. When electricity is supplied through PG&E's distribution system, it is "stepped down" from the high transmission voltage to a lower voltage suitable for use at the refinery. PG&E delivers 230 kilovolts (KV) to the Benicia Refinery through their transmission system to the Bahia Substation, located off East Second Street at the refinery. Exxon leases a portion of this substation from PG&E, and is responsible for conversion and distribution of the electricity to and within the refinery. There is sufficient capacity within PG&E's 230 KV transmission system to deliver the 13 MW to the Bahia Substation with no required system changes, other than electrical load leveling at the time of project start-up. Exxon will have to make modifications at an existing medium voltage substation and add a new low-voltage substation at the main process block area to distribute the electricity to the Clean Fuels facilities. The electricity for the modified hydrogen facilities will be provided from the existing main substation and a new unit substation.

2.6.5 Water Requirements

Petroleum refineries require a substantial volume of water for a variety of needs, including petroleum processing and equipment cooling. The Benicia Refinery is supplied with approximately 5 million gallons per day (gpd) of raw water for industrial use by the City of Benicia Water Division (City of Benicia 1993). This water is delivered from the City of Benicia water treatment plant, and is treated on-site at the refinery where it is used primarily for steam generation, circulation through cooling towers, and in the process units. By contract with the City, Exxon is allocated up to 11 million gpd of raw water. The refinery also receives approximately 7,500 gpd of treated water for domestic (potable) water uses from the City of Benicia Water Division. A more detailed discussion of existing water use and supply is provided in Section 4.13.

The project will require additional water. Exxon estimates that approximately 217 gallons per minute (gpm) (or 312,500 gpd) will be required for:

- Cooling water for miscellaneous pumps, compressors, and analyzers
- Cooling water for small rundown coolers (most services will be air cooled with fin fan coolers)
- Steam for hydrogen production in the existing hydrogen unit.

The above water needs will be met through an increase in raw water delivered to the refinery through Exxon's contract with the City of Benicia. No modifications to the refinery's physical water delivery system is anticipated, other than new on-site supply lines leading to the Clean Fuels project facilities. The potential impact of providing this water to the project is evaluated and discussed in Section 4.13.

2.6.6 Air Emissions and Controls

New and modified process equipment installed for the project would use Best Available Control Technology (BACT) to control project emissions. BACT is defined by the Bay Area Air Quality Management District (BAAQMD) and applies to new or modified sources of air emissions and requires the use or application of the most effective proven emission controls or the most stringent achievable emission limitations. New or modified sources with emissions of precursor organic compounds, nitrogen oxides, sulfur oxides, particulate matter, and/or carbon monoxide above established limits must use BACT technology to control air pollutants.

In addition to BACT requirements, other air quality regulations and requirements stipulate emission controls for storage vessels, inspection and maintenance for valves and connectors, New Source Performance Standards, and other emission controls or performance standards. The following discussion summarizes the air pollution control equipment and measures that Exxon has proposed to meet applicable air quality standards.

Sulfur Dioxide Emission Controls

Sulfur dioxide emissions would result from the combustion of fuels in process unit heaters. The quantity of sulfur dioxide emitted by process heaters is a result of the amount of sulfur contained in fuel. Exxon currently controls sulfur dioxide emissions by treating fuel gas. There are no new sulfur dioxide controls proposed as part of the project. Sulfur dioxide emissions from new clean fuels equipment would be controlled consistent with existing operations and systems.

The existing fuel gas treating system removes sulfur from the fuel gas in the form of hydrogen sulfide (H_2S). The fuel gas is contacted with an amine (methyldiethanolamine) solution in a contactor. The H_2S is stripped from the amine in a regenerator and sent to the sulfur recovery plant while the "lean" amine is reused.

The sulfur recovery plant is a modified Claus process consisting of a thermal stage followed by three catalytic reaction stages. In these stages, H_2S is converted to sulfur dioxide and finally elemental sulfur. Overall conversion of H_2S to sulfur in the plant, and subsequent treatment, is 99.9 percent.

Nitrogen Oxides Emission Controls

Nitrogen oxides emissions also result from combustion in process unit heaters. Potential controls for these emissions are aimed at reducing the formation of nitrogen oxides during the combustion process and removal of the pollutant from flue gas. Emissions from new process unit sources will be controlled by the use of low nitrogen oxide burners and selective catalytic reduction (SCR). At the existing hydrogen plant that will be modified by the project, Exxon proposes to use low nitrogen oxide burners and/or thermal De-NOx technology. Exxon has proposed these control technologies individually or in combinations for the Clean Fuels combustion process units to achieve the required emission limits for this pollutant. Exxon is also planning, as separate projects, to modify existing refinery nitrogen oxide emission sources within the overall refinery to meet upcoming BAAQMD nitrogen oxide emission control regulations.

Carbon Monoxide Emission Controls

Carbon monoxide is produced as a result of combustion processes. No specific control technologies for carbon monoxide are required or are proposed since predicted concentrations of this pollutant from the proposed project are within applicable BAAQMD criteria[9] and California Ambient Air Quality Standards.

Particulate Emission Controls

Combustion in heaters results in particulate emissions, as does dust generated from wind erosion of exposed soils, grading, construction, and other soil disturbing activities. Two types of particulate emissions are currently regulated: airborne particulates smaller than 100 microns in diameter (referred to as total suspended particulates or TSP) and particulates with an aerodynamic diameter smaller than or equal to a nominal 10 microns (referred to as PM_{10}). PM_{10} is a fraction of the total suspended particulates. Particulate emissions for process equipment would be controlled by using natural gas and treated refinery gas as the primary

---

[9] Modeled carbon monoxide concentrations are below the BAAQMD's threshold criteria set forth in Rule 2-2-233 (see Section 4.2.2).

fuel for heaters, furnaces, and boilers. Exxon has included measures to reduce emissions at the refinery to fully negate new particulate sources associated with the Clean Fuels project.

Fugitive Emissions Controls

Small leaks of petroleum vapors can occur at valves, pumps, pressure relief devices, compressors, and flanges. In general, these fugitive emissions will be controlled by a quarterly inspection and maintenance program for accessible components and an annual inspection and maintenance program for inaccessible components. Specific measures to minimize fugitive emissions include:

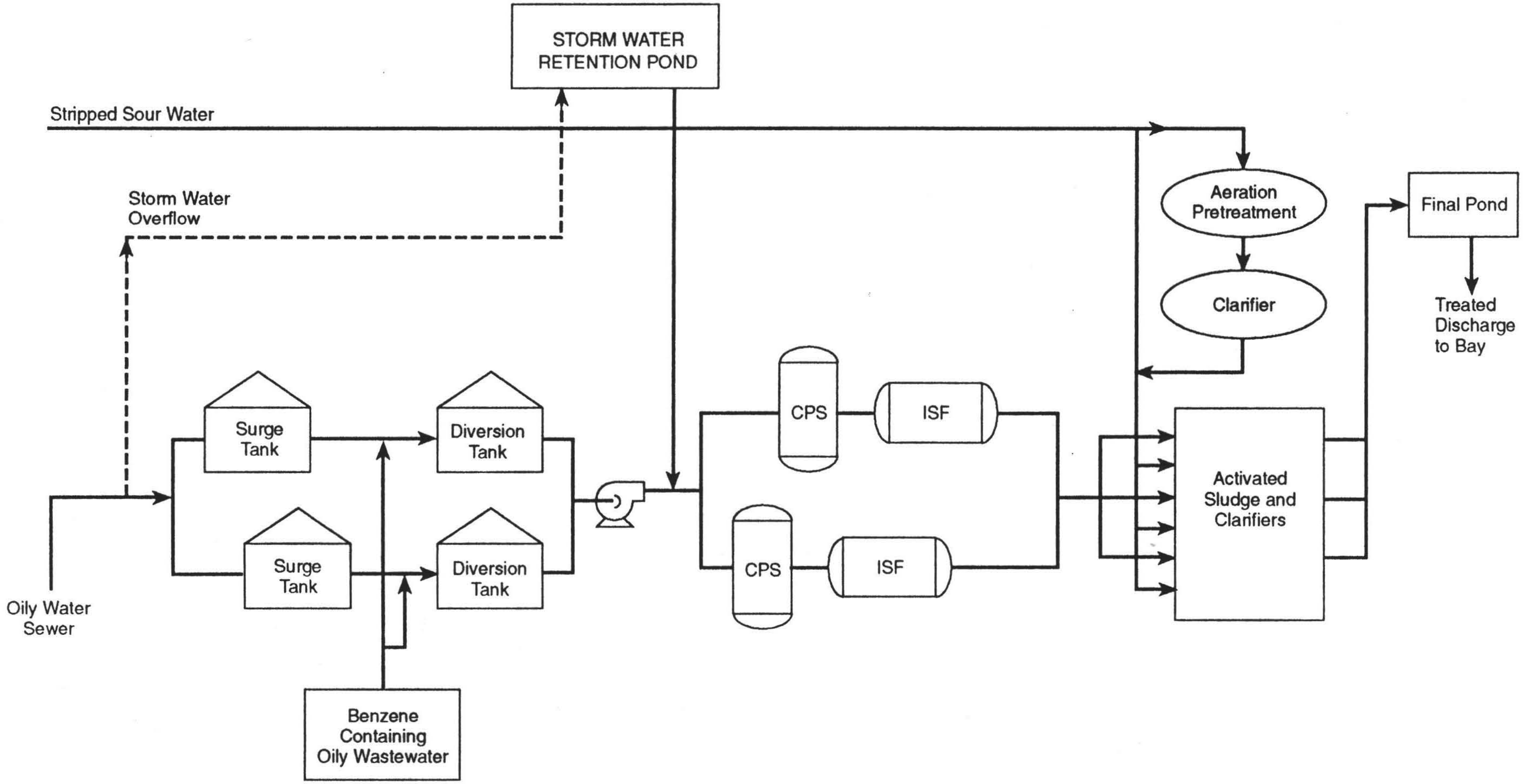
- All pressure relief devices will be piped to the refinery fuel gas system
- Low emission graphite packing will be installed on all valves except those in fresh water, wastewater, air or nitrogen use
- Double mechanical seals will be used on pumps and compressors and they will be inspected quarterly for fugitive emission
- Graphite or equivalent flange gaskets will be used

Other Emission Controls

The project includes the installation of new storage tanks. These tanks will be equipped with fixed roofs to minimize vapor losses. Vapors generated from petroleum liquids stored in the tanks will be collected by a vapor recovery system.

2.6.7 Wastewater Treatment

A schematic diagram of the Benicia Refinery wastewater treatment plant is provided in Figure 2-10. The plant receives three wastewater streams: oily water sewer, oily wastewater containing benzene, and stripped sour water. Effluent from the oily water sewer is discharged into one of two surge tanks in the treatment plant. During a storm, the first flush of runoff also discharges to the surge tanks before this water is diverted to the stormwater retention



Project No. 93C0336A	Exxon Clean Fuels Project	EXXON BENICIA REFINERY WASTEWATER TREATMENT FLOW DIAGRAM	Figure 2-10
Woodward-Clyde Consultants			

93C0336A-0600/082593

pond. Water from the retention pond enters the treatment plant just upstream of the corrugated plate separators. The oily wastewater stream containing benzene is discharged to diversion tanks in the treatment plant where it mixes with the effluent from the oily water sewer.

Wastewater is first passed through corrugated plate separators (CPS) in the treatment plant. These units provide gravity separation of oil and suspended solids from the wastewater. Oil and solids removed by the CPSs are returned to the refinery for processing and the wastewater flows to induced static flotation (ISF) units.

The ISF units are used to further remove oil and suspended solids contained in the effluent from the CPS units. An organic polymer is added to the wastewater upstream of the ISF units to coagulate oily solids which are then floated to the surface of the water by nitrogen entrained in a partial recycle stream. The floating material is skimmed from the surface and returned to the refinery for processing. The ISF effluent, which contains about 10 to 15 parts per million (ppm) oil and 20 to 30 ppm solids, is discharged to an activated sludge unit.

The activated sludge unit consists of three aeration cells and three clarifers operated in parallel. The aeration cells contain microorganisms that digest suspended and dissolved organic material in the wastewater. Wastewater from the aeration cells is discharged to the clarifers where the microorganisms settle to the bottom and clear water is discharged from the top to a holding pond before being discharged to Suisun Bay. The microorganisms collected in the clarifiers are recycled back to the aeration cells.

A portion of the stripped sour water from the refinery is routed to a chemical sewer pretreatment unit where aeration and microorganisms reduce the total organic carbon (TOC) in the water. Effluent from this unit is discharged to a clarifier where the pretreated water is separated from the microorganisms by gravity. The pretreated water is then discharged to the activated sludge unit and the biomass is dewatered and returned to the refinery for processing.

The project will generate additional wastewater which will be discharged to the refinery's existing wastewater treatment plant. Wastewater will be produced from the following Clean Fuels sources:

- Cooling water from miscellaneous pumps, analyzers and compressors, demin plant blowdown and stream condensate blowdown.

- Additional sour water from the proposed light catalytic naphtha hydrotreater unit, after being stripped in the existing sour water stripper.

- Condensate from the new compressor in the hydrogen plant.

Exxon estimates that the above wastewater streams collectively will add about 56 gallons per minute (gpm) to the existing refinery's discharge delivered to the wastewater treatment plant. This is about a 4 percent increase in the total refinery wastewater. This discharge includes 41 gpm that is oil-free and nitrogen-free utilities wastewater. The remaining 15 gpm is primarily oily condensate. The impact of adding this discharge to the wastewater treatment plant is addressed in Section 4.6.

2.6.8 Solid and Hazardous Waste Generation and Recycling

The project will result in the generation of additional solid wastes that will be recycled. Table 2-3 lists the proposed Clean Fuels facilities and the estimated volume of annual solid waste generation from each unit. The total estimated solid waste generation is 373,000 pounds, which would increase the total solid waste generation at the Benicia Refinery by about 0.4 percent. Most of the waste (95 percent) will be spent catalyst. Catalyst is used to enhance refining processes, and is routinely replaced when its effectiveness becomes reduced over time to a point where the efficiency of the process unit is affected. Spent catalyst is currently recycled by off-site vendors, through regeneration or reclamation, and is not disposed. Cleaning of the heat exchangers will produce about 20,000 pounds per year of sludge (5 percent of the total project solid waste). The sludge will be added to the current recycle stream to the refinery's coker unit where it will be refined into fuel and other products.

2.6.9 Raw Material Consumption and Product Yield

The project will change the rate of use of raw materials used for petroleum processing, and the refinery's product yield will also change. These changes are described in the subsections below.

TABLE 2-3

ESTIMATED SOLID WASTES GENERATED AND RECYCLED FROM OPERATION OF THE CLEAN FUELS PROJECT

Waste Stream	Annualized Amount (1000 lbs)
Heartcut Saturated Unit catalysts[a]	242
LCN Hydrofiner catalyst[a]	41
NOx Control SCR catalyst[a]	6
HCN Hydrofiner Catalyst[a]	64
Heat Exchanger Sludge (from cleaning)[b]	20
Total waste per year	373

[a] Catalysts are recycled by a vendor and are not disposed.
[b] Heat exchanger sludge is recycled to the coker unit for further refining.

Source: Exxon 1993b

Changes in Product Yield

Exxon does not propose to increase the total amount of gasoline produced by the Benicia Refinery. With the Clean Fuels project in operation, production of gasoline will slightly decrease, while production of diesel and jet fuel will slightly increase.

To meet the reformulated fuels requirement of reduced vapor pressure, additional pentanes and butanes must be removed from the gasoline. These refining products, typically referred to as light ends, can either be sold, consumed within the refinery as a fuel, and/or stored and seasonally blended with gasoline. Exxon estimates that the project will result in production of approximately 5,000 additional barrels per day of light ends. Exxon anticipates that there will be no increase in rail movements of butanes and pentanes. However, there is the potential that rail exports could increase as much as eight cars per day depending on operating yields.

Changes in Raw Material Use

Table 2-4 lists the changes in consumption of raw materials estimated by Exxon following implementation of the Clean Fuels project. As shown in Table 2-4, Exxon estimates that all of the required increases in raw materials can be met through once-per-year deliveries, with the exception of ammonia. Currently, the refinery receives about 180 truck deliveries of anhydrous ammonia per year. Exxon is proposing to change to aqueous ammonia, which is a safer form and presents less risks during transport and storage than anhydrous ammonia. Anhydrous ammonia is currently used at the pipestill's electrostatic precipitators for particulate matter emission control. With the proposed project, deliveries of anhydrous ammonia will be reduced to about 15 trucks per year (a reduction from the current 165 truck deliveries per year). The conversion of existing uses to aqueous ammonia will require about 60 trucks per year. The new uses of aqueous ammonia will require about 70 additional trucks per year, for a total of 130 trucks per year (60 existing plus 70 new trucks per year). Therefore, there will be a net decrease in the number of ammonia truck deliveries as well as conversion to a less hazardous material (Table 2-4).

TABLE 2-4

CHANGES IN RAW MATERIAL USE FROM OPERATION OF THE CLEAN FUELS PROJECT

Increased Chemical Use	Type	Quantity/Truck Delivery Frequency (1000 lbs)
Heartcut Sat. Unit Catalyst-1	Massive Nickel	154/once per year
Heartcut Sat. Unit Catalyst-2	Zinc Oxide/Alumina	88/once per year
LCN Hydrofiner	Nickel Molybdenum	41/once per year
HCN Hydrofiner	Nickel Molybdenum	64/once per year
Heat Transfer Oil	Dowtherm/Caloria HT	350/once per 4 years
Organic Amine/Salt	Flexsorb HP or equiv.	3,000 gallons/once per year
NO_x Control SCR Catalyst	Titanium/Vanadium	6/once per year
Ammonia for NO_x and PM Control	Aqueous Ammonia	6,500 gallons/2-3x per week (about 130 trucks per year)
	Total:	Approximately 100 to 150 additional truck deliveries

Decreased Chemical Use	Type	Quantity/Truck Delivery Frequency (1000 lbs)
Ammonia for PM control	Anhydrous Ammonia	Current deliveries: 1,000 gallons/165 trucks per year, 3x per week Proposed deliveries: 1,000 gallons/15 trucks per year
	Total:	Approximately 150 less truck deliveries

Source: Exxon 1993b

2.6.10 Safety Facilities

The Clean Fuels project could involve a risk of explosion or release of hazardous substances in the event of an accident or upset condition. Part of the design for the new facilities will be to prevent the occurrence and/or minimize the consequence of a catastrophic release of toxic, flammable, or explosive chemicals.

The project will use the existing flare system to minimize hydrocarbon emissions from the depressurization of process vessels within the refinery. Depressurization occurs during equipment maintenance and/or refinery upsets. During such events, vapor must be released from the affected unit. Safety relief valves are designed to release at pressures below that which would cause failure of the process equipment. These valves release the vapor through an enclosed pipe and into the flare gas compressor which recovers the vapor into the refinery fuel gas system for later use as fuel. If the quantity of vapor exceeds the capacity of the vapor recovery system, it is then routed to the flare for combustion at efficiencies that exceed 99 percent.

Fire fighting and safety equipment will be added to the refinery as part of the Clean Fuels project. Additions will include hydrants, hoses, safety showers, eyewash stations, detectors and monitors, and tank top-mounted deluge systems (Table 2-5). Detailed specifications for the proposed equipment and layouts will be developed by Exxon and will be subject to review by the Benicia Fire Department.

2.6.11 Project Construction

The following subsections describe the major steps involved in construction of the project.

<u>Site Preparation, Excavation, and Grading</u>

Construction of the project will involve site clearance activities and relocation of some existing facilities, earth moving and grading, transport of materials, fabrication and installation of new facilities, and modifications to existing refinery facilities. Most of the new Clean Fuels process equipment is planned for an area that is currently used for the storage of miscellaneous equipment and materials. No permanent facilities are located in this area,

TABLE 2-5

PLANNED FIRE FIGHTING SAFETY FACILITIES

Location
Process Unit, Main Block - New firewater loop pipe along center accessway - 16 new hydrant/monitors - 4 new hose reels - 4 new safety showers/eye wash stations - Hydrocarbon detectors/alarm on selected light hydrocarbon pumps to detect seal leaks
Tankage - Each tank equipped with top-mounted deluge system - 5 new hydrant/monitors

and therefore no demolition is required, although existing pavement and topsoil will be removed and replaced with granular fill. Exxon proposes to move these materials and equipment to other general storage areas within the refinery, and/or remove the equipment from the refinery and assign it to outside vendors for storage. Site preparation activities will result in the relocation or removal of approximately 12,500 cubic yards of soil and debris. Soils removed during excavation will be tested and disposed of in accordance with applicable federal and state regulations.

Excavation of the foundations for the new process equipment will require the removal of approximately 15,000 cubic yards of soil. These soils will also be tested and handled in accordance with applicable regulations. Equipment and structures will be supported on concrete foundations. The concrete will be mixed at local bulk plants and delivered to the construction site in trucks.

Table 2-6 lists the anticipated daily truck trips required to remove materials from the site and import construction material and equipment.

Construction and Installation of Structures

The proposed large storage tanks will be constructed on concrete foundations that will include spill and leak containment and detection systems. The tanks will be fabricated on site using floor, vertical and roof steel plates that are welded together.

Steel structures, used to hold the process units, piping, and other facilities will be assembled on-site using structural members that are prefabricated by off-site vendors and delivered to the refinery.

Many of the process units and vessels will be fabricated at vendor's shops and delivered to the refinery for installation. This includes heat exchangers and vessels less than 12.5 feet in diameter. The hot oil heater will be delivered to the refinery preassembled to the extent feasible and installed on foundations. Vessels larger than 12.5 feet in diameter are planned to be constructed on the site either in place on their foundations or in a temporary fabrication shop. Some equipment, such as piping, instruments, and conduit, will also be assembled in sections prior to delivery to the refinery.

TABLE 2-6

ANTICIPATED MAJOR MATERIAL DELIVERIES AND REMOVALS FOR CONSTRUCTION

Activity	Schedule	Approximate Length of Time	Average No. of Trucks Per Day
• Site Preparation: Excess soil/debris removal	1st Quarter 1994	3 months	15-20
• Site Preparation: Import of fill/paving materials	1st Quarter 1994 to 2nd Quarter 1994	6 months	10-15
• Civil Construction: Removal of excess soil	2nd Quarter 1994 to 1st Quarter 1995	12 years	2-5
• Major Materials Deliveries: Concrete, pipe, steel, equipment, etc.	2nd Quarter 1994 to 2nd Quarter 1995	15 months	5-10

Source: Exxon 1993a

Other Construction Activities

New refinery roads will be paved with asphalt. The process block area will be paved with concrete. The proposed storage/fabrication area next to the Gate 5 parking lot will be paved with gravel or asphalt (Figure 2-2).

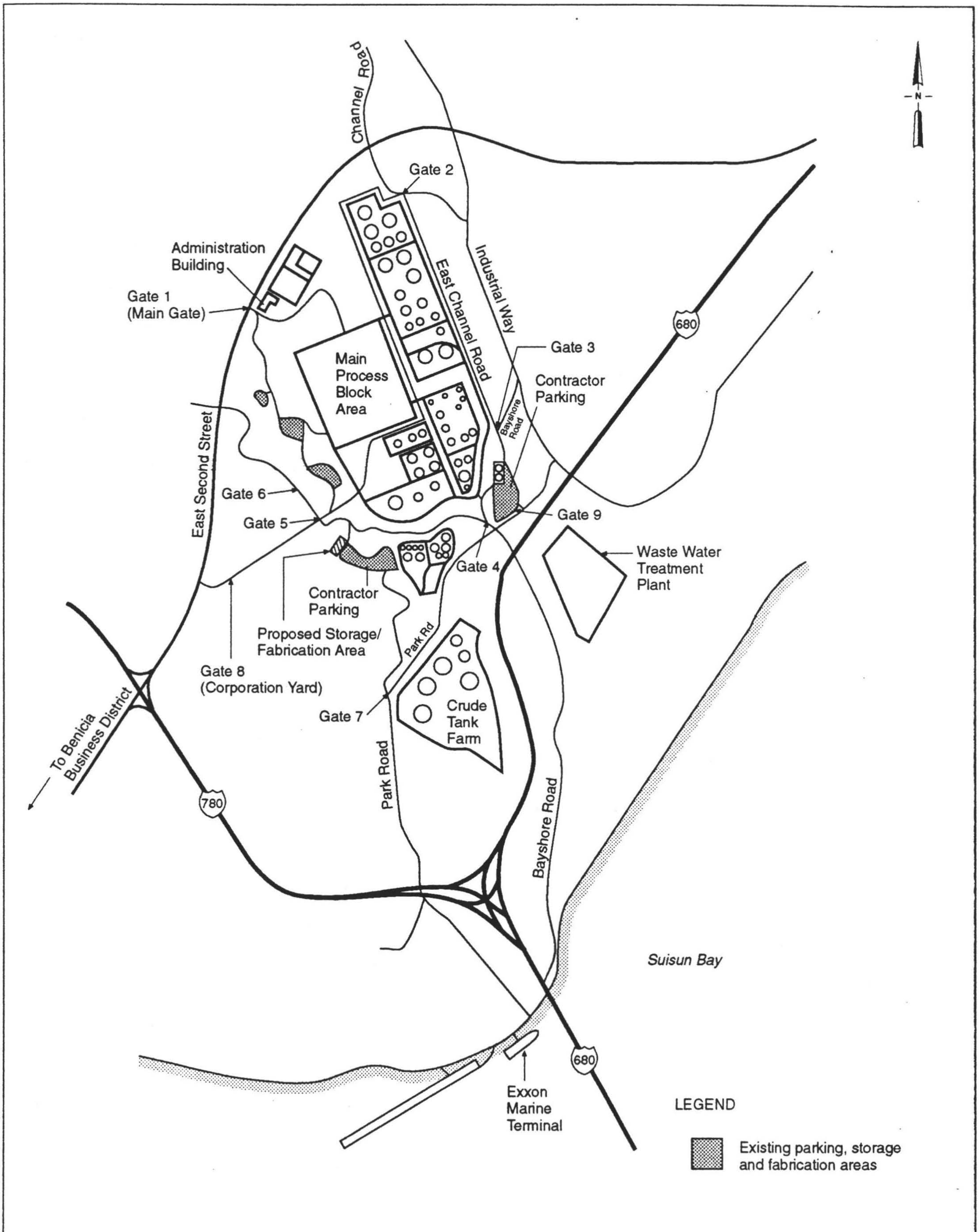
All new facilities installed at the refinery will be painted using the existing refinery colors of "Benicia Gold and California Green."

Construction of the project may necessitate that Exxon rent warehouse or paved storage space within the Benicia industrial park for temporary materials storage. This site would be used from early 1994 to early 1996 for the staging of equipment such as piping, valves, and fittings, but would not involve storage of hazardous materials. The temporary materials storage site is expected to be along Industrial Way, or a similar site within the Industrial Park that provides about 3 acres of storage area. The storage site will be temporarily fenced. Approximately 5 workers will be involved in loading, unloading, and security, and about 10 to 20 trucks per day will use this site during the construction period.

Lighting will be installed on new equipment and structures similar to the existing lighting at the refinery. Exterior lighting will be reflective and hooded to shine downward. Temporary construction lighting is expected only on an intermittent basis when specific work will require a two shift schedule.

Construction Access and Parking

Figure 2-11 shows the locations of refinery access gates and parking. There are a number of existing access gates to the refinery, and it is anticipated that material deliveries and removal of soils and other materials will be through Gate No. 4 from Bayshore Road. Construction workers are expected to drive into the refinery through Gate 8 (off East Second Street) and Gate 9 (off Park Road). The workers will park at two existing parking lots in the refinery, and shuttle buses will pick up and deliver the workers to their job sites.



Project No. 93C0336A	Exxon Clean Fuels Project	EXXON BENICIA REFINERY	Figure 2-11
Woodward-Clyde Consultants			

93C0336A-0600/082593

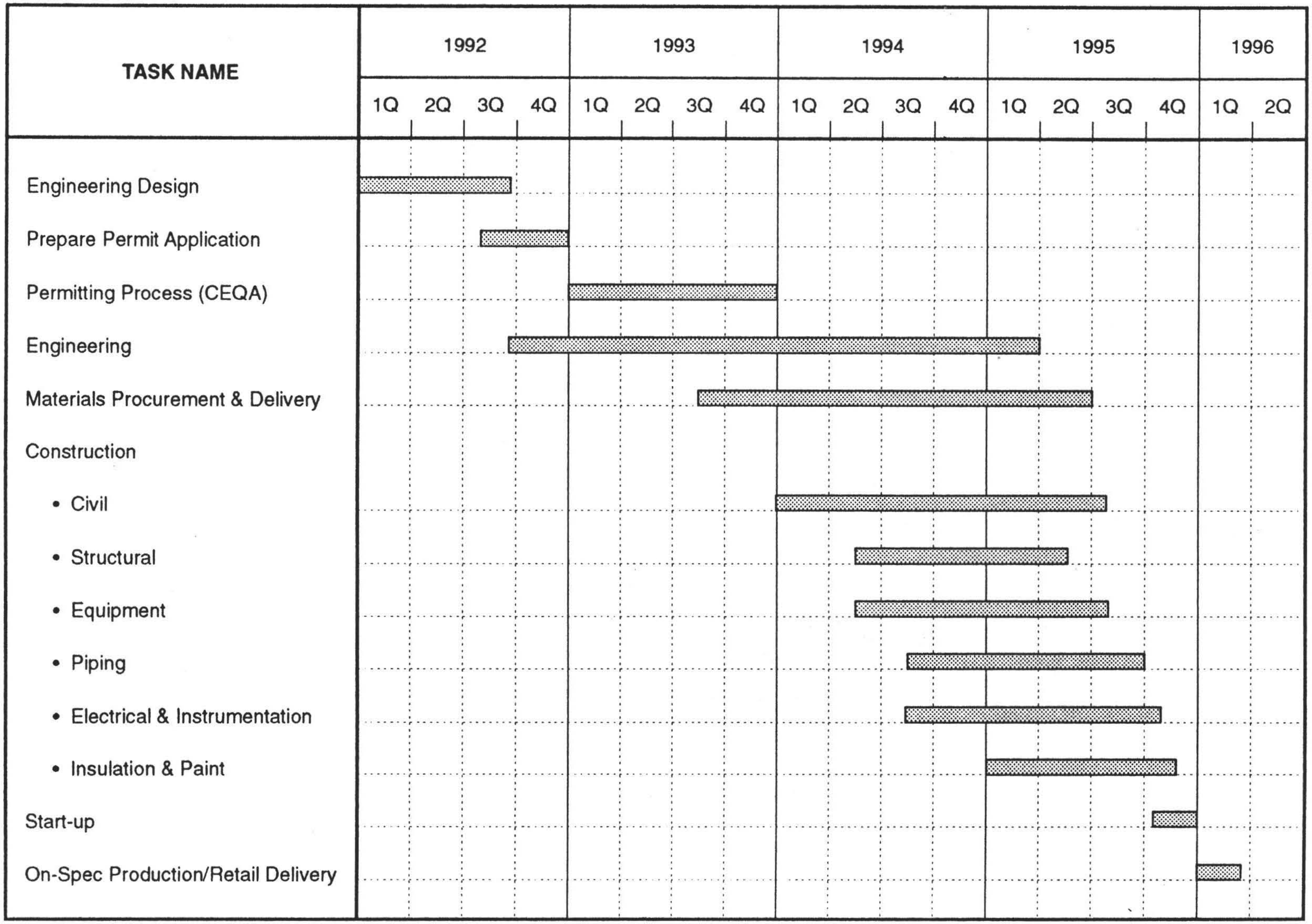
2.6.12 Project Schedule, Workforce, and Construction Hours

Exxon's proposed project schedule is shown on Figure 2-12. Depending on receipt of required project permits and approvals, Exxon plans to start construction at the beginning of 1994. Construction will last about 2 years, and will be completed by the first quarter of 1996. Exxon plans to begin manufacturing reformulated fuels at the Benicia Refinery in early 1996.

Project construction will require a substantial number of temporary construction workers from 1994 through 1995. Exxon estimates that the construction workforce will average about 300 to 500 workers with intermittent peaks of about 900 people. Figure 2-13 shows the estimated distribution of the workforce over the 2-year construction period.

Exxon anticipates that the construction work will take place between the hours of 7 a.m. and 6 p.m. An eight-hour workday with spot overtime effort is planned for the majority of the construction period. The new facilities will require "tie-in" to the existing refinery processes, and modifications are proposed to existing facilities which cannot be accomplished during routine operations and will require temporary refinery shutdowns. During temporary shutdowns, construction work will be scheduled for two 10-hour shifts, six to seven days per week. Exxon estimates that less than 10 percent of the total construction effort will be conducted during shutdown periods.

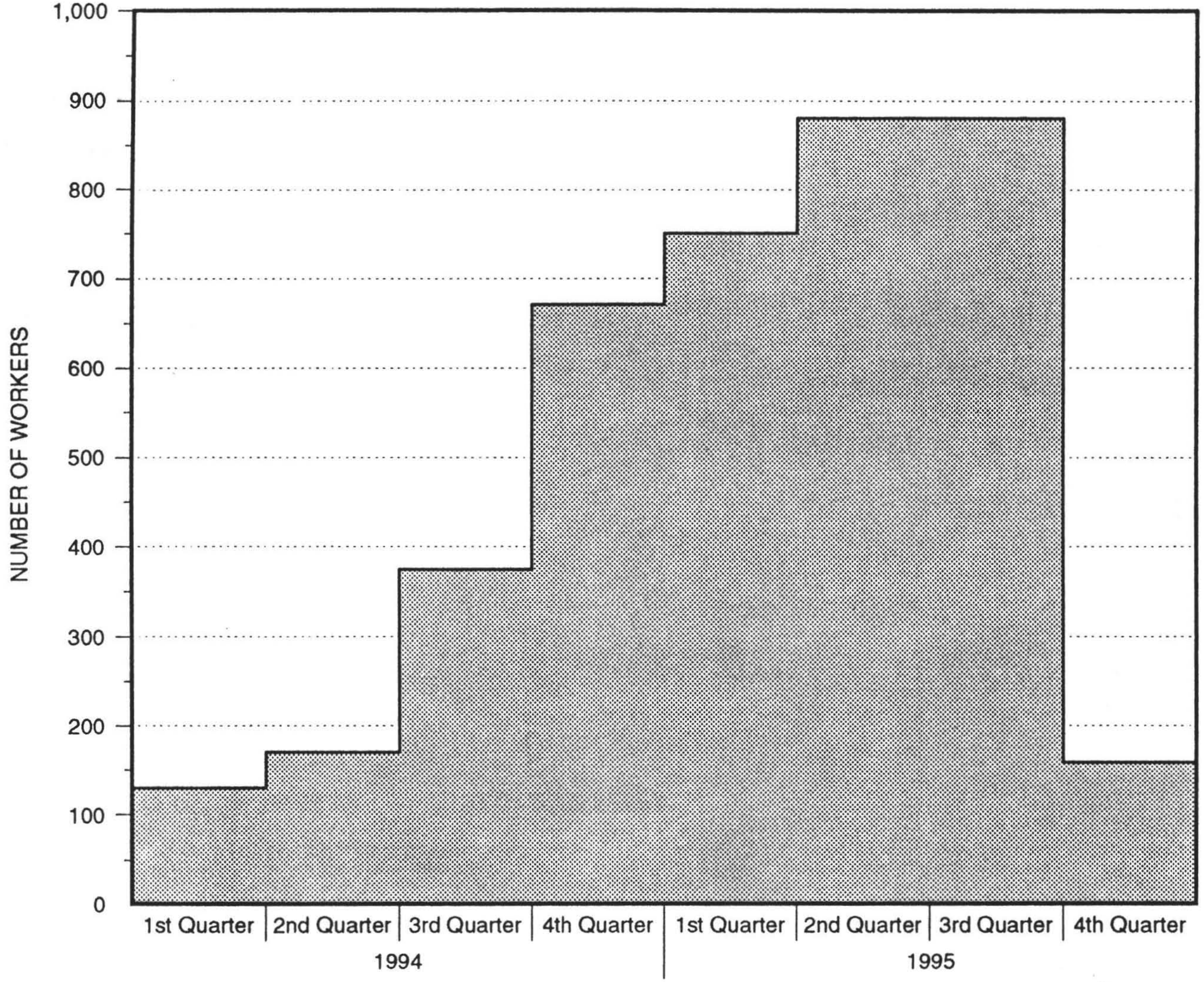
Project operation beginning in 1996 will require an additional 15 to 30 new permanent employees at the refinery. The refinery currently employs 382 full- and part-time workers. In addition, contractors are employed on an as-needed basis.



Source: Exxon 1993b

Project No. 93C0336A	Exxon Clean Fuels Project	ANTICIPATED PROJECT SCHEDULE	Figure 2-12
Woodward-Clyde Consultants			

93C0336A-0600/082593



Source: Exxon 1993a

Project No. 93C0336A	Exxon Clean Fuels Project	DISTRIBUTION OF CONSTRUCTION WORKFORCE OVER TIME	Figure 2-13
Woodward-Clyde Consultants			

93C0336A-0600/082593

3.0
OTHER RELATED AND CUMULATIVE PROJECTS

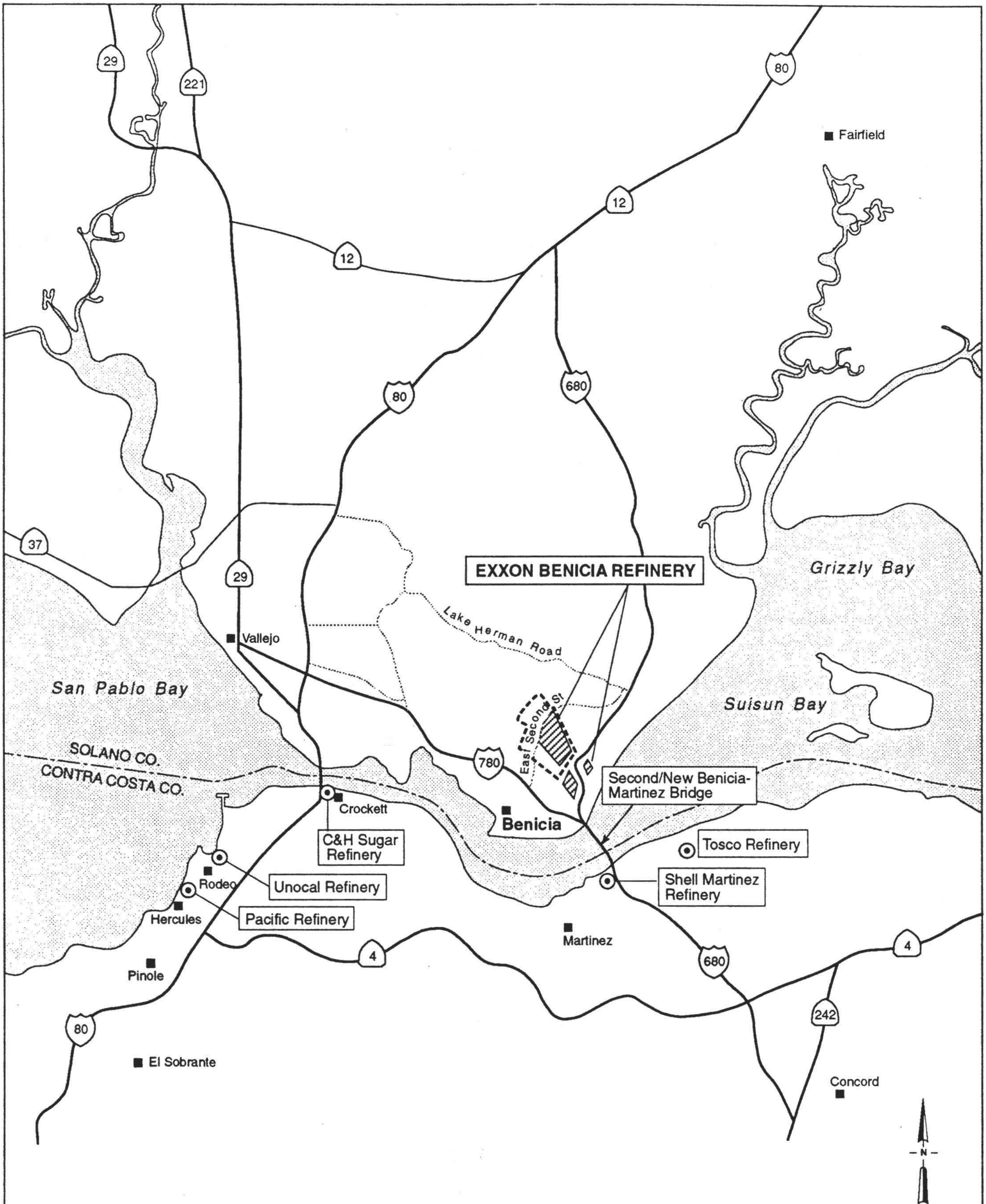
This section describes other projects that are planned or proposed at the Exxon Benicia Refinery, and within the regional area (Figure 3-1). These other projects are independent of Exxon's Clean Fuels project, but are important to this EIR due to the potential for cumulative impacts. The California Environmental Quality Act requires that cumulative impacts be addressed in an EIR by identifying whether there is the potential for impacts due to the proposed project that may not be significant by themselves but could be significant in association with other past, present, and future projects. The effects of past and present projects were taken into account in this EIR in the development of the environmental setting discussed by topic in Section 4.0. Other future related and cumulative projects or actions that could reasonably be expected to occur or coincide with the Exxon Clean Fuels project are identified in the subsections below. The potential for cumulative impacts of these future projects in association with the impacts identified for the Clean Fuels project is discussed and evaluated as appropriate for each environmental topic in Section 4.0.

3.1 OTHER PROJECTS AT THE EXXON BENICIA REFINERY

Exxon has a number of on-going and planned projects at the Benicia Refinery. The on-site projects described below are related to process equipment additions needed by Exxon to respond to the initial phases of the reformulated fuels requirements, other environmental regulatory requirements, the need for on-site staging and equipment areas, and on-going refinery maintenance needs.

3.1.1 Exxon MTBE Import Facilities

Methyl tertiary butyl ether (MTBE) is a blending additive that increases the oxygen content of gasoline. Regulations implementing both the Federal and State Clean Air Acts specify minimum oxygen content of gasoline for the purpose of reducing carbon monoxide emissions from motor vehicles (see Section 2.5). Exxon has been meeting the current requirements by importing MTBE to the Benicia Refinery and blending it with their manufactured gasolines during the winter months. In 1992, Exxon constructed a new 350,000-barrel storage tank at



Project No. 93C0336A	Exxon Clean Fuels Project	LOCATION OF OTHER RELATED AND CUMULATIVE PROJECTS	Figure 3-1
Woodward-Clyde Consultants			

93C0336A-0600/083093

the existing tank farm, and added a dock line to bring imported MTBE to the storage tank from their marine terminal. MTBE imports, in combination with MTBE production on site, will enable Exxon to meet the year-round oxygenation requirements as they are phased in.

3.1.2 Exxon MTBE Unit

Exxon has received Use Permit approval from the City of Benicia to add an MTBE production unit to the refinery. The process equipment for the MTBE unit will be added to the refinery's process block area east of and adjacent to the area where the main Clean Fuels process facilities will be constructed. The project includes a process unit, piping, pumps, methanol storage tank, and truck unloading area. The unit would produce up to 4,500 barrels per day of MTBE. An Initial Study/Negative Declaration was approved for this project in early 1993 (City of Benicia 1993). The MTBE unit is planned for construction over a 12-month period in 1993 and 1994. Completion of construction of the MTBE plant is expected to overlap with the first half of 1994 with the start of construction of the proposed Clean Fuels project.

3.1.3 Exxon Nitrogen Oxide Emissions Reduction Projects

Pursuant to new rules currently under development by BAAQMD, emissions of nitrogen oxides must be reduced for existing equipment and process units. In response, Exxon is planning to retrofit process heaters, boilers, and gas turbines at the Benicia Refinery. It is anticipated that the Bay Area Air Quality Management District (BAAQMD) will require the emissions reduction controls to be in place by the end of 1996 for gas turbines and by mid-1997 for heaters and boilers.

3.1.4 Other Projects at the Benicia Refinery

Other projects that are planned at the refinery include the construction of five storage and fabrication areas, and on-going and periodic refinery maintenance activities. Exxon plans to submit an application to the City of Benicia for a Use Permit to construct the five storage and fabrication areas. These areas are needed by Exxon for the storage of equipment and materials, and fabrication of equipment for the MTBE project and other refinery construction, maintenance, and turnaround activities. The storage and fabrication areas will all be located within the refinery complex. This construction is anticipated to be completed by the end of 1993.

All refineries require periodic major maintenance to clean and maintain the equipment and facilities. These major maintenance overhauls, referred to as refinery "turnarounds," are intended to prevent operational problems and breakdowns, and generally to maintain the quality and operational lifespan of a refinery's considerable investment in process facilities and equipment. A turnaround at the Benicia Refinery will involve up to 1,500 temporary maintenance workers for a period of about 1 to 2 months during the first half of 1994. The construction plans for the Clean Fuels project call for minimum staffing during the turnaround period.

3.2 RELATED PROJECTS WITHIN THE CITY OF BENICIA

Within the City of Benicia, future residential development would occur primarily in the Southhampton development, or as infill. The final buildout of Southhampton includes 800 dwelling units, which are being constructed at a rate of 200-300 units a year. Complete buildout is expected within the next 3 or 4 years. Future industrial development would occur within the Benicia Industrial Park, within industrial areas along I-680, and the (now vacant) Seeno property. These projects are included in the amount of development anticipated to be built out in the General Plan.

3.3 OTHER PROJECTS IN THE REGIONAL AREA

A number of related projects are proposed in the regional area. Many of these projects are modifications to Bay Area refineries in response to the reformulated fuels requirements and are similar to the Exxon Clean Fuels project, but vary in terms of the type of equipment that must be added, and the overall magnitude of each project. However, all of the reformulated fuels projects must meet the same regulatory deadlines, and therefore the schedules for construction and on-line operation may be similar. The status of each of the major Bay Area petrochemical refinery projects is discussed below, as well as other major projects that have been proposed, planned, approved, or are otherwise reasonably anticipated to occur within the regional vicinity of Benicia.

3.3.1 Shell Refinery - Martinez

The Shell Oil Company has proposed a major modification of their facilities at the Martin Manufacturing Complex to meet the reformulated fuels requirements as well as upgrade th capability to process high sulfur, heavy fuels into more valuable petroleum products. T modifications would take place on approximately 80 acres of the 881-acre complex, and adjacent County maintenance yard. Shell's proposed new process facilities include:

- C_5/C_6 Isomerization unit, including a decyclohexanizer
- Light cracked gasoline treater
- Alkylation unit
- Butane isomerization unit, that includes a catalytic reformate bottoming colun and a cracked gasoline bottoming column
- Gasoline hydrotreaters
- Distillate saturation unit
- Hydrogen plant
- Delayed coker with coker gasoline splitter column
- Coke barn
- Lube hydrotreater

In addition, a number of utilities, ancillary facilities, and other support equipment a proposed:

- Sulfur recovery unit and sour water system
- Cogeneration facility
- Cooling water tower
- Boiler feedwater treater
- Oil/water separators
- Flare system
- Tankage
- Pentane loading rack and rail extension
- Pipelines
- Sewer systems
- Reclaimed water systems

- Installation of support equipment including a new cooling tower, a new flare, new storage tanks, and three new hydrocarbon storage spheres.

The project is scheduled for construction beginning January 1994 through April 1996.

3.3.4 Unocal Refinery - Rodeo

To reduce aromatics and benzene in gasoline stocks, Unocal plans to install a splitter t in the reformer unit and a de-isopentanizer in the isomerization unit at the Rodeo refi Hydrogen production would be increased by adding pressure swing adsorption equipme the hydrogen plant. Refinery logistics would be improved by the addition of anothe loading rack, consolidation of gasoline blending units, and installation of eight new stc tanks.

Unocal proposed to modify and add to its refinery facilities to meet the reformulated requirements, and has recently submitted an application to Contra Costa County for a Permit. The project is proposed to be operational by 1996.

3.3.5 TOSCO Avon Refinery - Martinez

TOSCO is currently constructing an MTBE unit at its Avon refinery in Martinez. company also plans to add the following process units:

- Isomerization units (one for pentane-hexane and one for butane)
- FCC
- Hydrogenation plant
- TAME unit
- Naphtha hydrosulfurization unit

TOSCO proposes to construct new facilities and modify existing facilities to mee reformulated fuels requirement. It has filed an Air Permit application with the BAAQ and has filed a Land Use Permit application with Contra Costa County. Existing prc units would be modified to improve the production of reformulated fuels including addition of fractionation columns, expansion of existing hydrosulfurization units, expar of the hydrogen plant, expansion of the flare system, and reconfiguration of the existing FCC riser. The project is proposed to be operational by 1996. Refinery logistics would be improved through the addition of storage tanks, upgrading of blending and shipping facilities, and expansion of the marine vapor recovery system.

3.3.6 C & H Sugar Cogeneration Project - Crockett

Crockett Cogeneration has proposed to construct and operate a 240 megawatt (MW) net capacity cogeneration power plant at the C & H Sugar refinery in Crockett. The project would provide electricity to PG&E and steam to operate the sugar refinery. It would affect about 2.6 acres at the sugar refinery, and includes a gas turbine generator (159 MW), heat recovery steam generator, a steam turbine (80 MW), a single-shaft electric generator, condenser, back-up boilers, nitrogen oxide emission control equipment, water treatment equipment, switchyard, a 230-foot high stack, and other facilities. Project construction is anticipated over the period 1993 to 1995, for a planned delivery of electricity to the PG&E system by January 1996.

3.3.7 Benicia-Martinez New I-680 Bridge

Caltrans proposes to construct a new bridge across the Carquinez Strait parallel to and easterly of the existing Benicia-Martinez I-680 and Southern Pacific Railroad bridges. The bridge would provide four new traffic lanes to I-680. Northbound I-680 traffic would use the new bridge, and the existing bridge would be restriped for southbound traffic. The new bridge would have 10-foot shoulders, while the restriped existing bridge would have four travel lanes and a two-lane (two-way) bike/pedestrian facility separated from automobile traffic by a barrier. Structural bridge components necessary to accommodate future mass transit on the bridge would be provided. The project also includes a new 17 booth toll plaza between the existing I-680 Marina Vista interchange and the south end of the bridge. The south approach to the bridge and the I-680/I-780 interchange would be realigned to accommodate movements to and between the two bridges. The environmental review for the project is currently underway, and a supplemental Draft Environmental Impact Statement/ Report is expected in the fall of 1993. If approved, construction is anticipated to begin in late 1995. The project would be built in two phases: bridge construction would occur in the

1995 to 2005 timeframe, while associated freeway and interchange improvements would be built in the 2005 to 2015 period.

4.0

ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION

4.1 INTRODUCTION

Sixteen environmental, human health and safety, and cultural/social topics are evaluated in this EIR in the subsections that follow. The existing and future setting, the potential for the project to impact the resources, and recommended mitigation measures that could reduce or avoid potential impacts are described for each of these topics.

The environmental setting sections describe the existing environment as well as conditions in the future, where appropriate, when the project would be constructed and operated. The extent of the environmental setting area evaluated (the study area) differs between resources depending on the locations where impacts would be expected. The setting section, as well as the description of impacts, therefore, describes both local resources (at or near the Benicia Refinery and City of Benicia) and the regional area, which encompasses a broader geographic area and allows evaluation of regional and cumulative impacts.

The impact and mitigation sections identify specific impacts (or lack thereof) and related mitigation measures. The sections start with a definition of significance criteria, which are designed as threshold levels that indicate when a significant impact might occur. CEQA includes descriptions of impacts that are typically defined as significant, and these criteria were applied as appropriate to determine significance in this EIR. In some cases, established standards are used, such as for air and water quality where laws, regulations, or other standards have been defined that are appropriate significance thresholds. In other cases, more qualitative criteria are used as general indicators of significance based on professional judgment and generally accepted guidelines, such as for visual resources or socioeconomics.

Each potential impact is either clearly identified in the text in a short, highlighted statement that summarizes what potential impact may occur, or is avoided. The summary statement specifies whether the impact is "significant," "potentially significant," "not significant," or "would not occur" (would be avoided altogether). Beneficial impacts are also noted. The impact findings are followed by text describing the reasons for the determination.

Following the discussion of each impact and its significance, the need for mitigation is described and, if applicable, recommended mitigation measures are defined. Where an impact is not significant, mitigation is not required, although in some cases measures may be defined to ensure that a significant impact does not occur or that applicant- (Exxon) defined measures included in the Use Permit application are carried out as part of the project. Where impacts are identified as potentially significant or significant, mitigation measures are discussed and described in terms of their predicted effectiveness in reducing the impact to a level of nonsignificance.

Cumulative impacts are also evaluated in this EIR. Each resource topic includes a subsection at the end of the impacts and mitigation describing the potential for cumulative impacts. The evaluation focuses on the potential for past, present, and future plans and projects that might not cause a significant impact individually, but could when considered collectively. For many of the resources evaluated, there is no or little potential for cumulative impacts to occur because of the lack of possibility of overlapping impacts from the various cumulative and related projects (e.g., geologic resources). Where impacts are more regional in nature, or local impacts from other projects may overlap, cumulative impacts are evaluated in more detail (e.g., air quality). The cumulative and related projects evaluated were identified and described in Section 3.0.

Data and analysis for the project were provided by Exxon for several subjects, primarily air quality, public health risk, public safety, and noise. All studies and data provided by Exxon were independently reviewed and checked by the City's consultants who prepared this EIR. The sources of information for each of the studies are cited in the text, and references are listed in Section 6.0.

4.2 LAND USE

4.2.1 Environmental Setting

This section describes the land use setting for the project. The refinery is located entirely within the limits of the City of Benicia, and the Clean Fuels project modifications would be located entirely with the existing Benicia Refinery property boundary.

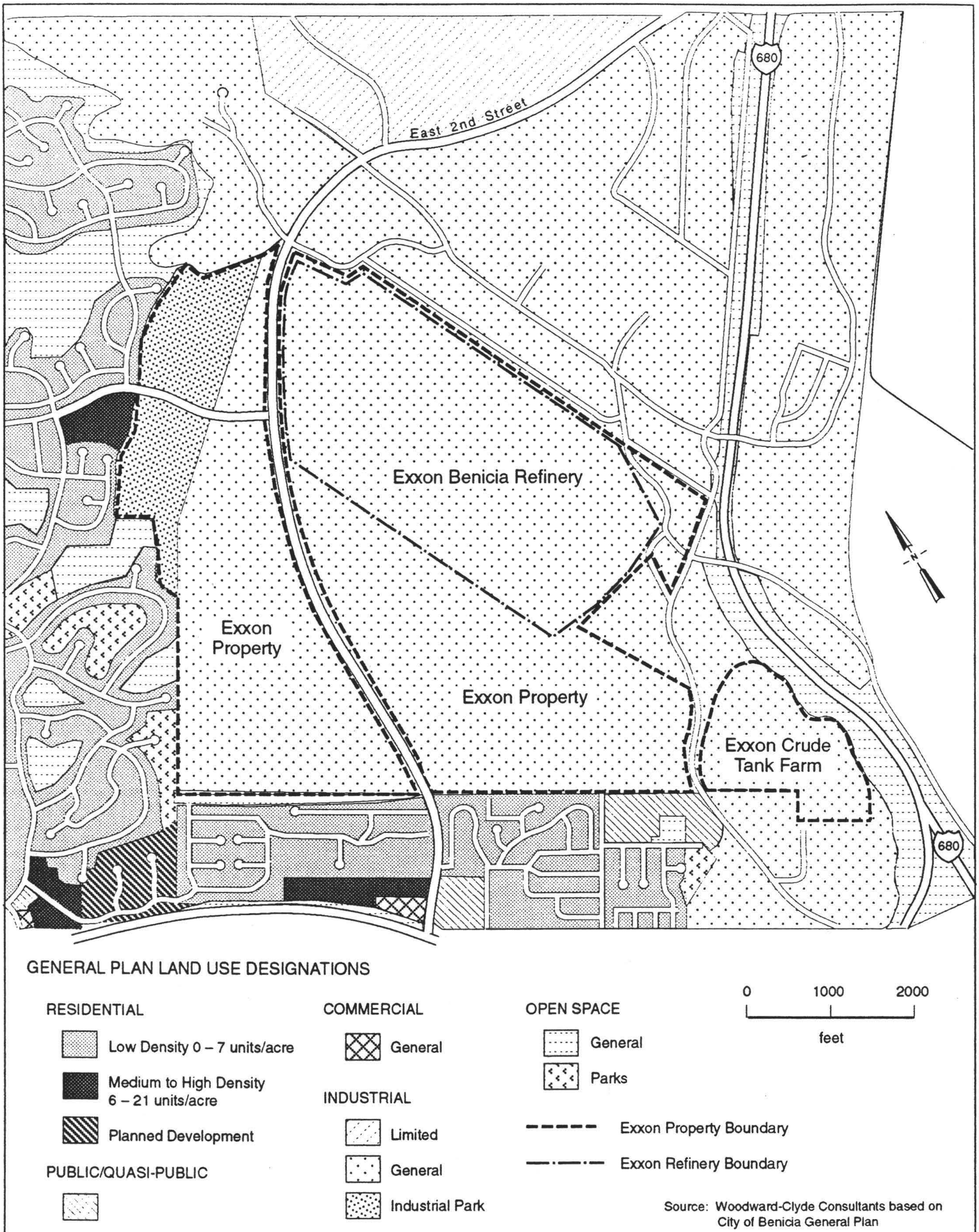
Regional Setting

The City of Benicia is the southernmost city in Solano County. Benicia is situated on the north side of the Carquinez Strait, east of San Pablo Bay and west of Suisun Bay. It is at the junction of Interstates 680 and 780. It is characterized by waterfront and residential development in the southern half; industrial uses to the northeast; and rolling hills, low density residential, and open space to the northwest. According to the City's General Plan, the "Major Industrial Planning" Area to the northeast is contained by the hills below Lake Herman Road on the north, the slopes above East Second Street to the west, the main ridgeline to the south, and Suisun Bay on the east" (City of Benicia 1979a). The Benicia Refinery is located in the Major Industrial Planning Area.

Existing Land Use Patterns

The Benicia Refinery began operations in 1969 on a 330-acre site within approximately 800 acres of land owned by Exxon. It is located on East Second Street, approximately 1.5 miles northeast of the downtown business area (Figure 2-1). The refinery is an intensive industrial complex within the hills above the Carquinez Strait and Suisun Bay. The refinery is laid out with process equipment located in a 45-acre process block area (Figure 2-2). The process block is flanked on the south and east by tank farms (Figure 2-10). The wastewater treatment plant for the refinery is separated from the main refinery area by I-680 (Figure 2-1).

Land uses in the vicinity of the Benicia Refinery are depicted on Figure 4.2-1. These uses are characterized by general industrial and low density residential development, with small areas of medium to high density residential, public/quasi public, limited industrial, and park land.



Project No. 93C0336A	Exxon Clean Fuels Project	GENERAL PLAN LAND USE DESIGNATIONS	Figure 4.2-1
Woodward-Clyde Consultants			

93C0336A-0600/083193

In general, the refinery complex is immediately bordered by 470 acres of mostly undeveloped Exxon property to the south and west, and general industrial uses to the north and east. The refinery and adjacent medium to heavy industrial uses comprise Benicia's industrial park, which is well removed from central Benicia. The industrial park area is generally enclosed within the area bordered by East Second Street, I-680, and I-780.

Exxon's undeveloped property extends to the west of East Second Street, and provides a buffer area between the refinery complex and residential uses located in the hills to the south and west of the refinery. The nearest residences are approximately one-half mile southwest from the boundary of the refinery on East Second Street. Several small park areas are located within the residential development.

Applicable Plans and Policies

A number of local planning documents were reviewed to determine whether or not the proposed Clean Fuels project would result in a conflict with existing land use plans, policies, and ordinances. The plans reviewed include the City of Benicia General Plan, the City of Benicia Zoning Ordinance, the Solano County General Plan, and the Suisun Marsh Local Protection Program. Plans, policies, and ordinances pertinent to the proposed project are presented below. An analysis of the project's consistency with these plans, policies, and ordinances is presented in Section 4.2.2.

City of Benicia General Plan. In general, the City of Benicia's land use policies support the location of industrial enterprises in the area designated for general industrial land uses. This is the predominant land use at and immediately surrounding the Benicia Refinery (Figure 4.2-1). The General Plan proposes to "emphasize the importance of industry for community income and employment. Special attention is given to the edges between industrial development areas and other land uses in the community. A buffer between industry and residential uses is shown west of East Second Street and north of the Highlands subdivision" (p. I-17). Several General Plan policies underscore the City's intent to provide buffer zones between divergent land uses such as residential and industrial or commercial areas. Specifically, land use policies call for the separation of residential areas from land uses which generate heavy traffic on residential streets or create noise, vibration, electrical disturbance, dust, or smoke. The following specific policies are pertinent to the proposed Clean Fuels project. It is the policy of the City of Benicia:

- To buffer housing from normally incompatible industrial land uses with appropriate intermediate land uses, by use of topography, or by use of landscaping.
- To continue the separation of truck traffic serving the industrial park from automobile routes within the City.
- To improve the visual acceptability of the industrial district with landscaping and to retain structurally sound historic buildings (City of Benicia 1979).

With respect to noise, the General Plan states two policies related to industrial land uses:

- Buffers identified in the Land Use Element should be used to separate divergent land use types.
- Land Use decisions should be based on the Noise Compatibility chart and acoustic reports required for all proposed developments in locations where noise levels exceed the "normally acceptable" range for the specified land use type (City of Benicia 1979a).

The General Plan specifically states that "the most appropriate locations for general industrial uses are in the big basin north of the Pine Lake area to East Second Street at Lake Herman Road. Relatively large, flat sites exist or can be prepared in this area. Separate truck and rail access is available. In addition, slopes are generally gradual enough to permit easy truck access (up to about 15% slope) and rail extensions (up to about 6% slope)" (City of Benicia 1979a).

City of Benicia Zoning Ordinance. The Benicia Refinery is located in an area zoned as IG--General Industrial District. According to City policies, the IG--General Industrial District is intended to provide sites for the full range of manufacturing, industrial processing, general service, and distribution uses deemed suitable for location in Benicia. The City of Benicia's Zoning Ordinance, amended by resolution by the Benicia City Council in January 1993, was reviewed with respect to regulations related to the General Industrial (I-G) District and specific regulations related to Use Permits. The following code sections are applicable to the proposed Clean Fuels project:

- Section 17.32.020. General industrial uses are permitted by right except that a use permit is required for oil and gas refining.

- Section 17.98.070. Alteration or expansion of a preexisting use for which a use permit is required. No preexisting use, established prior to the enactment of a use permit requirement under this ordinance, shall be altered or expanded without first obtaining a use permit for the alteration or expansion. Expansion shall be interpreted as enlargement or extension of the use so as to occupy any part of the structure or site, or another structure or site, which it did not occupy on the effective date of the use permit requirement. Alteration shall be defined as:

    1) a change the cost of which equals or exceeds $20 million or equals or exceeds 25 percent of current assessed valuation of the existing facility or structure, whichever is less; or

    2) a change which substantially alters the character or operation of the existing use including, but not limited to, hours of operation or scope of activities or services.

Alteration does not include any project that consists only of maintenance or repair of an existing facility or structure.

- Section 17.70.260. Hazardous Materials. A use permit shall be required for any new commercial, industrial, or institutional use, accessory use, or major addition or alteration to an existing use that involves the manufacture, storage, handling, transport, or processing of hazardous substances in sufficient quantities that would require permits as hazardous chemicals under the Uniform Fire Code adopted by the city.

<u>**Suisun Marsh Local Protection Program**</u>. The proposed Clean Fuels project is located outside the Marsh Protection Area identified in the Suisun Marsh Local Protection Program; therefore, the Program is not directly applicable to the Clean Fuels project. Nevertheless, the proposed project is consistent with the Program in that the proposed industrial development would occur entirely within the existing boundaries of the Benicia Refinery and would, therefore, be located and developed in a manner which protects marshland, wetland habitat, and the water quality of the area.

<u>**Mitigation Measure No. 1**</u>

No mitigation is required.

<u>**Impact No. 2**</u> **The proposed project would not affect existing and future land uses. No impact would occur.**

The proposed Clean Fuels project would not result in any adverse or significant impacts with respect to land use. As discussed above, the proposed project does not conflict with any of the plans, policies, or ordinances set forth in the City of Benicia, Solano County, or by the Suisun Marsh Local Protection Program. Since operations at the Benicia Refinery currently involve oil and gasoline refining, and since the project would be a modification to these operations located entirely within the existing refinery, the project would not disrupt or divide the physical arrangement of an established community.

Land use designations, zoning, and actual land uses in the area within an approximately one-half mile radius of the Benicia Refinery involve industrial manufacturing and similar activities. There are no recreational, educational, religious, or scientific uses of the area in the vicinity of the Benicia Refinery. Therefore, the Clean Fuels project would not result in a conflict with these types of sensitive land uses. The proposed project would not convert prime agricultural land to nonagricultural use, or impair agricultural productivity of prime agricultural land. Finally, the proposed Clean Fuels project would not result in a substantial alteration of the present or planned land uses of the area.

4.2.3 Cumulative Impacts and Mitigation

None of the planned or potential projects described in Chapter 3.0 would impact current land uses. All of the projects would be on land planned and zoned for the proposed use.

Much of the heavy industry in the San Francisco Bay is located along the margin of the Bay. From the turn of the century to the present, many communities on the Bay have relied on heavy industry for a large part of their economic base. The San Francisco Bay Area began realizing what has become unprecedented population growth in the 1970s. With increased population growth and accelerating housing costs in traditional areas of the region, residential development spilled over into what had been primarily industrial and agricultural areas. Since the 1970s, this increased residential growth has sometimes encroached on the traditional heavy industry areas, resulting in land use conflicts in many communities including Richmond, Martinez, Hercules, and Rodeo. These land use conflicts between suburban residential uses and industrial uses have not been pronounced in Benicia because of the land use plans, policies, and ordinances of the City and Solano County to maintain a buffer between these uses.

4.3 AIR QUALITY

The proposed Clean Fuels Project could result in emissions of various compounds into the atmosphere. These compounds can be generally classified as either "criteria air pollutants" or "air toxics."

Criteria air pollutants are compounds for which federal and state ambient air quality standards have been established to protect the public health and welfare, and include ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, suspended particulate matter, and lead. These are pollutants that are emitted from many types of sources including automobiles, stationary combustion processes, industrial facilities, construction activities, solvent/paint use, gasoline stations, and manufacturing facilities. This section addresses project emissions of criteria pollutants and their impact on air quality.

Air toxics are compounds of concern to public health. Potential project impacts on public health resulting from air toxics emissions are discussed in Section 4.4.

4.3.1 Environmental Setting

Climate and Meteorology

Regional Climatology. The climate of the San Francisco Bay Area is classified as Mediterranean, which is characterized by mild, wet winters and warm, dry summers. Regional climate is controlled primarily by the Pacific high-pressure system over the eastern Pacific Ocean, low pressure areas that are established in the interior during summer months, and local topography.

Local climates in the San Francisco Bay Area are strongly influenced by topography and proximity to the Pacific Ocean and San Francisco Bay. Cool, onshore winds blowing from the Pacific have a moderating effect. Coastal mountains in the Bay Area act as a barrier to onshore winds, resulting in the channeling of air flow along canyons, valleys, and the Carquinez Strait, as well as strong east-to-west temperature differences. The resulting overall air flow patterns are complex, exhibiting much local variation.

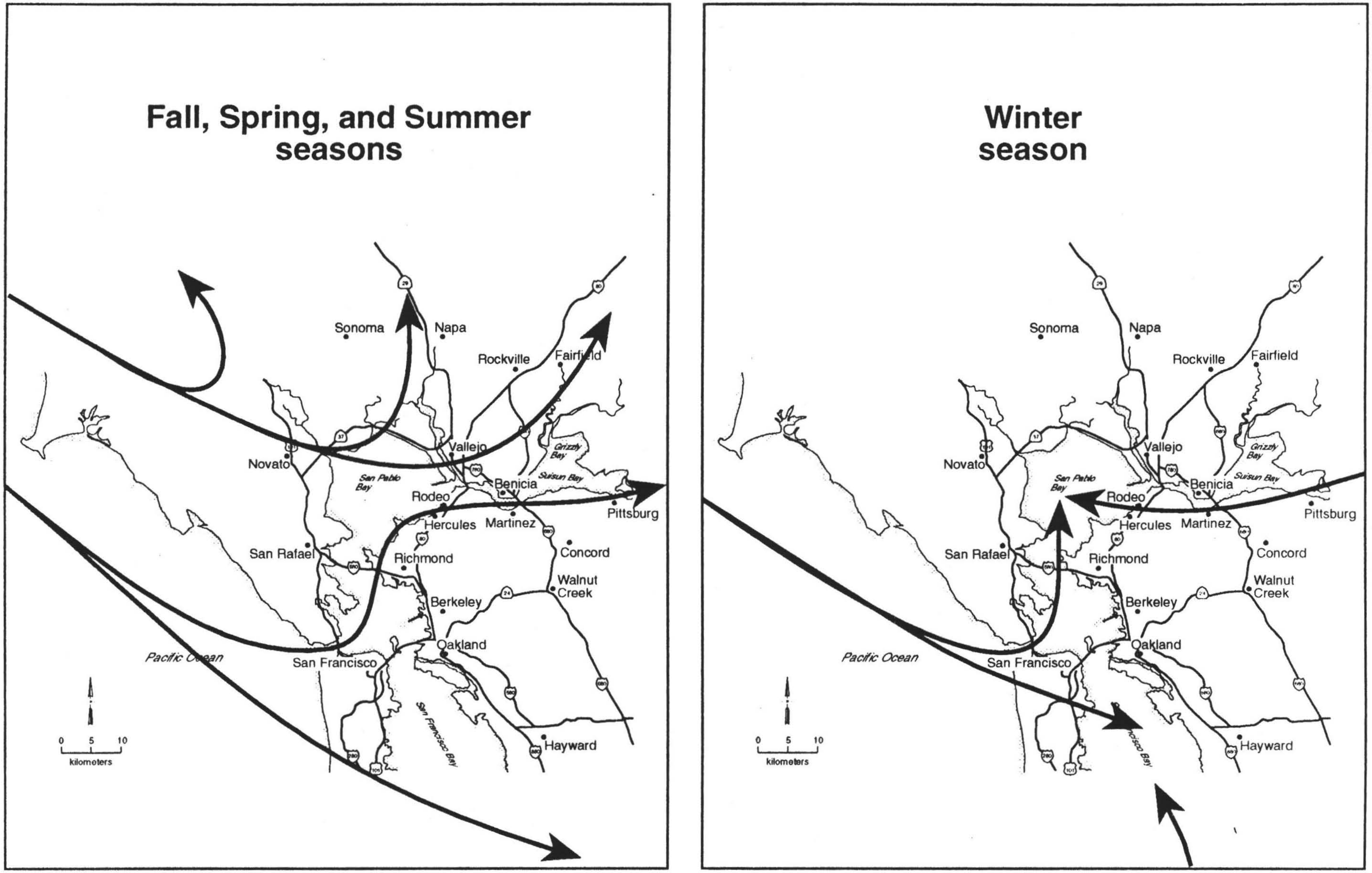
Surface Winds. Large-scale winds over the San Francisco Bay Area are predominantly from the west; however, local variations in the winds are created by the topography along the coastal areas adjacent to the Carquinez Straits. Prevailing winds vary on a diurnal and seasonal basis. Locally, in the Benicia area, the winds are predominantly from the southwest with an average annual wind speed of five miles per hour (2.2 meters per second). Bay Area wind flow patterns are shown on Figure 4.3-1. A wind rose showing the percent frequency of occurrence of wind speed and direction (from which the wind is blowing) in Benicia is provided on Figure 4.3-2.

Temperature. Proximity to the Pacific Ocean and San Francisco Bay, as well as local topography, are the greatest influences on temperature variability in the Bay Area. In the Benicia area, temperature fluctuations are small because of the strong influence of the marine climate. However, occasionally offshore continental air flows can cause more extreme variations in temperature. Average temperatures in Benicia vary from 50 degrees Fahrenheit (°F) in the winter to 70°F in the summer, with an annual average temperature of 57°F. The Benicia area experiences numerous summer days with temperatures in excess of 90°F (National Climatic Data Center 1992).

Precipitation. Precipitation in the Benicia area occurs mainly in the months of November through February and is generally associated with the passage of Pacific-frontal winter storm systems. Any rainfall occurring during the summer months is usually light and associated with isolated showers. The nearest precipitation monitoring station to the Benicia Refinery is the City of Martinez Water Treatment Plant. The annual average rainfall measured at that station is 14.6 inches per year, based on precipitation collected between 1987 and 1992 (National Climatic Data Center 1992).

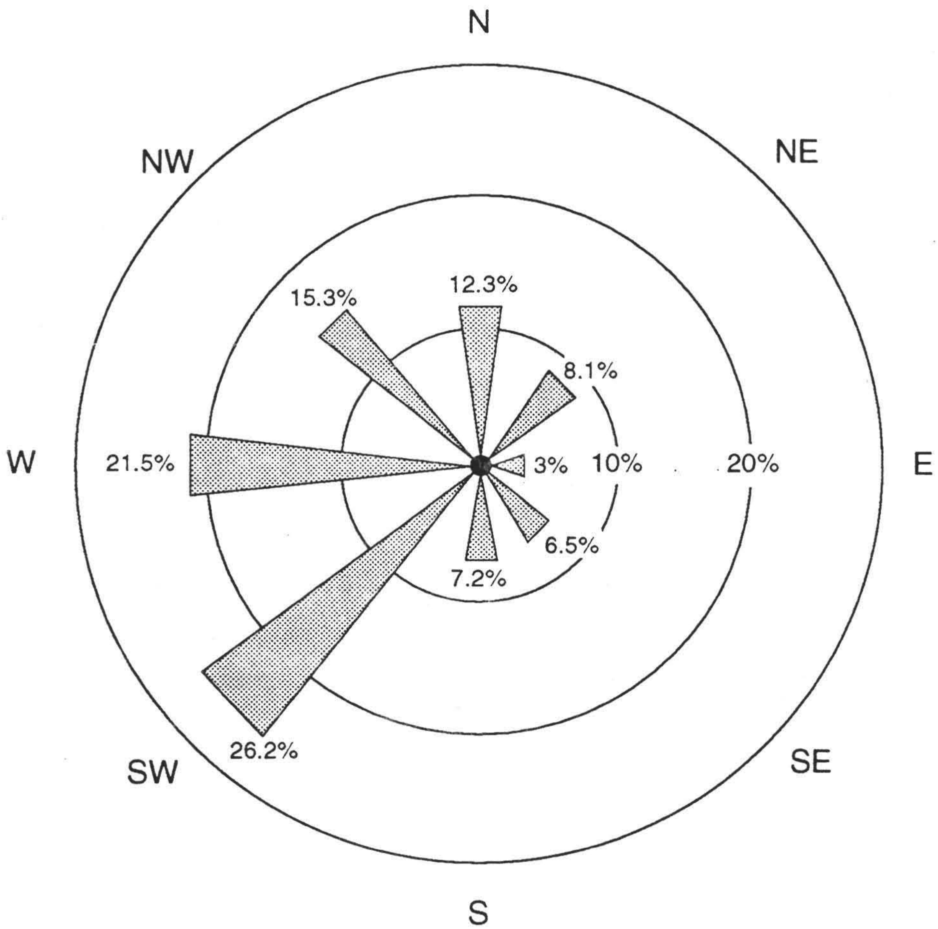
Air Quality

Air Quality Standards. Ambient air quality standards were first established in California starting in 1969 (California Ambient Air Quality Standards or CAAQS). Federal air quality standards were established later by the Environmental Protection Agency (EPA) following passage of the Clean Air Act of 1970 (National Ambient Air Quality Standards or NAAQS).



Project No. 93C0336A	Exxon Clean Fuels Project	PREVAILING SEASONAL BAY AREA WIND FLOW PATTERNS	Figure 4.3-1
Woodward-Clyde Consultants			

93C0336A-0600/083093



Surface Wind
Frequency of Wind Direction

Source: ENSR

Project No. 93C0336A	Exxon Clean Fuels Project	CITY OF BENICIA WINDROSE	Figure 4.3-2
Woodward-Clyde Consultants			

93C0336A-0600/083093

There are two types of national ambient air quality standards: "primary" standards to protect the public health, and "secondary" standards to protect public welfare (i.e., non-health effects such as visibility reduction, crop damage, or damage to buildings). Currently, there are six criteria pollutants for which both national and state standards have been established: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), particulate matter less than 10 micrometers in size (PM_{10}), and lead (Pb). California standards generally are more stringent than the national standards. In addition to standards for criteria pollutants, the state has established standards for sulfates, hydrogen sulfide (H_2S), vinyl chloride and visibility reducing particulates.

Existing Air Quality. Benicia is located in the San Francisco Bay Area Air Basin. The Bay Area Air Quality Management District (BAAQMD) and the California Air Resources Board (CARB) operate a regional network of air quality monitoring stations to identify ambient pollutant concentrations and to gauge the Bay Area's progress toward attainment of federal and state air quality standards. Monitoring stations throughout this network regularly take measurements of the six criteria pollutants: carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, and PM_{10}. Some stations collect information on all criteria pollutants, while others only monitor for specific pollutants.

Background ambient concentrations of criteria pollutants depend on the amount of emissions of these compounds or their precursors in a given area, wind patterns, and meteorological conditions. As a result, background ambient concentrations vary from location to location. However, areas located in close proximity and affected by similar sources and meteorological conditions can be expected to have similar background pollutant concentrations.

The BAAQMD maintains air quality monitoring stations at Benicia, Crockett, Martinez, Vallejo, Concord, and Pittsburg. The Benicia, Crockett, and Martinez monitoring stations measure ambient concentrations of SO_2 only, the Vallejo and Pittsburg stations only measure ambient concentrations of gaseous pollutants (particulates are not measured), while the Concord monitoring station monitors for all criteria pollutants. Criteria pollutant monitoring data used as being representative of existing background concentrations in the project area were selected based on the proximity of the monitoring station to Benicia, and on the similarity of wind conditions.

The locations of Vallejo, Concord, Martinez, and Pittsburg and the wind patterns for the San Francisco Bay Area are shown on Figure 4.3-1. As the figure illustrates, Vallejo is in close proximity to Benicia and experiences similar wind patterns. As a result, gaseous pollutant concentrations measured at the Vallejo monitoring station, except for SO_2, which is measured in Benicia, and PM_{10} which is only measured in Concord, were used as the best available data to represent the background concentrations in the vicinity of the Benicia Refinery. Since PM_{10} in the region is only measured at Concord, data from that station was used as the best available data to represent background PM_{10} levels.

Table 4.3-1 contains a three-year summary (1990 through 1992) of the maximum measured criteria pollutant concentrations at Benicia, Vallejo, and Concord, along with a summary of the monitoring data collected from these stations during the first three months of 1993. Table 4.3-1 compares these monitoring data with the corresponding federal and state air quality standards and indicates the number of days that the standards for each criteria pollutant have been exceeded over the period of record.

Attainment Status. Under the federal Clean Air Act Amendments of 1977, the NAAQS for all criteria pollutants were to have been attained throughout the United States by 1987 and maintained thereafter. The Air Quality Management Plan developed by the BAAQMD in 1982 was designed to bring the Bay Area into compliance with the Clean Air Act Amendments. Since 1977, air quality in the Bay Area has improved but the federal standards for carbon monoxide and ozone have not yet been officially attained. In 1990, the federal Clean Air Act was amended again, and nonattainment areas were required to be brought into compliance with federal standards in a time frame ranging from 6 to 20 years, based on the severity of the area's air quality problem. The Bay Area was designated as a "Moderate" nonattainment area for ozone, and the state was required to attain the national standard by the end of 1996. Recent air quality data shows that the Bay Area did not exceed the national ozone standard during the three year period from 1990-1992. The Bay Area is also designated as a "Moderate" nonattainment area for carbon monoxide. The national carbon monoxide standard was not exceeded in 1992.

The CAAQS, which are equal to or more stringent than the NAAQS, do not have a specific attainment date. State legislation (i.e., AB2595, the "California Clean Air Act of 1988")

TABLE 4.3-1

BACKGROUND AIR QUALITY DATA FOR THE BENICIA AREA

Pollutant	Average Time	California Air Quality Standards	Federal Primary Standards	Maximum Concentrations[1]				Number of Days Exceeding State Standard				Number of Days Exceeding Federal Standard			
				1990	1991	1992	1993[6]	1990	1991	1992	1993[6]	1990	1991	1992	1993[6]
Oxidants[2] (Ozone)	1 hr	0.09 ppm	0.12 ppm	0.11	0.11	0.10	0.07	2	2	1	0	0	0	0	0
Carbon Monoxide	1 hr	20 ppm	35 ppm	12.0	13.0	11.0	7.3	0	0	0	0	0	0	0	0
	8 hrs	9.0 ppm	9 ppm	9.0	9.6	6.6	5.8	0	1	0	0	0	1	0	0
Nitrogen Dioxide	1 hr	0.25 ppm	--[3]	0.08	0.09	0.07	0.05	0	0	0	0	--	--	--	--
	Annual	--	0.053 ppm	0.014	0.019	0.017	n/a	--	--	--	n/a	0	0	0	n/a
Sulfur Dioxide[4]	1 hr	0.25 ppm	--	0.04	0.04	0.03	n/a	0	0	0	n/a	--	--	--	--
	24 hrs	0.04 ppm	0.14 ppm	0.014	0.013	0.017	0.005	0	0	0	0	0	0	0	0
	Annual	--	0.03 ppm	0.001	0.001	0.001	n/a	--	--	--	--	0	0	0	n/a
PM_{10}[5]	24 hrs	50 µg/m³	150 µg/m³	147	111	73	49	6	13	8	0	0	0	0	0
	Annual	30 µg/m³	50 µg/m³	20.0	25.2	22.6	n/a	--	--	--	n/a	0	0	0	n/a
Lead	30-day	1.5 µg/m³	--	0.09	0.07	0.02	n/a	0	0	0	n/a	0	0	0	n/a
	Calendar Qtr.	--	1.5 µg/m³	0.07	0.06	0.02	n/a	0	0	0	n/a	0	0	0	n/a

Source: California Air Resources Board 1990, 1991, 1992.
Bay Area Air Quality Management District, 1993.

Notes: (1) Concentration units for ozone, carbon monoxide, nitrogen dioxide, and sulfur dioxide are in parts per million (ppm). Concentration units for PM_{10} and lead are in micrograms per cubic meter (µg/m³).
Data for NO_2, CO, O_3, and Pb are from the Vallejo monitoring station.
(2) California standard for ozone was 0.10 ppm for the years 1985-1988. The standard was changed to 0.09 ppm in 1989.
(3) "--" indicates no applicable standard.
(4) SO_2 data are from Benicia monitoring station.
(5) PM_{10} data are from Concord monitoring station since PM_{10} measurements are not taken in Vallejo.
(6) Available data from 1993 covers the first calendar quarter (Jan-Mar).
n/a Not available.

requires the CARB to expedite compliance with the state standards. Pursuant to the California Clean Air Act, the BAAQMD approved the 1991 Clean Air Plan on October 30, 1991. The Clean Air Plan implements the Bay Area's current strategy to attain the state's carbon monoxide and ozone standards.

Under the California Clean Air Act, the Bay Area has been designated by the CARB as nonattainment for carbon monoxide, ozone, and PM_{10}. Under the California Clean Air Act, the Bay Area has been designated as a "serious" nonattainment area for ozone. The Bay Area Air Basin is in attainment of the state and federal nitrogen dioxide, sulfur dioxide, lead, and the federal PM_{10} standards.

Regional Emissions Inventory. Each criteria pollutant behaves differently in the atmosphere. Carbon monoxide is a relatively inert compound in the atmosphere, leading primarily to localized air quality impacts where emissions are high. Ozone is not directly emitted into the atmosphere, but is formed by photochemical reactions between reactive hydrocarbons and nitrogen oxides[1] (NO_x) in the presence of sunlight. Ambient PM_{10} is comprised of directly emitted particulate matter and secondary particulates that form in the atmosphere through a variety of chemical reactions involving NO_x, sulfur oxides[2] (SO_x), and reactive hydrocarbons. Finally, ambient NO_2 and SO_2 are measured directly in the atmosphere since there are specific ambient air quality standards for these compounds.

The BAAQMD compiles inventories of emissions from sources associated with human activity (anthropogenic sources) for the nine Bay Area counties including the portion of Solano County where the project is located. The BAAQMD emissions inventory includes criteria air pollutants (nitrogen oxides, sulfur dioxide, carbon monoxide, and particulate matter) and precursors of criteria air pollutants (total organic gases and reactive hydrocarbons,

---

[1] NO_x refers to all oxides of nitrogen. Emissions of NO_x from combustion are primarily nitrogen oxide (NO) and NO_2. In the atmosphere, NO and NO_2 react photochemically with reactive hydrocarbons and water vapor to form ozone, as well as trace amounts of other short-lived NO_x compounds.

[2] SO_x refers to all oxides of sulfur. Emissions of SO_x from combustion are primarily SO_2, with 1 to 10 percent sulfur trioxide (SO_3). Sulfur trioxide is short-lived and rapidly reacts with water vapor in the atmosphere.

which the BAAQMD usually refers to as "POC," Precursor Organic Compounds). The current inventory is based on 1987 emissions data, the current base year used for air quality planning by the BAAQMD. Projections of expected future emission levels have also been prepared by the BAAQMD, based on expected growth rates in population, employment, industrial/commercial activity, travel, and energy use, under control measures already adopted by the District. The projected emissions do not include the effects of reformulated fuels in lowering emissions or control measures that are included in the 1991 Clean Air Plan.

In the Bay Area, anthropogenic emission sources are significantly greater than natural sources (BAAQMD 1991a). The emission inventory for the anthropogenic sources is made up of stationary sources (both point and area sources) and mobile sources including on-road motor vehicles and other mobile sources. On-road motor vehicles include light-duty passenger vehicles, light-, medium-, and heavy-duty trucks, motorcycles, and urban buses. Other mobile sources include off-road vehicles, trains, ships, aircraft, and mobile equipment.

Criteria pollutant emissions in the Bay Area for 1987 are presented in Table 4.3-2. Also shown in the table are the BAAQMD projected Bay Area criteria pollutant emissions levels for 1997, when the Clean Fuels Project would be in operation. As noted above, the projected 1997 emissions data do not account for the effects of reformulated fuels or other control measures specified in the 1991 Clean Air Plan that would have been implemented by 1997. Therefore, actual emissions in 1997 should be lower for all criteria pollutants than the levels provided in the table.

A summary of criteria pollutant emission levels for Solano County during 1987 and projected levels for 1997 are provided in Table 4.3-3. The projected 1997 emissions are based on the assumption that the County's percentage contribution to total Bay Area emissions would remain constant.

Exxon Benicia Refinery Emissions Inventory. Criteria pollutant emissions from the Benicia Refinery for 1992 are presented in Table 4.3-4. These data are based on the annual emissions inventory from all refinery sources submitted to the BAAQMD by Exxon. These emission sources include heater and furnace stacks as well as fugitive emissions from such equipment as valves and pumps.

TABLE 4.3-2

BAY AREA CRITERIA POLLUTANT EMISSION INVENTORY

Pollutant	1987[a] Bay Area Emissions (tons/day)	Projected 1997[b] Bay Area Emissions (tons/day)
Particulate Matter	950	1145
Sulfur Dioxide	109	106
Nitrogen Oxides	599	497
Carbon Monoxide	2729	2022
Total Organics[c]	1692	1260
Volatile Organics[c]	897	755

[a] Source: Base Year 1987 Emissions Inventory Report (BAAQMD 1991a).
[b] Source: Bay Area '91 Clean Air Plan, Volume IV (BAAQMD 1991b).
[c] Total organics and volatile organics not considered a criteria pollutant.

TABLE 4.3-3

SOLANO COUNTY CRITERIA POLLUTANT EMISSION INVENTORY

Pollutant	1987[a] Solano County Emissions (tons/day)	1987 Solano County Contribution to Bay Area Emissions (percent)	Projected 1996[b] Solano County Emissions (tons/day)
Particulate Matter	52.7	5.5	63
Sulfur Dioxide	17.4	16.0	17
Nitrogen Oxides	30.2	5.0	25
Carbon Monoxide	113	4.1	83
Total Organics[c]	88.7	5.2	66
Volatile Organics[c]	52.7	5.9	45

[a] Source: Base Year 1987 Emissions Inventory Report (BAAQMD 1991a).
[b] Estimated based on BAAQMD 1997 emission data for Bay Area and 1987 Solano County contribution to the Bay Area.
[c] Total organics and volatile organics not considered a criteria pollutant.

TABLE 4.3-4

1992 EXXON REFINERY CRITERIA POLLUTANT EMISSION INVENTORY

Pollutant	1992[a] Exxon Refinery Emissions (tons/day)
Particulate Matter	0.73
Sulfur Dioxide	15.35
Nitrogen Oxides	8.61
Carbon Monoxide	1.41
Total Organics[b]	3.64
Volatile Organics[b]	3.64

[a] Source: Base Year 1992 Emissions Inventory Report (BAAQMD 1993d).
[b] Total organics and volatile organics not considered a criteria pollutant.

Odorous Compounds

Some compounds emitted from petroleum refining have the potential to cause odors that could be classified as objectionable or a nuisance. Several compounds present in the Benicia Refinery air emissions, such as hydrogen sulfide (H_2S) and other sulfur compounds, ammonia, acrolein, formaldehyde, and xylene, are known to cause unpleasant odors. Emissions of sulfur dioxide (SO_2), benzene, toluene, polycyclic hydrocarbons, and other organic compounds could also cause unpleasant odors in high enough concentrations.

The basic properties of odors, as perceived by humans, have been described by four major criteria: detectability, intensity, character, and hedonic tone (AWMA 1992). The detection of an odor can be further classified into simple detection and specific recognition. Detection simply is the lowest concentration that can be perceived to elicit a sensory response. A person is aware that there is something added in the air, but is not able to distinguish it specifically. Recognition of an odor occurs when the minimum concentration is high enough for the individual to pick out the odor as having a characteristic quality identifiable by a segment of the population. The intensity of the odor refers to the strength of the odor sensation. The character of the odor refers to the recognizable smell of the odor (e.g., fishy, rancid, hay, sewer, turpentine, ammonia, etc.) (Cha 1991). Finally, the hedonic tone of an odor is a judgement criteria of the relative pleasantness or unpleasantness of the odor, and is influenced by factors such as an individual's subjective experience and the frequency of occurrence of the odor.

From January 1, 1992 to June 23, 1993, there were a total of 85 complaints received by the BAAQMD about the Benicia refinery. Twelve were confirmed,[3] but no notices of violations were issued (BAAQMD 1993d). These complaints included perceived odors beyond the refinery property line from H_2S, propane, wastewater tanks, and sulfur, as well as visible emissions such as smoke. Beyond the Exxon refinery property line there are surrounding marshlands and other industrial operations which can cause or contribute to the odors detected in the area.

---

[3] For an odor complaint to be confirmed, a BAAQMD staff member must be face-to-face with the complainant(s) and smelling the same odor. This has been the confirmation process for the District since 1986.

The following Benicia Refinery operations have been identified as potential sources of odors:

- Existing wastewater treatment biological oxidation unit
- Odorant injection into tankers at the LPG loading rack
- Odors from crude unloading and various process units
- Odors from diesel delivery trucks
- Odors from ammonia facilities

Rules, Regulations, and Standards

The proposed Clean Fuels project is being undertaken to comply with state and federal reformulated fuels requirements. These requirements are being enforced throughout California and in ozone nonattainment areas in other parts of the United States to reduce automobile emissions of carbon monoxide, volatile organic compounds, and air toxics. The proposed project is also subject to other federal, state, and local rules, regulations, and standards. These rules, regulations, and standards define: (1) maximum allowable incremental and cumulative ambient air quality impacts of the proposed project; (2) minimum acceptable emission control technology requirements; (3) requirements for offsetting emission increases associated with the proposed project; and (4) limitations on emissions of odorous compounds. The following discussion summarizes the major rules, regulations, and standards applicable to the proposed project.

Ambient Air Quality Standards. National and California ambient air quality standards (NAAQS and CAAQS) have been established for the six criteria pollutants: CO, NO_2, O_3, SO_2, PM_{10}, and lead. The purpose of the air quality standards is to protect public health and welfare. The NAAQS are defined as the maximum acceptable ambient concentrations that may be reached (annual and short-term standards) but not exceeded more than once per year (short-term standards only). The CAAQS are defined as ambient concentrations that may not be equalled or exceeded.

The 1990 federal Clean Air Act Amendments required re-classification of geographic areas in compliance with the NAAQS (attainment areas) as well as areas that do not attain the NAAQS (nonattainment areas). New or modifying sources located in nonattainment areas are subject to New Source Review (NSR) regulations, and those located in attainment areas are subject to Prevention of Significant Deterioration (PSD) regulations. Nonattainment areas are subject to new compliance deadlines based on the severity of present pollution levels. Since designation of an area is made on a pollutant and standard-specific basis, it is possible to be located in an area designated nonattainment for one pollutant, but attainment for other pollutants.

In the San Francisco Bay Area, the BAAQMD is the agency responsible for developing specific rules and strategies for attaining the NAAQS and submitting these rules to the CARB for inclusion in the State Implementation Program (SIP). Air quality aspects of new pollutant emitting facilities and facility modifications located in the San Francisco Bay Area Air Basin are governed by the BAAQMD NSR and PSD regulations (Regulation 2, Rule 2).

Federal Regulations for New and Modified Sources. Several federal regulations apply to the proposed project. These include New Source Performance Standards (NSPS), PSD and NSR. Each of these regulations is discussed below.

NSPS were promulgated under Section 111 of the Clean Air Act and implemented under 40 CFR Part 60 to develop standards of performance for new or modified sources and specify certain monitoring and reporting requirements. These standards define the minimum level of performance for operation of industrial sources and control of regulated pollutants. Some NSPS apply to the proposed project. These include NSPS for petroleum refinery equipment. The NSPS program is implemented by the BAAQMD.

PSD regulations were first promulgated by the EPA (40 CFR Part 52) to prevent air quality degradation in areas where criteria pollutant concentrations are below ambient standards (i.e., attainment areas). Particular emphasis is given to protection of air quality in national parks and wilderness areas (referred to as Class I areas). PSD regulations require new major sources or modification of an existing major source located in an attainment area to obtain a permit prior to construction.

If a new source or modification triggers the PSD review process for any attainment pollutant, then the PSD review is also required for all other attainment and certain noncriteria pollutants exceeding specified emission significance levels. Any source subject to PSD review must conduct an analysis to ensure the application of best available control technology (BACT) for all applicable pollutants.

For each pollutant subject to BACT, additional analyses may be required, including:

- Air quality dispersion modeling to demonstrate compliance with maximum allowable PSD increments and the NAAQS.

- Pre and/or post-construction air quality monitoring.

- Analysis of impacts on soils, vegetation, visibility, and Class I areas.

Class I areas have been defined as areas where pristine air quality is to be maintained. Class II areas have been designated as regions where moderate cumulative incremental increases in ambient pollutant increases are allowed. Class III areas are areas in which greater cumulative incremental pollutant increases are allowed. Currently, there are no Class III areas in the country. The San Francisco Bay Area is designated as a Class II area. For the proposed project, the nearest Class I area is Point Reyes National Seashore, located 50 kilometers from the project.

Emissions of pollutants for which a proposed project site is in a nonattainment area are governed by the EPA's NSR requirements, as specified in the 1990 Clean Air Act Amendments. Under these requirements, a permit for a new or modifying source may only be granted if the following conditions are met:

- Emission limitations must reflect Lowest Achievable Emission Rate (LAER) control technology standards.

- All other existing major sources owned or operated by the applicant within the state must be in compliance with applicable emission limitations and air quality standards.

- Emission reductions or offsets from existing sources in the area are required for reasonable further progress toward attainment of the NAAQS. The 1990 Clean Air Act Amendments specify offset ratios from 1.1 to 1 for marginal nonattainment areas to 1.5 to 1 for extreme nonattainment areas.

The LAER is defined as either the most stringent emission limit of a similar source found in the SIP or the lowest emission rate achieved in practice or reasonably expected to be achieved for such sources. In the federal system, LAER is intended to be much more stringent than BACT, but under California law BACT is essentially the same as LAER.

BAAQMD Regulations for New and Modified Sources. In the Bay Area, almost all new or modified stationary sources are subject to the requirements of BACT. According to BAAQMD requirements for new or modified facilities, for each criteria pollutant, except lead and ozone, with emissions in excess of 5.0 pounds per highest day or 365 pounds per year BACT is required. BACT is also required for precursor organic compounds with emissions in excess of the above emission thresholds. For lead, BACT is required if the cumulative increase in emissions since December 1, 1992 is 3.2 pounds per day or 0.6 tons per year. For hydrogen sulfide, total reduced sulfur, and reduced sulfur compounds, BACT is required if the cumulative emissions increase since December 1, 1992 is greater than 55 pounds per day or 10 tons per year.

The BAAQMD has authority for implementing and enforcing the EPA's NSR policy in the Bay Area. The BAAQMD's NSR requirements are either the same or more stringent than the federal requirements for stationary sources. The San Francisco Bay Area Air Basin is currently a nonattainment area for state and federal ozone and CO standards, and state PM_{10} standards; accordingly, some of the requirements under the BAAQMD's policy are more stringent than the federal policy.

The BAAQMD NSR policy requires emission offsets for a new or modified source with a cumulative increase in emissions of NO_x or precursor organic compounds (POCs) in excess of 1.0 ton per year since April 5, 1991. POCs and nitrogen oxides form ozone when they react in the presence of sunlight. The emission offsets must be provided for the entire cumulative increase at the following ratios:

	Required Offset Ratio	
Facility Emissions (tons/year)	**POC**	**NO_x**
less than 25	1.05 to 1	1.05 to 1
greater than or equal to 25 but less than 100	1.10 to 1	1.10 to 1
greater than or equal to 100	1.20 to 1	1.20 to 1

Any planned major facility that will constitute a new or modified emissions source with a cumulative increase since April 5, 1991 of more than 1.0 ton per year of PM_{10}, TSP, or sulfur dioxide, must provide offsets at either a 1.1 to 1 ratio or another ratio approved by the BAAQMD.

Emission offsets can be obtained from emission reductions onsite at the facility or from other offsite facilities. Offsite emission reduction credits must be verified and approved by the BAAQMD and "deposited" in the BAAQMD Emissions Bank before use as an offset. The Emissions Bank acts as a clearinghouse for emission reduction credits that can be used for offsets. The BAAQMD keeps track of the quantities of emission reduction credits available and the facilities that own them.

Modeling requirements are specified for facilities with a cumulative increase of carbon monoxide emissions since July 17, 1991, in excess of 25 tons per year. Modeling must show that the proposed project will not interfere with attainment or maintenance of the state carbon monoxide standards.

The BAAQMD has been granted authority by the EPA to implement the PSD program for all criteria pollutants. The local PSD program is somewhat different from the federal PSD program. The BAAQMD does not place as much emphasis on distinguishing between attainment and nonattainment pollutants in its permitting requirements as the EPA does. For this reason, most of the BAAQMD regulations resemble NSR regulations, which are more stringent than PSD regulations. However, certain aspects of the PSD program, such as the PSD increments and impact analysis requirements, are incorporated into the BAAQMD regulations.

Air quality dispersion modeling to demonstrate compliance with applicable NAAQS and PSD increments is required for facilities with cumulative emission increases, since the PSD baseline date, minus contemporaneous actual emission reductions at the facility in excess of:

- 40 tons per year of SO_2 or NO_x
- 25 tons per year of suspended particulate matter, or 15 tons per year of PM_{10}
- 100 tons per year of CO

A full PSD analysis, including: air quality, visibility, soils, and vegetation impact analyses, is required for a new or modified facility that will emit greater than 100 tons per year of CO, PM, POCs, SO_2 or NO_x and has had a cumulative increase of lead or other specified non-criteria pollutants since December 1, 1982 from the facility exceeding their BACT threshold values.

There are numerous other BAAQMD regulations, in addition to the BACT, offset, and PSD requirements previously discussed, which apply to the proposed project. Details of the regulations are contained in the Bay Area Air Quality Management District Rules and Regulations, Volumes 1 and 2.

Odor Regulations. The BAAQMD has rules and regulations that apply to emissions of odor causing substances. Regulation 7 specifies general limitations on odorous substances and specific emission limitations on certain compounds such as mercaptan and phenolic compounds. This regulation applies to a facility when and if the District receives confirmed complaints from more than 9 different complainants in a 90-day period. Public nuisance provisions are generally used for complaints. Regulation 9, Rule 2 specifically limits emissions of H_2S during a 24-hour period to levels that result in ambient ground-level concentrations equal to or less than 8.3×10^{-2} mg/m^3 (on a dry volumetric basis) for a 3-minute average, or 4.3×10^{-2} mg/m^3 for a 60-minute average. There are no state or federal regulations that apply specifically to controls of odors.

4.3.2 Criteria Pollutant Impacts and Mitigation Measures

The following project activities would result in criteria pollutant emissions: (1) construction of the proposed project; (2) operation of project equipment; and (3) increased refinery employee vehicle trips and rail traffic. Pollutant emissions from these elements of the Clean Fuels project could affect local and/or regional air quality, or could have cumulative or odor-related impacts. Therefore, the following analysis of the project's air quality impacts addresses these issue:

- Impacts of construction activities
- Local impacts from project operations
- Impacts from employee commuters
- Regional impacts from project operations
- Odor impacts
- Cumulative impacts from this and other reformulated fuels projects, other projects at the Benicia Refinery, and other major new sources

Study Area

The San Francisco Bay Area Air Basin was selected as the study area for assessing project-related and cumulative regional air quality impacts. This air basin includes most of the nine-county Bay Area including the portion of Solano County that encompasses Benicia. The local study area included the Benicia Refinery and the City of Benicia, and encompassed the area where maximum ground-level concentrations associated with project emissions would occur.

Impact Assessment Methodology

The air quality impact assessment discussed in this document was derived from emission estimates and air quality modeling conducted by Exxon Research and Engineering (ER&E) for their BAAQMD air permit application (Exxon 1993c). The air quality assessment prepared by Exxon was independently reviewed by Woodward-Clyde Consultants to judge its conformance with prescribed protocol and to verify calculations. Based on this review, the emissions estimates and air quality modeling was found to adequately follow current BAAQMD guidelines and no calculation errors were found. The assessment methodology is summarized below.

Emissions. The first step in assessing project impacts on air quality was to estimate project-related emissions of criteria pollutants. Emissions from the operation of project equipment were based on manufacturer's data and regulatory agency factors for the same types of equipment that would be installed for the project. Emissions from employee and construction worker vehicles and delivery trucks were based on CARB emission factors (from the EMFAC7EP program for years 1994/1995) and estimated number of trips per day, trip lengths, and vehicle speeds. Emissions from construction equipment exhaust were estimated using emission factors suggested by the BAAQMD (1985, revised 1991) and on an estimate of diesel fuel consumption by construction equipment. Fugitive dust emissions during construction were estimated based on the surface area disturbed, expected duration of activity in a given area, and an EPA emission factor of 1.2 tons of fugitive dust emitted per acre of construction per month of activity (EPA 1985). This emission factor accounts for fugitive dust emissions from land clearing, blasting, ground excavation, cut and fill operations, vehicle travel over construction areas, and wind erosion of exposed areas. To estimate the PM_{10} fraction of total fugitive dust emissions, a factor of 60 percent was applied, as recommended by the BAAQMD. This means that 60 percent of the total particulate matter is assumed to be PM_{10}. Emissions of VOCs from painting of tanks and other equipment were computed based on estimated quantities of paint needed and the maximum allowable VOC content in paint in California (2.8 pounds per gallon). All of the paint VOCs were assumed to be emitted to the atmosphere.

Ground-Level Concentrations. Air quality dispersion modeling was performed to assess the effects of the Clean Fuels project's emissions on local air quality. Modeling was performed for criteria pollutants that would have a net onsite emissions increase as a result of the proposed project. Air quality dispersion models compute ambient ground-level concentrations of pollutants based on meteorological conditions, geographical relationships of the emission sources and receptors (locations where concentrations are computed), emission source characteristics, and criteria pollutant emission rates from each source.

Maximum ground-level pollutant concentrations were estimated using three EPA-approved air quality dispersion models. Different models had to be used because of the complex terrain and variety of conditions found near the refinery. The SCREEN model was used to evaluate short-term concentration increases due to specific atmospheric phenomena resulting during the breakup of diurnal inversions and due to shoreline effects during light wind conditions. Terrain in the vicinity of the Benicia Refinery includes hills that are higher than the release height of the emissions sources. Therefore, both a flat terrain model and a complex terrain model were used. The Industrial Source Complex Short Term model (ISCST2) was used where the terrain was lower in elevation than the emission sources and to calculate building-induced downwash effects on ground-level concentrations. For conditions in which terrain was higher in elevation than the emission sources the COMPLEX I model was used. Modeling of project emissions was conducted in accordance with EPA and BAAQMD modeling guidance.[4]

Ground-level concentrations were computed using a rectangular grid of receptors extending out 5 kilometers (3.1 miles) from the refinery property boundaries in all directions. The receptor grid was defined such that maximum concentrations would be within the area modeled. Inputs to the models included: source emission rates, emission source information (such as stack height and diameter, stack gas exit temperature and velocity, and tank dimensions), locations of sources and receptors, and meteorological data. The meteorological data used for the models consisted of five years of onsite wind data combined with temperature, total cloud cover, ceiling height, and mixing height data from Travis Air Force Base.

Since CO is the primary pollutant of concern for local impacts from vehicles, ground-level concentrations of CO resulting from increased local traffic associated with project construction were estimated using the CALINE4 model. Vehicle emission rates from EMFAC7EP, provided by the BAAQMD (BAAQMD 1985, revised 1991) were input into the model along with meteorological parameters that would provide worst-case CO concentrations to receptors near the roadway (i.e., low wind speed, wind direction parallel to the roadway, low temperature, and stable atmosphere). The project-related 8-hour CO concentration

---

[4] At the request of the BAAQMD, the modeling was performed assuming the land use surrounding the refinery was "rural."

calculated from the CALINE4 model was added to a background 8-hour concentration of 3 parts per million (ppm), as recommended by the BAAQMD (1985, revised 1991). The total CO concentration was compared to the CAAQS and NAAQS to determine the significance of the project impact.

Construction Impacts and Mitigation

Activities associated with construction that would result in criteria pollutant emissions include: land clearing, excavation and grading, relocation of existing equipment, delivery of construction materials, construction worker vehicle traffic, and construction of new facilities. Additional activities, such as painting, would also result in emissions of criteria pollutants.

Emissions associated with construction of the proposed project would be temporary and would not occur concurrently with project operations. Because of this, potential air quality impacts resulting from project construction and operation were assessed independently.

Significance Criteria. Emissions-based significance criteria recommended by the BAAQMD (1985, revised 1991) were used to assess the significance of construction emissions. Construction emissions that exceed the levels provided in Table 4.3-5 were considered to cause a short-term significant air quality impact. In assessing CO impacts from construction worker vehicle traffic, the ambient air quality standards were used, as recommended by the BAAQMD (1985, revised 1991).

Emission Sources. Construction-related vehicle traffic includes trucks making pickups and deliveries and construction worker commuting. It was estimated that 10 trips per day would be made by diesel-powered trucks delivering materials and/or hauling off debris. Each trip was assumed to be 12 miles long at highway speed (55 mph) and 4 miles at urban speed (30 mph) within the City of Benicia. For gasoline-powered trucks making pickups/deliveries within the boundaries of the refinery, an estimated 60 trips per day would occur, with each trip being 2 miles at a plant speed limit of 15 mph.

The construction work force is expected to vary over the 20-month construction period. During the first year of project construction the average number of workers per day would

TABLE 4.3-5

BAAQMD EMISSION SIGNIFICANCE LEVELS

	Significance Criteria	
Pollutant	Daily[a] (lb/day)	Annual[b] (tons/year)
VOC	150	27
NO_X	150	27
SO_X	150	27
CO	550	100
Particulates	150	27
PM_{10}[c]	80	15

Source: BAAQMD (1985, revised 1991).

[a] Both daily and annual significance levels apply.
[b] Annual significance levels were computed using daily significance levels and assuming full-time source operation.
[c] PM_{10} significance level is based on the BAAQMD emission threshold used for defining a major modification of a major facility (BAAQMD Rule 2-2-221).

be 338, and would be 670 for the second year. The average number of daily trips would be 614 during the first year and 1,218 during the second year. The number of workers during peak construction periods would be approximately 900 workers, generating up to 1636 average daily trips per day. These trips are expected to result in 34,442 daily vehicle miles traveled (VMT), of which a large portion would be freeway-type trips. Vehicle emission rates for 40 mph were applied to the total vehicle miles traveled to calculate the daily emissions for construction worker traffic.

During construction of the new facilities in the process area, an estimated 4 acres would be disturbed during a 14 month period. Construction activities in the storage tank area would occur in two locations, with 4 acres disturbed during a 3-month period at one location, and 3 acres disturbed over a 5-month period at the other. To minimize fugitive particulate emissions, construction areas subject to dust generation would be wetted twice daily using approved watering procedures. This is expected to result in a 50% reduction in emissions.

An estimated 400,000 gallons of diesel fuel is expected to be used during project construction. The fuel consumption estimate was based on the type of construction project, activities involved, and estimated manpower requirements.

Impact No. 1 **Project construction activities would result in NO_x and PM_{10} emissions that would cause a short-term impact on air quality. This impact would be significant.**

Daily and annual average emissions from construction activities (including vehicle traffic) during the 20-month construction period are provided in Table 4.3-6. The annual average emissions are provided for both years during the construction period. Daily emissions are based on traffic conditions associated with the peak workforce of approximately 900 workers. This level of workforce would occur for about 6 months of the construction period, and therefore the daily worker vehicle emissions represent a short-term maximum. Annual average emissions are provided for each year of the construction period.

As indicated in Table 4.3-6, annual average construction emissions would exceed BAAQMD significance criteria for NO_x, PM, and PM_{10}. The primary source of NO_x emissions would

TABLE 4.3-6

SUMMARY OF CRITERIA POLLUTANT EMISSIONS FROM CONSTRUCTION ACTIVITIES

Construction Activity	Annual Average Construction Emissions (tons/year)						Daily Emissions (lbs/day)					
	VOC	NO_x	SO_x	CO	PM	PM_{10}	VOC	NO_x	SO_x	CO	PM	PM_{10}
Construction Related Trucks	0.2	1.2	0.3	1.0	0.2	0.2	1.0	6.7	1.7	5.3	1.4	1.3
Worker Vehicles[a]							44.6[a]	90.7[a]	15.3[a]	723.4[a]	166.6[a]	159.9[a]
1st Year	2.2	4.4	0.8	35.2	8.1	7.8						
2nd Year	4.3	8.7	1.5	70.0	16.1	15.5						
Fugitive Dust					29.9	17.9					163.8	98.4
Construction Equipment	6.0	42.1	4.8	11.0	2.5	2.5	32.8	230.8	26.3	60.2	13.9	13.4
Painting	4.2						23.0					10
Total							101.4	328.2	41.6	788.9	345.7	283.0
1st year	11.6	47.7	5.6	47.2	40.7	28.4						
2nd year	14.7	52.0	6.3	82.0	48.7	36.1						
BAAQMD Emission Significance Criteria	27	27	27	100	27	16	150	150	150	550	150	80

[a] Worker vehicle emissions are based on averages for the first and second years of construction, as listed under "Annual Average Emissions." Worker vehicle emissions listed under "Daily Emissions" represent the peak workforce (900 workers), which was used to calculate a maximum daily impact.

be from construction equipment. Although worker traffic would contribute to PM and PM_{10} emissions, fugitive dust would be the primary source of these emissions.

Daily emissions estimates include emissions from worker vehicle traffic during the peak (6 months) construction period. During this period, emissions would exceed BAAQMD significance criteria for NO_x, CO, PM, and PM_{10}. The CO emissions would be primarily from commute traffic associated with the peak-construction workforce. Although the CO emissions would exceed the BAAQMD daily significance threshold, they would not be considered significance since they would not cause or contribute to a violation of an ambient air quality standard. Modeling results for construction worker traffic indicated a maximum potential 8-hour CO concentration of 6.3 ppm, as compared to the 8-hour CAAQS of 9.0 ppm. The 8-hour CAAQS is the most restrictive standard for CO, and therefore, were used as a basis of comparison to significance thresholds.

Mitigation Measure No. 1

Construction would result in significant emissions of NO_x and PM_{10}. These emissions would be reduced through contract specifications and normal construction activity practices that would be included in the construction contract to mitigate construction impacts. Examples of these measures include:

- Timely and proper maintenance of construction equipment.
- Reduce idle time for construction vehicles.
- Watering disturbed (graded or excavated) surfaces as necessary, increasing frequency when weather conditions require.
- Water disturbed areas to form a compact surface after grading and earthworking.
- Using chemical dust suppressants when watering is not sufficient.

- Limiting areas to be cleared to facilities required for the project and necessary equipment and materials stockpile areas.

- Reducing speed limits for construction equipment and vehicles on unpaved roads when conditions require.

- Standard erosion control measures would be included as part of the grading plans.

Even with this mitigation measure, construction emissions are expected result in short-term, significant impacts.

Project Operation Impacts and Mitigation

The proposed project would involve installation of new facilities and modifications to several existing facilities. Some existing sources would also have their emissions increased or decreased since they are affected by changes associated with the project. These new and modified facilities would be the primary sources of criteria pollutant emissions from the project when it becomes operational. Additional emissions would be generated by increased vehicle traffic of new employees.

Local Impacts. Pollutants are dispersed in the atmosphere as they are emitted from a source, mixing with the air and increasing the ambient concentrations of those pollutants. The increase in pollutant concentrations caused by an emission source(s) depends on the rate and volume of emissions from the source, distance from the source, temperature of the exhaust plume, and atmospheric conditions.

Significance Criteria. Where possible, air quality impacts on Benicia were evaluated in terms of the ground-level concentrations of air pollutants caused by project emissions. As discussed in Section 4.3.1, the EPA and State of California have established National Ambient Air Quality Standards (NAAQS) and California Ambient Air Quality Standards

(CAAQS) for ground-level concentrations of NO_2, SO_2, CO, ozone and PM_{10}[5] (Table 4.3-7). The most stringent of those standards were used to assess the significance of local air quality impacts caused by the project. If ground-level concentrations of pollutants resulting from project emissions added to background concentrations of those pollutants exceeded the most stringent NAAQS or CAAQS, the air quality impact was judged to be significant. Emissions that did not result in concentrations above the standards were considered to have an insignificant impact on air quality.

The NAAQS and CAAQS are the most appropriate significance criteria for evaluating local air quality impacts because they are designed to protect public health and welfare. For example, the CAAQS have been adopted by the California Air Resources Board (CARB) at public hearing based on the recommendations of the State's public health authority, the Office of Environmental Health Hazards Assessment. All relevant and scientifically valid health studies are evaluated in setting the standards to determine the concentrations that cause short-term and long-term harm to sensitive individuals and groups. CARB, the EPA, and others regularly sponsor research to gain more insight into how pollutants affect human health and use those studies to review and update standards.

For most pollutants, the target group being protected by the NAAQS and CAAQS are individuals whose tolerance to exposure has been reduced by respiratory or coronary disease. The standards are set below the levels shown to cause harm to vulnerable individuals and groups to provide a margin of safety to account for uncertainties in the scientific data. This practice creates standards that are, as a matter of public policy, biased in the direction of being health-protective. Because individual sensitivity to environmental chemicals varies, and some individuals are hyper-sensitive, no ambient standard above zero will protect every individual in society. However, the CAAQS and NAAQS are intended to protect the vast majority of people from harm, even those made vulnerable by serious illness.

Impacts of ground-level concentrations of criteria pollutants resulting from project emissions were evaluated in two steps. In the first step, the calculated concentrations were compared

---

[5] NAAQS and CAAQS have not been established for VOC concentrations since these compounds are primarily of concern because of their contribution to regional ozone concentrations.

TABLE 4.3-7

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards	National Standards	
		Concentration	Primary	Secondary
Ozone	1 Hour	0.09 ppm (180 μg/m³)	0.12 ppm (225 μg/m³)	Same as Primary Standard
Carbon Monoxide	8 Hour	9.0 ppm (10 mg/m³)	9.0 ppm (10 mg/m³)	
	1 Hour	20 ppm (23 mg/m³)	35 ppm (40 mg/m³)	
Nitrogen Dioxide	Annual Average		0.053 ppm (100 μg/m³)	Same as Primary Standard
	1 Hour	0.25 ppm (470 μg/m³)		
Sulfur Dioxide	Annual Average		80 μg/m³ (0.03 ppm)	
	24 Hour	0.04 ppm (105 μg/m³)	365 μg/m³ (0.14 ppm)	
	3 Hour			1,300 μg/m³ (0.5 ppm)
	1 Hour	0.25 ppm (655 μg/m³)		
Suspended Particulate Matter (PM_{10})	Annual Geometric Mean	30 μg/m³		
	24 Hour	50 μg/m³	150 μg/m³	Same as Primary Standard
	Annual Arithmetic Mean		50 μg/m³	
Sulfates	24 Hour	25 μg/m³		
Lead	30 Day Average	1.5 μg/m³		
	Calendar Quarter		1.5 μg/m³	Same as Primary Standard
Hydrogen Sulfide	1 Hour	0.03 ppm (42 μg/m³)		
Vinyl Chloride (chloroethene)	24 Hour	0.010 ppm (26 μg/m³)		
Visibility-Reducing Particles	8 Hour (10 a.m. to 6 p.m., PST)	In sufficient amount to produce an extinction coefficient of 0.23 per kilometer due to particles when the relative humidity is less than 70 percent.		

to BAAQMD screening threshold concentration criteria (Table 4.3-8). For this analysis, these threshold levels were used as the primary concentration-based screening level for significance. The EPA and BAAQMD, and other air pollution control agencies, as a matter of public policy have defined increases in ambient concentrations that are less than these thresholds to be insignificant, too small to be considered a threat to ambient air quality standards. Concentrations of pollutants above these threshold criteria were evaluated in a second step to determine if they would cause a significant impact when added to existing air quality. The sum of estimated project-related concentrations were added to measured background concentrations and compared to the NAAQS and CAAQS to determine whether the project would result in a violation of the standards.

A different approach was taken for permanent increases in vehicle emissions associated with the project. These emissions will be scattered over a wide area and could not be effectively modeled. Therefore, the significance of vehicular emissions of these pollutants associated with the project were evaluated based on the BAAQMD emissions criteria presented in Table 4.3-5.

Impacts from Stationary Emission Sources. Stationary emission sources associated with the Clean Fuels project can be categorized as either combustion, fugitive, or storage tank sources. Combustion sources, such as boilers, heaters, and turbines produce emissions that are exhausted through stacks. Fugitive sources include valves, compressors, pumps, flanges, pressure safety valves, and dust from the new storage area. Table 4.3-9 provides a list of the new, modified, and affected facilities proposed for the Clean Fuels project and the type of emission sources they represent. The main source of criteria pollutant emissions would be from the combustion of fuel. The Clean Fuels project includes one new heater, two modified heaters, seven affected heaters, and two affected gas turbines. All of these units would be fired on refinery fuel gas except the new heater which is equipped to also fire vaporized pentane (Exxon 1993c). Table 4.3-10 lists the criteria pollutant emissions associated with the proposed project. A brief description of the methods used in computing emissions from the project is provided below.

Sulfur dioxide emissions from the heaters and turbines were calculated based on the total reduced sulfur content in refinery fuel gas (expressed as hydrogen sulfide) of 65 parts per

TABLE 4.3-8

SCREENING THRESHOLD CRITERIA FOR EVALUATING IMPACTS OF POLLUTANT CONCENTRATIONS

Pollutant/Averaging Time	Concentration (μg/m^3)
SO_2:	
3-hour	25
24-hour	5
Annual	1
NO_2:	19
1-hour	1
Annual	
PM_{10}:	
24-hour	5
Annual	1
CO:	
1-hour	2,000
8-hour	500

Source: BAAQMD Rule 2-2-233

TABLE 4.3-9

EMISSIONS SOURCE TYPES FOR EXXON CLEAN FUELS PROJECT
(Page 1 of 2)

Unit	Source Type		
	Combustion	Fugitives[a]	Storage Tanks
NEW SOURCES			
Heartcut Tower	None	Yes	None
Heartcut Saturation Unit	None	Yes	None
Cat. Reformer T-90 Tower	None	Yes	None
Cat. Naphtha T-90 Tower	None	Yes	None
LCN Hydrotreater	None	Yes	None
Hydrocarbon Storage Tanks (3)	None	Yes	3 tanks
C5/C6 Splitter	None	Yes	None
Aqueous Ammonia Storage Tank for NOx Control	None	Yes	1 tank
Hot Oil System	1 process heater 1 stack	Yes	1 tank
MODIFIED SOURCES			
Hydrocracking Unit	None	Yes	None
Hydrogen Plant - H_2U Furnaces	2 process heaters 4 stacks	Yes	None
Heavy Cat. Naphtha Hydrotreater	None	Yes	None
Virgin Light Ends Modifications	None	Yes	None
Alkylation Unit	None	Yes	None
Fugitive Dust Abatement	None	Yes	None

TABLE 4.3-9

EMISSIONS SOURCE TYPES FOR EXXON CLEAN FUELS PROJECT
(Page 2 of 2)

	Source Type		
Unit	Combustion	Fugitives[a]	Storage Tanks
AFFECTED EXISTING SOURCES			
Cat. Reformer Furnaces	6 process heaters 3 stacks	None	None
Alkylation Unit Gas Turbine	1 gas turbine 1 stack	None	None
Hydrocracking Unit Furnace	1 process heater 1 stack	None	None
Hydrocracking Unit Gas Turbine	1 gas turbine 1 stack	None	None
Logistics and Tankage	None	Yes	15 tanks
Rail Loading Rack	Locomotive	None	None
Wastewater Treatment	None	Yes	None

[a] Fugitives refers to fugitive emissions associated with project components other than combustion sources or tanks. This category includes all valves and flanges, regardless of size.

TABLE 4.3-10

CRITERIA POLLUTANT EMISSIONS FROM CLEAN FUELS PROJECT STATIONARY SOURCES (TONS/YEAR)

Unit	SO_2	NO_X	CO	TSP	PM_{10}	VOC
NEW SOURCES						
Heartcut Tower						2.3
Heartcut Saturation Unit						3.0
Cat. Reformer T-90 Tower						1.4
Cat. Naphtha T-90 Tower						1.8
LCN Hydrotreater						4.3
Hydrocarbon Storage Tanks (3)						2.7
Storage Tank Cleaning (3)						0.2
C5/C6 Splitter						1.0
Hot Oil System	12.8	17.1	19.7	5.8	5.8	5.0
Sub-Total New Sources	12.8	17.1	19.7	5.8	5.8	21.7
MODIFIED SOURCES						
Hydrocracking Unit						0.0
Hydrogen Plant - H_2U Furnaces	17.6	(-140.5)	27.2	8.0	8.0	5.8
Heavy Cat. Naphtha Hydrotreater						0.2
Virgin Light Ends Modifications						0.4
Alkylation Unit						0.3
Fugitive Dust Abatement				To be determined		
Sub-Total Modified Sources	17.6	(-140.5)	27.2	8.0	8.0	6.7
AFFECTED EXISTING SOURCES						
Cat. Reformer Furnaces	2.6	44.3	4.0	1.2	1.2	0.7
Alkylation Unit Gas Turbine	0.6	15.4	6.7	0.8	0.8	0.4
Hydrocracking Unit Furnace	1.0	3.4	1.5	0.9	0.5	0.5
Hydrocracking Gas Turbine	0.8	20.3	8.9	1.0	1.0	0.6
Motor Gasoline Tankage						(-9.0)
Rail Loading Rack	1.2	16.0	2.3	0.4	0.4	0.8
Wastewater Treatment						0.1
Sub-Total Affected Sources	6.2	99.4	23.4	3.9	3.9	(-6.1)
PROJECT TOTALS	**36.6**	**(-24.0)**	**70.3**	**17.7**	**17.7**	**22.3**

million by volume (ppmv), a heating value of 1,251 Btu/standard cubic foot (scf), and heat input requirements of the equipment. It was assumed that the hydrogen sulfide is converted to sulfur dioxide during combustion at a one-to-one ratio.

The quantity of nitrogen oxides (NO_x) emitted to the atmosphere is largely dependent on the type of equipment applied to reduce the formation of NO_x during combustion and/or to remove NO_x from the flue gas. Factors used to compute NO_x emissions were developed to reflect the type of control technology used. NO_x emissions from uncontrolled sources were based on EPA emissions factors, the heating value of the refinery fuel gas, and equipment duty.

A number of different control technologies would be used to reduce NO_x emissions from the proposed sources for the project. Emissions from the new source (Hot Oil System) would meet emission concentration limits of 10 ppmv using both Low-NO_x burners and selective catalytic reduction (SCR). Emissions from the existing hydrogen unit reformer furnaces would be controlled by Low-NO_x burners and/or Thermal DeNO_x. This would reduce the flue gas NO_x concentration from 90 ppmv to an average of 35 ppmv, resulting in an estimated NO_x reduction of 140.5 tons per year. The NO_x controls applied to project sources are summarized in Table 4.3-11.

Carbon monoxide emissions from combustion equipment were computed based on EPA emission factors (AP-42), the heating value of the refinery fuel gas, and heat input requirements of equipment.

Particulate emissions for existing and new combustion units were based on heat input requirements of equipment and emission factors developed by EPA (AP-42) (1991) for uncontrolled combustion of natural gas. For conservatism, the AP-42 factors were increased by 30 percent to account for potential differences between natural gas and the fuel gas used at the refinery, as well as formation of secondary particulates in units using ammonia injection for NO_x control. Particulate emissions reductions for the refinery which could partially offset the projects PM_{10} emissions may be generated onsite through dust control measures such as covering areas (areas were new tanks and equipment are located) and paving refinery roads that are currently unpaved.

TABLE 4.3-11

NITROGEN OXIDES EMISSION CONTROLS FOR COMBUSTION SOURCES

Unit	Source	Burner Type	NOx Control
NEW SOURCES			
Hot Oil System	1 heater	Low NO_x	Selective Catalytic Reduction
MODIFIED SOURCES			
Hydrogen Plant Furnaces	2 heaters	Low NO_x	Selective Non-Catalytic Reduction (Thermal $DeNO_x$ Optional)
AFFECTED SOURCES			
Cat. Reformer Furnaces	6 heaters	Single Stage	None
Hydrocracking Unit Furnace	1 heater	Low NO_x	Thermal $DeNO_x$
Hydrocracking Unit Turbine	1 turbine	-	None
Alkylation Unit Turbine	1 turbine	-	None

Emissions of VOCs would occur from both combustion sources and fugitive sources. Emissions of VOCs from combustion units were based on EPA emission factors (AP-42), the heating value of the refinery fuel gas, and heat input requirements for equipment. Fugitive VOC emissions were calculated for the new and modified process equipment, the equipment associated with the new and affected tanks, and the auto-refrigeration system on new tanks. The equipment includes valves, compressors, pumps, flanges, and pressure safety valves (PSVs). Emissions due to storage tank cleaning were also estimated. Emissions from gas valves and light liquid valves were computed using emission correlations recently developed by the EPA. The emission correlations were developed for use in estimating emissions from refineries if monitoring data are available. These correlations were used with actual monitoring data collected at the refinery during 1992 to calculate refinery-specific emission factors for gas and light liquid valves. The fugitive emissions estimates for gas and light liquid valves used for this analysis were based on a draft BPA report. The final version of this report (EPA 1993) has recently been published and contains slightly different correlations which would result in lower emissions, by about 5 tons per year, than those provided here. Emission rates for heavy liquid valves, flanges, light liquid pumps, heavy liquid pumps, and compressors were computed using emission factors supplied by the BAAQMD (1992b). For PSVs an emission factor developed by Exxon was used. This emission factor accounts for the capture and reuse in refinery process heaters and boilers of PSV emissions.

For the fugitive emission estimates, all valves and flanges were included in this estimate regardless of size. As part of the proposed project, Exxon will be welding all piping less than 2 inches (nominal pipe size).

Fugitive VOC emissions from new pumps (pump seals), compressors, and safety valves would be controlled by collecting the emissions in a closed piping system for use in the refinery's fuel gas system. On occasion, some of the captured fugitive emissions may be combusted at the existing flares. The average combustion efficiency of the process heater/flare combination is estimated to be 99.5 percent.[6] Any uncombusted emissions from this system were accounted for by using fugitive emission factors adjusted by a control factor of 0.005.

---

[6] This efficiency is based on a flare efficiency of 98 percent and an efficiency of 99.99 percent for the boilers and process heater combustion.

Impact No. 2 **The proposed project would result in a decrease of refinery emissions of NO_x. Therefore, the project would reduce the levels of NO_x in the local Benicia area. This would be a beneficial impact.**

As discussed in Section 2.6.6, the project would include installation of Low-NO_x burners and Thermal $DeNO_x$ on the hydrogen plant furnaces. This would reduce NO_x emissions from the hydrogen plant by 140.5 tons/year. As shown in Table 4.3-10, this reduction would more than offset the increased NO_x emissions resulting from project equipment and existing equipment affected by the project. Because the project would result in a net decrease in NO_x emissions, the project would have a beneficial impact on local NO_2 levels.

Mitigation Measure No. 2

No mitigation is required.

Impact No. 3 **Operation of the proposed project would result in a potential minor increase in flaring. This would not be a significant impact since flaring is designed to reduce air pollutant emissions during upset conditions.**

Under normal operating conditions of the Clean Fuels project, use of the flare would not be required. Flaring would only occur during upset conditions. Based on a review of flaring incidents over a 2-year period (1991-92) at the existing refinery, it was conservatively estimated that operation of the Clean Fuels project may contribute as much as 15 percent in incremental flaring relative to the 2-year period (Exxon 1993d). Assuming similar operating conditions to the 1991-92 period, a 15 percent increase would represent 5 additional cases of flaring over a 2-year period, in addition to 36 flaring incidents that would occur from existing refinery operations.

The incremental use of flaring from the Clean Fuels project during upset conditions is not expected to result in a significant local air quality impact since flares typically have a control efficiency of 98 percent or greater (Santa Barbara County Air Pollution Control District 1991). In addition, dispersion of pollutants from a flare is enhanced due to the high exhaust gas temperature.

<u>Mitigation Measure No. 3</u>

No mitigation is required.

<u>Impact No. 4</u> **Emissions from project equipment and tanks would result in an increase in local ambient concentrations of SO_x, PM_{10}, and CO. This impact is not significant.**

Air quality modeling was performed for project emissions of SO_x, PM_{10} and CO since there would be a net onsite emission increase of these pollutants (Table 4.3-10). Ambient ground-level concentrations of CO due to emissions from stationary sources were computed for 1- and 8-hour averaging periods. For SO_2, concentrations were computed for 1, 3-, and 24-hour averages, as well as an annual average concentration. For PM_{10}, concentrations were computed for 24-hour and annual averaging periods.

Table 4.3-12 compares the maximum ground-level concentrations of SO_2, PM_{10}, and CO calculated for project emissions with the BAAQMD's screening threshold concentration criteria (Table 4.3-8). As shown in Table 4.3-12, project-related concentrations of SO_2, PM_{10}, and CO, except for the 1- and 24-hour averaging periods for SO_2, do not exceed the BAAQMD screening threshold concentrations and therefore would not cause a significant local air quality impact.

There is no screening concentration threshold criteria for the 1-hour average SO_2 concentration, and the predicted 24-hour average SO_2 concentration was above the screening threshold. Therefore, these concentrations were further analyzed to determine whether they would result in a significant impact to air quality. This was done by adding the estimated project-related concentrations to measured background concentrations and comparing the results to ambient air quality standards. As shown in Table 4.3-13, the total concentrations (i.e., project plus background) would not exceed applicable federal or state standards; therefore, they would not result in a significant local air quality impact.

TABLE 4.3-12

COMPARISON OF MODELED PROJECT CONCENTRATIONS TO SCREENING THRESHOLD CRITERIA

Pollutant/Averaging Time	Maximum Concentration Increase for Clean Fuels Project (μg/m^3)	BAAQMD Screening Threshold Concentration Criteria	Exceed Threshold Criteria
SO_2:			
1-hour	18	None	N/A
3-hour	16	25	No
24-hour	6	5	Yes
Annual	0.3	1	No
PM_{10}:			
24-hour	3	5	No
Annual	0.2	1	No
CO:			
1-hour	177	2,000	No
8-hour	147	500	No

TABLE 4.3-13

COMPARISON OF MAXIMUM PROJECT CONCENTRATIONS OF SULFUR DIOXIDE WITH STATE AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	Maximum Concentration Increase for Clean Fuels Project (μg/m^3)	Ambient Background Concentration (μg/m^3)	Total Concentration (μg/m^3)	Standards (μg/m^3)	
					National	State
SO_2	1 hour	18	105	123	-	655
	3 hour	16	105[a]	121	1300[b]	-
	24 hour	6	45	51	365	105
	annual	0.3	2.6	2.9	80	-

[a] 3-hour ambient background conservatively assumed equal to 1-hour ambient background.
[b] Secondary standard.

Mitigation Measure No. 4

No mitigation is required. However, in accordance with BAAQMD rules (Regulation 2, Rule 2, Subsections 302 and 303), the project would require offsets of SO_x to obtain an air permit for the project. Exxon proposes to obtain these emission offsets from the BAAQMD Emissions Bank. Those offsets would be greater than project emissions by a ratio of 1.1 to 1, or 43.9 tons/year.

Since the specific source of the SO_x offsets is not known at the present time, it is uncertain whether these offsets would be contemporaneous with the proposed project or not. Because of this, use of these offsets was not considered in the evaluation of potential impacts.

Impacts from Mobile Source Emissions. Mobile source emissions due to project operation would be from additional employee vehicle trips and rail traffic. The project would not have an increase in the number of truck trips to the refinery. Locomotive emissions associated with the project are not addressed here. These emissions are included in the stationary source emissions as specified by the BAAQMD.

An additional 30 employees are expected to work at the refinery as a result of the project. The maximum projected work force of 30 employees is expected to take approximately 75 trips per day, resulting in an additional 1520 VMT. Most of this travel would be on freeways.

Impact No. 5 **Project-related employee vehicles would increase emissions of NO_x, SO_x, VOCs, and PM_{10}. This impact is not significant.**

As shown in Table 4.3-14, vehicular emissions of NO_x, SO_x, VOCs, and PM_{10} associated with the project would be less than the BAAQMD emissions significance criteria for these pollutants. It should be noted that the combined impact of mobile and stationary sources associated with the project is evaluated in the subsequent section under "Regional Impacts."

TABLE 4.3-14

VEHICLE EMISSION FROM PROJECT OPERATIONS

Pollutant	Vehicle Emissions (tons/year)	BAAQMD Emissions Significance Criteria (tons/year)
SO_x	0.1	27
NO^x	0.8	27
CO	6.1	100
PM_{10}	1.3	15
VOC	0.4	27

Mitigation Measure No. 5

No mitigation is required.

Impact No. 6 **Project-related employee vehicles would increase CO concentrations on roads in Benicia. This would be an insignificant impact on local air quality.**

Construction worker vehicle trips would be much higher than vehicle trips associated with project employees (1,636 trips per day versus 75 trips per day). As discussed for impact No. 1, CO emissions from construction worker vehicle trips would result in an insignificant air quality impact. Therefore, the CO impacts from the addition of 30 employees would not be significant.

Mitigation Measure No. 6

No mitigation is required.

Regional Impacts

In addition to causing direct, local impacts on air quality, emissions of SO_x and NO_x along with VOCs from the proposed Clean Fuels project can cause regional air quality impacts. These pollutants are reactive in the atmosphere. VOCs and NO_x react in the atmosphere in the presence of sunlight to produce ozone and other photochemical oxidants (commonly termed smog). NO_x and SO_x can react in the atmosphere to produce PM_{10} in the form of nitrates and sulfates. Typically, SO_x, NO_x, and VOCs can travel long distances from their sources before these reactions are complete. Therefore, emissions from the refinery can contribute to the formation of photochemical oxidants and particulates in another part of the San Francisco Bay Area.

Carbon monoxide and most PM_{10} emissions are relatively non-reactive in the atmosphere. Therefore, they are not considered to be regional pollutants. Localized high concentrations of these pollutants are generally caused by local sources and not by a combination of sources scattered throughout a region.

Significance Criteria. There are currently no approved dispersion modeling tools that can effectively quantify the contribution to regional ozone concentrations or secondary PM_{10} caused by VOC, NO_x, and SO_x emissions from an individual source or facility located in an urbanized area. Therefore, emission-based criteria were used to determine the significance of project emissions on regional air quality.

The significance of regional impacts was based on changes in emissions of regional criteria pollutants in the San Francisco Bay Area Air Basin as a result of the project. Project emissions from stationary and mobile sources were summed separately. Onsite emission reductions and emission reductions resulting from the use of Exxon's reformulated fuel in the San Francisco Bay Area were subtracted from project emission sources to obtain the total emissions associated with project operations. If resulting total net emissions exceeded the BAAQMD emissions criteria (Table 4.3-5), the project was judged to have a significant impact on regional air quality.

Emissions Associated with Project Operations. As shown in Table 4.3-10 and discussed under impact No. 2, project emissions of NO_x would be offset by onsite reductions of this pollutant. This would result in a net reduction in NO_x emissions from the refinery.

Proposed project equipment, project modifications to existing equipment, and existing equipment affected by the project would result in total VOC emissions of 31.3 tons/year. The reduction in Reid vapor pressure and benzene in gasoline blending stocks as a result of the project would reduce fugitive VOC emissions from gasoline storage tanks by 9 tons/year. Therefore, the project would result in a net increase in VOC emissions of 22.3 tons/year (Table 4.3-10).

Proposed project equipment, project modifications to existing equipment, and existing equipment affected by the project would increase SO_x emissions from the refinery by 36.6 tons/year (Table 4.3-10). These emissions would not be reduced by onsite offsets or necessarily by offsets taken contemporaneously with the project at another source in the San Francisco Bay Area.

On a regional scale, the production of low-sulfur diesel fuel and reformulated gasoline will substantially reduce criteria pollutant emissions from motor vehicles and other internal combustion engines. Table 4.3-15 shows the estimated benefits of reformulated gasoline in the Bay Area, Solano County, and Benicia in 1996. Reformulated gasoline is a key component of the Bay Area's Clean Air Plan and of California's strategy to reduce emissions from its biggest polluter, the motor vehicle.

Exxon sells approximately 700,000 barrels of gasoline a week from the Benicia Refinery in the San Francisco Bay Area. This represents about 20 percent of the Bay Area market. Table 4.3-16 presents the regional reduction in criteria pollutants that would be directly attributed to the reformulated fuel produced by the Benicia Refinery.

Impact No. 7 **The proposed project would result in a net decrease in emissions of criteria pollutants that cause regional air quality impacts. This would be a beneficial impact on regional air quality.**

Table 4.3-16 provides an inventory of project-related emissions of regional air pollutants (i.e., SO_x, NO_x, and VOCs). As shown in the table, project equipment, project modifications or affects on existing refinery equipment, and traffic caused by project employees would increase emissions of SO_x and VOCs. Project modifications to the existing hydrogen plant furnaces would result in a net decrease in refinery emissions of NO_x. Onsite offsets of NO_x and VOCs combined with regional reductions in vehicle emissions of criteria pollutants from the use of reformulated fuel produced by the Benicia Refinery would more than offset the emission increases caused by the project. Therefore, the project would result in a net decrease in regional emissions of SO_x, NO_x, and VOCs.

Particulate matter emissions from the project would incrementally contribute to PM_{10} concentrations in the San Francisco Bay Area. The reduction in SO_x and NO_x emissions from vehicular exhaust attributed to the use of reformulated fuel from the refinery would more than compensate for these increased emissions. As discussed above, SO_x and NO_x contribute to

TABLE 4.3-15

CRITERIA POLLUTANT REDUCTIONS FROM REFORMULATED GASOLINE IN 1996 (tons per year)

Pollutants	Bay Area[a]	Solano[a]	Benicia[b]
Reactive hydrocarbons[c]	9,490	339	20
Carbon monoxide	75,920	3,285	197
Sulfur oxides	1,825	95	6
Nitrogen oxides	4,015	365	22

[a] Source: California Air Resources Board 1993.

[b] Benicia approximately 6% of Solano County benefits.

[c] Reactive hydrocarbons not considered a criteria pollutant.

TABLE 4.3-16

INVENTORY OF REGIONAL CRITERIA POLLUTANTS ASSOCIATED WITH PROJECT OPERATIONS

Pollutant	Stationary Source Emissions (tons/year)	Worker Vehicle Trip and Truck Trip Emissions (tons/yr)	Total Emissions From Mobile and Stationary Sources (tons/year)	Onsite Emission Reductions (tons/year)	Pollutant Reductions[a] Attributable to Use of Exxon Reformulated Fuels in the San Francisco Bay Area (tons/yr)	Total Project Regional Emissions (tons/year)	BAAQMD[b] Emission Significance Levels (tons/year)	Significant Impact on Regional Air Quality
SO_2	36.6	0.1	36.7	-	-365	-328.3	27	No
NO_X	116.5	0.8	117.3	-140.5	-803	-826.2	27	No
VOC[c]	31.3	0.4	31.7	-9.0	-1898	-1875.3	27	No

[a] Source: CARB 1993 and based on 20% gasoline market share in the Bay Area for Exxon.

[b] Based on BAAQMD's daily emission significance level of 150 lb/day.

[c] VOC not considered a criteria pollutant.

PM_{10} concentrations through the formation of secondary particulates (sulfates and nitrates). Roughly 1/6th of NO_x emissions and 1/4th of SO_x emissions become PM_{10}. For this reason, the proposed project would not contribute to the regional PM_{10} problem.

Mitigation Measure No. 7

No mitigation is required because of the overall emission benefit of using Exxon reformulated fuels in the Bay Area. It should also be noted, as discussed under mitigation measure No. 4, it will be necessary for Exxon to obtain offsets for SO_x emissions in order to obtain an air permit from the BAAQMD. Exxon proposes to obtain these emission offsets from the BAAQMD Emissions Bank. Those offsets would be greater than project emissions by a ratio of 1.2 to 1, or 43.9 tons/year.

Since the specific source of the SO_x offsets is not known at the present time, it is uncertain whether these offsets would be contemporaneous with the proposed project or not. Because of this, use of these offsets was not considered in the evaluation of potential impacts. However, if contemporaneous offsets are obtained (for example, the shutdown of another source in the region concurrent with the project), this would be an added benefit to regional air quality.

4.3.3 Odor Impacts and Mitigation

Impacts of odorous compounds emitted from the proposed project were evaluated based on ground-level concentrations calculated during the public health risk assessment (refer to Section 4.4). Modeled compounds that would have the potential to cause objectionable odors noticeable in the vicinity surrounding the proposed project include: acrolein, ammonia, formaldehyde, hydrogen sulfide, sulfur dioxide, and xylenes. Odor impacts were evaluated at the local level since odors are typically a localized problem.

Significance Criteria. The significance criteria for odorous compounds were based on odor detection thresholds. Because the effect of each compound is different, each chemical has its own specific odor threshold concentration, which represents the level at which odors would be noticeable to humans. For this analysis, the lowest odor detection thresholds from a detailed search of existing literature (Amoore and Hautala 1983, Calvert and Englund 1984, and Stern 1976) were used. Maximum 1-hour predicted ground-level concentrations exceeding these thresholds were deemed to have a significant impact. Similarly, if BAAQMD standards for allowable emissions based on BAAQMD Regulation 7 or Regulation 9, Rule 2 were violated, the project would have a significant impact.

Impact No. 8 **Normal operation of the proposed project would not result in offsite ground-level concentrations of odorous compounds that exceed odor thresholds. Therefore, normal operations would result in no odor impacts.**

Table 4.3-17 shows the expected maximum 1-hour concentrations of potential odor-causing chemicals from the project based on modeling conducted for the project health risk assessment. These maximum concentrations represent the highest anticipated concentrations of these chemicals during normal operations for locations outside the refinery property boundary. With the exception of H_2S, the maximum concentration of each compound in the analysis is below the significance criteria by an order of magnitude or greater. The projected maximum 1-hour H_2S concentration is about 27 percent of the applicable threshold. Given the acute and localized nature of odor impacts, it is unlikely that these estimated concentrations will add significantly to existing odors in the vicinity of the refinery.

The maximum 1-hour H_2S concentration is also well below the allowable 1-hour level specified in BAAQMD Regulation 9, Rule 2. For shorter time periods (e.g., 3-minutes), normal project operations are expected to result in H_2S concentrations below the applicable 3-minute threshold.

Mitigation Measure No. 8

No mitigation is required.

TABLE 4.3-17

SUMMARY OF ODOR IMPACTS

Chemical	Modeled 1-hour Maximum Concentration (mg/m^3)	Odor Threshold Concentration (mg/m^3)	Comments
Acrolein	9.14×10^{-8}	3.66×10^{-1} (a)	Below Threshold
Ammonia	3.43×10^{-2}	$3.61 \times 10^{+0}$ (a)	Below Threshold
Formaldehyde	1.58×10^{-4}	$1.02 \times 10^{+0}$ (a)	Below Threshold
Hydrogen Sulfide	1.38×10^{-4}	6.50×10^{-4} (b)	Below Threshold
Sulfur Dioxide	1.21×10^{-1}	$1.23 \times 10^{+0}$ (b)	Below Threshold
Xylenes	1.47×10^{-2}	$1.17 \times 10^{+0}$ (c)	Below Threshold

(a) Source: Amoore and Hautala 1983.

(b) Source: Calvert and Englund 1984.

(c) Source: Stern 1976.

4.3.4 Cumulative Impacts

The new state and federal reformulated fuel specifications will require modifications to all of the refineries in the San Francisco Bay Area. Many of the refineries will have to add hydrotreating units to reduce sulfur concentrations in fuel products. Some refineries will also add units that further process residual oils, producing more reformulated fuel from each barrel of crude. As of November 1992, gasoline sold in California was required to contain elevated levels of oxygen, primarily to produce less CO emissions when burned. At present, the refineries in the Bay Area are blending MTBE with gasoline stocks to meet this requirement.

The TOSCO and Chevron refineries in addition to the Benicia Refinery plan to construct plants to produce oxygenates.

Many of these modifications will require the installation of new furnaces, heaters, and reboilers that produce all of the criteria pollutants. Criteria pollutants would also be emitted from the planned Crockett cogeneration plant. New or modified sources within these proposed projects would be required to use BACT to minimize emissions and, in most instances, would be required to offset any remaining increased emissions of VOCs, NO_x, SO_2, and PM_{10}, in amounts greater than would be emitted. The needed offsets would be obtained by closure or modification of existing sources at the facility (onsite offsets) or from emission reductions at other facilities (offsite offsets). While these offsets would result cumulatively in an overall decrease in regional emissions (if the offsets are contemporaneous in time with the emission increases), and in some cases a local net reduction in emissions, local impacts from cumulative development of these projects were still evaluated.

A program administered by the BAAQMD to address cumulative air quality impacts is the Prevention of Significant Deterioration (PSD) program. The PSD program is a long-standing federal requirement with the goal of preventing the deterioration of air quality in areas that currently meet ambient air quality standards. Areas that meet ambient standards are considered clean air areas, not in absolute terms, but the sense that concentrations of individual pollutants are low enough not to impact public health and welfare. The program perceives clean air to be a resource to be conserved by preventing significant deterioration in air quality.

The PSD program operates by capping the cumulative increase in ambient concentrations of SO_2, NO_2, and PM that can be caused by new or expanding stationary sources. The cap exists in the form of an "air quality increment" which fixes the amount that air quality is allowed to deteriorate above a baseline concentration for each pollutant. While the program recognizes that any new or expanding source, including motor vehicles, can contribute to air quality deterioration, it only holds larger sources (major sources) responsible for ensuring that the increments are not exceeded. A major source that has a cumulative increase in emissions of 15 to 40 tons/year, depending on the pollutant, is held accountable for both its individual impact ("increment consumption") and the cumulative impact of other sources in the region (that portion of the increment already consumed). This increment analysis is performed using maximum permitted emission levels. Once the allowed air quality increment in an area is consumed by the cumulative impact of all sources, the cap on air quality deterioration is reached and new or expanding major sources can no longer be permitted in the area.

Smaller sources are allowed to contribute to air quality deterioration without evaluating their increment consumption, because their individual impacts are deemed to be small and because it would be administratively impractical to include them directly in the PSD program. However, the contribution of smaller sources to overall air quality deterioration must be accounted for by larger sources seeking to meet PSD requirements. In addition, all new or modified sources, no matter how large or small, cannot cause or contribute to a violation of the ambient air quality standards, irrespective of the PSD increments.

The estimated emissions from the Exxon Clean Fuels project are below the applicable BAAQMD emission levels which would require a PSD analysis.[7] Therefore, a PSD analysis was not performed for this project. These emissions increases, however, would need to be considered as part of the next PSD project that affects the area, or if cumulative emission increases from the refinery as a result of a future refinery project, which would include the current project's emissions, exceed the levels requiring a PSD analysis.

[7] Only emission increases from new and modified sources are counted toward the PSD emission threshold. Emissions associated with the "affected" sources are within permitted levels and therefore do not count toward PSD applicability.

Significance Criteria. The evaluation of the cumulative impacts of ground-level concentrations of criteria pollutants was done in two steps. In the first step, the calculated concentrations (using air quality modeling) from the project were compared to BAAQMD screening threshold concentration impact criteria (Table 4.3-8). The EPA and BAAQMD, as a matter of public policy, consider sources with impacts below these concentration levels to be insignificant contributors to air quality deterioration and too small to interfere with the attainment or maintenance of ambient air quality standards. Modeled concentrations of pollutants above these threshold criteria were evaluated in a second step to determine if they would cause a significant cumulative impact to air quality. That second step consisted of adding project-related concentrations to existing background concentrations and to estimated concentrations from other proposed or planned projects in the region that could affect air quality in Benicia, and comparing this result with the ambient air quality standards. As recommended by the BAAQMD (BAAQMD 1985, revised 1991), if the sum of concentrations from these sources caused the air quality standards to be violated, the project was judged to have a significant cumulative air quality impact.

Impact No. 9 **Project emissions of NO_x would not have a cumulative impact on local air quality. No cumulative impact would occur.**

As discussed above, the proposed project would result in a net decrease in NO_x emissions from the refinery. For this reason, the project would have a beneficial impact on local cumulative NO_2 levels. In addition to the Clean Fuels project, Exxon is planning to retrofit existing heaters, boilers, and gas turbines at the Benicia Refinery as part of the Nitrogen Oxides Emissions Reductions projects. These projects are being carried out in response to new rules under development by the BAAQMD for reduction of nitrogen oxides emissions from existing refinery equipment. These projects will result in additional NO_x emission reductions from the Benicia Refinery.

Mitigation Measure No. 9

No mitigation is required.

<u>Impact No. 10</u> Project emissions of CO, PM_{10}, and SO_x would have a cumulative impact on local air quality. This impact would not be significant.

The maximum predicted CO and PM_{10} concentrations resulting from project emissions would be below the BAAQMD's screening threshold concentration criteria of significance (Table 4.3-12). While the project would contribute to the air quality deterioration for this pollutant, the contribution would be too small to result in significant cumulative air quality impacts.

The maximum modeled 24-hour SO_2 concentration (over a 5-year period) from project emissions was 6 $\mu g/m^3$ compared to the significance level of 5 $\mu g/m^3$, slightly above the threshold criteria (Table 4.3-12), but well below the CAAQS for SO_2 for this averaging time of 105 $\mu g/m^3$. Because the predicted maximum concentration was above the threshold, the potential for cumulative impacts were evaluated further.

Of the other projects that are planned or proposed at the Exxon Benicia Refinery, and other projects within the regional area that were identified in Section 3.0 (Other Related and Cumulative Projects), the following projects could be associated with cumulative SO_2 impacts:

- Exxon MTBE Unit
- Shell Refinery - Martinez: reformulated fuels
- Pacific Refinery - Hercules: reformulated fuels
- Chevron Refinery - Richmond: MTBE and reformulated fuels projects
- Unocal Refinery - Rodeo: reformulated fuels
- TOSCO Avon Refinery - Martinez: reformulated fuels
- C & H Sugar Cogeneration Project - Crockett

Other projects identified in Section 3.0 and not listed above would not involve significant emissions of SO_x, and therefore were not considered.

Of the potential Exxon projects, the MTBE Unit project would result in a net onsite reduction of SO_x emissions (1.5 tons per year) (ENSR 1993b) and would result in a beneficial cumulative impact. The Exxon MTBE Import Facility is currently in operation and was considered as part of the existing environment.

Of the projects identified within the vicinity of the Exxon facility several were eliminated from evaluation of cumulative impacts since these are projects that are too distant to result in cumulative impacts. While these projects may have local impacts their contribution to a cumulative impact with the proposed project would be insignificant due to the decrease in pollutant concentrations over the distance separating the projects. The following projects were eliminated for this reason:

- Pacific Refinery
- Chevron Refinery
- Unocal Refinery

The remaining three projects (Shell, TOSCO, and C & H Sugar Cogeneration) were evaluated for cumulative SO_2 impacts on local air quality.

The Shell Clean Fuels project at the Martinez refinery would result in a net decrease in SO_2 emissions (about a 420-ton-per-year decrease) due to the burning of lower sulfur content fuel in three existing boilers at the facility (EIP Associates 1993). Thus, Shell would not contribute to cumulative SO_2 concentrations and would result in a beneficial cumulative impact.

The C & H Sugar Cogeneration Project would use natural gas as fuel for the proposed gas turbines. Since natural gas has only trace amounts of sulfur in it, SO_x emissions from burning natural gas are generally small. Estimated SO_x emissions from the gas turbines are about 8 tons per year (EIP Associates 1993); 4.6 times lower than those from the proposed Clean Fuels project. Furthermore, as part of the C & H cogeneration project, the existing two boilers will be shut down, resulting in a decrease of 120.8 tons per year of SO_x emissions. This will result in a net decrease of 112.8 tons per year in SO_x emissions from the cogeneration project. Therefore, the C & H cogeneration project in Crockett would not significantly contribute to cumulative SO_2 impacts with the proposed Clean Fuels project.

Emissions from the TOSCO reformulated fuels project are unknown, but have been estimated to have SO_2 emissions of about 93 tons per year (EIP Associates 1993). This emission rate is about 2.5 times higher that the SO_2 emissions from the Exxon project. Specific information on whether TOSCO will provide onsite emission reductions to mitigate some or all of the expected SO_2 emission increases is not available. Therefore, an analysis was performed to estimate potential cumulative SO_2 impacts. Assuming that both the Exxon project and the TOSCO reformulated fuels project would produce similar pollutant dispersal characteristics but with TOSCO's impacts being approximately 2-1/2 times greater than Exxon's due to the higher emissions, the maximum concentration expected near the TOSCO refinery would be about 15 $\mu g/m^3$. Assuming TOSCO's maximum SO_2 concentration at the Exxon project's maximum impact point is 10 times lower (based on BAAQMD 1993c), the resulting concentration would be about 1.5 $\mu g/m^3$. When this concentration is added to the background concentration of 44.5 $\mu g/m^3$ and the maximum Exxon Clean Fuels Project of 5.7 $\mu g/m^3$, the resulting total concentration would be 52 $\mu g/m^3$. This concentration is well below the 24-hour SO_2 increment of 91 $\mu g/m^3$ and the state standard of 105 $\mu g/m^3$. Therefore, the project would not result in a significant cumulative impact.

Mitigation Measure No. 10

No mitigation is required.

4.4 PUBLIC HEALTH RISK

As indicated in Section 4.3, the proposed Clean Fuels Project would result in emissions of various compounds into the atmosphere that can be generally classified as either criteria air pollutants or air toxics.

Criteria air pollutants are compounds for which federal and state ambient air quality standards (airborne concentrations) have been established to protect the public health and welfare. Air quality impacts caused by project emissions of criteria pollutants are discussed in Section 4.3 of the EIR.

Emissions of air toxics is the primary source of potential public health risks caused by the project. No specific air quality standards have been established for these compounds, but they are known or suspected of causing short-term (acute) and/or long-term (chronic or carcinogenic) adverse human health effects. Air toxics include both organic and inorganic chemicals, and are emitted from the same types of sources as other air pollutants. This section discusses the potential for public health impacts due to project emissions of air toxics.

4.4.1 Environmental Setting

Related Regulations

Federal. Air toxics have been regulated at the federal level since the Clean Air Act Amendments (CAAA) of 1977. Following the passage of this law, regulations for seven hazardous air pollutants (HAPs) were promulgated as National Emission Standards for Hazardous Air Pollutants (NESHAPS) over a 13-year period. These regulations relied on the establishment of allowable HAP concentrations from specific types of emission sources.

The federal Clean Air Act Amendments of 1990 revamped the NESHAPS program to offer a technology-based approach for reducing air toxic emissions. Under the 1990 CAAA, a group of 189 substances were identified as HAPs, and slated for regulation under a two-phased program. The first phase involves requiring facilities to control air toxic emissions by the installation of Maximum Achievable Control Technology (MACT). MACT standards will be set by the federal EPA, but are expected to be implemented and enforced in the San Francisco Bay Area by the Bay Area Air Quality Management District (BAAQMD). MACT standards will vary, depending on the type of emission source. The EPA has not yet promulgated any final MACT standards, but listed petroleum refining operations on July 16, 1992, as sources for which MACT standards are to be promulgated. When final petroleum refining NESHAPS regulations are promulgated by the EPA, the Benicia Refinery would become subject to its requirements.

The second phase of control involves determination of the residual health risk represented by an air toxics emissions source after implementation of MACT standards. Residual risk standards are to be set within eight or nine years after MACT standards for a source category are promulgated.

State. California's air toxics control program began in 1983 with the passage of the Toxic Air Contaminant Identification and Control Act, better known as Assembly Bill 1807 (AB 1807) or the Tanner Bill. The Tanner Bill established a regulatory process for the scientific and public review of individual toxic compounds. When a compound becomes listed as a "toxic air contaminant" (TAC) under the Tanner process, the California Air Resources Board (CARB) normally establishes minimum statewide emission control measures to be adopted by local air pollution control districts (APCDs). Recent legislative amendments (AB 2728, Tanner 1992) required the CARB to incorporate all 189 federal HAPs into the list of TACs. In April 1993, the CARB added 171 new substances to the state program (18 of the 189 federal HAPs had previously been listed by the CARB).

The second major component of California's air toxics program, supplementing the Tanner process, was provided by the passage of AB 2588, the Air Toxics "Hot Spots" Information and Assessment Act of 1987. AB 2588 currently addresses over 500 air toxics, including all of the Tanner-designated TACs. Under AB 2588, specified facilities must quantify emissions of more than 200 of the substances and report them to the local APCD.[1] (The use, production, or presence of the other pollutants must be reported to the local district, but do not need to be evaluated further.) The APCD then identifies high priority facilities from the

[1] The Bay Area Air Quality Management District is the APCD for the San Francisco Bay Area.

reported toxic emissions; these high priority facilities must prepare and submit health risk assessments. If the APCD determines that there is a significant public health risk posed by a given facility, the facility is required to notify the public in the affected area, and develop and implement a risk reduction plan.

Local. In compliance with federal law, the Bay Area Air Quality Management District (BAAQMD) has adopted rules to implement NESHAPS regulations established under the 1977 Clean Air Act Amendments. In compliance with state law, the BAAQMD has also developed various regulations pursuant to the Tanner process for existing and future TAC emission sources, and is administering the AB 2588 program.

In addition, since 1987 the BAAQMD has operated under a risk management policy for new and modified sources which includes a risk screening analysis of all permit applications for potential air toxic emissions. If projected emissions of specified air toxic compounds from a proposed new or modified source suggest a potential public health risk, then the applicant is required to submit a health risk assessment. For new or expanding projects, the project must apply best available control technology for toxics (T-BACT) when the calculated risk is more than 1 in 1 million. The maximum risk level for a project acceptable to the BAAQMD is 10 in 1 million.

Background Levels of Air Toxics

Current ambient levels of air toxics define the existing environment. Emissions from the existing Benicia Refinery contribute to current background levels.

Concentrations of air toxics are not monitored in Benicia. The BAAQMD does operate air toxics monitoring stations in Martinez and Vallejo to measure ambient concentrations of some of the HAPs of greatest concern to the District. Of these two stations, Martinez is the closest and most representative of meteorological conditions in Benicia. In addition, Martinez is affected by the same type of emission sources as Benicia. Table 4.4-1 provides air toxics monitoring data for both Martinez and Vallejo.

TABLE 4.4-1

AMBIENT AIR TOXICS DATA FOR MARTINEZ, VALLEJO, AND THE BAY AREA IN 1992

	Martinez		Vallejo		Bay Area Average[a]	
Chemical	ppb	μg/m³	ppb	μg/m³	ppb	μg/m³
Acetaldehyde	NM[b]	--	NM	--	1.8	4.6
Benzene	1.39	4.43	1.63	5.19	2.01	6.50
1,3-Butadiene	NM	--	NM	--	0.25	0.60
Carbon tetrachloride	0.11	0.73	0.11	0.73	0.13	0.83
Chloroform	0.01	0.05	0.02	0.10	0.03	0.15
Dichloromethane	ND[c]	--	1.26	4.58	1.05	5.78
Ethylene dibromide	ND	--	ND	--	ND	--
Ethylene dichloride	ND	--	ND	--	ND	--
Formaldehyde	NM	--	NM	--	2.0	2.5
Tetrachloroethylene	0.96	6.82	0.23	1.63	0.30	2.06
Toluene	2.34	8.79	2.81	10.6	3.50	13.1
Trichloroethane, 1,1,1-	0.51	2.70	6.39	33.8	1.51	8.14
Trichloroethylene	ND	--	ND	--	0.11	0.60
Vinyl Chloride	ND[b]	--	ND	--	ND	--

Source: BAAQMD 1993a
[a] 1991 data
[b] NM = not monitored at this location
[c] ND = not detected at this location

The air in Martinez is probably affected by emissions from the Shell and Tosco refineries as well as the Benicia Refinery. To give some perspective on the influence of refineries and other sources on ambient air quality, the average concentrations of air toxics for 19 monitoring sites in the Bay Area are also provided in Table 4.4-1. The table shows that Martinez, near several refineries, has similar levels of air toxics as the rest of the Bay Area. The largest single source of background cancer risk from air toxics in the Bay Area comes from motor vehicles, according to the BAAQMD (BAAQMD 1992a). Other studies have made similar findings for California in general (Cooper and Reisman 1992).

Cancer Risk. Cancer risk is defined as the lifetime probability (chance) of developing cancer as a result of exposure to a carcinogen. The risk to any exposed individual is typically expressed in terms of chances in a million of contracting cancer. The cancer risk for inhaling air toxics is estimated by multiplying the concentration of the chemical in the air by a cancer "unit risk factor." This factor estimates cancer risk for continuous exposure to 1 $\mu g/m^3$ of a chemical over a 70-year lifetime, assuming that an average person breathes 20 cubic meters of air per day. Unit risk factors are based on long-term studies of human populations where possible. In many cases, data on human response to carcinogens is incomplete and cannot be used to quantify risk. In those cases, unit risk factors are based on animal data that has been extrapolated to humans.

The procedures used to calculate cancer risk assume that the risk is proportional to the concentration at any level of exposure; that is, there is no non-zero dose that would result in a zero probability of contracting cancer. This is a conservative assumption for low doses that may tend to over estimate actual cancer risk.

Unit risk factors currently used by regulatory agencies in California and the Bay Area come from the California Air Pollution Control Officers Association (CAPCOA) 1992 AB 2588 Risk Assessment Guidelines (CAPCOA 1992). Table 4.4-2 shows these factors for the pollutants monitored by the BAAQMD and for other chemicals of concern for the Benicia Refinery.

Table 4.4-3 gives the estimated cancer risk resulting from air toxics concentrations monitored in Martinez and Vallejo, as well as for the average concentration of these pollutants measured

TABLE 4.4-2

UNIT RISK FACTORS FOR SELECTED AIR TOXICS

Chemical	Unit Risk Factor ($m^3/\mu g$)
Acetaldehyde	2.2×10^{-6}
Arsenic	3.3×10^{-3}
Benzene	2.9×10^{-5}
Beryllium	2.4×10^{-3}
1,3-Butadiene[1]	2.8×10^{-4}
Cadmium	4.2×10^{-3}
Carbon tetrachloride	4.2×10^{-5}
Chloroform	5.3×10^{-6}
Chromium VI	1.4×10^{-1}
Dichloromethane (methylene chloride)	1.0×10^{-6}
Formaldehyde[2]	1.3×10^{-5}
Lead	8.0×10^{-5}
Nickel	2.6×10^{-4}
Polycyclic aromatic hydrocarbons (PAHs)	1.7×10^{-3}
Selenium	1.4×10^{-4}
Tetrachloroethylene[3]	5.8×10^{-7}
Trichloroethylene	2.0×10^{-6}

Source: CAPCOA 1992

[1] 1,3-Butadiene URF recently reduced to 1.7×10^{-4}, but modeled as 2.8×10^{-4} in risk assessment.

[2] Formaldehyde URF recently reduced to 6.0×10^{-6}, but modeled as 1.3×10^{-5} in risk assessment.

[3] Tetrachloroethylene URF recently increased to 5.9×10^{-6}. Not a pollutant for Benicia Clean Fuels Project.

TABLE 4.4-3

CANCER RISK FOR AMBIENT AIR IN MARTINEZ, VALLEJO, AND THE BAY AREA (PER MILLION)

Chemical	Martinez	Vallejo	Bay Area Average
Benzene	128	151	190
Carbon tetrachloride	31	31	35
Chloroform	<1	<1	<1
Tetrachloroethylene	4	1	1
Vinyl chloride	[<31][a]	[<31][a]	<31
Methylene Chloride	[6][b]	[6][b]	6
Trichloroethylene	[1][b]	[1][b]	1
1,3-Butadiene	[100][b]	[100][b]	100
Formaldehyde	[15][b]	[15][b]	15
Acetaldehyde	[9][b]	[9][b]	9
Metals, dioxins and PAHs	[107][b]	[107][b]	107
Asbestos	[40][b]	[40][b]	40
TOTAL	473[c]	493[c]	536

Source: Calculated from Tables 4.4-1 and 4.4-2 unless otherwise noted

[a] Not detected anywhere in Bay Area. Number shown is risk calculated at the monitoring detection limit.

[b] Not reported for Martinez or Vallejo; number shown is average for Bay Area (BAAQMD 1992a).

[c] Includes Bay Area average for 1,3-butadiene, formaldehyde, acetaldehyde, metals, PAHs, dioxins, methylene chloride, trichloroethylene, and asbestos, as well as a calculated risk from vinyl chloride assuming exposure at detection limit.

at all Bay Area stations. The cancer risks for air toxics presented in this table do not account for all of the potential risk from air toxics. Not all air toxics are monitored in the Bay Area, and different chemicals are monitored at different stations. In addition, while the air pathway represents the primary pathway for exposure to air toxics, some cancer risk can be attributed to indirect pathways such as deposition of air toxics on the soil and subsequent ingestion through consumption of vegetables and fruits grown in the soil. Because of the conservative nature of the calculations used to estimate cancer risk, the probabilities provided in Table 4.4-3 are expected to capture most of the risk associated with air toxics.

The risk values for air toxic levels in Martinez and Vallejo can be compared against the background cancer incidence rate in the United States from all causes, which is about 1 in 4, or 250,000 in a million. It is generally believed that a large portion of the total background cancer risk comes from smoking habits, genetic susceptibilities, diet, natural radiation including radon, and other lifestyle factors. According to one source, smoking may account for about 40% of the background cancer incidence (Wilson and Crouch 1982). The calculated cancer risk from air toxics (Table 4.4-3) in Martinez and Vallejo represent about 0.2% of the average background cancer risk.

Non-Cancer Risk. In determining potential non-cancer health risks from air toxics, it is assumed that there is a dose of the chemical of concern below which there would be no impact on human health. Non-cancer health risk is measured in terms of a hazard index, which is the concentration of an air toxic compound divided by its acceptable exposure level (AEL). If the reported concentration of a given chemical is less than its AEL, then its hazard index is less than 1.0 and there is no health effect. When more than one chemical is involved, it is assumed that multiple subthreshold exposures could result in an adverse health effect. Typically, for a given set of chemicals, hazard indices are summed for each organ system that each chemical can affect. For any organ system, a total hazard index exceeding 1.0 indicates a potential health effect.

AELs currently used by regulatory agencies in California and the Bay Area are contained in the CAPCOA AB 2588 Risk Assessment Guidelines (CAPCOA 1992). Table 4.4-4 shows these current AEL values for the air toxics monitored in Martinez and Vallejo and other chemicals of concern for the Benicia Refinery.

TABLE 4.4-4

ACCEPTABLE EXPOSURE LEVELS FOR SELECTED AIR TOXICS
(Page 1 of 2)

Chemical	Acceptable Exposure Level ($\mu g/m^3$)
Acetaldehyde	$9.0 \times 10^{+0}$
Acrolein	2.0×10^{-2}
Ammonia	$1.0 \times 10^{+2}$
Arsenic	5.0×10^{-1}
Benzene	$7.1 \times 10^{+1}$
Beryllium	4.8×10^{-3}
Cadmium	$3.5 \times 10^{+0}$
Carbon tetrachloride	$2.4 \times 10^{+0}$
Chloroform	$3.5 \times 10^{+1}$
Chromium VI	2.0×10^{-3}
Copper	$2.4 \times 10^{+0}$
Dichloromethane	$3.0 \times 10^{+3}$
Formaldehyde	$3.6 \times 10^{+0}$
Hydrogen sulfide	$4.2 \times 10^{+1}$
Lead	$1.5 \times 10^{+0}$
Manganese	4.0×10^{-1}
Mercury	3.0×10^{-1}
Napthalene	$1.4 \times 10^{+1}$
Nickel	2.4×10^{-1}
Nitrogen dioxide	$4.7 \times 10^{+2}$
Phenol	$4.5 \times 10^{+1}$
Selenium	5.0×10^{-1}
Sulfur dioxide	$6.6 \times 10^{+2}$

TABLE 4.4-4

ACCEPTABLE EXPOSURE LEVELS FOR SELECTED AIR TOXICS
(Page 2 of 2)

Chemical	Acceptable Exposure Level ($\mu g/m^3$)
Tetrachloroethylene	$3.5 \times 10^{+1}$
Toluene	$2.0 \times 10^{+2}$
Trichloroethane 1,1,1	$3.2 \times 10^{+2}$
Trichloroethylene	$6.4 \times 10^{+2}$
Xylenes	$3.0 \times 10^{+2}$
Zinc	$3.5 \times 10^{+1}$

Source: CAPCOA 1992

Chronic toxicity is defined as adverse health effects caused by prolonged chemical exposure. Chronic effects are the result of continued administration of chemicals over an extended period of time. Symptoms of chronic effects usually do not appear until long after exposure commences. The lowest no-effect exposure level for a noncarcinogenic air toxic is the chronic AEL. Below this threshold, the body is capable of eliminating or detoxifying the chemicals rapidly enough to prevent long-term health-effects. Annual average concentrations of air toxics are compared against chronic AELs to obtain a hazard index for health effects caused by chronic exposure to chemicals in the air.

Acute toxicity is defined as adverse health effects caused by a brief chemical exposure of no more than 24 hours. For most chemicals, the air concentration required to produce acute effects is higher than levels required to produce chronic effects because the duration of exposure is shorter. One-hour average concentrations are compared against acute AELs to obtain a hazard index for health effects caused by relatively high, short-term exposure to chemicals in the air.

Table 4.4-5 shows the estimated non-cancer health risk from the monitored air toxics in Martinez and Vallejo, and the average values for all Bay Area monitoring stations. The hazard index values presented in Table 4.4-5 are not published estimates from the BAAQMD, but instead are calculations from the available monitoring data. The organ system with the highest hazard index calculated from the background data is the gastrointestinal system and liver (GI/liver), with values of 0.50, 0.46, and 0.44, respectively, for Martinez, Vallejo, and the Bay Area average. Since these values are below 1.0, there is little potential for toxicity in sensitive individuals. Whether any toxicity for noncarcinogenic air pollutants is occurring in the Benicia area depends on whether other substances that are not monitored by the BAAQMD contribute substantially to the hazard index.

Health Risks Caused by the Existing Benicia Refinery

In accordance with AB 2588 regulations, Exxon performed a health risk assessment (Radian 1991) for the Benicia Refinery to evaluate its impact on health to the surrounding communities. Health risks from emissions of air toxics were estimated in accordance with

TABLE 4.4-5

NON-CANCER CHRONIC HAZARD INDEX[a] (HEALTH RISKS) FOR AMBIENT AIR IN MARTINEZ, VALLEJO, AND THE BAY AREA

Chemical	Martinez	Vallejo	Bay Area Average	Affected Organ(s)
Benzene	0.06	0.07	0.09	nervous system
Carbon tetrachloride	0.30	0.30	0.35	gastrointestinal/liver
Chloroform	<0.01	<0.01	<0.01	gastrointestinal/liver
Tetrachloroethylene	0.19	0.05	0.06	gastrointestinal/liver; kidney
Toluene	0.04	0.05	0.07	nervous system; reproductive system
Trichloroethane 1,1,1	<0.01	0.11	0.03	gastrointestinal/liver; nervous system; reproductive system
TOTAL	0.50	0.46	0.44	gastrointestinal/liver

[a] The hazard index significance threshold is 1.0.

Source: Calculated from Tables 4.3-1 and 4.3-4 the CAPCOA Guidelines in effect in 1990 (CAPCOA 1990), except that some toxicity factors were updated to 1991 values approved by the California Office of Environmental Human Health Assessment (OEHHA). Table 4.4-6 summarizes the risks by environmental pathway of exposure as presented in the 1991 health risk assessment. All exposure estimates were performed for a hypothetical maximally exposed individual (MEI), who is assumed to reside 7 days a week, 24 hours per day for 70 years at the point outside of the refinery property where the combination of annual average concentrations of emitted chemicals produce the highest cancer risk. The MEI for the existing refinery was located near Carlisle Court in the Southhampton residential area.

Since the time the health risk assessment was prepared, CAPCOA has updated its guidelines, most recently in 1992 (CAPCOA 1992). Moreover, the BAAQMD requested that Exxon revise its dispersion modeling methodology for the Clean Fuels project, and, in addition, new methods for estimating emissions from refinery combustion sources have become available. Therefore, the risk estimates made in 1991 could change if the assessment were performed with the new methods and data. Note that the real risks, whatever they are, do not change; it is only the methods of estimation that have changed, presumably in the direction of more accuracy.

Rather than undertake a complete new assessment of pre-project risks, Radian has analyzed the effect of several of the key changes described above, and this analysis was reviewed for this EIR. Exxon estimates that the changes overall would reduce the risk estimate by about 0.7 in a million, to about 8.4 in a million (R2C2 1993). The methods used to estimate this risk were reviewed by the preparers of this EIR, who determined them to be reasonable and conservative (R2C2 1993).

The risk assessment for the existing refinery (Radian 1991) also considered the risks of non-cancer health effects from chronic and acute exposures to refinery emissions. The largest chronic hazard indices calculated for the facility were 0.045 for the kidney, 0.032 for the gastrointestinal/liver, and 0.018 for the respiratory system at a point near the cancer risk MEI. The major contributors to chronic non-cancer risk were cadmium and nickel. Many of the post-1991 changes discussed with respect to modeling cancer risk would apply to the non-cancer risk. Because the chronic hazard indices presented in the 1991 health risk assessment

TABLE 4.4-6

SUMMARY OF CANCER RISKS FOR THE EXISTING BENICIA REFINERY (per million population)

	Exposure Pathway						
Chemical	Inhalation	Soil Ingestion	Vegetables	Fish	Dermal Absorption	Mother's Milk	Total[a]
Arsenic	0.027	0.067	0.016	<0.001	0.001	--[b]	0.111
Benzene	1.3	--[c]	--	--	--	--	1.3
Benzo(a)-pyrene[d]	0.17	0.20	1.5	0.48	0.46	0.007	2.8
1,3-Butadiene	0.37	--	--	--	--	--	0.37
Carbon tetrachloride	0.21	--	--	--	--	--	0.21
Cadmium	0.57	--[e]	--	--	--	--	0.57
Chromium VI	0.42	0.93	0.20	<0.001	1.4	--	2.9
Ethylene dibromide	<0.001	--	--	--	--	--	<0.001
Ethylene dichloride	<0.001	--	--	--	--	--	<0.001
Formaldehyde	0.10	--	--	--	--	--	0.10
Nickel	0.67	--	--	--	--	--	0.67
Total	3.8	1.2	1.7	0.48	1.9	0.007	9.1

Source: Radian 1991

[a] Totals may not add due to rounding
[b] Arsenic and chromium do not concentrate substantially in mother's milk
[c] Benzene, butadiene, carbon tetrachloride, ethylene dibromide, ethylene dichloride, and formaldehyde are vapors
[d] Representing polycyclic aromatic hydrocarbons
[e] Cadium and nickel are not evaluated for carcinogenicity by non-inhalation routes

are all at least 20 times below 1.0, no chronic non-cancer health effects are expected as a result of current refinery air emissions. For the effects of acute exposures,[2] the maximum predicted off-site one-hour concentrations of each chemical were compared against criteria of acceptable exposures at whatever locations these concentrations were highest. The chemical that was closest to posing an acute non-cancer health risk was hydrogen sulfide, for which the maximum one-hour concentration was 3.9 $\mu g/m^3$ and the AEL is 42 $\mu g/m^3$, yielding an acute hazard index of 0.093. The exposure location for this calculation is also west of the refinery, somewhat further south than the cancer risk MEI. Again, this result indicates that acute health effects from the Benicia Refinery are unlikely under normal operating conditions.

The cancer and non-cancer risk estimates for existing operations at the Benicia Refinery can be compared with risks calculated from the ambient levels of air toxics presented in Tables 4.4-3 and 4.4-5. The maximum cancer risk estimate for the refinery is in the vicinity of 8.4 in a million, while the cancer risk from ambient air toxics in Martinez and Vallejo, expected to be representative of Benicia, is in the vicinity of 500 in a million. Therefore, the refinery currently contributes about 1.7% of the cancer risk from airborne toxic pollutants for the MEI; its contribution to risk for other Benicia residents would be lower. This value is similar to the BAAQMD estimate of the contribution of all refineries (2%) to the average Bay Area air toxics risk (BAAQMD 1992a). The greatest chronic hazard index from current refinery emissions is 0.045 for the kidney, while the highest hazard index from ambient air toxics is 0.51 for the GI/liver. The actual hazard index from ambient air toxics is probably higher than reported in this document, since many non-carcinogenic toxicants are not monitored by the BAAQMD. Therefore, the contribution of the Benicia Refinery to the total hazard index at the MEI, about 9%, is probably lower than calculated here. Comparisons for acute non-cancer health risks are not meaningful because peak concentrations of ambient air toxics are not reported by the BAAQMD.

---

[2] The acute effects considered here are those from routinely higher short-term emissions and unfavorable short-term meteorological conditions. They do not include the potential for acute exposure from various kinds of upset and accident conditions, which are covered in Section 4.4.

4.4.2 Impacts and Mitigation

__Significance Criteria__

Cancer risk (the probability or chance of contracting cancer) and the non-cancer hazard index (chronic and acute) were the measures used to evaluate potential public health risk impact. Under various state and local regulations, a cancer risk of greater than 10 in 1 million for the project is considered to be a significant impact on public health. For new or expanding sources, the BAAQMD requires the application of T-BACT for projects with estimated cancer risks exceeding 1 in 1 million; once T-BACT is applied, the acceptable risk level for a project is 10 in 1 million. In addition, the 10 in 1 million risk level is used by the Air Toxics "Hot Spots" (AB 2588) program and California's Proposition 65 as the public notification level for existing sources. For the proposed project, then, the significance criterion for the maximum lifetime incremental cancer risk is 10 in a million. This maximum incremental risk would add to the risk of cancer from all other causes combined, which in the United States today is about 250,000 in a million (or 25%), as discussed above. Environmental and occupational exposures are generally thought to be responsible for a small portion of this background risk. But, because they are often involuntary and in principle can be reduced by regulatory initiatives, environmental and occupational carcinogens are a principal focus of regulatory policy.

In terms of potential noncancer (acute and chronic) health effects, the cumulative exposure to those compounds must be below the AELs established by the California Office of Environmental Health Hazard Assessment (OEHHA) and contained in the 1992 CAPCOA Guidelines (CAPCOA 1992), as measured by the chronic and acute hazard indices. Each of these indicators must be below a value of 1.0 for the maximally impacted organ system in order for the cumulative exposure to noncarcinogenic air toxics to be insignificant.

__Impact Assessment Methodology__

As part of its air permit application for the proposed project, Exxon Research and Engineering Company (ER&E) conducted a health risk assessment for project emissions to comply with the BAAQMD air toxics new source review policy (ER&E 1993a). Because the

BAAQMD must, by their regulations, consider only increases in emissions from a project when considering potential impacts, and not on-site emission decreases, Exxon did not consider the emissions offsets that are incorporated into the project in estimating the project's incremental risk. The risk assessment was submitted and reviewed by the BAAQMD, and judged acceptable on July 19, 1993.

The health risk assessment for the proposed project was independently reviewed by ENSR Consulting and Engineering and its subconsultant, R2C2, to judge its conformance with prescribed risk assessment methods and to verify calculations. Based on this review, the assessment was found to adequately follow the current CAPCOA risk assessment guidelines (CAPCOA 1992), and no calculation errors were found. The assessment methodology is summarized below, followed by a discussion of the inherent uncertainties in this methodology.

A health risk assessment is conducted in four basic steps. First, emissions of air toxics from the project are quantified. Second, ground-level concentrations resulting from the transport and dilution of these emissions through the atmosphere are estimated by air dispersion modeling. Third, potential public exposure to these compounds resulting from this atmospheric transport are calculated for the direct exposure pathway of inhalation and indirect pathways through deposition of particulate-borne pollutants onto soil or water and subsequent ingestion. Finally, potential cancer and non-cancer health effects resulting from the calculated exposures are estimated using dose-response relationships developed from toxicological data.

In the project health risk assessment (ER&E 1993a), new, modified, and affected[3] emission sources were identified for the Clean Fuels Project, as well as for two related projects for which permits were received since 1991. The corresponding air toxic emission rates were estimated for all of these sources. A total of 46 new, modified, affected and related project sources were identified, including combustion sources for supplying heat, fugitive emissions

---

[3] An "affected unit" is a currently operating unit that is expected to experience an emissions increase as a result of the proposed project, although this emissions increase is within the unit's current permit conditions. Under BAAQMD regulations, such a unit does not need to be included in an air toxics new source review analysis; however, Exxon included these units in the project's risk assessment to obtain a health-conservative estimate of risk.

from process units, emissions from storage tanks, and emissions from rail and ship traffic that might be generated by the project. The chemicals of concern identified for the project are listed in Table 4.4-7. Table 4.4-8 provides a list of the emission sources evaluated in the health risk assessment. After the health risk assessment was performed, some emissions sources were removed from the proposed project by Exxon (e.g., HCU distillation unit). Therefore, actual risks would be less than those reported here.

The atmospheric transport and dilution of emissions were estimated using two EPA-approved dispersion models: the Industrial Source Complex Short Term 2 (ISCST2) model and the COMPLEX I model. These mathematical models estimate dilution of emissions by diffusion and turbulent mixing with clean air as they move away downwind from an emissions source. The models can predict the resulting cumulative, ground-level concentrations of pollutants from many point and area sources at numerous specified locations (termed receptors). The models can also take into account the rise of a plume from a point source caused by the temperature and velocity of the exhaust. The ISCST2 model is best suited for receptors below emission release heights, while COMPLEX I is designed for receptors above final plume heights. This protocol was followed for modeling emissions from the Clean Fuels Project. For receptors between these two heights, both models were run and the highest predicted concentrations at each receptor were used. In addition, the modeling considered the effect of "building downwash," which is the introduction of turbulence in the wind flow as a result of structures. Both process units and tanks were considered to be structures for the purposes of the downwash calculations. The effect of these calculations is to bring the plume from elevated sources (stacks) down to ground level more quickly, generally increasing concentrations at nearby locations.

The behavior of pollutant plumes depends on local meteorology. Five years of surface wind and temperature data collected at the Benicia Refinery were included as input to the modeling. A wind rose showing the percent frequency of occurrence of wind speed and direction for the local data is provided in Figure 4.3-2 (in the Air Quality Section 4.3). Upper air and cloud cover data, used to calculate atmospheric turbulence and the available atmospheric height for pollutant mixing, was obtained from Travis Air Force Base. The Air Force base is the closest location considered representative of the Benicia area where these data are collected.

TABLE 4.4-7

CHEMICALS OF CONCERN

SUBSTANCE	REASON FOR CONCERN
ORGANIC CHEMICALS	
Acetaldehyde	carcinogen; respiratory irritant
Acrolein	respiratory irritant
Ammonia	respiratory and skin irritant
Benzene	carcinogen; neurotoxic
1,3-butadiene	carcinogen
Formaldehyde	carcinogen; allergic sensitizer; respiratory irritant
Hydrogen sulfide	odor; eye injury; pulmonary edema; respiratory irritant
Napthalene	headache, nausea, cardiovascular system damage
Phenol	eye, mucous membrane, skin, and respiratory irritant
PAHs	carcinogen
Toluene	neurotoxic; reproductive system damage
Xylenes	respiratory irritant; reproductive system damage
ELEMENTS AND INORGANIC COMPOUNDS	
Arsenic	carcinogen; respiratory irritant; neurotoxic; cardiovascular system damage
Beryllium	carcinogen; respiratory irritant
Cadmium	carcinogen; respiratory irritant; kidney damage
Chromium VI	carcinogen; respiratory irritant; gastrointestinal, liver, and kidney damage
Copper	respiratory irritant
Lead	carcinogen; neurotoxic, cardiovascular, immune, reproductive, and kidney system damage
Manganese	neurotoxic; respiratory irritant
Mercury	neurotoxic; respiratory irritant; cardiovascular, gastrointestinal, liver, and kidney damage
Nickel	carcinogen; respiratory irritant; kidney and immune system damage
Nitrogen dioxide	respiratory irritant
Selenium	carcinogen; eye, nose, and throat irritation
Sulfur dioxide	respiratory irritant
Zinc	respiratory irritant; cardiovascular sytem damage

TABLE 4.4-8

PROJECT SOURCES INCLUDED IN HEALTH RISK ASSESSMENT FOR CLEAN FUELS AND RELATED PROJECTS (Page 1 of 2)

Source Number	Source Name
1	Hydrogen Unit Furnace F-301
2	Hydrogen Unit Furnace F-351
3	Cat. Reformer Furnace F-2901, F-2902, F-2903, and F-2904
4	Cat. Reformer Furnace F-2905
5	Cat. Reformer Furnace F-2906
6	Hydrocracking Unit Furnace F-401
7	Hydrocracking Unit Turbine GT-401
8	Alkylation Unit Turbine GT-1031
9	Hydrogen Unit Pre-reformer HPHT1
10	Hydrogen Unit Pre-reformer HPHT2
11	Hot Oil System HO
12	HCU Distillation Unit Fired Reboiler HDRB
13	SG 2301[a]
14	Rail Loading Rack (Locomotive)
15	MTBE Import Tug and Ship[a]
16	C5/C6 Splitter
17	HCU Modifications
18	Benzene Heartcut Tower
19	Cat. Reformer T-90 Tower
20	Heartcut Saturation Unit
21	Cat. Naphtha T-90 Tower
22	LCN Hydrotreater
23	C5/Heartcut/MOGAS Component Combination Tank, 70 kbbl
24	C5/Heartcut/MOGAS Component Combination Tanks, 2 each at 175 kbbl
25	Mogas Tankage (Day Tanks)
26	Mogas Tankage (Area 1 Tanks)

TABLE 4.4-8

PROJECT SOURCES INCLUDED IN HEALTH RISK ASSESSMENT FOR CLEAN FUELS AND RELATED PROJECTS (Page 2 of 2)

Source Number	Source Name
27	Light Heavy Catalytic Naphtha Modification
28	Aqueous Ammonia Storage (Unloading and Tank)
29	Aqueous Ammonia Storage (ESP)
30	Hot Oil System (Furnace)
31	Hydrogen Unit Pre-reformer and Hydrogen Unit Furnace
32	Mogas Tankage (Tank #1751)
33	Mogas Tankage (Tank #1752)
34	Mogas Tankage (Tank #1753)
35	Mogas Tankage (Tank #1754)
36	Mogas Tankage (Tank #1755)
37	Mogas Tankage (Tank #1756)
38	Mogas Tankage (Tank #1758)
39	Mogas Tankage (Tank #1759)
40	Mogas Tankage (Tank #1760)
41	Mogas Tankage (Tank #1761)
42	Mogas Tankage (Tank #1762)
43	Mogas Tankage (Tank #1763)
44	Mogas Tankage (Tank #1711)
45	Mogas Tankage (Tank #1733)
46	Mogas Tankage (Tank #1771)

[a] Related (non Exxon Clean Fuels) projects

Source: ER&E 1993a

The five-year average and maximum hourly pollutant concentrations calculated from the dispersion modeling were used to estimate risks. The highest off-property average concentrations were used to estimate cancer risk and chronic non-cancer health effects from long-term exposure. Maximum hourly concentrations were used to estimate acute non-cancer health effects.

Cancer and chronic non-cancer health risks were calculated for a hypothetical MEI from multiple exposure pathways including: inhalation of the airborne chemicals; ingestion of soil, human milk, and locally-grown vegetables that might be affected by deposition of wind-borne particulate emissions; and dermal absorption from affected soil coming into contact with skin. Subsequent adjustments were made to the health risk assessment to include risks from possible ingestion of locally-caught fish and cattle grazing on local grasses potentially affected by refinery emissions that may deposit on local waters and grasses. The potential for acute health effects was assessed only from exposure via the inhalation pathway, the primary pathway of concern for this type of health effect.

In the final step of the health risk assessment, the calculated exposure at the MEI via all environmental pathways were summed for each air toxic. The total for each air toxic was multiplied by the appropriate unit risk factor or divided by the appropriate chronic AEL (Tables 4.4-2 and 4.4-4) to estimate the cancer and chronic non-cancer health risks caused by air toxic emissions from the project. The total cancer and chronic non-cancer health risks were calculated by summing the individual risks for chemicals affecting the same organ system for each air toxic. The acute non-cancer health risk for each air toxic was assessed by comparing the total exposure to the appropriate acute AEL (Table 4.4-4). Acute health risks for different air toxics are not additive. The MEI location over the short time period of an acute exposure (1 hour or less) is different for each chemical, and peak concentrations of each chemical often do not occur over the same time period.

Uncertainties in the Methodology

Predictions of future health risks related to the proposed Clean Fuels Project entail substantial uncertainties because of gaps in scientific knowledge and the inability of mathematical models to exactly predict real-world conditions. In general, there are model and data uncertainties with respect to the assumed emissions, dispersion modeling, and toxicological factors, and uncertainties with respect to the characteristics of the potentially exposed population. For example, the size of the calculated health risk for a given source of air toxics is dependent on the length of time of the exposure. Several different exposure times could be used in the assessment, including the average period of U.S. residency in one location (about 9 years), the 90th percentile of residency in one location (about 30 years), or an entire lifetime (about 70 years). Because risk assessments are so often performed in relation to the protection of public health, the assumptions used for these assessments have tended to more likely overestimate risk rather than underestimate it. The health risk assessment methodology described above for the Clean Fuels Project followed the CAPCOA AB 2588 Risk Assessment Guidelines (CAPCOA 1992) for the most part. These procedures are more likely to overestimate than underestimate health risks. A description of the major assumptions used to address uncertainties in the four major areas of an air toxics health risk assessment is provided below.

Emissions. Emission estimates for project equipment are based on manufacturer's data and regulatory agency factors for the same types of equipment that would be installed for the project. These estimates could over- or underestimate actual project emissions. The chemicals modeled for the health risk assessment were those with toxicity criteria in the CAPCOA risk assessment guidelines.

To help insure that the health risk assessment represented an upper bound of the actual risk, existing refinery emission sources were included in the evaluation if there was a possibility that the project could increase those emissions. In addition, no credit was taken for the fact that emissions of some chemicals from storage tanks would decrease with the project because of changes in the composition of the stored products due to reformulation (R2C2 1993). Finally, as mentioned above, the health risk assessment included emission sources that were subsequently removed from the proposed project.

<u>Air Dispersion Modeling.</u> In general, EPA-approved dispersion models, such as those used for the project health risk assessment, tend to overpredict concentrations rather than underpredict them. For example, all chemical emissions are assumed not to be transformed in the atmosphere. For certain pollutants (e.g., ammonia), conversion to less toxic forms may occur sufficiently fast to result in lower concentrations than those estimated by modeling. The models use assumptions about plume dispersion that tend to overpredict concentrations. The modeling procedure grouped multiple sources together (e.g., project fugitive emissions from valves and flanges were grouped into units) which tends to overestimate ground-level concentrations because it concentrates these emissions into narrower plumes than would be produced in the real world when scattered around the refinery.

<u>Exposure Assessment.</u> The most important uncertainties related to health risk assessments concern the definitions of exposure pathways and the characteristics of the exposed population. The choice of a residential MEI is very conservative in the sense that no real person is likely to spend 24 hours a day, 365 days a year over a 70-year period at exactly the point of highest toxicity-weighted annual average air concentrations. The greatest actual exposure is likely to be at least two times, and perhaps more than 10 times lower than that assumed for the MEI.

As mentioned above, the project health risk assessment considered the following exposure pathways: inhalation, dermal contact, direct ingestion of soil, ingestion of vegetables and fruits contaminated by direct deposition of project emissions or by taking up contaminants that have deposited on the soil and ingestion of mother's milk. The assessment excluded ingestion of drinking water and livestock products such as beef, milk, poultry, and eggs. The drinking water pathway was excluded from the assessment because there is no evidence of the local drinking water supply being affected by project emissions. An adjustment was made to the ER&E analysis (R2C2 1993) to account for ingestion of locally-grown beef. Beef cattle have been observed grazing northwest of the refinery, where particulate-bound pollutants from the refinery could deposit directly onto the edible portion of the forage, or into the soil where they could be ingested directly or taken up into the forage. The risk estimate from this pathway was estimated at 0.0013 in a million; to account for potential uncertainties, an estimate of 0.01 in a million was used. Although it is possible that some people in the vicinity of the refinery consume other locally produced livestock products, land use analysis suggests that these pathways are unlikely. An adjustment was also made for consumption of fish taken from the Carquinez Strait or Suisun Bay where some of the air toxics emitted from the refinery would fall. This pathway provided an estimated cancer risk of 0.0006 in 1 million (ER&E 1993b).

Toxicity Assessment. Estimates of toxicity for the compounds considered in the health risk assessment came from the CAPCOA AB 2588 Guidelines (CAPCOA 1992), which is a relatively conservative compilation of toxicity information. Toxicity estimates are derived either from observations in humans or from projection of information derived from experiments with laboratory animals. Human data are obviously more relevant for health risk assessments, but is typically incomplete or uncertain because of: the difficulty of isolating a specific exposure pathway from other environmental sources; insufficient numbers of people studied; relatively high occupational exposures masking low environmental exposures; or because the population studied may be more or less susceptible than the population as a whole. Cancer risk coefficients from human data are typically considered best estimates and are applied without safety factors. When toxicity estimates come from animal data, they usually involve extra safety factors to account for possibly greater sensitivity in humans, and the less-than-human-lifetime observations in animals. Overall, the toxicity assumptions and criteria used in the project risk assessment are biased toward overestimating risk.

Summary of Uncertainties. Table 4.4-9 summarizes the uncertainties of the assumptions used in the project health risk assessment. Although the assessment process includes both assumptions that overestimate and underestimate risk, on balance, risk is probably overestimated by a substantial margin.

Impact No. 1 **An increase of 1.76 in a million in the incidence of cancer in the surrounding population would result from long-term exposure to chemicals emitted to the atmosphere from the proposed project. This impact is not significant.**

Cancer risks from the Clean Fuels Project were calculated for the following chemicals listed in CAPCOA AB 2588 Guidelines (CAPCOA 1992) as potentially carcinogenic:

TABLE 4.4-9

SUMMARY OF UNCERTAINTIES IN RISK ASSESSMENT FOR EXXON CLEAN FUELS PROJECT

	Will Probably Result in Risks Being	
The Treatment of This Uncertainty	Overestimated	Underestimated
Omission of some potential sources		X
Use of available emission factors	?	?
Selection of substances to include in the assessments		X
Use of ISCST2 and COMPLEX1 atmospheric dispersion models	X	
Use of Travis meteorological data for upper air	?	?
Limitation of exposure pathways considered		X
Selection of exposure parameter values	?	?
Use of hypothetical maximally exposed individual	X	
Use of CAPCOA unit risk factors for cancer	X	
Use of CAPCOA chronic toxicity criteria	X	
Use of CAPCOA acute toxicity criteria	X	

? = Risk may be over or underestimated for this parameter.

Acetaldehyde
Arsenic
Benzene
Beryllium
1,3-butadiene
Cadmium
Chromium VI
Formaldehyde
Lead
Nickel
Polycyclic aromatic hydrocarbons (PAHs)
Selenium

Cancer risks via the inhalation pathway were calculated for all 12 chemicals. Risks from the other pathways, which require deposition of air toxics, were calculated only for arsenic, beryllium, chromium (hexavalent), and PAHs. Acetaldehyde, benzene, 1,3-butadiene, and formaldehyde would be emitted as gases and would therefore not deposit on the ground. CAPCOA has not developed potency factors for cadmium, lead, nickel, and selenium by pathways other than inhalation. This is because CAPCOA has not identified sufficient evidence to indicate that these substances are human carcinogens when exposure occurs via non-inhalation pathways.

Cancer risks associated with project emissions are provided by chemical and pathway in Table 4.4-10 (ER&E 1993a). The cancer risk presented in this table totals 1.75 in 1 million at the MEI, which is located on the southwest boundary of the refinery property, just west of East Second Street. This risk was adjusted by adding 0.0006 in 1 million from the fish ingestion pathway and 0.01 in 1 million from the beef ingestion pathway. Therefore, the maximum cancer risk from the proposed project might reach 1.76 in 1 million. This is well below the significance criteria of 10 in 1 million for this type of health risk.

TABLE 4.4-10

CANCER RISKS BY CHEMICAL AND PATHWAY FOR EXXON CLEAN FUELS PROJECT (per million)

	Exposure Pathway					
Chemical	Inhalation	Soil Ingestion	Vegetables	Dermal Absorption	Mother's Milk	Total[a]
Acetaldehyde	<0.001	--[b]	--	--	--	<0.001
Arsenic	0.008	0.011	0.003	<0.001	--	0.022
Benzene	0.796	--	--	--	--	0.796
Beryllium	0.002	0.008	0.002	<0.001	--	0.013
1,3-Butadiene	<0.001	--	--	--	--	<0.001
Cadmium	0.004	--[c]	--	--	--	0.005
Chromium VI	0.286	0.002	<0.001	<0.001	--	0.290
Formaldehyde	0.010	--	--	--	--	0.010
Lead	<0.001	--	--	--	--	<0.001
Nickel	0.002	--	--	--	--	0.002
PAHs	0.083	0.077	0.403	0.049	0.128[d]	0.613
Selenium	<0.001	--	--	--	--	<0.001
Total	1.193	0.099	0.409	0.050	0.128	1.751

Source: ER&E 1993a

[a] Totals may not add due to rounding.
[b] Acetaldehyde, benzene, butadiene, and formaldehyde are vapors.
[c] Cadium, lead, nickel, and selenium are not evaluated for carcinogenicity by non-inhalation routes.
[d] According to CAPCOA Guidelines, risks from mother's milk should not be added to 70-year risks. Total risk for this person is 1.236 in a million, calculated assuming mother is exposed for first 21 years, the child receives milk for the last year of the mother's exposure period, and then adult is exposed for final 44 years.

Mitigation Measure No. 1

The proposed project would include air pollution control systems judged to be T-BACT by the BAAQMD. No further mitigation is necessary.

Impact No. 2 **Any increase in the incidence of chronic, non-cancer health effects in the surrounding population, resulting from long-term exposure to project-emitted chemicals would be well below the hazard index criterion of 1.0. This impact is not significant.**

Chronic hazard indices were calculated for 23 chemicals that would be emitted by the Clean Fuels project. The CAPCOA Guidelines (CAPCOA 1992) do not list chronic AELs for two chemicals of concern, 1,3-butadiene and PAHs. Therefore, these two chemicals were evaluated only for cancer risk. Exposures were calculated for all pathways. The hazard indices and organ systems potentially affected by these chemicals are listed in Table 4.4-11. As shown in the table, most of the chemicals affect the respiratory system, which is therefore the target organ of interest.

The MEI location for chronic non-cancer health risk associated with project emissions was different from that for cancer. The chronic non-cancer MEI was located just off the westerly tip of the refinery boundary. The total hazard index there was estimated to be 0.0122 (ER&E 1993a). This value is well below the significance criterion of 1.0; therefore, the potential increase in chronic non-cancer health effects from the proposed project is insignificant. Because the total hazard index is so far below the significance criterion, no adjustments for potential fish or beef ingestion were made (R2C2 1993). These adjustments would be of the same percentage order as the adjustments made for cancer risk.

Mitigation Measure No. 2

No further mitigation is necessary.

TABLE 4.4-11

CHRONIC NON-CANCER HEALTH RISKS FOR THE EXXON CLEAN FUELS PROJECT (Page 1 of 2)

	Hazard Index			
Chemical	Inhalation	Indirect	Total	Affected Organ(s)[c]
Acetaldehyde	<0.0001	--[a]	<0.0001	respiratory system
Acrolein	<0.0001	--	<0.0001	respiratory system
Ammonia	0.0050	--	0.0050	respiratory system; and skin
Arsenic	<0.0001	<0.0001	<0.0001	respiratory system; cardiovascular; nervous system
Benzene	0.0002	--	0.0002	nervous system
Beryllium	0.0001	--	0.0001	respiratory system
Cadmium	<0.0001	<0.0001	<0.0001	respiratory system; kidney
Chromium VI	0.0015	0.0015	0.0015[b]	respiratory system; gastrointestinal, liver; kidney
Copper	<0.0001	--	<0.0001	respiratory system
Formaldehyde	0.0006	--	0.0006	respiratory system
Hydrogen sulfide	<0.0001	--	<0.0001	nervous system; respiratory system
Lead	--	0.0002	0.0002	nervous system; cardiovascular system; immune system; reproductive system; kidney
Manganese	0.0001	--	0.0001	respiratory system; nervous system
Mercury	<0.0001	<0.0001	<0.0001	respiratory system; nervous system; cardiovascular system; gastrointestinal/liver; kidney
Napthalene	<0.0001	<0.0001	<0.0001	cardiovascular system
Nickel	<0.0001	--	<0.0001	respiratory system; immune system; kidney
Nitrogen dioxide	0.0037	--	0.0037	respiratory system
Phenol	<0.0001	--	<0.0001	respiratory system, kidney
Selenium	<0.0001	--	<0.0001	respiratory system
Sulfur dioxide	0.0009	--	0.0009	respiratory system

TABLE 4.4-11

CHRONIC NON-CANCER HEALTH RISKS FOR THE EXXON CLEAN FUELS PROJECT (Page 2 of 2)

	Hazard Index			
Chemical	Inhalation	Indirect	Total	Affected Organ(s)[c]
Toluene	0.0002	--	0.0002	nervous system; reproductive system
Xylenes	0.0001	--	0.0001	respiratory system; reproductive system
Zinc	<0.0001	--	<0.0001	respiratory system; cardiovascular system
TOTAL HAZARD INDEX			0.0122[d]	respiratory system

Source: ER&E 1993a

[a] A majority of the chemicals either are emitted as vapors or do not have oral AELs.
[b] Inhalation and oral exposures affect different organ systems.
[c] The organ systems listed in the ACE program are not completely consistent with those in CAPCOA 1992.
[d] Total is only for those chemicals affecting the respiratory system; total may not add due to rounding.

<u>Impact No. 3</u> **Acute non-cancer health effects in the surrounding population would increase slightly from combustion sources as a result of short-term exposure to chemicals emitted to the atmosphere from the proposed project. This impact is not significant.**

Acute hazard indices were calculated for 12 chemicals that would be emitted by the Clean Fuels Project (Table 4.4-12). Nitrogen dioxide (NO_2) had the highest acute hazard index at 0.64. The next highest hazard index was 0.19 for sulfur dioxide (SO_2). Both of these chemicals would be emitted from a variety of combustion sources and both are criteria air pollutants. These acute hazard indices are below the significance criteria for this health risk.

<u>Mitigation Measure No. 3</u>

No mitigation is necessary.

4.4.3 Cumulative Impacts

The only other proposed project at the Benicia Refinery is the construction of a plant to produce methyl tertiary butyl ether (MTBE), a gasoline additive required by the CARB to reduce carbon monoxide emissions from automobiles (refer to Section 3.1 for further discussion of the MTBE project). The cancer risk attributable to the MTBE unit was estimated to be 0.09 in 1 million at an MEI location west of the refinery (ENSR 1993b), near the MEI for existing refinery emissions, but well north of the MEI location for the Clean Fuels Project. Emissions from the MTBE facilities (both import facilities and the planned MTBE plant) were included in the emissions used to calculate risks for this EIR. The MTBE facilities risks make a minor contribution to total risk levels, and the combined risks are well below the significance criterion of 10 in 1 million. Similarly, the estimated chronic hazard index associated with the MTBE project was about 0.0006, which would not be cumulatively significant with the Clean Fuels Project hazard index of 0.0122. The highest acute hazard index for the MTBE project was 0.004 for mercury, which would not cumulatively add to the Clean Fuels Project acute hazard indices.

TABLE 4.4-12

ACUTE NON-CANCER HEALTH RISKS FOR THE EXXON CLEAN FUELS PROJECT

Chemical	Maximum 1-Hour Concentration ($\mu g/m^3$)	Acute AEL ($\mu g/m^3$)
Acrolein	9.14×10^{-5}	$2.50 \times 10^{+0}$
Ammonia	$3.43 \times 10^{+1}$	$2.10 \times 10^{+3}$
Copper	1.89×10^{-3}	$1.00 \times 10^{+1}$
Formaldehyde	1.58×10^{-1}	$3.70 \times 10^{+2}$
Hydrogen sulfide	1.38×10^{-1}	$4.20 \times 10^{+1}$
Lead	1.29×10^{-3}	$1.50 \times 10^{+0}$
Mercury	1.49×10^{-4}	$3.00 \times 10^{+1}$
Nickel	4.72×10^{-4}	$1.00 \times 10^{+0}$
Nitrogen dioxide	$3.01 \times 10^{+2}$	$4.70 \times 10^{+2}$
Selenium	1.59×10^{-5}	$2.00 \times 10^{+0}$
Sulfur dioxide	$1.21 \times 10^{+2}$	$6.55 \times 10^{+2}$
Xylene	$1.47 \times 10^{+1}$	$4.40 \times 10^{+3}$

Source: ER&E 1993a

The BAAQMD estimated the cumulative impact of the other refinery clean fuels projects described in Section 3.2 on the MEI for the Benicia Refinery Clean Fuels Project. That estimate assumed that the magnitude of the risk contribution from the other clean fuels projects at the Exxon MEI location would be consistent with a cumulative impact analysis conducted by the BAAQMD from AB2588 inventories (BAAQMD 1993b). If more accurate information was not available, the maximum incremental cancer risk for a clean fuels project was assumed to be 10 in 1 million at that project's MEI. The BAAQMD concluded that the added cancer risk at the Benicia Refinery MEI would be about 0.8 in 1 million for emissions primarily from the Shell and TOSCO refineries (BAAQMD 1993c). The remaining refinery projects (Unocal, Pacific and Chevron) would not contribute in any significant degree to cancer risk at the MEI location for the Exxon project. For cumulative non-cancer impacts, all of the clean fuels projects show chronic and acute hazard indices much less than 1.0 and would not be cumulatively significant.

The proposed cogeneration plant at the C&H Sugar factory in Crockett would emit some of the combustion-related air toxics that would be emitted from the project. No health risk assessment is known to have been conducted for the cogeneration project, but assuming that the project meets the BAAQMD permitting criterion of 10 in a million, the incremental risk at the Clean Fuels Project MEI would probably be less than 2 in 1 million. Consequently, the cumulative maximum cancer risk of the Benicia Refinery Clean Fuels Project, other Bay Area reformulated gasoline projects, and the Crockett cogeneration plant would be less than 5 in 1 million, below the 10-in-1-million significance criterion. The non-cancer impacts would also remain insignificant.

As discussed in Section 4.4.1, the cancer risk at the pre-project MEI location from current Benicia Refinery emissions is estimated to be about 8.4 in 1 million. The Clean Fuels Project cancer risk, calculated at a different location, would be about 1.8 in 1 million. Based on the manner in which health risks from the project decrease with distance from the project MEI location, the project would contribute a risk of about 1.5 in a million (R2C2 1993) at the pre-project MEI location. Adding cancer risks from other related projects would result in a total cumulative health risk of less than 13 in a million. Note that this overall post-project health risk should not be compared against the 10-in-a-million criterion, which applies only to incremental risk. When the federal and state clean fuels programs are fully implemented, emissions of benzene, 1,3-butadiene, and perhaps other chemicals will fall substantially in the Bay Area, reducing the current cancer risks from ambient levels of these compounds (CARB 1991). The BAAQMD has estimated that the cancer risk from ambient levels of benzene and butadiene (about 300 in a million) will be reduced by almost half (139 in a million) when the reformulated fuels program is in place. This reduction would accrue to everyone in the Benicia area, including anyone living near the refinery. Exxon's share of the Bay Area gasoline sales is about 20%, and therefore the proposed Clean Fuels project would help achieve these risk reductions.

4.5 PUBLIC SAFETY

4.5.1 Environmental Setting

Introduction

Refining crude oil involves working with flammable materials under heat and pressure. This type of operating environment creates inherent hazards for fire and explosion, and for the possible release of toxic vapors or gases. Because of these inherent hazards, the design, operations, and maintenance of refineries, including the Benicia Refinery, are oriented toward preventing accidents that would cause damage to the facility and potential offsite property damage or injury to members of the public.

The Benicia Refinery is sited to minimize the likelihood of conflicts with other land uses. As discussed in Section 2.2, the refinery occupies 331 acres of the 800-acre property owned by Exxon. The process block, which is the source of the majority of hazards associated with petroleum refining, covers 46 acres and is buffered from the City of Benicia by the surrounding Exxon property (Figure 2-1).

A variety of federal and state laws have been in existence for many years to promote safe industrial practices. In recent years, there has been an increase in regulations that are aimed at protecting worker and public safety from catastrophic accidents at industrial plants including refineries. The major regulations are described below.

The California Health and Safety Code (Article 2 of Chapter 6.95) requires facilities handling significant quantities of acutely hazardous materials to establish a Risk Management and Prevention Plan (RMPP) for the facility. An RMPP identifies potential accident scenarios involving acutely hazardous materials, evaluates the impacts of those accidents with regard to public safety, provides an audit of administrative and operating programs designed to prevent accidents involving acutely hazardous materials, and provides emergency response plans to minimize releases and their effects should they occur. Exxon submitted an RMPP to Solano County in November 1990.

In addition to its existing rules for worker safety, the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) passed a rule in May, 1992, which addresses the prevention of catastrophic accidents. This rule, known as Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119) requires companies handling hazardous substances in excess of specific threshold amounts to develop and implement process safety management (PSM) systems. The PSM rule is directed primarily at protecting workers within the facility. Many of the key components of the PSM systems for the Benicia Refinery have long been in existence, and are being reviewed, modified where appropriate, and incorporated into the PSM program. As part of this program, Exxon is currently conducting Process Hazard Analysis Studies (HazOps) in addition to those conducted for the RMPP to identify potential hazard concerns associated with either existing or proposed process units.

The Federal Clean Air Act Amendments of 1990 mandate that the U.S. Environmental Protection Agency (EPA) create regulations to require facilities possessing listed chemicals above specified threshold amounts to develop and implement Risk Management Plans (RMPs). These plans will be similar to California's RMPPs, except they will include consideration of fire and explosion hazards as well as releases of toxic materials. Exxon will prepare an RMP for the Benicia Refinery when the EPA regulations are promulgated.

This section begins with a brief description of the hazards associated with the Benicia Refinery, including a discussion of the potential for the release of acutely hazardous materials. This is followed by a summary of the accident history at the refinery and a discussion of the probability of major accidents. The section concludes with a description of design features and operating/maintenance practices to prevent accidents at the Benicia Refinery.

Hazards Associated with the Benicia Refinery

Fires and Explosions. Most of the fire and explosion hazards associated with a refinery involve process equipment. As discussed in Chapter 2.0, petroleum refining involves manipulation of hydrocarbons often under high temperatures and pressures.

In some cases, the hydrocarbons contained in process vessels and piping are at temperatures above their flash point and could catch fire if exposed to an ignition source and to the air. Therefore, failure of process equipment that leads to a release of hydrocarbons into the air can lead to fires. Releases of lighter hydrocarbons can form a vapor cloud that could explode if it came into contact with an ignition source.

Most releases of hot hydrocarbons in refineries are relatively small and result from the failure of seals and gaskets at flanges, pumps, and valves or pinhole leaks in heat exchanger tubing. Fires resulting from these releases are quickly contained by closing valves to the piping that supplies fuel for the fire.

Overpressure of vessels in process units could result in an explosion that could involve other nearby equipment and potentially cause offsite property damage and injury to members of the public. Overpressure would occur if air entered a process vessel, resulting in immediate and rapid combustion of the hydrocarbon vapors contained in it. Most of the units in the refinery are closed systems operating at a positive pressure. Therefore, a hole in a vessel or piping would result in the release of hydrocarbons instead of the introduction of air into the vessel; therefore, introduction of air into most process units is not a credible accident scenario.

The cat cracker, fluid coker, and mirox units at the refinery mix hydrocarbons with a fluidized catalyst in a reactor vessel. Spent catalyst from the reactor vessel in these units is recirculated to a separate regeneration vessel or vessels where air is introduced to burn carbon off of the catalyst. Pressure imbalances between the reactor and regeneration vessels could result in the intrusion of air into the reactor vessel. Depending on the amount of air introduced into the reactor and operating conditions, there could be a large enough explosion to destroy the unit and conceivably cause substantial damage. This type of accident is avoided through the land use buffers at the Benicia Refinery, specific operating procedures, continuous monitoring of process operations, and automatic shutdown devices.

The existing pipestill unit contains a vacuum tower where a vacuum is used to separate light hydrocarbons that remain in the bottom cuts of the pipestill. A hole in the vacuum tower or related piping would draw air into the unit, leading to a fire and/or explosion.

Other ways that a process vessel could be overpressured is by continuing to supply heat to the vessel after the flow of hydrocarbons through the system has been stopped due to the loss of electrical power or failure of instrument air pressure used to remotely drive most control valves. Overpressure of process vessels could also result from the loss of cooling water, allowing a buildup in the temperature of the vessel.

The likelihood for these types of accidents is minimized at the Benicia Refinery in several ways. In the event of an instrument air failure, controlling valves are designed to move automatically by spring load to their "fail safe" positions. These fail safe positions may be either full-closed or full-open depending on specific operating conditions. All pressurized equipment is also protected by passive mechanical pressure relief devices. These devices include pressure relief valves and rupture discs[1] designed to open at pressures below those that would damage process equipment. In the event of excess pressure buildup in a piece of equipment, these pressure relief devices would open automatically. Since these devices are mechanical, they do not need electrical power or instrument air to function properly.

Pressure relief devices in the refinery are combined through a piping network that is designed to contain process gases and liquids vented through the devices. This piping conveys liquids and gases to large drums where they can be recovered. When the pressure relief is large, as would occur during emergency shutdown of a process unit, the volume of gas in the drums becomes greater than the ability of the fuel gas system to capture it. The excess gas then rises through a liquid seal into the flare where it is burned. The liquid seal protects against entry of air into the pressure relief piping. This prevents the possibility of a flammable mixture of hydrocarbons and air from forming in the lines to the flare.

Petroleum refining produces gases such as propane and butane. These gases are collected, liquified, and used primarily as fuel at the Benicia Refinery. Hydrogen is also manufactured at the facility for use in the refining process. A leak in process equipment containing these gases could lead to an unconfined vapor cloud explosion. If the explosion was large, it could The most probable result in offsite public safety impacts. The hydrocarbon gases produced in the refining process are heavier than air and could travel some distance close to the ground before coming into contact with an ignition source and burning or exploding.

---

[1]A rupture disc is a piece of metal bolted between flanges that is designed to rupture at a specific pressure.

A failure to ignite fuel gas in the refinery heaters or a failure to purge remaining gas during a shutdown of these heaters could cause an explosion. The overpressure damage from such an explosion would not be great enough to compromise surrounding process equipment.

Accidents resulting in fires or explosions in tanks and vessels used to store flammable hydrocarbon liquids and gases at the Benicia Refinery are much less likely than fires or explosions in process equipment. Hydrocarbon liquids are stored at ambient temperatures and pressures. Liquid petroleum gas (LPG) products such as propane and butane are stored under their own vapor pressure in spheres and bullets. No ignition sources are located in the vicinity of the hydrocarbon storage facilities.

A fire in a liquid hydrocarbon storage tank would not be expected to lead to an explosion. The fire would involve the surface of the hydrocarbon liquid. Such a fire is prevented from spreading by transferring the hydrocarbons from the involved tank to another tank and applying water to surrounding tanks to keep them cool. This type of accident at the Benicia Refinery is not expected to result in public safety impacts.

A leak from an LPG sphere or bullet could lead to an unconfined vapor cloud explosion. Massive failure of one of these storage vessels and exposure to an ignition source could lead to a boiling liquid, expanding vapor explosion (BLEVE). This type of explosion may generate a blast overpressure wave with fragments of the vessel being projected long distances. The contents of the sphere or bullet may cause an immediate fireball or may form a vapor cloud which immediately ignites. This type of accident could involve surrounding equipment and lead to offsite property damage or injury to members of the public.

Industry standards for LPG storage have been developed and implemented to substantially reduce the potential for a BLEVE. The American Petroleum Institute (API) has published API Standard 2510 which governs the design and construction of LPG installations in the petrochemical industry and addresses transfer, loading, and unloading equipment.

Potential Releases of Acutely Hazardous Materials. The RMPP prepared for the Benicia Refinery identified two acutely hazardous materials of greatest concern in the event of an accident: anhydrous (gaseous) ammonia and hydrogen sulfide (H_2S). Anhydrous ammonia is used for emissions control at the pipestill and in the hydrocracker and Dimersol process unit. Hydrogen sulfide is generated in the refining process and is handled in significant amounts in the following units:

- Pipestill
- Hydrofiners (light virgin naphtha, jet fuel, diesel, cat feed, and heavy naphtha)
- Hydrocracker
- Catalytic cracker
- Sulfur recovery unit/sour water stripper

At ambient temperature and pressure, ammonia is a colorless, toxic gas with a characteristic sharp odor. Exposure to 50 ppm of ammonia for several hours is irritating but not painful. Exposure to 300 to 500 ppm for one hour may result in irritation of eyes, nose, and throat. Exposure to ammonia concentrations of 2500 to 6500 ppm for 30 minutes may cause serious injury to the lungs.

At ambient temperature and pressure, H_2S is a colorless, toxic gas with a characteristic rotten egg odor at extremely low concentrations. Exposure to concentrations of H_2S as low as 10 parts per million (ppm) for 1 hour may result in mild eye and throat irritation. Exposure to moderate concentrations (up to about 100 ppm) may lead to eye and respiratory tract irritation and headache. There is evidence that prolonged exposure to concentrations above 100 to 200 ppm may cause olfactory fatigue, and H_2S odor would no longer be detected. Exposure to H_2S concentrations above about 1000 ppm can be lethal.

The RMPP identified four credible, worst-case accident scenarios for each of the acutely hazardous materials. The most severe and the most likely of these four scenarios for each chemical are summarized in Table 4.5-1 along with the resulting maximum one-minute concentration of the chemical at the boundary of the Exxon property.

For ammonia, the credible worst-case accident was determined to be the rupture of a pipe connected to a vessel in the Dimersol unit. This accident could be caused by metal fatigue or external impact. Under this scenario, the entire inventory of the vessel would exhaust to the atmosphere in 24 minutes with a calculated release rate of 367 pounds per minute at ground level. This accident scenario was estimated to result in a maximum one-minute concentration of 61 ppm ammonia at the nearest refinery boundary. Based on Emergency

TABLE 4.5-1

SUMMARY OF ACCIDENT SCENARIOS AT THE EXISTING BENICIA REFINERY

AHM[a]	Case	Scenario Description	Distance to Fenceline (meters)[d]	AHM Release Rate (lb/min)	Duration of Release (min)	Release Height (ft)	Highest One-Minute Offsite Concentration (ppm)[e]	Probability of Occurrence
NH_3[b]	Credible worst-case	Dimersol Unit Pipe Failure	704	367	24	0	61	Medium
NH_3	More likely case	Loading Hose Failure	540	386	15	3.3	56	Medium to High
H_2S[c]	Credible worst-case	SRU Combustor Flame Loss	457	159	5	200	2.5	Medium
H_2S	More likely case	Stripper Pump Seal Leak	530	41.7	5	0	1.5	Medium to High

[a] AHM = Acutely Hazardous Material.
[b] NH_3 = Ammonia.
[c] H_2S = Hydrogen sulfide.
[d] "Distance to Fenceline" is the distance from the site of the accident scenario to the nearest refinery boundary.
[e] The highest concentrations noted here occur near the refinery boundary, except for the SRU Combustor scenario; the location of the highest concentration for that scenario is estimated at 1,820 meters downwind.

Response Planning Guidelines (ERPG) established by the RMPP regulatory program, this concentration would cause a noticeable odor and mild irritation (since it is greater than 25 ppm over a 1-hour exposure period) but would not cause serious or irreversible health effects (since it is less than 200 ppm over a 1-hour exposure period).

A more likely worst-case accident involving ammonia at the Benicia Refinery would be the failure of a loading hose from an ammonia delivery truck. This failure could result from a defective or worn hose, a hose coupling failure, or operator error. Such an accident was calculated to result in a 15-minute release of ammonia at a rate of 386 pounds/minute. The release was assumed to take place 3.3 feet above the ground. The maximum one-minute concentration of ammonia at the nearest Exxon property boundary was estimated to be 56 ppm. This accident would have essentially the same offsite impact as the credible worst-case accident scenario for ammonia.

The worst-case accident for H_2S at the refinery was identified as a complete failure of one of the process trains in the sulfur recovery unit due to the flame going out in the combustor that burns the H_2S converting it to SO_2. This accident would result in the release of H_2S for five minutes at a calculated rate of 677 pounds/minute. The release would occur through a 200-foot-high bypass stack. The accident would result in a maximum 1-minute ground-level concentration of 2.5 ppm H_2S approximately 6000 feet, or slightly over a mile, downwind of the sulfur recovery unit located on the eastern edge of the refinery process block (Figure 2-2). Based on ERPG levels (since this is greater than 0.1 ppm exposure over 1 hour), this would cause a noticeable odor and mild irritation but would not cause a serious or irreversible health effect (since this is less than 30 ppm exposure over 1 hour).

A more likely accident resulting in the release of H_2S would be a reflux pump seal leak in the sour water stripper. This was calculated to result in the release of 41.7 pounds/minute of H_2S for 5 minutes. The release was calculated to cause a maximum 1-minute concentration of 1.5 ppm H_2S at the nearest Exxon property boundary. This would cause a noticeable odor and mild irritation but it would not result in serious or irreversible health effects.

Accident History of the Refinery Industry and Benicia Refinery

Table 4.5-2 lists accidents that have taken place at the refinery between June 1990 and May 1993 for which damage was large enough to warrant an insurance claim. This list is representative of the types of accidents that have occurred at the refinery that have resulted in fires. None of these accidents resulted in worker injuries, offsite property damage, or injuries to members of the public.

Refinery accidents with effects on public safety are too rare to predict based on the records of an individual refining company. For example, there have been no accidents in the history of the Benicia Refinery that have caused offsite injuries or structural damage. However, there have been community impacts caused by accidents at a few of the 190 refineries in the United States over the past 30 years. The National Fire Protection Association (NFPA) and the insurance industry (M&MPC 1990) studied the 50 worst accidents in international oil refining over the past 30 years. Although those accidents caused losses of between $6 million and $330 million, and onsite staff or fire fighter deaths, only 33 percent of the 50 worst accidents involved offsite damage greater than broken windows or smoke. Surveys of 64 refineries by the American Petroleum Institute (API 1989) reported 131 fires, 5 with damages over $1 million. None of these fires spread offsite. In addition, no offsite deaths have been reported for any of the major refinery accidents investigated by the NFPA and the insurance industry. Based on the above national statistics, the probability of an accident at the "average" refinery that would result in major offsite damage is about 1 chance in 500 years, and the chance of an accident causing offsite injury is about 1 in 6000 years. This probability estimate is for all types of refinery hazards that could lead to substantial offsite consequences.

Facility Design Features and Operating/Maintenance Practices to Prevent Accidents

Refinery Design. The Benicia Refinery was designed to minimize the occurrence of flammable mixtures of hydrocarbons and air, and to eliminate the presence of a source of ignition in association with flammable materials. In addition, process safeguards are incorporated into the refinery in the form of instrumentation, automatic shutdown systems, over design of equipment operating at high and low pressures, and selection of hardware design specifications with a proven operating history in the refinery industry.

TABLE 4.5-2

BENICIA REFINERY - ACCIDENT HISTORY JANUARY 1990 THROUGH MAY 1993[a]

Date	Incident Description	Cost of Incident	Material Released	Injuries?	Comments
01/12/90	Oil and water overflowed out of the main refinery sewer into a nearby creek during a heavy rainstorm.	$10,000	5 gallons of oily water (due to sewer backup).	None	Cleanup performed around the clock.
06/17/90	Coupling between a turbine and air blower failed and caused a release of lube oil, which immediately produced a fire.	$200,000	Approx. 30 bbls of lube oil and a small amount of fuel gas were burned.	None	Fire was under control 30 minutes.
11/06/90	A hydrogen fire was caused by a packing failure on an orifice tap block valve.	$24,000	1 cubic meter of hydrogen.	None	--
06/02/92	A flange leak and small fire occurred during an emergency shutdown of the Hydrocracker Recycle Compressors.	$3,500	200 cubic meters of hydrogen and 5 barrels of light gas oil/diesel.	None	Fire lasted for 6 minutes. No off-site impacts.
08/09/92	A fire resulted from a flange leak at the hot gas valve manifold at the Hydrocracker Unit.[b]	$750,000	2,000 cubic meters of hydrogen and 15 bbls of light gas oil/diesel.	None	--

[a] This table lists incidents at the Exxon Refinery that required a Petroleum Refining Hazard Loss Report (Report No. 8021) for the Exxon Insurance Services Corporation. These Reports are required whenever a fire or explosion causes greater than $2,500 worth of damage or whenever an incident causes greater than $25,000 worth of cleanup costs. As the table shows, there were no incidents that produced a significant off-site impact.

[b] The hydrocracker recycle hydrogen compressor tripped due to low lube oil pressure caused by a failure of the main lube oil pump. During shutdown, cooler process oil backed into the "hot gas" valve manifold causing sudden cooling of the flanges, causing them to leak.

Process operations at the refinery are monitored and adjusted with a computerized control system. Monitoring data from instruments on the process equipment are fed to a computer which then makes appropriate process adjustments in such parameters as temperature, pressure, and flow rate. The computerized system can identify trends in temperatures and pressures as they develop in the refining system. This allows operators to prevent pressure or temperature increases or decreases before they become significant enough to require flaring of some of the hydrocarbon vapors in the equipment. The system can also be programmed to implement corrective actions to specific abnormal events, which provides a second line of defense to operator or system error. The computerized control system maintains a continuously updated operating data base which allows precise trouble shooting and corrective actions by operators. Each non-steady state event that occurs in the refinery and the conditions surrounding such an event can be accurately reconstructed and the controlling logic for process equipment can then be altered, as necessary, to minimize the possible reoccurrence of that event.

In addition to the computerized control system and operators for this system, there are outside operators monitoring the functions of individual pieces of process equipment. These operators continuously check equipment for leaks, vibrations, and odors. They also monitor instrumentation located on each piece of equipment (e.g., temperature, pressure, material levels, and flow).

As discussed previously, pressurized equipment in the refinery is protected by passive mechanical pressure relief devices piped to the flare system. These devices are designed to open at pressures that protect equipment from damage. The vapors vented through the devices are captured for use as fuel gas or if the venting is great enough, the gases are burned in the refinery flares.

Employee Training. Refinery employees receive comprehensive training in first aid, fire fighting, the use of personnel protective equipment, the handling of volatile materials, the use of respiratory equipment, and the safe conduct of their specific job assignments. Recurring, mandatory safety training is provided on a regular basis.

Safety Committees. There are several safety committees at the Benicia Refinery. These committees meet bimonthly to monthly and focus on both on-the-job and off-the-job safety. The Operations and Lab Employees Safety Committee conducts safety audits of maintenance work at the refinery on the average of two to four times a day.

Safety Equipment. Safety equipment is located throughout the Benicia Refinery. Personnel protective equipment includes hard hats, safety glasses with side shields, and Nomex coveralls, which are required for all refinery employees in operating areas. Personnel working in acid or caustic areas are required to wear acid goggles or face shields. Ear protection is required in high noise areas where engineering controls are infeasible. Sturdy leather work shoes are required in operating areas. Safety shoes are readily available, subsidized by the refinery, and worn by most refinery personnel. Leather gloves are provided to all operation employees.

There is a comprehensive program for respiratory protection at the refinery. The refinery has 150 self-contained breathing units and operations personnel are checked out on this equipment monthly. Half-face respirators are provided for dust and hydrocarbon exposures. Required fit-tests are performed annually for all employees who need this equipment.

Safety boards are located in all operating areas of the refinery. A safety board includes emergency respiratory equipment, ear protection, rescue stretchers, safety gloves, fire blankets, acid suits (as required), and eye goggles.

There are fixed eye wash/safety showers in all operating units of the refinery. In addition, portable eye wash/safety showers are set up in outlying areas.

Operating Manuals. Operating procedures have been developed for each process unit at the Benicia Refinery and are summarized in operating manuals for each specific unit. The operating manuals contain procedures for preparation for start-up, normal operating conditions and controls, computer control programs (where appropriate), normal shutdown, emergency procedures, and special procedures.

Maintenance and Emergency Procedures. Safety-related maintenance procedures at the Benicia Refinery are contained in the Accident Prevention Manual. This manual is issued, or is available, to all refinery employees and contains the refinery's safety rules, regulations, permits, and procedures. The manual is updated approximately every three years.

There are also refinery-wide emergency procedures contained in an Emergency Procedures Manual. This manual addresses fires, hydrocarbon releases, vapor releases, evacuation plans, and loss of electricity, steam, nitrogen and other refinery-wide operating systems. Refinery-wide emergency simulations are routinely held and critiqued. Operating unit special emergency simulations are held twice every seven weeks and are critiqued by the operating teams.

Hazard analysis sessions for mechanical jobs are required. Their purpose is to discuss and identify potential safety problems.

Work Permit System. A detailed work permit system is in place at the refinery to provide a systematic approach to overseeing and approving work performed in the process areas to minimize the risk of accidents. Permits are required for all cold work, hot work, hot work for equipment in service, trenching, excavation, smoking, opening any equipment, blinding[2] any pipe or vessel, entering any closed space, electrical work, fresh air work, and safety valve servicing for equipment in service.

Preventative Maintenance Activities. Critical instrument checks are performed once per quarter on instruments which, if they fail to operate, could cause serious consequences to personnel, equipment, or the environment. Every operating unit has a Task Manual which identifies the preventative maintenance and safety check tasks to be performed for that unit for the day, shift, or month. An inspection program is in place at the refinery that consists of scheduled ultrasonic and radiographic testing to determine piping and vessel wall thickness for all critical systems. A vibration monitoring and oil testing program is used to regularly check compressors and pumps. There is a program of turnaround inspection at the refinery in compliance with API 510 inspection intervals and internal standards. Turbine overspeed checks are performed once per year on all general purpose steam turbines. All fixed and mobile cranes in the refinery are inspected monthly by Exxon and annually by an outside certified inspector.

[2]"Blinding" refers to the sealing of an open pipe or vessel.

Incident Investigation Procedures. The Accident Prevention Manual includes detailed procedures for reporting on-the-job accidents resulting in injury to an employee. These reporting procedures include the responsibilities of refinery management and other personnel and the actions that should be taken by each to prevent further accidents of a similar nature.

Hazards Associated with Transportation

As discussed in Section 2.6.9, the proposed project would alter truck shipments of spent catalyst and ammonia to and from the refinery, and may increase the number of rail car shipments of pentane from the facility. Other shipments of products or wastes would not change. The discussion of transportation hazards provided here is limited to the hazards that would be changed by the proposed project and could potentially jeopardize public safety.

Transportation accidents involving rail cars of petroleum products can result in fires and explosions. If a rail car carrying light petroleum liquids is breached during an accident and there is an ignition source present such as fire or sparks, the material would ignite. Rail cars carrying these liquids that are not breached but are exposed to fire could potentially explode. Depending on the location of the accident, subsequent fires or explosions could result in substantial property damage and injuries.

A truck accident involving anhydrous ammonia could result in a breach of the tank. Depending on the nature of the breach, the escaping gas could form a dense enough plume to cause severe injuries or fatalities near the site of the accident.

Accidents involving the types of spent solid catalysts used at the refinery are not expected to jeopardize public safety. The spent catalysts are relatively inert and if spilled could be readily cleaned up immediately after the accident.

4.5.2 Impacts and Mitigation Measures

Introduction

This section begins with a description of the significance criteria used to evaluate potential public safety impacts associated with the project. The methodology used to assess project impacts is then summarized. This is followed by a discussion of potential direct and cumulative project impacts and the significance of those impacts. Mitigation measures and mitigation monitoring procedures are provided for identified significant impacts.

In addition to public safety issues, provisions for worker safety were reviewed in relation to the Clean Fuels project. The project would add equipment to the refinery that contains inherent hazards to workers, but this is not expected to adversely impact worker safety at the facility because the type of new equipment proposed has a long record of reliability and because existing regulations and safety programs would be extended to cover the Clean Fuels project. Specifics of these provisions are shown below.

- Equipment reliability. The proposed project equipment is commonly used in the refinery industry and has a long record for reliable operation.

- Employee training. Operation and maintenance personnel would receive comprehensive training on the safe conduct of their specific job assignments. This would also include regularly scheduled, mandatory refresher training on safety.

- Safety equipment. All operating and maintenance personnel would be required to wear appropriate protective equipment, and safety boards would be located in the new process areas.

- Preventive maintenance. Project equipment would be incorporated into the scheduled maintenance program for the refinery, which includes specific preventative maintenance and safety checks conducted each day, shift, month, and quarter.

- Work permit system. The refinery work permit program would be extended to the proposed project equipment. This program provides a systematic approach to overseeing and approving work performed in process areas to minimize the risk of accidents.

- Safety audits. The Benicia Refinery has several safety committees that focus on both on-the-job and off-the-job safety. These committees conduct daily safety audits of mechanical jobs at the refinery. These committees and audits would include the proposed project equipment.

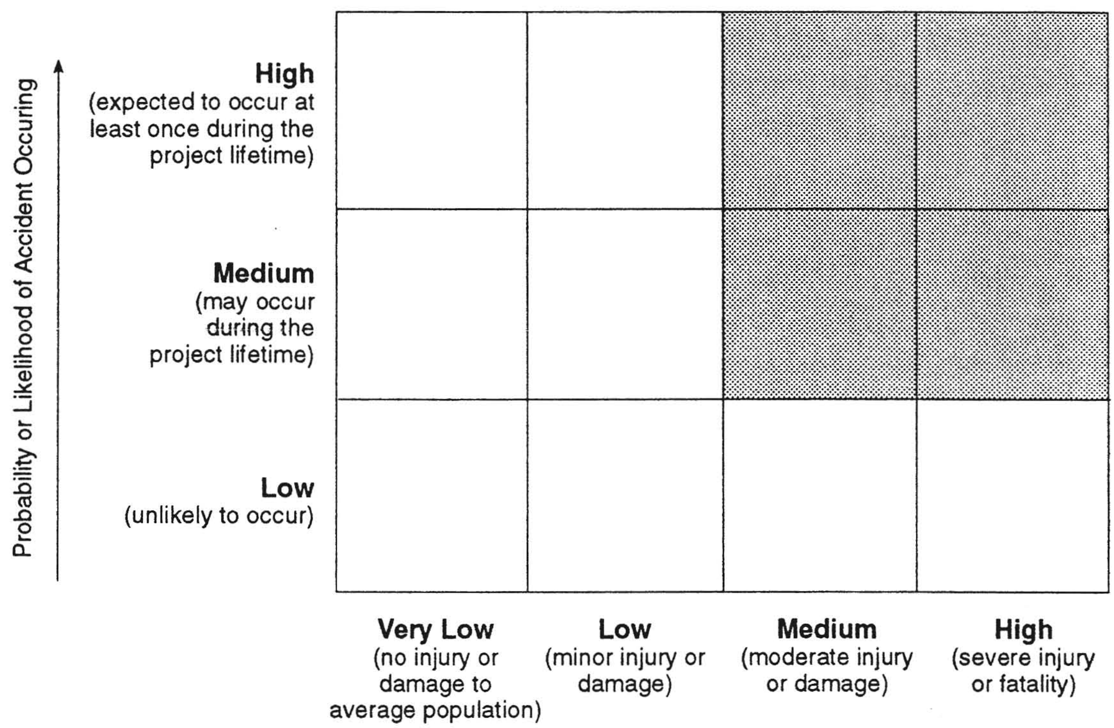
The proposed project would also be included in the process safety management system which has been put in place at Exxon in response to recent OSHA requirements.

Significance Criteria

Evaluation of the significance of public safety impacts resulting from the proposed project must take into account both the consequences of an accident and the likelihood or probability of the accident taking place. For example, the consequences of a large comet or meteor hitting the earth would be significant but the probability of this event happening is so small that the hazard is largely discounted.

The relationship between accident severity and probability of occurrence in defining the significance of public safety impacts can best be expressed in a matrix (Figure 4.5-1). Accidents that are unlikely to occur during the life of the project and would not cause offsite property damage or injury are not considered to be significant impacts to public safety. On the other hand, accidents that are expected to occur at least once during the life of the project and could cause injuries or fatalities and substantial property damage are defined as significant public safety impacts. Figure 4.5-1 shows other combinations of accident severity and probability that were defined as significant for this impact assessment. As noted in the figure, the combination of severe accident consequences with unlikely probability of occurrence was not judged to be a significant impact. The approach to evaluating the significance of public safety impacts shown in Figure 4.5-1 was adopted from the California Office of Emergency Services RMPP guidelines (OES 1989).

Public safety impacts associated with the project include toxic releases, fires, and explosions. Quantitative criteria for categorizing the severity (e.g., low, medium, and high) of these three impacts were developed for use in the impact significance matrix shown in Figure 4.5-1. These criteria were based on the range of effects caused by toxic releases, fires, and explosions.



These combinations of severity and likelihood identify situations of major concern that are considered significant.

Source: ENSR

Project No. 93C0336A	Exxon Clean Fuels Project	RISK OF UPSET ANALYSIS MATRIX	Figure 4.5-1
Woodward-Clyde Consultants			

93C0336A-0600/083093

Among the different standards available for judging the impact of exposure to acutely hazardous materials, the Emergency Response Planning Guidelines (ERPG) (AIHA ORC 1988) were selected as being the most applicable for the impact analysis of hydrogen sulfide and sulfur dioxide. The ERPGs were developed by a task force established by the Organization Resources Counselors, Inc. (ORC) to address the need for reliable, consistent, and well-documented emergency planning guidelines. The American Industrial Hygiene Association (AIHA) has established a technical committee of health professionals to formally review, revise, and approve ERPGs submitted by the ORC Task Force. The definitions of the ERPG levels for acutely hazardous materials are provided in Table 4.5-3. Table 4.5-4 lists the evaluation criteria used to judge the significance of potential releases of hydrogen sulfide and sulfur dioxide.

A separate analysis was performed to evaluate the relative difference in public safety between the use of anhydrous ammonia and aqueous ammonia in emission control equipment at the refinery. The evaluation criteria used for that analysis were slightly different than the criteria used for hydrogen sulfide and sulfur dioxide. For ammonia, ERPG levels 2 and 3 were used to define low and medium accident severity, respectively. The ammonia concentration that represents the one percentile lethal concentration was used as a measure of high accident severity. Table 4.5-5 lists the accident severity evaluation criteria used for the assessment of potential ammonia releases.

Radiant heat is a potential hazard that can be associated with either fires or explosions. Radiant heat impacts for the accidents considered in this assessment were measured in terms of kilowatts per square meter (kW/m^2) of energy (Table 4.5-6).

Impacts from explosions are of concern wherever flammable gases and ignition sources are present or where processes operate under high temperatures and pressures. Impacts of this hazard were described in terms of overpressure (i.e., shock waves). The criteria used to measure the severity of potential impacts are provided in Table 4.5-7 and are based on criteria presented in the American Institute of Chemical Engineering Guidelines for Chemical Hazardous Evaluation Procedures (AIChE 1989 and Clancey 1972). Any identified accidents expected to occur with a medium or high frequency were considered significant if the projected blast overpressure at the Exxon property boundary exceeded 0.7 pound per square inch atmosphere (psia).

TABLE 4.5-3

DEFINITIONS OF EMERGENCY RESPONSE PLANNING GUIDELINES

ERPG	Definition
ERPG-1	The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.
ERPG-2	The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.
ERPG-3	The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

TABLE 4.5-4

TOXIC IMPACT EVALUATION CRITERIA

Qualitative Level	Quantitative Level, ppm		Description
	Hydrogen Sulfide	Sulfur Dioxide	
Very Low	<0.1	<0.3	Concentration below which irritation is not expected in the general population.
Low	0.1 to 30	0.3 to 3	Concentration above which irritation could occur in the general population. (ERPG-1 to ERPG-2)
Medium	30 to 100	3 to 15	Concentration above which moderate adverse health effects could be experienced in the general population. (ERPG-2 to ERPG-3)
High	above 100	above 15	Concentration above which irreversible adverse health effects or fatality could occur in the general population. (above ERPG-3)

TABLE 4.5-5

HEALTH EFFECTS CRITERIA USED IN AMMONIA RISK COMPARISON

Exposure Level	Level of Concern (ppm) for Various Averaging Times				
	10 min	15 min	25 min	30 min	60 min
ERPG-2	490	400	310	283	200
ERPG-3	2,450	2,000	1,550	1,415	1,000
LC_{01}	10,000	9,000	6,975	6,365	4,500

ERPG 2 - "The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action."

ERPG 3 - "The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects."

LC_{01} - One percentile lethal concentration.

Source: Dames & Moore 1993

TABLE 4.5-6

HEAT IMPACT EVALUATION CRITERIA

Qualitative Level	Quantitative Level[a,b]	Description
Very Low	<1.6 kW/m^2	Level below which even minor injury is not expected.
Low	1.6 to 4.0 kW/m^2	Level causing pain but allowing escape with no more than second-degree burns.
Medium	4.0 to 12.5 kW/m^2	Level causing second-degree burns within 20 seconds, but allowing escape.
High	above 12.5 kW/m^2	Level with the potential for third-degree burns; fatality possible at higher levels.

[a] Heat impacts are described in terms of thermal radiation intensity, and measured in kilowatts per square meter (kW/m^2).

[b] BLEVE impacts are calculated based on 20 seconds exposure.

TABLE 4.5-7

BLAST IMPACT EVALUATION CRITERIA

Qualitative Level	Quantitative Level[a]	Description
Very Low	<0.3 psia	Level below which even minor injury is not expected.
Low	0.3 to 0.7 psia	Level above which glass breakage and minor damage could occur.
Medium	0.7 to 2.3 psia	Level above which moderate structural damage is likely.
High	above 2.3 psia	Lower limit of serious structural damage.

[a] Blast impacts are described in terms of overpressure or shock waves, and are measured in pounds per square inch atmosphere (psia).

Table 4.5-8 lists the probabilities estimated for the accidents considered in the impact assessment. For the purposes of this assessment, a low probability was defined as having a frequency of less than 0.002 per year. An accident with this probability is unlikely to occur during the 30-year lifetime of the project. An accident that may occur in the lifetime of the project (moderate probability) was defined to have a frequency of 0.002 to 0.02 occurrence per year. An accident that would be expected to occur at least once in the lifetime of the project (high probability) was defined to have a frequency of more than 0.02 occurrence per year.

Impact Assessment Methodology

Two separate assessments were conducted for public safety impacts of the proposed project. Exxon Research and Engineering evaluated the impacts of fires, explosions, and releases of acutely hazardous materials other than ammonia (ER&E 1993b). The Clean Fuels Project and NO_x emission controls planned for the refinery would significantly increase the use of ammonia at the Benicia Refinery. For this reason, a separate assessment was conducted by Dames & Moore (1993) to compare the public safety impacts of the project relative to the current use of ammonia at the refinery. That assessment also took into account the transportation of ammonia from the chemical supplier to the refinery. Both of these studies were independently reviewed for the City of Benicia by ENSR Consulting and Engineering.

The public safety impact assessments were conducted in the following steps:

- Hazard identification/evaluation
- Selection of representative accident scenarios
- Quantitative frequency analysis
- Quantitative consequence analysis
- Comparison of severity and risk to significance criteria
- For ammonia, the pre- and post-project accident risks were compared

Figure 4.5-2 provides a schematic diagram of the assessment steps for the study conducted by Exxon Research and Engineering. Figure 4.5-3 is a schematic diagram of the assessment steps for the Dames & Moore study. As indicated in these two figures, the assessment methodology for both studies followed the same general steps. In the Dames & Moore study,

TABLE 4.5-8

ACCIDENT PROBABILITY EVALUATION CRITERIA

Qualitative Level	Quantitative Level[a] (per year)	Description
Low	less than 0.002	Unlikely to occur.
Medium	0.002 to 0.02	May occur during the project lifetime (30 years); probability of occurrence assumed to be above 5% (about 1 in 20 chances).
High	more than 0.02	Expected to occur at least once during the project lifetime (30 years); probability of occurrence assumed to be above 50% (i.e., 1 in 2 chances).

[a] Method of Calculating Annual Probability:

p = annual probability of failure, i.e., the probability that the accident will occur at least once per year.

P = probability of failure in next N years, i.e., the cumulative probability that the accident will occur at least once in the N year interval.

$p = 1 - (1 - P)^{1/N}$

to calculate 5% probability of occurrence in 30 years

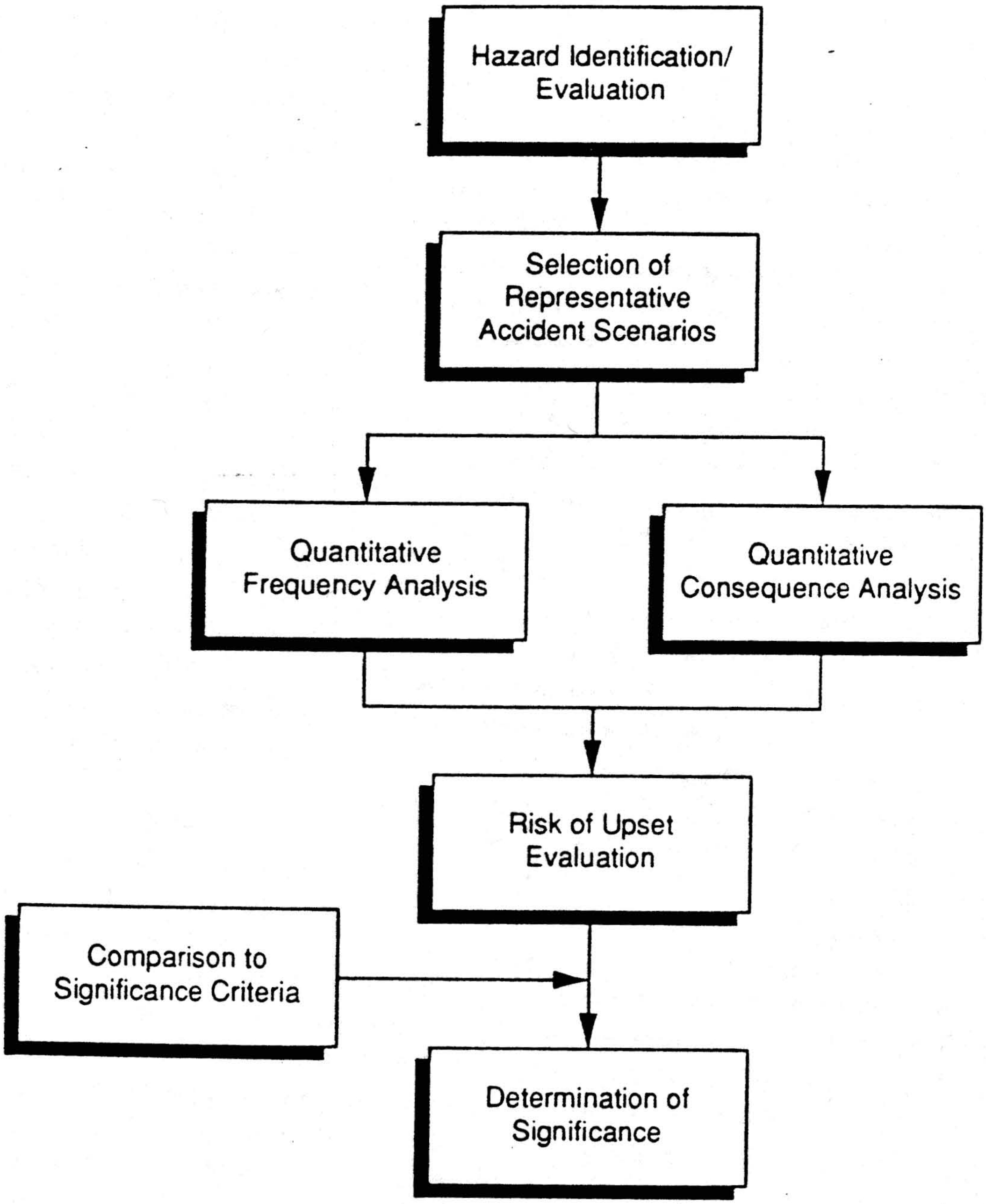
$p = 1 - (1 - 0.05)^{1/30}$

$= 0.002$

to calculate 50% probability of occurrence in 30 years

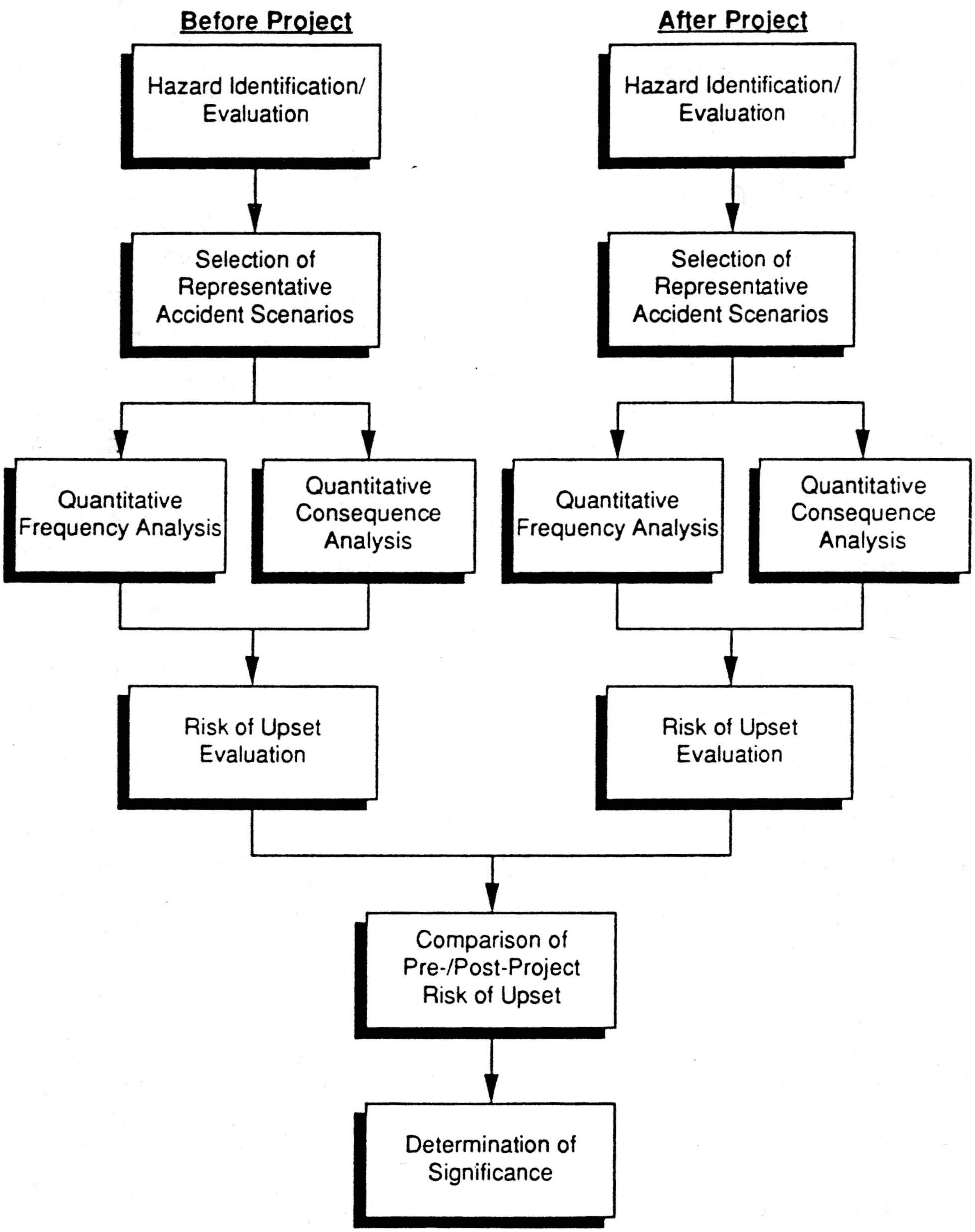
$p = 1 - (1 - 0.5)^{1/30}$

$= 0.02$



Source: ENSR

Project No. 93C0336A	Exxon Clean Fuels Project	RISK OF UPSET EVALUATION METHODOLOGY FIRES, EXPLOSIONS, AND TOXIC RELEASES OTHER THAN AMMONIA	Figure 4.5-2
Woodward-Clyde Consultants			



Source: ENSR

Project No. 93C0336A	Exxon Clean Fuels Project	AMMONIA RISK OF UPSET EVALUATION METHODOLOGY	Figure 4.5-3
Woodward-Clyde Consultants			

93C0336A-0600/083093

accidents involving ammonia were analyzed before and after the project and the two were compared before determining the significance of the potential public safety impacts.

Impact Assessment

Impact No. 1 **The proposed project includes equipment and operations that could have public risks related to fires, explosions, or the release of hydrogen sulfide or sulfur dioxide. The probability and consequences of these risks are estimated to be less than significant. This impact is not significant.**

The following primary pieces of equipment and areas of operation were considered for evaluation of fire, explosion, and toxic release hazards. These areas were selected based on refinery operations, typical failure modes for refinery equipment, and the chemistry and physical properties of the process streams:

- Pumps
- Fractionation towers
- Heat exchangers (fin-fan and shell and tube)
- Compressors
- Atmospheric storage vessels
- Heaters
- Reactors
- General purpose vessels
- Rail car loading and transport

Based on this evaluation, the following potential accidents were identified that could have effects beyond Exxon's property:

- Large pump fire
- Fire at a fractionation tower
- Fire at a fin-fan cooler
- Fire at a shell and tube heat exchanger
- Fire at a compressor

- Fire at an atmospheric storage tank
- Fire at a reactor
- Fire at a general purpose vessel
- Fire while loading a rail car
- Accident and fire during rail car transport
- Fire as a cause of overpressuring process equipment

The frequency of occurrence for each of these accidents was estimated using a "fault tree" evaluation. This evaluation dissected the initiating and intermediate failure events leading to a release, such as a vapor release from a reactor vessel that leads to a fire. A frequency or probability was assigned to each event in the fault tree leading to the ultimate release. The combination of these frequencies provided the overall probability of occurrence for each accident. The resulting probabilities for these accidents are provided in Table 4.5-9.

Consequence scenarios associated with these types of equipment system failures were identified based on checklists provided in the Guidelines for Chemical Processing Quantitative Risk Analysis (AIChE 1989) and Loss Prevention in the Process Industries (Lees 1980). Information from Exxon's world-wide operations over the last 30 to 40 years and information reported for accidents at other refineries were also considered in the identification of accident consequences. Nine possible accident consequence scenarios were identified that could result from the accidents listed above. Those scenarios are:

- Vapor cloud explosion resulting from hydrocarbon release through a 0.75-inch hole in process equipment

- Vapor cloud explosion resulting from hydrocarbon release through a 2-inch hole in process equipment

- Thermal radiation from pool fire in process area

- Thermal radiation from pool fire in storage tank area

- Overpressure and thermal radiation from BLEVE of a rail car

TABLE 4.5-9

FREQUENCIES OF VARIOUS ACCIDENT SCENARIOS

Failure Scenario	Calculated Frequency of Failure/Year
Large Pump Fire	7.1×10^{-6}
Fire at a Process Tower	1.2×10^{-6}
Fire at a Fin-Fan Center	4.2×10^{-5}
Fire at a Shell and Tube Exchanger	6.3×10^{-7}
Fire at a Compressor	1.4×10^{-4}
Fire at an Atmospheric Storage Tank	1.6×10^{-4}
Fire at a Reactor	8.5×10^{-7}
Fire at a General Purpose Vessel	1.0×10^{-6}
Fire while Loading a Rail Car	2.7×10^{-6}
Accident and Fire During Rail Car Transport	6.7×10^{-5}
Fire as a Cause of Overpressure	3.0×10^{-6}

Source: ENSR 1993

- Hydrogen sulfide release through a 0.75-inch hole in process equipment

- Hydrogen sulfide release through a 2-inch hole in process equipment

- Fire resulting in sulfur dioxide release through a 0.75-inch hole in process equipment

- Fire resulting in sulfur dioxide release through a 2-inch hole in process equipment

Some of the process streams proposed for the Clean Fuel project would operate at temperatures and pressures high enough so that loss of containment could lead to a vapor cloud explosion. The worst case accident involving proposed project equipment that would lead to this consequence would be a release from the proposed light cat naphtha (LCN) hydrofiner unit. Operating pressures are relatively high for this unit compared to other proposed project equipment, and operating temperatures are high enough that a release of the contents of the unit (primarily pentane) might quickly flash to vapor beyond the release point, leading to a vapor cloud which could explode if contact is made with an ignition source.

For the calculations of the blast impact from such a vapor cloud explosion, it was assumed that the material would be released through either a 0.75-inch hole or a 2-inch hole. Based on the data used for the consequence analysis, a 0.75-inch hole in process piping represented the most credible/probable release scenario while the release from a 2-inch hole would represent a probable worst-case scenario.[3] It was also assumed that the release from both hole sizes would last five minutes before the vapor cloud ignited. This time was based on documented vapor cloud explosions at refineries and petrochemical plants (Process Safety Progress 1993).

Most of the process equipment proposed for the Clean Fuel project consists of fractionation towers. This equipment operates at relatively low pressures and temperatures. An accident resulting in a release from this equipment is likely to form a pool of hydrocarbons that could ignite. For the analysis of accident consequences, it was assumed that a break in the piping

---

[3] The fault tree analysis for the accident scenarios resulting in a 0.75-inch and 2-inch hole are the same. To represent the difference in frequencies between these two release diameters, frequencies from a 0.75-inch release were adjusted downward by one order of magnitude for the 2-inch release.

from the proposed heartcut naphtha T90 tower to the storage tanks would result in a 10 minute release of the contents of the piping before the flow was stopped, forming a hydrocarbon pool covering 1,964 square feet to a depth of 2.5 feet. It was assumed that if the pool was ignited, it would burn for 1.25 hours.

A pool fire associated with the failure of a proposed storage tank was also evaluated in the consequence analysis. Because the hydrocarbons stored in the proposed tanks would be at essentially ambient temperatures and pressures, a vapor cloud explosion is not likely from such an accident. The failure of one of the proposed tanks would result in the formation of a pool covering 110,000 square feet to a depth of 2.5 feet. It was assumed that if the pool was ignited, it would burn for 1.25 hours.

Hydrogen sulfide would be contained in the proposed LCN hydrofiner. To evaluate the consequences of a release of this acutely hazardous material, it was assumed that there would be a leak in the stream stripper overhead in this unit resulting in the release of hydrocarbon vapors containing 0.48 mole[4] percent of H_2S. Other relevant parameters for this release include:

- Operating pressure of 120 psia and operating temperature of 201° F
- Average molecular weight of 57.52
- Heat capacity ratio of 1.127
- Heat capacity of 0.519 Btu/pound/° F
- Compressibility factor of 0.886

The consequence analysis evaluated releases from both a 0.75-inch and a 2-inch hole in the piping.

A leak in the stream effluent system of the proposed LCN hydrofiner would result in the release of a vapor containing hydrocarbons and 0.12 mole percent H_2S. Because of the temperature (690° F) of this stream, the vapor could ignite, resulting in the conversion of the H_2S into sulfur dioxide (SO_2). Other relevant parameters for this consequence analysis include:

[4] "Mole" is the amount of a substance that has a weight in grams numerically equal to the molecular weight of the substance.

- System pressure of 665 psia
- Average molecular weight of 82.09
- Heat capacity ratio of 1.122
- Heat capacity of 0.758 Btu/pound/° F
- Compressibility factor of 0.785

The consequence analysis evaluated releases from both a 0.75-inch and a 2-inch hole in the piping.

A boiling liquid, expanding vapor explosion (BLEVE) could occur as a result of a rail car accident involving petroleum products from the refinery. A fire next to a rail car carrying 81 tons of butane would cause the contents of the car to rise to a temperature of 248° F and a pressure of 226.3 pounds per square inch gauge (psig). At this point the car may fail, releasing a combination of butane gas and aerosol droplets which would be ignited by the fire.

A BLEVE was not considered to be a credible event for the proposed process equipment or storage tanks. Although throughput of the process equipment may be high, most of the proposed equipment would have a low inventory of liquids at any given time (i.e., less than five tons). A BLEVE involving this small amount of material is unlikely and if it did occur the consequences should be less than that associated with a BLEVE of a rail car.

The equations and models used by Exxon Research and Engineering (ER&E 1993b) to calculate the nine accident consequences postulated above were independently reviewed by the City of Benicia's consultant (ENSR)and were determined to be conservative, providing a conservative estimate of potential consequences. The calculated frequencies of the accident scenarios provided in Table 4.5-9 and the estimated severity of the consequences at Exxon's property boundary are combined in Table 4.5-10. Figure 4.5-4 is a matrix of the significance of the nine accident consequences based on the impact significance criteria described above. As indicated in the figure, none of the potential accidents associated with the Clean Fuel project would result in a significant public safety impact.

TABLE 4.5-10

SUMMARY OF ER&E RISK OF UPSET MODELING RESULTS

	Accident Scenario	Frequency Range	Consequence at Industrial Fenceline
1.	Vapor Cloud Explosion Resulting from 3/4" Release in Process Area	3.0×10^{-4}/yr - 1.2×10^{-6} yr low	0.07 psig very low
2.	Vapor Cloud Explosion Resulting from 2" Release in Process Area	3.0×10^{-5}/yr - 1.0×10^{-7}/yr low	0.23 psig very low
3.	Thermal Radiation from Pool Fire in Process Area	1.0×10^{-4}/yr - 1.2×10^{-6}/yr low	<1.6 kW/m^2 very low
4.	Thermal Radiation from Pool Fire in Storage Area	3.2×10^{-4}/yr low	3.96 kW/m^2 low
5.	Overpressure and Thermal Radiation from BLEVE of a Rail Car	6.7×10^{-5}/yr low	>2.3 psig & >12.5 kW/m^2 high
6.	Hydrogen Sulfide Dispersion from 3/4" Release in Process Area	3.0×10^{-4}/yr - 1.2×10^{-6}/yr low	0.09 ppm very low
7.	Hydrogen Sulfide Dispersion from 2" Release in Process Area	3.0×10^{-5}/yr - 1.2×10^{-7}/yr low	4.0 ppm low
8.	Fire Resulting in Sulfur Dioxide Dispersion from 3/4" Release in Process Area	3.0×10^{-4}/yr - 1.2×10^{-6}/yr low	0.18 ppm very low
9.	Fire Resulting in Sulfur Dioxide Dispersion from 2" Release in Process Area	3.0×10^{-5}/yr - 1.2×10^{-7}/yr low	0.36 ppm low

Conversion Factor Used: 1.0 kW/m^2 = 317.2 Btu/hr ft^2

Probability or Likelihood of Accident Occuring	Very Low (no injury or damage to average population)	Low (minor injury or damage)	Medium (moderate injury or damage)	High (severe injury or fatality)
High (expected to occur at least once during the project lifetime)				
Medium (may occur during the project lifetime)				
Low (unlikely to occur)	**1, 2, 3, 8**	**4, 6, 7, 9**		**5**

(Shaded cells: Medium and High severity at Medium and High likelihood.)

These combinations of severity and likelihood identify situations of major concern that are considered significant.

Source: ENSR

Project No. 93C0336A	Exxon Clean Fuels Project	RISK OF UPSET ANALYSIS MATRIX	Figure 4.5-4
Woodward-Clyde Consultants			

Mitigation Measure No. 1

No mitigation is required.

Impact No. 2 **The proposed project would reduce the risk of public safety impacts associated with the use of ammonia at the Benicia Refinery. This is a beneficial impact.**

Exxon proposes to limit the use of anhydrous ammonia to the existing Dimersol unit. All other ammonia requirements for the refinery would be met with aqueous ammonia. While the proposed project and future NO_x controls for the refinery would increase the use of ammonia, the conversion from anhydrous to aqueous ammonia for most uses would reduce the potential for public safety impacts. Anhydrous ammonia is 100 percent ammonia that is a gas at atmospheric temperatures and pressures. The accidental release of anhydrous ammonia due to process equipment failure or a delivery truck accident could result in a concentrated plume of ammonia gas that could cause severe injuries. The aqueous ammonia that would be used at the refinery contains only 28 percent ammonia. A spill of this material would pool and the ammonia would take many hours to completely evaporate. In fact, aqueous ammonia could be readily cleaned up before all of it evaporated. Because of its lower ammonia content and slower rate of ammonia release to the atmosphere, an aqueous ammonia spill would result in a much smaller and less concentrated gas plume than a spill of anhydrous ammonia.

The Dames & Moore study (1993) quantitatively estimated the reduction in public safety impacts associated with the conversion of most refinery operations from anhydrous to aqueous ammonia. The HazOps studies conducted for the Benicia Refinery RMPP were used to identify current ammonia hazards at the facility. A preliminary hazard analysis was used to identify potential accidents resulting in releases from the proposed aqueous ammonia system. In identifying hazards associated with this system, Dames & Moore considered storage, unloading activities, distribution piping, and vaporization and injection of the aqueous ammonia at the point of its use.

Based on the hazards identified through the RMPP and the preliminary hazards analysis, the following accident scenarios were selected for a quantitative risk assessment:

Anhydrous Ammonia Accident Scenarios

- Storage tank failure at pipestill
- Storage tank failure at Dimersol unit
- Liquid loading line failure at pipestill
- Liquid loading line failure at Dimersol unit
- Large transportation spill
- Small transportation spill

Aqueous Ammonia Accident Scenarios

- Failure of 4-inch loading line on storage tank
- Leak from storage tank line flange
- Unloading spill liquid pool
- Distribution line failure
- Post-vaporizer line failure
- Large transportation spill
- Small transportation spill

The probability of an accident resulting in an ammonia release was evaluated using both historical records of applicable facilities and the fault tree evaluation technique described above for the Exxon Research and Engineering study. Table 4.5-11 presents the calculated probabilities of anhydrous and aqueous ammonia accidents.

The atmospheric dispersion of ammonia was modeled in order to estimate the potential consequences of an ammonia release from the 13 accident scenarios listed above. The atmospheric dispersion of ammonia from an accidental release is largely dependent on the mass release rate and the duration of the release. Release rates for the accident scenarios were estimated assuming a flashing flow for anhydrous ammonia releases and evaporating liquid pools for aqueous ammonia spills. The computer model SuperChems was used to predict the flashing release rate of anhydrous ammonia from existing vessels and hoses, the spreading of aqueous ammonia within the refinery after a spill, and evaporation of ammonia from aqueous solution pools. The model predicts the physical and thermodynamic properties of aqueous and anhydrous ammonia given such parameters as tank size, ground surface, and

TABLE 4.5-11

SUMMARY OF PROBABILITIES FOR RELEASE SCENARIOS OF ANHYDROUS AND AQUEOUS AMMONIA

Equipment Failure Scenarios	Annual Probability	Frequency (years)
Existing Equipment		
Pipestill Vessel Failure	3×10^{-5}	33,000
Hydrocracker Vessel Failure	1×10^{-5}	100,000
Dimersol Vessel Failure	1×10^{-5}	100,000
Pipestill Unloading Failure	9×10^{-4}	1,100
Hydrocracker Unloading Failure	--[a]	--[a]
Dimersol Unloading Failure	3×10^{-5}	33,000
Proposed/Future Equipment		
Aqueous Ammonia Storage Tank Failure	2×10^{-4}	5,000
Dimersol Vessel Failure	1×10^{-5}	100,000
Aqueous Ammonia Unloading Release (5 minutes)	3×10^{-2}	33
Dimersol Unloading Failure	3×10^{-5}	33,000
Distribution Pipe Failure	4×10^{-3}	250
Vaporize/Vapor Line Failure	3×10^{-4}	3,000

[a] Currently not in operation.

Source: Dames & Moore 1993.

dike size for aqueous ammonia spills and vessel size, hole size, and ambient temperature and pressure for anhydrous ammonia. A modeling system based on the SLAB dispersion model (Ermak 1989) was also used to simulate denser-than-air gas and two-phase releases from the accident scenarios. Table 4.5-12 provides the calculated release rate, duration of release, and total mass release of ammonia for each accident scenario.

Tables 4.5-11 and 4.5-13 summarize the calculated probabilities of ammonia releases from process and transportation accidents, respectively. Tables 4.5-14 and 4.5-15 present the consequences of ammonia releases from process and transportation accidents, respectively, in terms of hazard footprints. These hazard footprints indicate the area that would be subject to high concentrations of ammonia. ENSR has independently reviewed the Dames & Moore study and agrees with its conclusions.

The comparison of risks associated with the ammonia accident scenarios is shown in the impact significance matrix provided in Figure 4.5-5. As indicated in the matrix, the proposed project would tend to reduce the public health impacts associated with the use of ammonia at the Benicia Refinery.

Mitigation Measure No. 2

No mitigation is required.

4.5.3 Cumulative Impacts

Other industrial projects listed in Chapter 3.0 are located too far away from the Benicia Refinery to cause cumulative public safety impacts related to process equipment accidents. In most cases, impacts from fires, explosions, or toxic releases are either limited to the industrial property or rapidly decrease with distance away from the property fenceline.

Other projects at the Benicia Refinery are not expected to cumulatively increase public safety impacts. The future addition of NO_X emission control equipment to existing combustion sources would require increased use of ammonia at the refinery. However, the conversion of this control equipment from the anhydrous to aqueous ammonia would result in an overall decrease in hazards at the refinery. The construction of the MTBE unit will add hazards to the facility, but it is not reasonable to expect that the hazards of the MTBE unit and the proposed project would overlap. Proposed equipment would be spaced in accordance with

TABLE 4.5-12

AMMONIA (NH_3) RELEASE RATES AND DURATIONS FOR OFF-SITE CONSEQUENCE ANALYSIS

Scenario #/Description		NH_3 Release Rate (lb/min)	Duration (min)	Total NH_3 Mass (lbs) Released	Basis
Anhydrous Ammonia Releases					
AN-1)	Vessel Failure (large crack)	313.9	23	7,220	Horizontal Jet
AN-2)	Failure of Liquid	404.8	15	6,072	Horizontal Jet
AN-3)	Transportation Spill (large)	1,720.9	10	17,209	Horizontal Jet
AN-4)	Transportation Spill (small)	148.3	10	1,483	Horizontal Jet
Aqueous Ammonia Releases					
AQ-1a)	Failure of Tank Loading Line	23.4	60	1,405	Evaporating Pool
AQ-1b)	Leak from Storage Tank Line Flange	26.1	60	1,563	Evaporating Pool
AQ-2)	Unloading Spill Liquid Pool	4.5	60	271	Evaporating Pool
AQ-3)	Distribution Line Failure	22.8	60	1,365	Evaporating Pool
AQ-4)	Post-Vaporizer Line Failure	9.5	10	95	Horizontal Jet
AQ-5)	Transportation Spill (large)	297.6	60	17,857	Evaporating Pool
AQ-6)	Transportation Spill (small)	27.8	60	1,668	Evaporating Pool

Source: Dames & Moore 1993

TABLE 4.5-13

PROJECT RELEASE PROBABILITIES FOR AQUEOUS AND ANHYDROUS AMMONIA TRANSPORT

Ammonia Release Scenario	Annual Expected Probability of Truck Accident	Conditional Probability of Any Release	Conditional Probability of a Large Release	Probability of Presence of Populated Land Use[a]	Probability of Meteorological Conditions Producing Off-Highway Exposure[b]	Total Annual Probability of Release with Worst-Case Exposure[c]
Existing						
Large Anhydrous	2.65×10^{-2}	0.1	0.25	0.8	0.66	3×10^{-4}
Small Anhydrous	2.65×10^{-2}	0.1	0.75	0.8	0.3	5×10^{-4}
With Clean Fuels Project						
Large Anhydrous	8.46×10^{-4}*	0.1	0.25	0.8	0.66	1×10^{-5}
Small Anhydrous	8.46×10^{-4}*	0.1	0.75	0.8	0.3	2×10^{-5}
Large Aqueous	5.71×10^{-2}	0.15	0.5	0.4	0.28	5×10^{-4}
Small Aqueous	5.71×10^{-2}	0.15	0.5	0.4	0.3	5×10^{-4}

Source: Dames & Moore (1993).

*Note: Calculation of accident probability for future anhydrous transport

$$2.65 \times 10^{-2} \text{ accidents/year} \times \frac{6 \text{ proposed trips}}{188 \text{ existing trips}} = 8.46 \times 10^{-4} \text{ accidents/year}$$

The total probability calculation for the proposed anhydrous ammonia scenarios are conservative in that they do not take credit for an expected change in routing (from Tracy, CA rather than San Jose, CA) which could reduce the total annual probabilities by a factor of 2 due primarily to the lower land use factor associated with this route.

[a] Probability of truck accident occurring with populated (residential/commercial) land use adjacent to highway.

[b] Based on distribution frequency from 5 years of data of combinations of wind speed and stability classes producing off-highway exposure at maximum level. Frequency of wind direction is not accounted for.

[c] Represents the cumulative annual probability of an accident with release producing worst-case off-site exposure on potential populations, calculated by multiplying the proceeding five factors.

TABLE 4.5-14

MAXIMUM HAZARD FOOTPRINTS

Release Scenario		LEVEL 1[a] Downwind (m)	LEVEL 1[a] Crosswind (m)	LEVEL 1[a] Area (m^2)	LEVEL 1[a] People Exposed	LEVEL 2[b] Downwind (m)	LEVEL 2[b] Crosswind (m)	LEVEL 2[b] Area (m^2)	LEVEL 2[b] People Exposed	LEVEL 3[c] Downwind (m)	LEVEL 3[c] Crosswind (m)	LEVEL 3[c] Area (m^2)	LEVEL 3[c] People Exposed
AN-1a)	Storage Tank Failure at Pipestill	1109 (171)	195 (65)	1.63E+05 (7.55E+03)	(*)	303 (46)	102 (17)	2.17E+04 (4.79E+02)	* (*)	92 (8)	37 (2)	2.27E+03 (7.78E+00)	* (*)
AN-1b)	Storage Tank Failure at Dimersol	1089 (171)	202 (69)	1.65E+05 (7.78E+03)	(*)	297 (52)	107 (19)	2.20E+04 (5.51E+02)	* (*)	93 (14)	42 (2)	2.37E+03 (1.37E+01)	* (*)
AN-2a)	Liquid Loading Line at Pipestill	1042 (177)	210 (47)	1.68E+05 (8.38E+03)	(*)	309 (47)	109 (18)	2.36E+04 (5.09E+02)	* (*)	93 (8)	40 (2)	2.43E+03 (7.89E+00)	* (*)
AN-2b)	Liquid Loading Line at Dimersol	1023 (177)	217 (75)	1.70E+05 (8.62E+03)	(*)	301 (52)	115 (20)	2.40E+04 (5.82E+02)	* (*)	94 (14)	44 (2)	2.52E+03 (1.42E+01)	* (*)
AQ-1a)	Failure of 4" Loading Line on Storage Tank	240	35	6.26E+03	*	77	22	1.24E+03	*	23	13	2.16E+02	*
AQ-1b)	Leak from Storage Tank Line Flange	263	36	7.11E+03	*	85	23	1.37E+03	*	24	14	2.51E+02	*
AQ-2)	Unloading Spill Liquid Pool	88	14	9.23E+02	*	33	8	2.11E+02	*	11	5	3.73E+01	*
AQ-3)	Distribution Line Failure	242	33	6.03E+03	*	79	21	1.16E+03	*	24	13	2.27E+02	*
AQ-4)	Post-Vaporizer Line Failure	132	11	9.21E+02	*	46	5	1.45E+02	*	11	2	1.43E+01	*

[a] Maximum extent that 200 ppm was exceeded for 60 minutes or dose-weighted equivalent.
[b] Maximum extent that 1000 ppm was exceeded for 60 minutes or dose-weighted equivalent.
[c] Maximum extent that 4500 ppm was exceeded for 60 minutes or dose-weighted equivalent.
* Footprint does not impact populated areas.
- Values in parentheses represent modeling results that include plume dilution effects.

Source: Dames & Moore, 1993

TABLE 4.5-15

MAXIMUM HAZARD FOOTPRINTS TRANSPORTATION RELEASE SCENARIOS

Release Scenario	LEVEL 1[a] Downwind (m)	LEVEL 1[a] Crosswind (m)	LEVEL 1[a] Area (m^2)	LEVEL 1[a] People Exposed[c]	LEVEL 2[b] Downwind (m)	LEVEL 2[b] Crosswind (m)	LEVEL 2[b] Area (m^2)	LEVEL 2[b] People Exposed	LEVEL 3[c] Downwind (m)	LEVEL 3[c] Crosswind (m)	LEVEL 3[c] Area (m^2)	LEVEL 3[c] People Exposed	Fatalities
Large Transportation Spill - Anhydrous NH_3	1966	429	6.25E+05	685	631	233	1.04E+05	120	190	89	1.15E+04	11	0.10
Small Transportation Spill - Anhydrous NH_3	531	112	4.38E+04	40	142	55	5.43E+03	6	43	18	4.97E+02	0	0
Large Transportation Spill - Aqueous NH_3	1423	142	1.70E+05	184	372	98	2.51E+04	20	75	55	3.31E+03	0	0
Small Transportation Spill - Aqueous NH_3	239	42	7.70E+03	8	76	29	1.66E+03	0	[d]	[d]	[d]	0	0

Source: Dames & Moore 1993.
[a] Maximum extent that 200 ppm was exceeded for 60 minutes or dose-weighted equivalent.
[b] Maximum extent that 1000 ppm was exceeded for 60 minutes or dose-weighted equivalent.
[c] Maximum extent that 4500 ppm was exceeded for 60 minutes or dose-weighted equivalent.
[d] Level of concern not exceeded over the liquid aqueous ammonia pool.

LIKELIHOOD	Negligible Odor	Minor OSHA (onsite)	Major>ERPG-2	Severe>ERPG-3	Potentially Lethal
Frequent 10^{-1}/yr					
Likely 10^{-2}/yr	• Short Unloading Accident				
Unlikely 10^{-3}/yr		• Distribution Line Failure			
Rare 10^{-4}/yr		• Tank Spills • Anhydrous Unloading Release (existing) • Vaporizer/Vapor Line Failure	• Small Aqueous Ammonia Transport Spill	• Small Aqueous Ammonia Transport Release (existing) • Large Aqueous Ammonia Transport Spill	• Large Anhydrous Ammonia Transport Release (existing)
Extra-ordinary 10^{-5}/yr		• Anhydrous Unloading Release (with Clean Fuels project)		• Small Aqueous Ammonia Transport Release (with Clean Fuels project)	• Large Anhydrous Ammonia Transport Release (with Clean Fuels project)
Remote 10^{-6}/yr					
Not Credible 10^{-7}/yr					• Ammonia Transport Release Anhydrous (proposed)

OFFSITE CONSEQUENCE →

Source: ENSR

Project No. 93C0336A	Exxon Clean Fuels Project	HAZARD SCENARIO RISK RANKING MATRIX FOR WORST CASE CREDIBLE HAZARDS	Figure 4.5-5
Woodward-Clyde Consultants			

93C0336A-0600/083193

the National Fire Code to prevent involvement of adjacent equipment in the event of a fire in a process unit.

Impact No. 3 **The proposed project would have a cumulative impact on potential rail car accidents in the San Francisco Bay Area. This impact would not be significant.**

Clean fuels projects proposed for the refineries in the San Francisco Bay Area would increase rail traffic of hazardous materials at the Exxon Benicia Refinery, the Shell refinery in Martinez, and the Pacific refinery in Hercules. The combined increase in rail traffic from these three projects is estimated to total approximately 6,500 cars per year. Rail traffic from all three projects is most likely to overlap between Hercules and Benicia. Based on national rail accident statistics, the increased probability of rail accidents that could lead to a BLEVE caused by this increased traffic is approximately 1 chance in 3,200 years (frequency of 3.1×10^{-4}). This would be an insignificant impact.

Mitigation Measure No. 3

No mitigation is required.

4.6 NOISE

This introduction describes the fundamentals of noise, how it is measured and expressed, and how noise is perceived by the human ear. Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. Sound levels are usually measured and expressed in decibels (dB) with 0 dB corresponding roughly to the threshold of hearing (decibels and other technical acoustical terms are defined in the glossary, Section 8.0).

Most of the sounds which we hear in the environment do not consist of a single frequency, but rather a broad band of frequencies, with each frequency differing in sound level. The intensities of each frequency add together to generate a sound. The method commonly used to quantify environmental sounds consists of evaluating all of the frequencies of a sound in accordance with a weighting that reflects the fact that human hearing is less sensitive at low frequencies and extreme high frequencies, but more sensitive in the mid-range frequencies. This is called "A" weighting, and the decibel level so measured is called the A-weighted sound level (dBA). In practice, the level of a sound source is conveniently measured using a sound level meter that includes an electrical filter corresponding to the A-weighting curve. Typical A-weighted sound levels measured in the environment and in industry are shown in Table 4.6-1 for different noise sources.

Although the A-weighted noise level may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most environmental noise includes a conglomeration of sounds from distant sources which create a relatively steady background noise where no particular source is identifiable. To describe the time-varying character of environmental noise, the statistical noise descriptors, L_{10}, L_{50}, and L_{90}, are commonly used. They are the A-weighted noise levels equaled or exceeded during 10%, 50%, and 90%, respectively, of a stated time period. A single number descriptor called the L_{eq} is also widely used. The L_{eq} is the average A-weighted noise level during a stated period of time.

In determining the daily level of environmental noise, it is important to account for the difference in response of people to daytime and nighttime noises. During the nighttime, exterior background noises are generally lower than the daytime levels. However, most

TABLE 4.6-1

**TYPICAL SOUND LEVELS
MEASURED IN THE ENVIRONMENT AND INDUSTRY**

A-Weighted Sound Level in Decibels	Distance from Representative Noise Source	Representative Noise Environments	Subjective Impression
140			
130	Civil Defense Siren (100')		
120	Jet Takeoff (200')		Pain Threshold
110		Rock Music Concert	
100	Pile Driver (50')		Very Loud
	Ambulance Siren (100')		
90		Boiler Room	
	Freight Cars (50')	Printing Press Plant	
80	Pneumatic Drill (50')	In Kitchen With Garbage Disposal Running	
	Freeway (100')		
70			Moderately Loud
60	Vacuum Cleaner (10')	Data Processing Center	
		Department Store	
50	Light Traffic (100')	Private Business Office	
	Large Transformer (200')		
40			Quiet
30	Soft Whisper (5')	Quiet Bedroom	
20		Recording Studio	
10			Threshold of Hearing
0			

household noise also decreases at night and exterior noise becomes very noticeable. Further, most people sleep at night and are very sensitive to noise intrusion. To account for human sensitivity to nighttime noise levels, a descriptor, L_{dn} (day/night average sound level), was developed. The L_{dn} divides the 24-hour day into the daytime hours from 7:00 am to 10:00 pm and the nighttime hours from 10:00 pm to 7:00 am. The nighttime noise level is weighted 10 dB higher than the daytime noise level. The Community Noise Equivalent Level (CNEL) is another 24-hour average which includes both an evening and nighttime weighting.

The effects of noise on people can be listed in three general categories:

- subjective effects of annoyance, nuisance, dissatisfaction
- interference with activities such as speech, sleep, learning
- physiological effects such as startling, hearing loss

The levels associated with environmental noise, in almost every case, produce effects only in the first two categories. Workers in industrial plants can experience noise in the last category. Unfortunately, there is as yet no completely satisfactory way to measure the subjective effects of noise, or of the corresponding reactions of annoyance and dissatisfaction. This is primarily because of the wide variation in individual thresholds of annoyance, and habituation to noise over differing individual past experiences with noise.

Thus, an important way of determining a person's subjective reaction to a new noise is to compare the new source to the existing noise environment. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by the hearers.

With regard to increases in A-weighted noise levels, knowledge of the following relationships are helpful in understanding this report.

- Except in carefully controlled laboratory experiments, a change of 1 dB cannot be perceived.

- Outside of the laboratory, a 3 dB change is considered a just-perceivable difference.

- A change in level of at least 5 dB is required before any noticeable change in community response would be expected.

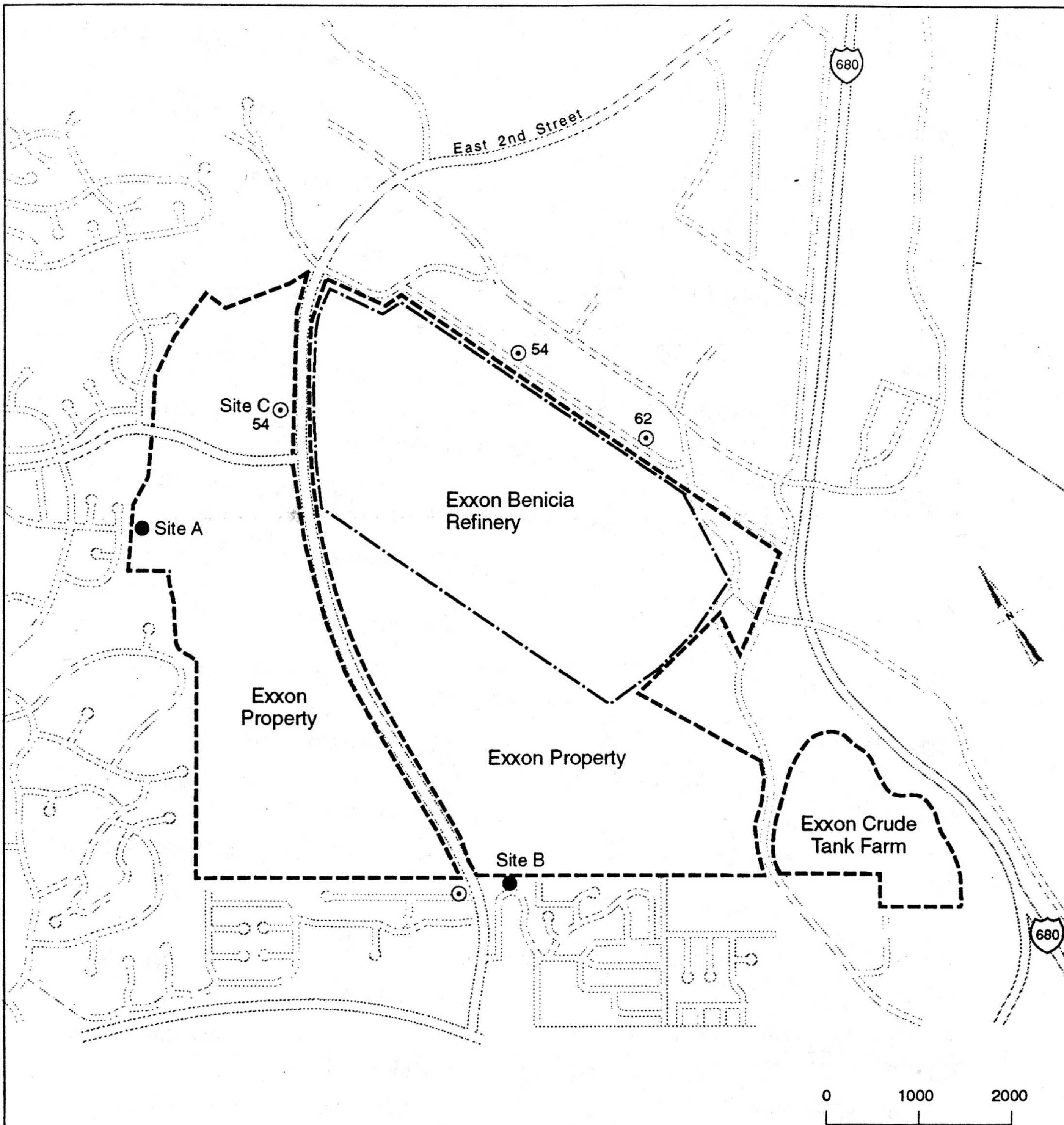
- A 10 dB change is subjectively heard as approximately a doubling in loudness, and would almost certainly cause an adverse change in community response.

4.6.1 Environmental Setting

Regulatory Background

Federal and State. There are no Federal regulations or state laws directly applicable to the noise assessment for this project. The California Environmental Quality Act (CEQA) includes qualitative guidelines for determining the significance of adverse environmental noise impacts. According to CEQA (Appendix G[p]), a substantial increase in noise at a sensitive location such as a residence, resulting from a project, is considered to cause a significant adverse impact (significance criteria used to evaluate noise impacts are specifically defined in Section 4.6.2).

City of Benicia. The Noise Element of the City of Benicia General Plan sets forth guidelines to evaluate the compatibility of a particular land use with the community noise environment. Residential development is considered normally acceptable where the community noise equivalent level (CNEL) ranges up to 60 dBA. The definition of normally acceptable for a given land use category is "the range of noise levels are compatible with the specified land use type. No special noise insulation is required in buildings of conventional construction." These guidelines are primarily used to evaluate the compatibility of an existing noise environment where a noise sensitive land use, such as housing, is proposed to be sited. It is, however, an important threshold for assessing noise impacts because it does establish a community standard. Other land uses considered equally sensitive to noise include hotels and motels, schools, libraries, churches, hospitals, nursing homes, playgrounds, and neighborhood



LEGEND

●	Long Term Noise Measurement Location with Average Refinery Noise in dB
54 ⊙	Short Term Traffic Noise Measurement Location
– – – –	Exxon Property Boundary
—·—·—	Exxon Refinery Boundary

Project No. 93C0336A	Exxon Clean Fuels Project	NOISE MEASUREMENT SITE LOCATIONS	Figure 4.6-1
Woodward-Clyde Consultants			

93C0336A-0600/083093

northern plant property lines to obtain a representative sample of the average steady level of refinery noise. Each of the noise measurement locations is described below.

<u>Location A, Allen Way</u>. Noise levels were measured at the rear fence of 382 Allen Way. This location was selected because there was a direct line-of-sight between the rear yard of the residence and most of the refinery. Parts of the refinery were obscured by an intervening hill. The results of the noise measurements are shown on Figure 4.6-2. Refinery noise is the dominant noise source at this location. The bold line on the figure represents the hourly average noise level (L_{eq}). Statistical descriptors are represented by the other lines on the graph. There was a significant variation in noise levels during the approximately 45 hours of measurements. When the monitor was started, there was a gentle north wind, lowering the refinery noise at this location. Noise levels were elevated during portions of both evenings. This was likely a time when atmospheric conditions were most conducive to noise propagation. There was an unexplained activity during the early morning of June 18 which substantially elevated noise levels. This could either have been a noise event at the refinery, or a local unrelated noise source. This noise did not occur during the time when the CNEL was determined and was not included in that calculation. As shown on the figure, the measured CNEL was 57 dBA. The existing CNEL at location A would be considered normally acceptable for residential land uses according to the City of Benicia's guidelines since the CNEL was less than 60 dBA.

<u>Location B, La Cruz</u>. This residence is located at 37 La Cruz at the top of a hill west of the refinery. There is an unobstructed view of the entire refinery from the rear yard of this home and its neighbors. Noise from the refinery was the dominant noise source at this residence. Vehicular traffic on East Second Street and Interstate 680 contributed to background noise levels. There was also a significant variation in hourly average noise levels at location B. The hour-by-hour variation at locations A and B correlates very well between midnight and 6:00 pm on June 17. Local noise sources or the atmospheric conditions did cause differences in the trends both before and after this time period. Measured noise levels are shown on Figure 4.6-3. The CNEL at location B would be considered conditionally acceptable.

Location C, East Second Street. Residences adjoin East Second Street between Interstate 780 and Tennys Drive. A noise measurement was conducted adjacent to the residence located at the northwest corner of Seaview Drive and East Second Street. The results of this measurement are summarized in Table 4.6-3. During the 15-minute measurement, vehicular traffic was counted on the roadway. This traffic count was then input into a noise prediction model approved by the Federal Highway Administration and Caltrans (FHWA-RD-77-108). The calculated noise level was within 0.5 dB of the measured level based on the actual traffic counts during the measurement. The model, therefore, correlates well with vehicular traffic on this roadway. Based on traffic data prepared for this study (Omni-Means 1993a), the existing peak hour average noise level and CNEL at this measurement location are estimated to be 68 dBA. The noise environment falls in the conditionally acceptable category according to the City General Plan. For new construction, this category of noise would warrant an acoustic study to develop design features that would reduce exterior noise levels.

4.6.2 Impacts and Mitigation

Significance Criteria

The goals and policies contained in the City of Benicia Noise Element were previously discussed. Project noise impacts would be considered significant under the following conditions:

- If noise resulting from the proposed project increased average ambient noise levels (CNEL) by more than 3 dBA and those noise levels increased from below the applicable acceptability level to above the acceptable level (e.g., 60-dBA CNEL for residences) are defined by the City of Benicia Code 8.20.190 (Table 4.6-2).

- If noise resulting from the project increased average ambient noise levels (CNEL) by more than 3 dBA where existing levels are already above the applicable criteria provided in Table 4.6-2.

- If the project-generated noise resulted in a 5-dBA increase in the CNEL at the property line and the resulting level remained below the maximum considered

TABLE 4.6-3

SHORT-TERM (15 MINUTE) TRAFFIC NOISE MEASUREMENT

Location: At the typical housing setback from East Second Street (55 feet from the centerline) near Seaview Drive.

Date	Start Time	L_{eq}[1]	L_{01}[2]	L_{10}[3]	L_{50}[4]	L_{90}[5]
6/18/93	9:55 am	65	76	69	59	47

Traffic on East Second Street During the Measurement Period	
Autos	108
Trucks	9
Buses	1
Motorcycles	1

[1] L_{eq} -- The average A-weighted noise level during the measurement period.

[2] L_{01} -- The A-weighted noise level that is exceeded during the measurement period 1 percent of the time.

[3] L_{10} -- The A-weighted noise level that is exceeded during the measurement period 10 percent of the time.

[4] L_{50} -- The A-weighted noise level that is exceeded during the measurement period 50 percent of the time.

[5] L_{90} -- The A-weighted noise level that is exceeded during the measurement period 90 percent of the time.

normally acceptable.

These criteria for significance recognize:

(1) The threshold levels of acceptability established by the local government or agencies; and

(2) That once the threshold level has been passed, any noticeable change above that level (a 3-dBA ncrease) results in a significant degradation of the noise environment; and

(3) A clearly noticeable change (a 5-dBA increase) in the noise environment, even though the acceptability threshold has not been reached, is considered a substantial increase and would result in a significant impact under CEQA.

Short-term impacts resulting during the construction phase are considered significant under the following conditions:

- Construction equipment noise levels exceeding 60 dBA during the daytime or 55 dBA during the nighttime outside of a residence and also exceeding existing ambient noise levels.

Noise impacts resulting from construction are assessed somewhat differently than noises due to plant operations. The construction phase does not create a long-term increase in noise levels. The potential for speech interference during the daytime or sleep disturbance at night are the most appropriate criteria for the purpose of assessing construction noise impacts. When the hourly average construction noise level during the day exceeds 60-dBA L_{eq} in an outdoor activity area near a residence, the construction noise will begin to interfere with speech communication. Construction activity at night that would generate an hourly average noise level exceeding 55-dBA L_{eq} outside a residence would cause noise levels inside to exceed 35 dBA even when the windows are closed. A noise level in excess of 35 dBA would begin to interfere with sleep.

Section 8.20.150 of the City of Benicia Noise Ordinance prohibits construction activities at night (10 pm to 7 am) when construction is occurring within 500 feet of a residential property. No such properties exist in the area and this section of the Ordinance is, therefore, not applicable.

Operational Noise Impacts

Impact No. 1 **Operating equipment for the proposed project would result in a minor increase in community noise levels. This impact is not significant.**

Exxon Research and Engineering Company prepared an assessment of expected community noise levels resulting from the Clean Fuels Project (Natanson 1993a), which was independently reviewed by the acoustical engineering firm of Illingworth & Rodkin Inc. for the City of Benicia. The noise from each of 130 separate major pieces of equipment required for the project were taken into consideration. Noise from each piece of equipment was projected out to numerous locations in the surrounding area and noise level contours were predicted. The predicted hourly average noise levels are shown on Figure 4.6-4.

The Exxon study included noise data for each individual piece of equipment. Calculations were independently done during preparation of this EIR starting with the individual equipment noise levels. A check of the predicted noise levels at measurement location B (on La Cruz Avenue) indicated A-weighted noise levels would be approximately 14 dBA higher than shown on Figure 4.6-4. This discrepancy was satisfactorily explained in a subsequent letter from Exxon (Natanson 1993b). The noise contours assumed that all equipment would meet the Exxon in-plant noise criteria of 85 dBA at the defined worker exposure location. Exxon would require that their vendors meet this noise level limit. The unmitigated noise levels were projected out to the worker exposure distances for each piece of equipment. They were then adjusted to 85 dBA prior to projecting them out to the nearest sensitive receptor locations in the community. Example calculations were reviewed and the calculation methods were appropriate. Given the 85-dBA worker exposure location noise limit, the contours on Figure 4.6-4 provide a reasonable estimate of project-generated equipment noise levels in the community.

achieve these limits. Exxon would have a person experienced in noise control engineering review these submittals and determine that the calculations supplied by the vendors and the noise control treatments are reasonable, accurate, and of sufficient detail to allow them to independently determine that the noise level limits are likely to be met. Compliance with these reviewed requirements would substitute for onsite or community noise monitoring. Exxon would request the vendor to provide noise monitoring if Exxon has reason to believe that noise from a particular piece of equipment would exceed the allowable limit.

As an option, as noise or sound power levels are identified for proposed equipment, Exxon could reevaluate noise levels, and have this reevaluation independently reviewed by the City. If the reevaluation demonstrates no significant impact from the project as a whole, then the City could consider making the finding that no further mitigation is required.

Impact No. 2 **Traffic generated by operation of the proposed project would not result in increased noise levels. No impact would occur.**

The proposed project would result in a small increase in the number of workers (30-50 new employees) at the Benicia Refinery, and an associated increase in vehicular traffic on East Second Street and the rest of the road network. The increase in traffic noise is logarithmically proportional to the increase in traffic. Operation-related traffic is minor and would result in no increase (less than 0.5 dBA) in noise along roads serving the site.

Mitigation Measure No. 2

None required.

Construction-Related Noise Impacts and Mitigation

Impact No. 3 **Construction traffic is calculated to generate less than a 3-dBA increase in traffic noise along East Second Street. This impact is not significant.**

Construction workers would be traveling to and from the project site each day. Vehicular traffic would access the site via East Second Street and Bayshore Road. Residences adjoin East Second Street between Interstate 780 and Tennys Avenue. There are no sensitive receptors adjoining Bayshore Road. During the peak construction traffic hours, noise levels are calculated to increase by about 2 dBA along East Second Street. Construction traffic would, therefore, result in an imperceptible increase in traffic noise levels along East Second Street during the early morning and late afternoon hours. The CNEL resulting from construction traffic is calculated to increase by, at most, 1 dBA at residences along East Second Street. This would be a small increase and would not result in a significant noise impact.

Mitigation Measure No. 3

None required.

Impact No. 4 **Construction of processing units and other equipment would generate noise that would be audible but would not exceed the significance criteria. This impact is not significant.**

The construction of the Clean Fuels Project would take place over two years. Major construction activities would occur in three areas on the project site. The construction activities would be concentrated in those areas on the site shown on Figure 4.6-4 where the concentric circles are located. These construction sites would be located approximately 3,300 feet from noise monitoring locations A and B representing the nearest sensitive receptors to the facility. Construction would occur in phases, including relocation of existing equipment, grading and foundation work, erection of the new facilities, and paving and finishing. Noise levels have been estimated for large industrial/manufacturing projects

(ESEERCO 1977). At a distance of approximately 3,000 feet, worst-ease hourly average construction noise levels during the various phases outlined above would be expected to reach about 52 dBA. These projections assume good sound propagation conditions and no noise attenuation from the ground, terrain, or vegetation. The projected worst case hourly average construction noise levels would, therefore, be below the 60-dBA daytime and 55-dBA nighttime significance threshold. Construction noise would not result in a significant noise impact.

Mitigation Measure No. 4

Noise level projections assume equipment is properly muffled. The construction contractor should be required to operate and maintain all internal combustion engine driven equipment fitted with mufflers specified for the equipment and maintained in good condition.

4.6.3 Cumulative Impacts and Mitigation

Impact No. 5 **The proposed project, in combination with other proposed industrial projects, would result in a potentially significant noise impact at sensitive receptors in the area.**

Operations at the Benicia Refinery are the only significant source of industrial noise affecting residences near the facility. Unlike some other resources, noise impacts are localized. The environmental noise created by a noise source spreads out and is dissipated as it propagates through the atmosphere. Also, the dominant noise source controls what is heard and measured. As an example, when the noise level from one source is 10 dB above the noise level from another source, the lesser noise source makes no measurable contribution to the cumulative noise level.

Other projects proposed at the refinery include a methyl tertiary butyl ether (MTBE) production unit and modification to existing equipment to reduce air emissions. The projected noise levels from the MTBE unit were studied in the Community Noise Assessment prepared by Exxon Research (Stocky 1992). Noise levels from the MTBE unit are predicted to be more than 10 decibels below noise from the Clean Fuels Project. MTBE unit noise would, therefore, be insignificant.

Mitigation Measure No. 5

Cumulative noise impacts can be mitigated to a less than significant level if all new equipment at the Exxon Refinery is required to meet the 85-dBA worker noise exposure limit. Vendors supplying equipment for the nitrogen plant addition would be required to demonstrate compliance with the 85-dBA worker noise exposure limit. This measure would be carried out by Exxon personnel experienced in noise control engineering who would review submittals for compliance with the required limits to assure that the noise control treatments included in the design are reasonable and would be expected to provide the necessary noise reduction.

Impact No. 6 **Cumulative traffic noise impacts upon sensitive receptors in the area would not be significant.**

The vehicular traffic resulting from construction and operation of the proposed project would make no change in the community noise environment. Other projects unrelated to the Clean Fuels Project are expected to result in background growth and traffic along East Second Street. Noise levels from Clean Fuels construction traffic were estimated by comparing existing with proposed traffic levels at peak construction, and calculating the resulting noise increase along all of the streets where construction traffic would increase. Noise levels are predicted to increase by less than 3 dBA as a result of cumulative development. A 3-dBA increase would not be substantial and there would be no cumulative noise impact resulting from traffic in the area.

Mitigation No. 6

None required.

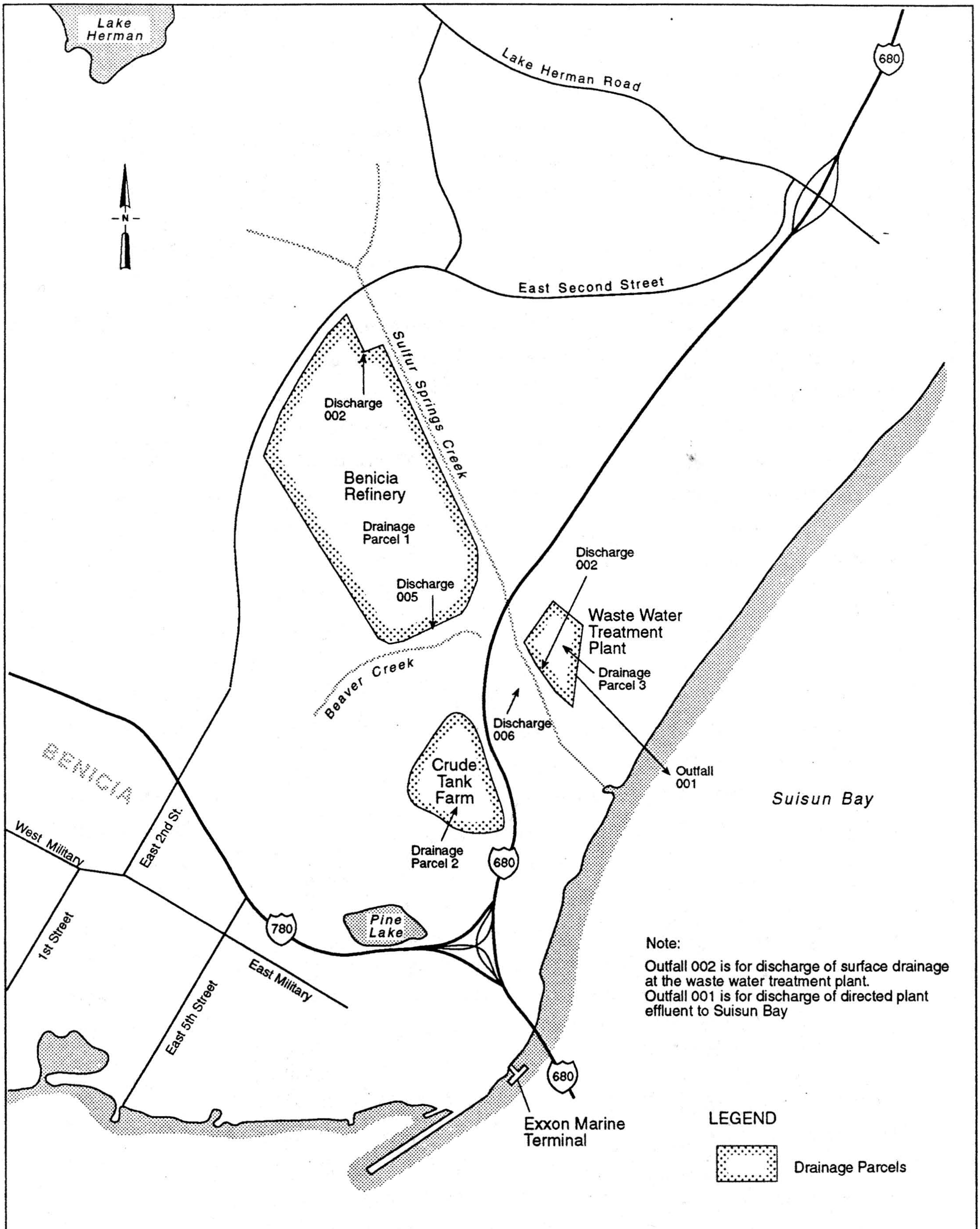
4.7 SURFACE WATER HYDROLOGY AND QUALITY

4.7.1 Environmental Setting

The Exxon Benicia Refinery is situated within rolling, low-elevation hills (ranging up to 200 to 300 feet) above Suisun Bay. Several small drainage catchments are located in the area. The largest of these is the Lake Herman/Sulphur Springs Creek watershed. Sulphur Springs Creek is impounded by Lake Herman Reservoir located to the north of the refinery. Below the reservoir, the creek eventually discharges to Suisun Bay (Figure 4.7-1). Along the eastern border of the refinery, the creek is channelized where it passes through the Benicia Industrial Park. Other small ephemeral tributaries to Sulphur Springs Creek flow from west to east near the refinery property. These include Beaver Creek, a drainage located along the southern boundary of the refinery.

Existing Storm Water Drainage System at the Exxon Benicia Refinery

As is common of most refineries, the majority of the surfaces within the Benicia Refinery are covered with impervious materials and storm water runoff is generally rapid. The storm drainage system at the refinery is divided into three major drainage parcels: Parcel 1 is the main refinery area, administration building, and product tank farm, Parcel 2 contains the crude oil tank farm, and Parcel 3 drains the area surrounding the waste water treatment plant (Figure 4.7-1). Within each of the drainage parcels, stormwater may be handled three different ways. First, some specific areas are diked or otherwise contained such that stormwater flows are collected and may be detained before they are released to the waste water treatment plant. This controlled system allows the refinery to regulate the volume of storm water flow that enters the waste water treatment plant at any given time. Second, there are areas where storm-water runoff is not collected or detained, and drains directly into a collection system that transports the flows to the waste water treatment plant. Finally, there are areas (primarily undeveloped) where storm water drains to a system of outfalls that are permitted under the National Pollutant Discharge Elimination System (NPDES), which eventually drain to Suisun Bay. The refinery's storm-water system for each of the major drainage parcels is described below.



Project No. 93C0336A	Exxon Clean Fuels Project	LOCATION OF DRAINAGE PARCELS AND STORMWATER OUT FALLS	Figure 4.7-1
Woodward-Clyde Consultants			

93C0336A-0600/083193

Parcel 1, the main refinery area, covers approximately 197 acres. Except for a 1-acre undeveloped area between the administration building and main process block, runoff from Parcel 1 flows to the waste water treatment plant through the storm-water drainage system. Dikes enclose approximately 61 acres of this drainage area. Drainage from the diked areas is controlled (detained) by manually operated valves so storm water that flows into the areas can be stored and drained to the treatment plant after the storm ends. Runoff from the remaining 137 acres is not controlled and flows directly to the treatment plant (Dames and Moore 1990).

Storm-water runoff is transported to the treatment plant through a 72-inch-diameter pipe. This water is treated at the plant as discussed in Section 2.6 and discharged to San Francisco Bay via an NPDES-permitted outfall 001 (Figure 4.7-1). Storm water falling in the 1-acre undeveloped area between the administration building and main processing block is discharged directly to receiving waters via NPDES discharge points 005 and 002 (Figure 4.7-1).

Parcel 2 drains about 123 acres and encompasses the crude oil tank farm. This area is located to the south of the main refinery and is geographically separated from it (Figure 4.7-1). Approximately 37 acres of Parcel 2 are diked to contain the crude oil tanks. Runoff from these areas can be stored and released to the treatment plant via the storm drain system after the storm ends. Runoff from the remaining 86 acres outside of the diked areas would not come into contact with crude oil; therefore, it is collected and discharged to Sulphur Springs Creek (and ultimately to Suisun Bay) through NPDES-permitted discharge point 006. Since 70 percent of the runoff in this parcel drains directly to the Bay, and the remaining amount can be released to the treatment plant in a controlled manner, runoff from this parcel does not contribute to peak flows or impact the treatment plant during a storm event.

Parcel 3 is the area surrounding the waste water treatment plant. This drainage area covers approximately 20 acres, all of which is diked (Dames and Moore 1990). Approximately half of this drainage area is covered by three surface water impoundments: an equalization pond, a retention pond, and a final pond. The equalization and retention ponds had historically been used for waste water storage prior to processing through the biological oxidation unit.

These ponds have been modified so that currently only storm-water runoff in excess of the treatment plant processing rate (2,500 gallons per minute [gpm]) is diverted into them. Exxon is currently expanding the capacity of the retention pond. The final pond is downstream of the treatment plant and receives treated effluent prior to discharge to San Francisco Bay. Storm water that falls on the 10 acres of Parcel 3 that is outside of the three ponds is collected and pumped to the retention pond for later processing at the treatment plant.

The process equipment for the Clean Fuels project is located in an undiked drainage area of Parcel 1. About half of the 2.75 acres that would be occupied by project equipment and tanks is currently paved. The remaining area is graded and graveled. The area is now used for truck parking and equipment storage. Three hydrocarbon tanks will be added to a controlled drainage area of Parcel 1. Drainage Parcels 2 and 3 would not be altered by the Clean Fuels project.

An additional area, located near the Gate 5 parking lot (Figure 2-2) would be graded and used for equipment fabrication. This area is not within any of the drainage parcels described above. Runoff from this area flows overland to an unnamed drainage and then into Sulphur Springs Creek.

Receiving Waters and Beneficial Uses

Discharges from the Benicia Refinery ultimately drain into Suisun Bay and the Carquinez Strait, the channel between Suisun Bay and San Pablo Bay of the San Francisco Delta system. In the Basin Plan (RWQCB 1991), the San Francisco Regional Water Quality Control Board identifies a number of beneficial uses of Suisun Bay and the Carquinez Strait that must be protected. The beneficial uses include:

- Water contact recreation
- Non-contact water recreation
- Navigation
- Ocean commercial and sport fishing
- Wildlife habitat

- Estuarine habitat
- Fish spawning and migration

The State Water Resources Control Board's Water Quality Assessment indicates that San Pablo and Suisun bays have elevated levels of mercury and selenium and have recently experienced fish declines. Selenium is of particular concern because it is known to bioaccumulate in tissues of aquatic organisms. Data on selenium concentrations in marine organisms indicate that food chains in Suisun Bay, Carquinez Strait, eastern San Pablo Bay, and the South Bay have elevated concentrations of this element (SFEP 1992).

Waste Water Treatment

A description of the components of the waste water treatment plant is provided in Section 2.6.7. Treatment capacity is discussed below.

Flows and Hydraulic Capacity. Process waste water and oil-free utilities waste water (i.e., filter backwash, boiler and cooling system blowdown) discharge to the treatment plant at an average rate of 1177 gpm (Dames and Moore 1990). Stripped sour water[1] flows to the treatment plant at an average rate of 300 gpm with a maximum rate of 400 gpm. The hydraulic capacity of the plant is limited by the capacity of the activated sludge clarifiers to a maximum of 2,500 gpm. The average process and utility waste water flow of 1177 gpm, combined with the average sour water flow of 300 gpm, uses approximately 60 percent of the hydraulic capacity of the treatment plant. The remaining 40 percent of capacity (or 1,023 gpm of flow) is available for treating stormwater runoff.

Peak Flows and Runoff Volumes. Dames and Moore (1993) performed stormwater runoff computations for the 5, 10, and 20-year, 24-hour storm events from the refinery. These storm events would result in runoff volumes from the overall refinery of approximately 26, 34, and 39 acre-feet, respectively. The runoff computations indicated that the existing drainage system has the capacity to easily convey runoff from the refinery's undiked areas during a 20-year storm event. The analyses also indicate that the existing drainage system, waste

[1] Sour water is water containing ammonia and hydrogen sulfide generated during the refining process.

water treatment capabilities, and impoundment volumes, including the expanded stormwater retention pond, are capable of handling the 5-, 10-, and 20-year, 24-hour storm events provided that the impoundment basins are dry prior to the storm, drainage into diked areas of the refinery can be retained and released after the storm event, and the treatment plant is operating at the design capacity of 2,500 gpm. If several storms occur over a period of several days, the storm-water storage and treatment capacity can be exceeded. That is, the refinery's containment (impoundment) areas that are designed to store and temporarily detain storm-water flows may become partially or entirely filled from a series of successive storms, thereby reducing available capacity for storm-water detention in the event of additional successive storms. When this occurs, excess storm water and process effluent bypass the treatment plant and are discharged directly to the Bay. As an example, a bypass of a mixture of storm water and process water occurred during mid-January 1993 when a large storm (approximately 2.5 inches in 24 hours) was preceded by several days of rain. Exxon is expanding the stormwater retention pond, in part, to reduce the frequency of such events.

Treated waste water is discharged into Carquinez Strait at a depth of 18 feet via a 12-inch pipe. The diffuser at the end of the pipe provides a minimum dilution ratio of 15:10.

NPDES Discharge Limitations and History of Compliance

Discharges from the Benicia Refinery are controlled under a NPDES permit Order No. 90-096 (NPDES No. CA0005550), which is regulated by the San Francisco Regional Water Quality Control Board (RWQCB). This permit covers the discharge of process waste waters from the waste water treatment plant and storm water. Routine water quality monitoring is conducted on outflows from one outfall (Waste 001) into the Carquinez Strait, and from four outfalls (002, 003, 005, 006) into the Sulphur Springs Creek.

Treatment Plant Discharges. The discharge limitations in the NPDES permit for the treatment plant are summarized for mass effluent in Table 4.7-1 and for concentration limits in Table 4.7-2. Toxicity bioassays are required for these discharges. These bioassays consist of placing three-spine stickleback and fathead minnow (or rainbow trout) in undiluted treatment plant effluent and evaluating their survival over a 96-hour period. The permit limitation on the toxicity tests requires a survival rate of not less than 50 percent. Discharge

TABLE 4.7-1

MASS EFFLUENT LIMITATIONS FOR DISCHARGE POINT, WASTE 001

Constituent	Units	Monthly Average	Maximum Daily
BOD (5-day @ 20C)	lbs/day	1416.	2549.
	kg/day	643.6	1159.
TSS	lbs/day	1133.	1777.
	kg/day	515.	808.7
COD	lbs/day	9888.	19060.
	kg/day	4495.	8664.
Oil and Grease	lbs/day	412.	772.5
	kg/day	187.3	351.1
	mg/l	8.	15.
Phenolic Compounds	lbs/day	5.42	19.06
	kg/day	2.46	8.66
Ammonia as N	lbs/day	772.5	1700.
	kg/day	351.1	772.7
Sulfides	lbs/day	7.47	16.7
	kg/day	3.4	7.59
Total Chromium	lbs/day	6.36	18.25
	kg/day	2.89	8.30
Hexavalent Chromium	lbs/day	0.52	1.16
	kg/day	0.24	0.53
Settleable Solids	ml/l/hr	0.1	0.2

Source: NPDES Permit Order No. 90-096. California Regional Water Quality Control Board. San Francisco Bay Region.

BOD - Biochemical Oxygen Demand
TSS - Total Suspended Solids
COD - Chemical Oxygen Demand

TABLE 4.7-2

CONCENTRATION LIMITS FOR DISCHARGE POINT, WASTE 001

Constituent	Daily Average (μg/l)
Arsenic	200
Cadmium	30
Chromium VI*	110
Copper	200
Cyanide	25
Lead	56
Mercury	1
Nickel	71
Silver	23
Zinc	580
Phenols	500
PAHs	150

Source: NPDES Permit Order No. 90-096. California Regional Water Quality Control Board. San Francisco Bay Region.

* This limit can be met as total chromium.

from Waste 001 is also subject to the following receiving water limitations:

- No floating, suspended, or deposited macroscopic particulate matter or foam
- No bottom deposits or aquatic growth
- No alteration of turbidity or apparent color beyond present natural background levels
- No visible, floating, suspended, or deposited oil or other products of petroleum origin
- No toxic or other deleterious substances to be present in concentrations or quantities which will cause deleterious effects on aquatic biota, wildlife, or waterfowl, or which render any of these unfit for human consumption either at levels created in the receiving waters or as a result of biological concentrations.

Monitoring of the discharge from the treatment plant to the Bay is required under the self-monitoring program to confirm compliance with NPDES permit stipulations, and is reported monthly to the RWQCB. These reports were obtained and reviewed for this EIR (Exxon 1991-1993). For the period between January 1991 through June 1993, all constituents were reported to be in compliance except for toxicity.

Toxicity of the refinery effluent (discharge point Waste 001) exceeded permit limitations 11 times in 1991, and 4 times in 1992. Most of these fish bioassay failures were related to insufficient nitrification thereby creating high nitrite levels in the water. Changes have been made by Exxon to improve performance of the bio-oxidation system and general treatment plant operations to increase nitrification. For a recent 6-month period (November 1992 through June 1993), there were no fish bioassay failures.

Selenium discharge limitations are expressed as a 12-month rolling mass average based on historical performance. The weekly mass estimate is calculated from the weekly concentration measurement and the average weekly flow rates. The 12-month rolling average is calculated as the average of the previous 52 weekly mass estimates. Exxon has not violated the selenium 12-month rolling average of 2.07 lb/day. The refinery's 1992 average mass was 1.89 lb/day.

In addition to the numeric indicator, the permit limits any selenium discharge increase by stating:

> These limits are intended to be a cap on current performance, and any enforcement action by the Board will be based on violation of that narrative standard as well as violation of the explicit numeric limits listed below.

Additionally, Regional Water Quality Control Board Order No. 91-026 (February 20, 1991) will require that the Exxon Refinery reduce discharges to a maximum daily selenium effluent limit of 50 parts per billion by December 1993 and a mass emission rate calculated on a running annual average of 0.97 lb/day.

Storm Water Discharges. Discharge points for the refinery's storm water runoff are from Outfalls 002, 003, 005, and 006 (Figure 4.7-1). Discharge limitations for untreated storm water are outlined in Table 4.7-3. Storm water runoff from the Clean Fuels process equipment area and tanks (to be located in Drainage Parcel 1) would flow to the treatment plant for processing. Storm water runoff for the proposed equipment fabrication and storage area adjacent to the Gate 5 parking area would flow to an unnamed drainage; this area is not within a drainage parcel.

4.7.2 Impacts And Mitigation

Significance Criteria

The CEQA guidelines list a series of conditions which could result in significant water quality and hydrology-related environmental impacts. According to CEQA, a project could have hydrology-related impacts if 1) the project results in changes in surface absorption rates, drainage patterns, or the rate and amount of runoff, and 2) exposes people or property to water-related hazards such as flooding. Based on this, the following significance criteria were used in evaluating hydrological impacts from the project:

TABLE 4.7-3

STORMWATER RUNOFF LIMITATIONS

Constituent	Monthly Average (mg/l)	Maximum Daily (mg/l)
BOD (5-day @ 20)	26.	48.
TSS	21.	33.
COD	180.	360.
Oil and grease	8.	15.
Phenolic Compounds	0.17	0.35
Total Chromium	0.21	0.60
Hexavalent Chromium	0.028	0.062

Source: NPDES Permit Order No. 90-096 California Regional Water Quality Control Board. San Francisco Bay Region.

BOD - Biochemical Oxygen Demand

TSS - Total Suspended Solids

COD - Chemical Oxygen Demand

- Substantial change in the rate and amount of surface runoff. A substantial change is considered to be a change which would cause exceedance of the refinery's treatment plant capacity.
- Changes in runoff or drainage patterns which would result in substantial flooding, erosion, or siltation.

The following significance criteria were used to evaluate the impact of the Clean Fuels project on water quality:

- Substantial change in concentrations and loads of pollutants to the receiving water. A substantial change is considered to be a change which would cause exceedance of the current NPDES effluent limitation.

Storm Water Runoff Impacts and Mitigation

The following impacts were identified for storm water runoff.

Impact No. 1 **Increased storm water runoff would result from the increase in the amount of paved surfaces added by the Clean Fuels project. This impact would not be significant.**

Approximately half of the 2.75-acre project area is currently paved and contributes runoff to the waste water treatment plant. The increase of approximately 1.4 acres of impervious surface caused by the project would slightly increase the amount of runoff flowing to the treatment plant during storm events; this impact is discussed below. No discharge to Sulphur Springs Creek or Beaver Creek occurs from this area so no hydrological impacts (e.g., flooding) to the creeks would occur due to this project. The three new hydrocarbon tanks would be placed in a controlled runoff area (i.e., an impoundment or containment area capable of temporarily detaining storm water flows); therefore, there would be no change in peak storm water runoff flows to the treatment plant.

The proposed Clean Fuels process equipment area (2.75 acres) represents approximately 2 percent of the total undiked drainage area of Parcel 1. Since about half of the Clean Fuels project area is currently covered with impervious material, the impervious surface added by the project (1.4 acres) represents about 1 percent of the total undiked drainage area of Parcel 1. During a 20-year, 24-hour storm event, the currently unpaved portion of the proposed Clean Fuels process area would contribute approximately 0.2 acre-foot[2] (65,165 gallons) of runoff to the treatment plant. With the Clean Fuels process equipment in place, this area would contribute 0.36 acre-foot[3] (117,298 gallons), or about 0.16 acre-foot (52,132 gallons) more than under current conditions.

As discussed in Section 4.7.1, the refinery consists of areas where rainfall is contained and temporarily detained before being released to the waste water treatment plant, and areas where the storm water runoff is not contained, and flows directly to the treatment plant, or in undeveloped areas flows to a permitted NPDES outfall and to Suisun Bay. The additional flow from the new paved areas of the Clean Fuels process area (0.16 acre-foot for a 24-hour, 20-year storm event) would flow directly (not detained) to the treatment plant. This additional flow will utilize a portion of the excess capacity of the treatment plant that is currently available to process storm water runoff. This means that Exxon must withhold additional storm water flows within the contained (diked or otherwise controlled) portions of the refinery to avoid storm water runoff flows that exceed the hydraulic capacity of the treatment plant during a maximum storm event. To evaluate this potential impact, the total runoff from a maximum storm event was added to the existing waste water treatment plant capacity to determine if the project would change the size of the storm events that can be handled by the refinery's storm water storage and treatment system.

Table 4.7-4 lists runoff and waste water flows for a 20-year, 24-hour storm event. This is the maximum storm event used by Exxon to design the capacity of their storage and treatment system. Table 4.7-4 shows that such an event would currently result in 34 acre-feet

---

[2] Calculated based on U.S. Soil Conservation Service (1986) runoff curve number of 77 and precipitation of 3.8 inches over 24 hours (see Dames and Moore 1990).

[3] Calculated based on U.S. Soil Conservation Service (1986) runoff curve number of 94 and precipitation of 3.8 inches over 24 hours (see Dames and Moore 1990).

TABLE 4.7-4

COMPARISON OF RUNOFF AND PROCESS WASTEWATER FLOWS, TREATMENT CAPACITY, AND STORAGE VOLUMES FOR A 20-YEAR, 24-HOUR STORM EVENT

	CURRENT CONDITIONS*			POST-PROJECT CONDITIONS		
	acre-feet	gallons	GPM	acre-feet	gallons	GPM
FLOWS TO TREATMENT PLANT						
STORMWATER RUNOFF 24 HOURS (PARCELS 1 AND 3)	42.75	13,929,181	9,682	42.91	13,981,314[b]	9,717[b]
PROCESS/UTILITIES[a] WASTEWATER	5.56	1,811,608	1,259	5.8	1,889,807	1,313[c]
STRIPPED SOUR WATER	1.46	475,710	331	1.46	475,710	332
TOTAL FLOW TO TREATMENT PLANT	49.77	16,216,499	11,272	50.17	16,346,831	11,362
TREATMENT PLANT PROCESSING RATE	11.05	3,600,000	2,500	11.05	3,600,000	2,500
STORM WATER STORAGE VOLUMES						
REQUIRED STORAGE VOLUME (total flow to treatment plant minus processing rate)	38.72	12,616,091	--	39.12	12,746,831	--
AVAILABLE STORAGE VOLUME	39.44	12,850,688	--	39.44	12,850,688	--
EXCESS STORAGE CAPACITY (available volume minus required volume)	0.72	234,597	--	0.32	103,857	--

* Includes modifications resulting from in-progress MTBE project.
[a] Utilities wastewater refers to water from filter backwash and boiler and cooling system blowdown.
[b] These volumes equal current flows plus the increase in runoff with the project.
[c] These volumes equal current flows plus the additional 56-gpm Clean Fuels wastewater flow.

of runoff, which would increase by 0.16 acre-foot to about 34.2 acre-feet (rounded) with the project in place. The treatment plant currently processes approximately 5.56 acre-feet over a 24-hour period, which would increase by 56 gpm (about 0.2 acre-foot per 24 hours) due to additional process flows coming from the Clean Fuels equipment, for a total of 5.8 acre-feet per day. When combined with stripped sour water flows, the total quantity of water that would need to be processed by the treatment plant from a 24-hour, 20-year storm combined with process flows would be 49.77 acre-feet currently, increasing to 50.17 acre-feet with the project. Because the treatment plant can process 11 acre-feet of flow per day, the refinery must be capable of temporarily storing 38.72 acre-feet of rainfall currently, and 39.12 acre-feet with the Clean Fuels project, in order to sufficiently handle a 20-year, 24-hour design storm event without having excess flow bypass the treatment plant. As shown in Table 4.7-4, the available storm water storage capacity is 39.4 acre-feet, which provides 0.72 acre-feet excess storage capacity currently, and 0.32 acre-feet with the project. This means that the Clean Fuels project would reduce the available storm water storage capacity of the refinery by 0.4 acre-foot, but that a design 20-year, 24-hour storm event could still be handled without exceeding the capacity of the system.

It should be noted, however, that the storm water storage capacity of the refinery has been exceeded in the past when multiple large storms occur over a short period of time (e.g., several days). This can happen if the storm water storage basins are partially or entirely filled as a result of consecutive storms, followed by a major storm event. Closely spaced major storms will occur in the future, and exceedances of the refinery's capacity can occur, with or without the project. The increased runoff associated with the proposed project would increase the frequency of such an event by 1 percent or less; therefore, this impact is not considered significant.

Runoff from the proposed equipment storage/fabrication area near the Gate 5 parking lot would not change appreciably with the project. The area is currently relatively level and unpaved, and does not contribute runoff to the waste water treatment system. Best management practices, according to the RWQCB's BMP guidelines for industrial storm water pollution prevention, would be implemented during equipment fabrication to prevent pollutants from entering the storm drains. After project modifications the area would be graded and would remain unpaved. No significant storm water runoff impacts are predicted for this element of the project.

Mitigation Measure No. 1

The increase in storm water runoff from the Clean Fuels project is not considered significant and no mitigation is required.

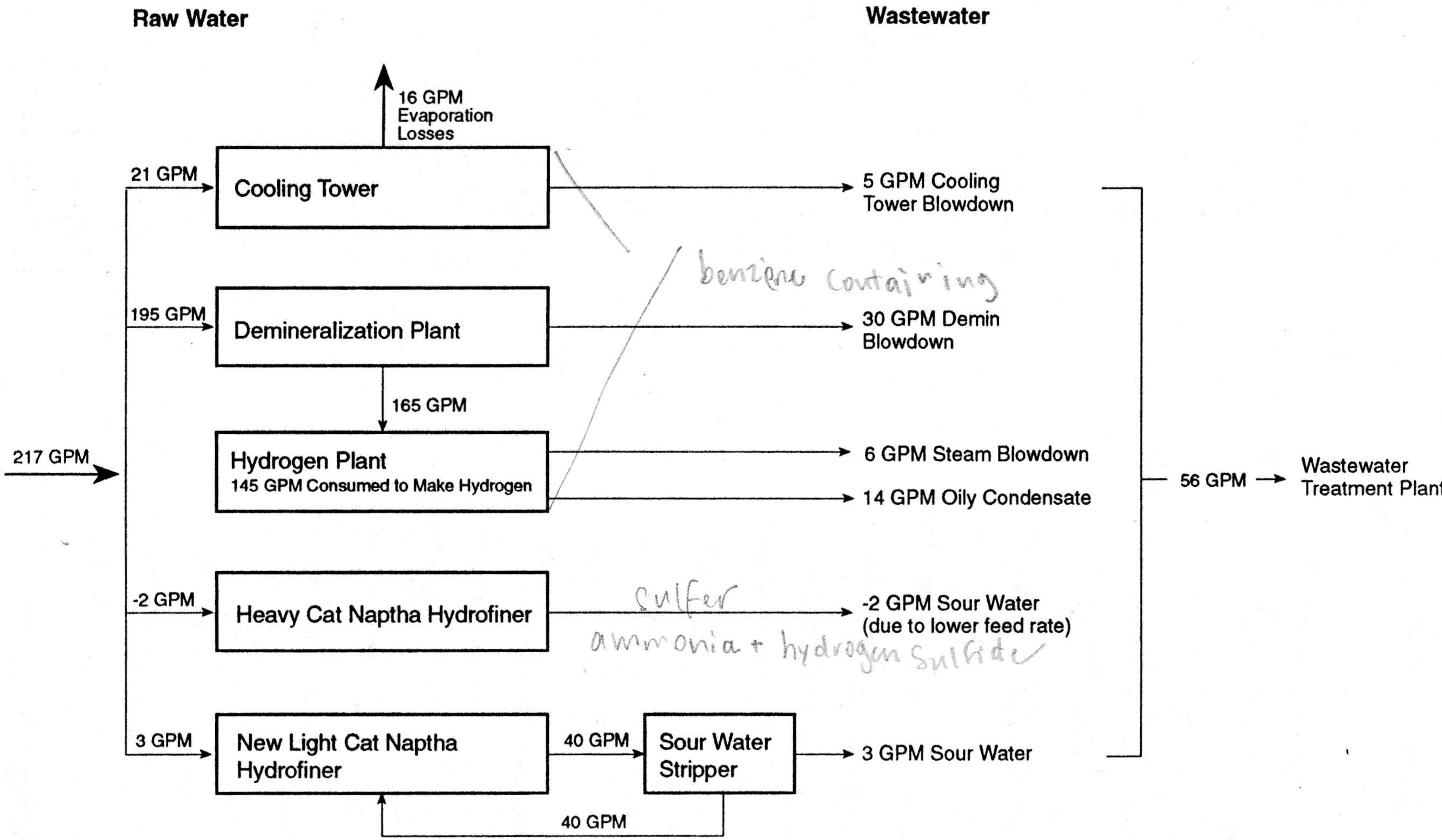
Water Quality Impacts and Mitigation

The proposed project would use an additional 217 gpm of raw water, of which 56 gpm would end up as additional waste water discharged to the treatment plant. Figure 4.7-2 shows the water balance for the additional 217 gpm of water that would be used for the project. The 56 gpm of waste water consists of several blowdown streams as well as some process waste water. The following is a discussion of the impacts to water quality of this additional waste water flow.

Impact No. 2 **The Clean Fuels project would result in an increase of 0.04 lb/day of selenium discharged to Suisun Bay. This impact is not significant.**

Selenium discharges are expected to increase slightly as a result of the Clean Fuels project. Table 4.7-5 presents an estimate of the increase in selenium as a result of the refinery modification project. Selenium is expected to increase by a total of 0.04 lb/day (2.1 percent of 1992 average) based on available data. If this increase is added to the 1992 average of 1.89 lb/day, the projected total mass discharge is 1.93 lb/day, which is below the current limit of 2.07 lb/day. Therefore, the project is not expected to exceed the current mass limit of the refinery's NPDES permit.

An additional dimension to the selenium issue is the previously mentioned RWQCB Order No. 91-026, which will require that the Benicia Refinery comply with a maximum daily selenium effluent limit of 50 parts per billion by December 1993 and a mass loading rate calculated on a running annual average of 0.97 lb/day. While operations at the Exxon Refinery do not result in exceedances of the current permitted discharge limit for selenium



Project No. 93C0336A	Exxon Clean Fuels Project	CLEAN FUELS PROJECT WATER BALANCE	Figure 4.7-2
Woodward-Clyde Consultants			

93C0336A-0600/083193

TABLE 4.7-5

EXXON CLEAN FUELS PROJECT
POTENTIAL SELENIUM DISCHARGE

Selenium in Raw Water

Basis: Raw Water Contains 6.6 ppb Selenium
Raw Water Consumption = 217 gpm
Selenium Reduction at Biotreater = 30% (observed)

Discharge = $217 \times 1440 \times 8.34 \times 6.6 \times 10^{-9} \times 0.7$
= 0.01 lb/day

Selenium Discharge in Raw Water =	0.01 lb/day

Selenium from New Light Cat Naphtha Hydrofiner

Basis: LCN contains 20 ppb, 19 kBD, 6.01 lb/gal
Selenium Removal 50%, Same as Existing HCN Hydrofiner
Selenium Reduction at Biotreater = 30% (observed)

Discharge = $19{,}000 \times 42 \times 6.01 \times 20 \times 10^{-9} \times 0.5 \times 0.7$
= 0.03 lb/day

Selenium Discharge from New Hydrofiner =	0.03 lb/day
Total Selenium Discharge	0.04 lb/day

(2.07 lb/day), present discharge levels do exceed the new limits (0.97 lb/day) set to become effective in December 1993.

Selenium control is currently addressed by several provisions in the NPDES permit. Previous studies have involved assessment of selenium sources and treatment options. Results of the studies are summarized below.

Selenium Sources and Evaluation. The main source of selenium entering the refinery is crude oil. Other minor sources include other purchased feed stock, purchased chemicals and even raw water. Within the refinery, the selenium is transferred to waste water by several processes such as the fluid coker, fluid catalytic cracker, and the hydrofiners for heavy hydrocarbon fractions. Selenium behaves chemically similar to sulfur in these processes. The sulfur is present as hydrogen sulfide and the selenium is present as hydrogen selenide in "sour gases." These compounds are condensed simultaneously with steam to form "sour condensates," and join with refinery wash waters to form sour water. To remove hydrogen sulfide and ammonia, sour gas and sour water streams are collected from all refinery operations and stripped prior to discharge to the sewer system and waste water treatment. Stripping is a chemical process to separate light components, usually gaseous, from heavier liquids. All sour water is treated in sour water strippers where the sulfur is removed and eventually recovered in catalytic reactors. Not all selenium is stripped out and some stays with the stripped water. Although there is some recycling and reuse of stripped sour water within the refinery, the majority of the selenium eventually reaches the waste water treatment plant.

Selenium Removal. A number of processes have been studied for selenium removal from refinery waste water, including biological treatment, evaporation, precipitation, adsorption, and ion exchange. The processes provide varying degrees of removal. Extensive bench-scale tests were conducted for Exxon by a consultant on the different selenium-containing waste water streams at the refinery. Iron absorption/coprecipitation was effective in treating the waste water effluent sufficiently to meet the future lower selenium NPDES limit. However, considerable amounts of waste sludge are produced containing primarily the iron used to coprecipitate the selenium. Under normal dry weather flow conditions, 8 to 10 tons per day of sludge would be produced to remove roughly one pound per day of selenium. The sludge would be classified as a California hazardous waste due to high selenium and vanadium levels. Further studies are underway by Exxon and also in a joint effort by all Bay Area refineries through the Western States Petroleum Association. It is anticipated that these research efforts will provide significant improvement to existing technologies, such as iron coprecipitation.

<u>Impact of the Clean Fuels Project</u>. As discussed previously, Exxon's Clean Fuels project would increase selenium slightly (by 0.04 lb/day), which would not increase the refinery's selenium discharge above the current regulated limit. Current refinery discharges exceed the future limit (effective December, 1993), and it is anticipated that the refinery will exceed the new limit after December, 1993. However, the Clean Fuels project will not be in operation until late 1995/early 1996. Exxon must meet RWQCB's order (No. 91-026) limiting total selenium discharges to 0.97 lb/day. Exxon must achieve this limitation through new treatment technology or other changes at the refinery that reduce or remove selenium from the waste water stream. The addition of 0.04 lb/day would not affect the choice of selenium treatment technology or its applicability to the waste stream. Based on the RWQCB order regarding selenium discharge limits, Exxon will have to bring the entire refinery into compliance by the time the Clean Fuels project is ready to start up. The treatment or removal processes carried out by Exxon will have to achieve a greater margin of selenium removal than the future limitation, due to the fact that discharge loadings fluctuate with normal variations in refinery operations. A 0.04 lb/day change in selenium would therefore not impact the ability of the refinery to meet the future limits. Since the conclusion that this is not a significant impact is predicated on the fact that Exxon must comply with the selenium discharge limitation imposed by the RWQCB, Exxon should report on compliance actions to the City of Benicia to demonstrate that the refinery will comply with the waste discharge order by the time that the Clean Fuels project is ready for operation, and that the addition of 0.04 lb/day would not adversely affect Exxon's compliance measures.

<u>Mitigation Measure No. 2</u>

Exxon should report to the City as to its compliance with the applicable cap on selenium discharge set by the RWQCB.

Impact No. 3 **The Clean Fuels process equipment would result in a minor increase in nitrogen and organic pollutant loads to the refinery's waste water treatment plant. The plant is capable of processing these increased pollutant loads. This impact is not significant.**

Out of the 56 gpm of waste water generated by the project, only the stripped sour water (1 gpm) and oily condensate (14 gpm) would contain significant amounts of nitrogen and hydrocarbons, respectively. The additional 1 gpm of sour water would represent less than 0.2 percent additional nitrogen load to the treatment plant. This would have no impact on plant performance or water quality. The additional 14 gpm of oily condensate is from the hydrogen plant. The condensate is expected to contain less than 0.5 percent (by weight) of light hydrocarbon, which would be readily biologically degraded in the treatment plant. No significant impacts to water quality from organic or nitrogen loading is predicted.

Mitigation Measure No. 3

The increase in nitrogen and organic loading is not significant and no mitigation is required.

Impact No. 4 **The Clean Fuels project would increase the total quantity of metals in the waste water discharge, but this increase is below the refinery's effluent discharge limitations. This impact is not significant.**

Total metals in the waste water generated by the project would be from 41 gpm of blowdown waste streams (5 gpm cooling tower, 30 gpm demineralization, and 6 gpm steam) and 14 gpm of oily condensate.

To estimate the increase in metals concentrations and loads, Table 4.7-6 summarizes the contribution of selected metals (copper, lead, nickel, vanadium, and zinc) to the treatment plant, and compares these estimates to the metals limitations in the current NPDES permit. These metals are targeted by the RWQCB in the current NPDES permit for source control.

The estimated concentrations of copper, lead and zinc are significantly lower than the current effluent limitations. The refinery's current NDPES permit is due for renewal in 1995, which roughly coincides with the time that the Clean Fuels modification project is completed. Therefore, it is appropriate to also compare the additional contribution of metals from the

TABLE 4.7-6

ESTIMATE OF CLEAN FUELS WASTEWATER METALS

	Copper	Lead	Nickel	Vanadium	Zinc
A. METALS CONCENTRATION (ppb)					
Current Metals Concentrations in Treatment Plant Effluent (1992 average)[a]	20	6	40	--	28
Estimated Metals Concentrations from Combined Existing and Clean Fuels Project Wastewater	21	6	42	--	30
Current NPDES Effluent Limitations	200	56	71	None	580
1995 NPDES Effluent Limitations[b]	37	53	65	None	580
B. METALS LOAD (pounds/day)					
Estimated Metals Loads from Clean Fuels Project Wastewater (weighted average before treatment)	0.02	0.003	0.03	0.4	0.03
Current Metals Loads in Treatment Plant Effluent (1992 average)	0.3	0.09	0.65	NA	0.45
Clean Fuels Project Wastewater Metals Load Contribution (%)[c]	5.2	3.2	4.4	--	6.3

[a] Average concentrations based on monthly NPDES monitoring data for 1992.
[b] Based on draft documentation provided by Lila Tang of the San Francisco Regional Water Quality Control Board.
[c] Clean Fuels Project wastewater load concentration = [Clean Fuels Project wastewater load(Current WWTP load + Project wastewater load)] x 100.

Clean Fuels project waste water to the proposed 1995 effluent limitations in Table 4.7-6. The comparison shows that, even with the expected lower effluent limitations in 1995, the estimated concentrations of copper, lead, nickel, and zinc from the combined current and project waste water would be well under the proposed limits. For example, the proposed 1995 limit for copper concentrations is 37 ppb. The estimated concentration of copper from combined existing and Clean Fuels effluent is 21 ppb, 16 ppb under the 1995 limit. Therefore the addition of small amounts of metals due to the Clean Fuels project has no significant impact on water quality.

Although there are currently no limits on copper, lead, nickel, and zinc loads in the permit, estimations of the increased loads of these metals from the Clean Fuels project were evaluated. Table 4.7-6 shows that the expected increase in metals loadings from the project range from about 3 percent (lead) to 6 percent (zinc) above current metals loads. This assumes that there is no reduction in metals as the additional waste water from the Clean Fuels project passes through the treatment plant. Because some metals reduction is expected to occur, the estimated increases in metal loadings are likely to be lower.

In the recently proposed waste load allocation for copper (RWQCB 1993a), the RWQCB proposed a load limitation of 0.356 lb copper per day on waste water from the Benicia Refinery. Current copper loads, estimated at 0.310/day, meet the proposed copper load limitation. An estimated increase of about 5 percent from the Clean Fuels project waste water would increase the total copper load to 0.327 lbs. per day, which would remain below the proposed copper load.

<u>**Mitigation Measure No. 4**</u>

The small increase in metals concentrations and loads from the Clean Fuels Project is not considered significant and no mitigation is required.

4.7.3 Cumulative Impacts

<u>**Hydrology**</u>

Other projects at the Benicia Refinery include the addition of an MTBE unit, retrofitting to reduce nitrogen oxide emissions, and construction of five storage and fabrication areas. The

MTBE unit would be constructed in an area of the refinery process block that is currently paved with impervious material and would not change current runoff conditions. The storage and fabrication areas would be graded and leveled, as necessary, and used for the storage of equipment and maintenance activities that are currently located on the site of the Clean Fuels project. These areas would not be paved and are not expected to increase runoff at the refinery. Since other projects at the refinery would not change runoff conditions appreciably, no cumulative hydrological impacts are expected.

Water Quality

Discharge of pollutant loads to San Francisco Bay, including organics, metals, and selenium are expected to increase as a result of the following:

- Future modifications to refineries in the Bay region

- Expansion or modifications of other industries contributing waste waters directly to the Bay

- Expansion of regional waste water treatment plants to accommodate regional residential, commercial and industrial growth

The proposed project would not increase the amount of organic material discharged to Suisun Bay. The mass load of metals in the refinery waste water discharge would increase by about 3 to 6 percent with the project. The project would also increase the mass loading of selenium by about 2 percent.

The RWQCB has developed a strategy for improving the quality of San Francisco Bay waters that addresses point (industrial) and nonpoint (municipal storm water) sources that discharge to the Bay. The RWQCB's San Francisco Bay Region have recently promulgated and proposed plans to limit the cumulative discharge of pollutants to the Bay. These plans include the following:

- San Francisco Bay Region Basin Plan (RWQCB 1991)
- Proposed Copper Waste Load Allocation (RWQCB 1993a)
- Proposed Selenium Waste Load Allocation (RWQCB 1993b)

The Basin Plan is a comprehensive plan that sets policies to address all industrial, commercial, and nonpoint source discharges to the Bay. The toxic pollutant control strategy in this plan includes three main components: (1) research (e.g., programs to determine the distribution and effects of toxic pollutants, long-term programs to develop effluent requirements), (2) investigation and monitoring (e.g., identification and monitoring of sensitive areas, requiring the use of more sensitive toxicity tests, and investigation of urban runoff by industries and local agencies), and (3) control of toxic pollutants by establishment of water quality objectives and regulation of dischargers through the National Pollutant Discharge Elimination System (NPDES). Additionally, the RWQCB has proposed two plans (the copper and selenium waste load allocations) to control the amount of copper and selenium into the Bay. In these plans, the RWQCB has proposed an aggressive approach to allocating specific numerical copper and selenium loads to all major discharges to the Bay, including industries (e.g., refineries), waste water treatment plants, and nonpoint discharges. These plans are developed to restrict the cumulative discharge of pollutants to the Bay.

The promulgation of effluent limitations for selenium provides an example of how the regulatory process is designed to protect receiving waters as a whole from cumulative sources. In response to the EPA, the RWQCB began in 1990 to develop more stringent control strategies to address the discharge of selenium to the San Francisco Bay system. Although no federal water quality criteria had been violated, there was concern about selenium because of its high potential for bioaccumulation and adverse impacts. The RWQCB decided to pursue establishing lower selenium limits to prevent potential violations, and address the impacts of bioaccumulation. In establishing these limitations, it was recognized that selenium has a number of natural and man-made sources, but that refineries contributed a large fraction of the total Bay selenium loading (the Delta outflow is considered the other major contributor). It was also recognized that there has been no established link between refinery discharges and elevated levels of selenium in animal tissue (RWQCB 1990). Therefore, the RWQCB focused on establishing limits on selenium concentrations and loadings that would reduce the total selenium input to the San Francisco Bay system. Alternative methods of selenium reduction, such as requiring refineries to change to the use of crude with a lower selenium level was not considered a feasible option by the RWQCB.

To lower cumulative selenium levels, two regulatory limitations were established. First, all Bay Area refineries were ordered to limit selenium concentrations to no more than 50 ppb by December, 1993. This standard was derived from meeting the EPA fresh water criteria of 5 ppb at the edge of dilution of the discharge. This limitation was also consistent with the State Water Resources Control Board's Bay & Estuary Plan water quality objectives. Second, a mass emission rate for each refinery was also established. For Exxon's Benicia Refinery, a mass emission limit of 0.96 lbs/day was calculated based on 50 ppb at their 1990 running annual average waste water treatment flow. This limit is also effective in December, 1993. Similar limitations were established for the Shell, Unocal, Tosco, Pacific, and Chevron refineries. The RWQCB determined that their proposed order would lead to a 50 percent reduction in cumulative selenium discharge from refinery sources to the San Francisco Bay system (RWQCB 1991). These new regulations have elicited comments ranging from concerns that the limitations may be impossible to achieve and are not appropriate, to comments that the limitations are not stringent enough. However, the RWQCB determined that the discharge limitations were the most feasible and achievable means of reducing the levels of selenium in the Bay, and that the cumulative reductions in selenium would have a beneficial effect in terms of reduced bioaccumulation of this constituent.

Compliance with water quality effluent limitations established by the NPDES permit for an individual source, such as the Benicia Refinery, are therefore designed to achieve water quality goals established for a water body or system as a whole. Compliance with individual NPDES discharge limitations would minimize the potential for cumulative significant impacts to water quality. As discussed above, the Benicia Refinery with the project is capable of meeting future, more stringent NPDES permit limitations except for selenium. Exxon is currently working on strategies to reduce selenium loads in their waste water, and the additional selenium added by the project would not inhibit these efforts. Because NPDES permit limits have been established to prevent cumulative water quality impacts to the San Francisco Bay system, and because the proposed project would not inhibit compliance with new selenium standards, the project would not result in a significant cumulative water quality impact.

4.8 GROUNDWATER AND HAZARDOUS MATERIALS CONTAMINATION

4.8.1 Environmental Setting

<u>**Regional Hydrogeologic Setting**</u>

The Benicia Refinery lies in the transition between the low-lying tidelands and foothill areas west of Suisun Bay. This area is within the San Francisco Bay Area Hydrologic Basin and is bounded to the east by the Suisun-Fairfield Valley Groundwater Basin and to the west by the Napa-Sonoma Valley Groundwater Basin (CDWR 1975, 1980). The area has not been designated as a groundwater basin due to the limited occurrence of groundwater. A study of the groundwater development potential classified the area as marginal to adequate for livestock or single family domestic use (Webster 1972).

<u>**Regional Groundwater Occurrence**</u>. Groundwater occurs in the region in several geologic units. The younger water-bearing units comprise the younger alluvium, older alluvium and the Sonoma volcanic rocks. The older units comprise Tertiary and Cretaceous-age sedimentary rocks (Thomasson et al. 1960). The younger alluvium consists of interfingering fluvial and estuarine silt, clay, and sand deposited by streams (fluvial) and in the tidal marshes (estuarine) of Suisun Bay and the Carquinez Strait. It yields small amounts of water to wells and transmits water readily in the fluvial deposits and less well in the estuarine portions. The older alluvium (Pleistocene age) comprises loose to moderately compacted fluvial silt, clay, gravel, and sands. Its overall ability to transmit water (permeability) varies depending on the thickness and extent of the gravel and sand lenses. The older alluvium comprises most of the sediments which fill the larger valleys and drainages in the region and serves as the principal water-bearing geologic unit (aquifer) in the Fairfield-Suisun area north of the facility. The volcanic-origin rocks (Sonoma volcanics) are also of Pleistocene age and are comprised of interbedded tuff, agglomerate, and flow rock. The volcanic rocks present within a few miles of the facility are mostly flow rocks which cap the northern portion of the Sulfur Springs Mountains northwest of Benicia. The groundwater flow in these rocks can be significant in the fractured portions of the formations, but overall the quantity is less than that of the older alluvium (Thommason et al. 1960).

The Tertiary and Cretaceous-age bedrock aquifer is not considered a significant source of groundwater in the region. Groundwater occurs in limited quantities in the fractured bedrock which comprises the low-lying hills west and northwest of the project site. The permeability of the fractured bedrock may be locally great enough to provide flow to individual wells but regionally is not a significant water-bearing rock formation (Thommason et al. 1960).

Regional Groundwater Flow Direction and Rate. Regional groundwater flow direction (gradient) is generally from the recharge areas in the hills northwest of the refinery toward the tidal marshes of Suisun Bay and the Carquinez Strait. Flow gradient in the older alluvial aquifer has been estimated at 25 to 40 feet per mile (0.004 to 0.007 feet per foot) (Thommasson et al. 1960).

Regional Groundwater Quality. Groundwater quality in the region ranges from generally good in the alluvial sediments to poor in the tidal marsh sediments. The groundwater in the alluvial aquifer may have locally high concentrations of boron, chloride, and iron. The groundwater in the estuarine sediments is brackish to saline (CDWR 1975).

Regional Existing and Potential Groundwater Uses. Groundwater is used in the region for agriculture and to a smaller degree for domestic use. Agricultural use is heavy in the Suisun Valley north of the proposed project site because of the extensive thickness of the older alluvium there, but is very limited in the low lying hills northwest of the refinery because of the limited occurrence of water-bearing formations. Potential future development of groundwater resources is limited by the scarcity of alluvium in the region around and to the northwest of the refinery.

Local Hydrogeologic Setting

Local Groundwater Occurrence. The Benicia Refinery area is underlain by manmade fill, Bay Mud, younger alluvium, older alluvium, and Tertiary and Cretaceous-age sedimentary rock. Groundwater occurs under unconfined or semi-confined conditions in all of the above formations, but is primarily found in the younger and older alluvial material (Dames & Moore 1988). Dames & Moore (1988) defined four water-bearing zones beneath the Exxon Benicia Refinery. These zones include:

- The vadose zone including observed perched water zones
- Uppermost (water table zone)
- Older sediments zone
- Bedrock zone

The shallow soil zone between the surface and the water table (vadose zone) is comprised of organic rich silty clay and clayey silt near Suisun Bay and gravelly clays in the upland areas of the refinery. It ranges in thickness between 0.5 foot near the refinery's waste water treatment ponds along the eastern portion of the site, to 8 to 25 feet near the crude oil tank farm. The vadose zone is also referred to as the unsaturated zone and while not fully saturated with groundwater, localized areas of saturation (perched zones) may occur that are not continuous with the rest of the water table. Perched zones have been identified near the crude oil tank farm in the upland portion of the facility. Clayey gravels and gravelly silty clays overlying less-permeable bedrock appear to have entrapped water at a depth of 8 to 25 feet below the surface. The water table is believed to be in the bedrock and, while not known exactly, is expected to be at a greater depth (Dames & Moore 1988).

The second zone is the upper most water-bearing zone (water table zone) which is comprised of gravelly clay fill and silty clay (Bay Mud) near the waste water treatment ponds to older alluvium and fractured bedrock in the upland portions of the refinery. The thickness of the zone ranges from 4 to 12.5 feet along the bay front to more than 25 feet in the upland areas of the facility.

The third water-bearing zone is the older alluvium which is comprised of silty clay and clayey silt with localized lenses of silty to gravelly sand water-bearing zone. Dames & Moore (1988) reported that these localized lenses occur at the base of the older sediment sequence and believed them to be the principal water-bearing stratum within the deposits. Approximately 24 feet of Bay Mud separates the older alluvium from the surface. Groundwater may be semi-confined in this stratum.

The fourth zone is comprised of the Tertiary and Cretaceous-age bedrock which consists of fractured shales, siltstones, and sandstone of the Panoche Formation. Although no borings have penetrated the bedrock and encountered groundwater at the facility, the interpolated depth to groundwater is estimated to be 30 to 40 feet.

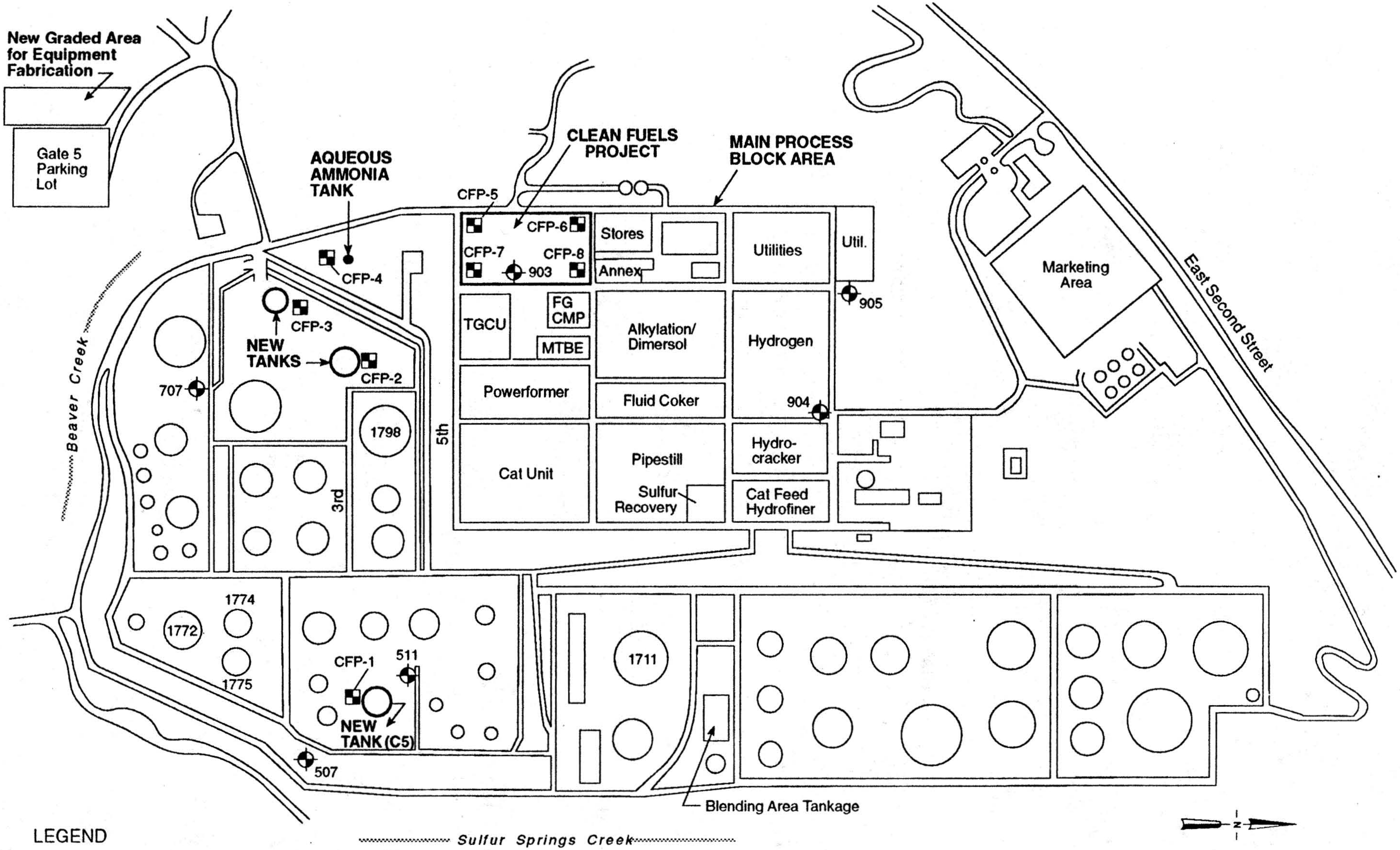
Local Groundwater Flow Direction and Rate. Depths to groundwater where project construction would take place range from a minimum of 11 feet to over 35 feet in the upland portions of the facility. Local gradients at the refinery follow the regional pattern but vary slightly in magnitude and direction (Harding Lawson 1993a).

At the refinery, groundwater moves generally toward Sulphur Springs Creek which flows in a channel that parallels the eastern boundary of the refinery (Figure 4.8-1, also Figure 4.7-1 in Section 4.7). The flow rate is estimated to be between 5 and 100 feet per year (Harding Lawson 1993a). Groundwater flow near existing Tank 1798 (located near the proposed hydrocarbon tanks; see Figure 4.8-1) flows southwesterly and away from Sulphur Springs Creek toward a drainage known locally as Beaver Creek. A bedrock ridge which underlies the facility near this tank was cut during original refinery construction activities and the spoil material used to fill the drainage immediately to the southwest (Beaver Creek). The lower permeability bedrock fill may act as a barrier to shallow groundwater flow creating a divide in that portion of the facility. In non-drought years, a spring has been observed to issue from the fill area creating a small amount of surface water flow in Beaver Creek.

Infiltration and migration of groundwater recharge may follow fractures in bedrock and/or other preferential flow pathways. Flow of water through these preferential pathways may be greater than flow through surrounding material.

A study was performed by Dames & Moore (1988) to evaluate the degree of influence of tides in the Carquinez Strait on groundwater in the vicinity of the waste water treatment ponds. Water levels were measured in eight monitoring wells in the vicinity of the ponds to observe whether groundwater levels showed a correlatable response to tides. Five of the wells showed effects of tidal influence of less than 0.2 foot. Tidal effects are measurable in the Suisun Bay side of the facility, but do not extend into the upland portions of the site.

Local Groundwater Quality. Groundwater quality in the refinery area ranges from good in the upland areas of the facility to brackish to saline in the areas along Suisun Bay



LEGEND

CFP-2 Soil Boring Location

511 Well/Piezometer Location

Reference: Harding Lawson (1993b)

Project No. 93C0336A	Exxon Clean Fuels Project	SOIL AND GROUNDWATER SAMPLE LOCATIONS FOR PROPOSED CLEAN FUELS FACILITIES	Figure 4.8-1
Woodward-Clyde Consultants			

93C0336A-0600/083093

(Dames & Moore 1988). The saline to brackish water has a chloride content of 510 to 40,000 milligrams per liter (mg/l) and is of such poor quality that it is of limited beneficial use (Harding Lawson 1993b). The fresh water resources in the upland areas while of potentially good quality, occur in small quantities which limits its beneficial use. Free phase liquid hydrocarbons have been observed in monitoring wells at five locations around the facility (Figure 4.8-1) including:

- Tank 1798 (between 3rd and 4th Streets) - 0.6 inches of diesel fuel
- Tanks 1772, 1774 and 1775 (along Sulphur Springs Creek near 2nd Street) - 5 inches of JP-4 jet fuel
- Blending Area Tankage (9th Street) - 5-inches of gasoline
- Tank 1711 (between 7th and 9th Streets) - detectable quantity of reformate
- Waste Water Treatment Plant - (adjacent to Suisun Bay) - undetermined quantity of heavy hydrocarbons

Remediation of the free phase hydrocarbons is in the planning stages and has not been initiated. Exxon is not currently subject to Regional Water Quality Control Board order but has committed to recover free phase hydrocarbons from areas where it has been detected. Remedial activities will include characterization of the nature and extent of contamination and cleanup.

Groundwater quality data collected as a part of a geotechnical and hydrogeological evaluation for the proposed project included soil and groundwater sampling and analysis in the areas to be affected by new construction. Samples were collected from monitoring wells near all proposed project equipment and tanks (Figure 4.8-1). The results are summarized in Table 4.8-1. Petroleum hydrocarbons (as gasoline and diesel) up to 10 mg/l were reported in two wells at the proposed hydrocarbon tank in the southeast tank farm area (Wells 511 and 507). Benzene (2.2 mg/l), toluene (0.62 mg/l), and xylenes (0.32 mg/l) were reported in one well (Well 507) near this tank location. Benzene concentrations of this well exceed the

TABLE 4.8-1

SUMMARY OF CHEMICAL TEST RESULTS FOR GROUNDWATER SAMPLES

Location	Date Sampled	TPHg mg/kg	TPHd mg/kg	TPHo mg/kg	Benzene mg/kg	Toluene mg/kg	Ethyl Benzene mg/kg	Xylenes mg/kg
Clean Fuels Process Block P903	03/10/93	ND (.05)	ND (.05)	ND(.5)	ND (.0005)	ND (.005)	ND (.005)	ND (.005)
Aqueous Ammonia Tank MW-707	07/29/92	ND (.05)	ND (.05)	ND (.5)	ND (.0005)	ND (.005)	ND (.005)	ND (.005)
	10/15/92	ND (.05)	ND (.05)	ND (.5)	ND (.0005)	ND (.005)	ND (.005)	ND (.005)
New Tanks See results for MW-707, above.								
C5 Tank MW-511	03/12/92	ND (.05)	ND (.05)	ND (.5)	ND (.0005)	ND (.005)	ND (.005)	ND (.005)
	05/12/92	ND (.05)	ND (.05)	ND (.5)	ND (.0005)	ND (.005)	ND (.005)	ND (.005)
	07/07/92	ND (.05)	ND (.05)	ND (.5)	ND (.0005)	ND (.005)	ND (.005)	ND (.005)
	10/13/92	ND (.05)	0.057	ND (.5)	ND (.0005)	ND (.005)	ND (.005)	ND (.005)
MW-507	07/07/92	10	2.6	ND (.5)	2.2	0.62	ND (.01)	0.32
	10/13/92	F.P.(1)	--	--	--	--	--	--
	01/18/93	F.P.(1)	--	--	--	--	--	--

Source: Harding Lawson (1993b)
ND = Not detected above reporting limits. Reporting limits listed in parenthesis.
F.P. = Free phase hydrocarbons characterized in jet fuel: approximately 4 inches thick.
TPH = Total petroleum hydrocarbons.
(1) = Proposed C5 Tank site not previously developed. Depth to groundwater is approximately 29 feet below ground surface. See text for discussion.

0.001 mg/l maximum contaminant level (MCL; California Department of Health Services) for drinking water.

<u>Groundwater Wells</u>. According to the California Department of Water Resources (CDWR), 98 wells are located within a 1-mile radius of the refinery. Ninety-four of these are monitoring wells associated with the refinery which are discussed in the previous section. The remaining four wells consist of three offsite monitoring wells and one domestic well. The water supply well is located at a residence in the City of Benicia and its use is unknown. Groundwater is generally not used for domestic purposes, as the city system obtains potable water from surface water sources (imports from the Sacramento River via the North Bay Aqueduct, supplemented by water from Lake Herman).

4.8.2 Impacts and Mitigation

Potential impacts to groundwater from the proposed project include (1) effects on water quality from accidental spills or leaks of hazardous materials or petroleum liquids, (2) effects on water quantity due to a reduction in the flow velocity, volume, or water table elevation due to construction activities, such as dewatering or foundation placement, and (3) interference with remediation of existing contamination.

<u>Significance Criteria</u>

An impact to groundwater is considered significant if, in the absence of mitigation measures, one or more of the following circumstances might occur:

- Substantial degradation or depletion of groundwater resources
- Substantial interference with groundwater recharge
- Substantial interference with groundwater flow rate or direction (gradient)
- Groundwater discharge that substantially degrades surface water quality

Potential impacts with respect to existing hazardous materials contamination are considered potentially significant if one or more of the following circumstances might occur:

- Potential for the proposed project to result in soil contamination which by itself or in combination with existing soil contamination could have the potential to adversely impact groundwater quality.

- Potential for the project to significantly impact the ability to investigate, control, or remediate existing contamination.

<u>**Study Area**</u>

The study area for groundwater and hazardous materials impacts evaluation includes the area covered by the existing Exxon Benicia Refinery, Sulphur Springs Creek from the northwestern refinery boundary until the confluence with Sulphur Springs Slough and the entire reach of Sulphur Springs Slough to where it enters Suisun Bay.

<u>**Impact No. 1**</u> **Excavation and construction of the project would not measurably impact groundwater quantity, flow or direction. This impact is not significant.**

The proposed project would involve construction of new tankage and process equipment at four major locations within the existing refinery. Construction of the proposed facilities would impede infiltration of precipitation on approximately 2 to 3 acres due to paving and placement of structures. As discussed in Section 4.8.1, there are very limited groundwater resources in the project area. The sites of proposed equipment and tankage are not located in the important recharge areas situated in the upland hills west of the facility. Further, some of the sites of new construction are currently paved so little infiltration if any occurs in these areas. Therefore, the loss of 2 to 3 acres for infiltration of runoff would not measurably affect the quantity of water in the local aquifers. This is not considered a significant impact.

Foundations and excavations for project facilities would not be expected to encounter groundwater, and therefore would not affect groundwater elevations, rate of flow, or flow direction. Based on preliminary plans, the proposed project construction sites are underlain by materials that provide good foundation support, therefore, only shallow spread footing type foundations would be used and pile foundations are not anticipated. Excavations for foundation construction would be limited to the upper few feet of soil and should not encounter the groundwater table. Groundwater level measurements were recorded by Harding Lawson (1993b) in each of the major construction areas (Table 4-8.2). The depths to groundwater below the ground surface ranged from a minimum of 11 feet in the vicinity of the new hydrocarbon tanks to a maximum of 35 feet in the vicinity of the Clean Fuels process area with an average depth of 15 feet. The depth to groundwater in construction areas is sufficient to preclude construction impacts during foundation construction. No groundwater is currently being withdrawn from wells located within the proposed project area. There are no identified impacts to groundwater quantity or flow direction due to new foundation construction.

Mitigation Measure No. 1

No mitigation is required.

Impact No. 2 **Construction and operation of the project would have a low potential to impact groundwater quality. This is not a significant impact.**

Potential contamination of groundwater resources due to accidental spills of chemicals, petroleum, other raw process materials or waste products from the proposed project would be avoided or minimized by the contaminant and detection systems that are part of the proposed facilities. Improvements for the proposed project that store or handle such materials, such as the new hydrocarbon and pentane storage tanks, are designed for secondary containment in the event of accidental release. Tank design calls for the steel tank to be underlain by a liner with a leak detection system placed in between plus a liner covering the entire earthen containment area to prevent accidental spills from infiltrating the ground. The proposed new process areas would be constructed over pavement which would prevent infiltration of spills or releases. These design measures reduce the potential for impacts to groundwater quality to less that significant levels.

The Clean Fuels project would be constructed in areas of the facility where groundwater is found at 11 to 35 feet of depth. In the event of an accidental chemical release to the ground,

TABLE 4.8-2

SOIL AND GROUNDWATER CONDITIONS

Proposed Construction Site	Soil/Rock Depth (feet)	Depth to Groundwater (feet)
Clean Fuels Project Process Area	Rock at surface in north and southwest: up to 30 feet of fill on east side	14 to 35
Aqueous Ammonia Tank	15 feet of fill over colluvium/rock	14
New tanks near the MTBE tank	22 feet of fill over colluvium/rock	11
C5 Tank	Rock at surface	29

Source: Harding Lawson (1993b)

groundwater quality would not be immediately impacted and remedial activities could be implemented before the release reached the water table. The Emergency Response Manual for the Benicia Refinery (Exxon 1989) provides for prevention and cleanup of spills and releases of fuels and chemicals. The purpose of the plan is to provide for responsive control and cleanup of spills or other releases to minimize potential effects to human health and the environment. Implementation of the Emergency Response Manual together with the above design measures would prevent potential impacts to groundwater quality.

Impact No. 3 **Contaminated soils are present at the project site. Contamination is below threshold levels for remediation, and removal of contaminated soils due to construction of proposed facilities would be subject to further investigation and proper disposal. This impact is not significant.**

Soil testing has been previously performed by consultants for Exxon to assess the presence of soil contamination in the major construction areas for the proposed project. A total of 12 soil borings (shown on Figure 4.8-1) were advanced in the major process areas for the proposed project (Harding Lawson 1993b). The soil samples were screened using a photoionization detector which qualitatively detects the presence of petroleum hydrocarbons and volatile organic compounds. None of the samples exhibited a response from the detector, so only the uppermost samples collected (2.5 feet of depth) were analyzed. The 12 samples were analyzed for petroleum hydrocarbon quantified as diesel and gasoline by EPA Method 8020 and for benzene, ethyl benzene, toluene and xylenes (common constituents of fuel petroleum) by a modified EPA Method 8015.

The analytical results are summarized on Table 4-8.3. Petroleum hydrocarbons such as diesel were detected in a total of four samples: two collected in the vicinity of the Clean Fuels process equipment site and one each in the aqueous ammonia tank and new petroleum tank areas. Concentrations were less than 2 milligrams per kilogram (mg/kg) (Harding Lawson 1993b). Groundwater quality protection regulatory limits for total petroleum hydrocarbons in soil is 100 mg/kg (RWQCB 1990); therefore, the detected quantities of total petroleum hydrocarbons in soil do not pose a threat to groundwater quality, do not warrant excavation and disposal, and the project would not affect the levels of current contamination. The

TABLE 4.8-3

SUMMARY OF CHEMICAL TEST RESULTS FOR SOIL SAMPLES IN THE PROJECT AREA

Location	Date Sampled	TPHg mg/kg	TPHd mg/kg	TPHo mg/kg	Benzene mg/kg	Toluene mg/kg	Ethyl Benzene mg/kg	Xylenes mg/kg
Clean Fuels Process Block								
CFP-8-02.5	03/12/93	ND (.1)	ND (1)	ND (10)	ND (.005)	ND (.005)	ND (.005)	ND (.005)
CFP-7-02.5	03/12/93	ND (.1)	1.0	ND (10)	ND (.005)	ND (.005)	ND (.005)	ND (.005)
CFP-6-02.5	03/12/93	ND (.1)	ND (1)	ND (10)	ND (.005)	ND (.005)	ND (.005)	ND (.005
CFP-5-02.5	03/12/93	ND (.1)	1.7	ND (10)	ND (.005)	ND (.005)	ND (.005)	ND (.005)
Aqueous Ammonia Tank								
CFP-4-02.0	03/12/93	ND (.1)	1.1	ND (10)	ND (.005)	ND (.005)	ND (.005)	ND (.005)
New Tanks								
CFP-3-02.5	03/12/93	ND (.1)	ND (1)	ND (10)	ND (.005)	ND (.005)	ND (.005)	ND (.005)
CFP-2-02.5	03/12/93	ND (.1)	1.7	ND (10)	ND (.005)	ND (.005)	ND (.005)	ND (.005)
C5 Tank								
CFP-1-02.0	03/12/93	ND (.1)	ND (1)	ND (10)	ND (.005)	ND (.005)	ND (.005)	ND (.005)

Source: Harding Lawson (1993b)

ND = Not detected above reporting limits. Reporting limits listed in parenthesis.
TPH = Total petroleum hydrocarbons.

project design calls for further soil testing during demolition in preparation for foundation construction. If further contaminated soil is discovered, it would be removed and disposed of offsite in accordance with applicable local state and federal laws (Exxon 1993a). Based on these data, potential impacts related to contaminated soils are not expected to be significant.

Mitigation Measure No. 3

No mitigation measures are required.

Impact No. 4 **There would be no effect to groundwater remediation activities due to construction. No impacts would occur.**

As discussed above, groundwater monitoring has shown free liquid phase hydrocarbons at 5 locations across the site. None of the free product has been identified in the areas of new construction for the proposed project. Soil contamination (see Impact No. 4) is below levels requiring remediation of the site. Therefore, the project would not affect the need for groundwater or soil cleanup activities. No impacts are identified.

Mitigation Measure No. 4

No mitigation measures are required.

4.8.3 Cumulative Impacts and Mitigation

Impact No. 5 **The proposed Clean Fuels project and other projects planned at the refinery would have no adverse individual or cumulative impacts to groundwater resources. Other projects in the regional area are too distant to contribute any impacts to groundwater in the Benicia area. No cumulative impacts would occur.**

Other projects at the Exxon Benicia Refinery include the MTBE plant and the NO_x reduction project. Neither of these projects would adversely affect groundwater. The MTBE plant will be constructed in close proximity to the Clean Fuels project area within the refinery's main process block, where groundwater is at least 11 feet or more below grade. Construction of the MTBE project would have no effect on groundwater, as documented in the MTBE Negative Declaration/Initial Study (ENSR 1993a). The NO_x reduction project would involve equipment and modifications at the main process block that are above ground, and would also not affect groundwater resources. There would be no additive or cumulative impacts to groundwater from these projects with the Clean Fuels facilities.

Other related projects identified in Section 3.0 that would be constructed in the region, including reformulated fuels projects at other Bay Area refineries, would be too distant to contribute cumulative impacts to the groundwater resources in the Benicia area. The nearest projects are across the Carquinez Strait, and it is not expected that there would be cross-contaminations of groundwater aquifers that are separated by the Strait.

Mitigation Measure No. 5

No mitigation is required.

4.9 GEOLOGY AND SEISMICITY

4.9.1 Environmental Setting

Regional and Site Geology

Topography. The western part of the Benicia Refinery occupies a graded bedrock hill that reaches an elevation of approximately 200 feet above sea level at the northern boundary of the refinery property. This hill is dissected by a relatively narrow, southeastward-trending valley. The eastern part of the site is located on a much broader, flatter valley that has an elevation in the range of 10 to 20 feet above sea level.

Bedrock Geology. The Benicia Refinery is located in the Coast Ranges of central California. Within the project region, the Coast Ranges are characterized by northwest-trending ridges, valleys, and faults. Two bedrock geologic units of Cretaceous[1] geologic age are present in the project region: the Franciscan Assemblage, which is made up principally of rocks formed in a deep marine environment; and the Great Valley Sequence, which is made up of sedimentary rocks that were deposited in a continental slope marine environment. The Franciscan Assemblage rocks make up the lower plate of a complex system of thrust faults known as the Coast Ranges Thrust. The Great Valley Sequence, located on the upper plate of the Coast Ranges Thrust, forms much of the eastern flank of the Coast Ranges.

The bedrock in the project area is part of the Great Valley Sequence, but differing nomenclature has been applied to it. It has been mapped as being part of the Chico Formation (Weaver 1949, Tolman 1931) or the Panoche Formation (Dibblee 1980). As described by Weaver (1949), the formation is composed largely of thinly laminated alternating thin layers of dark brownish gray clay shale and dark brown sandstone in zones several hundred feet thick, interbedded with medium- to coarse-grained massive brownish gray sandstones and conglomerates in layers from 5 feet to more than 100 feet in thickness. Weathered sandstones and sandy shales in the formation are reported to be weak (Tolman 1931).

---

[1] From 135 to 65 million years ago.

Dibblee (1980) indicates that the bedrock in the project area consists principally of micaceous shale with thin sandstone beds. He indicated that the bedding dips to the southwest at inclinations in the range of 20° to 57°.

Recent studies conducted for the MBTE project at the refinery identify the bedrock beneath the site as consisting of interbedded sandstone and mudstone that is moderately consolidated, closely fractured, weathered and weak (ENSR 1993a). According to that report, the bedrock at the site dips to the southwest, and is covered by up to six feet of colluvial soil. A report on another recent study (Harding Lawson 1993b) indicates that localized zones of intense fracturing are present within the mudstone, and have been observed locally within the refinery. According to this report, the principal fracture orientation commonly is perpendicular to the bedding, and the fracture spacing ranges from less than an inch in the mudstone to one to two feet in the sandstone.

Colluvium. The major hillside swales within the refinery property are generally partially filled with colluvium, a thick soil deposit that accumulates primarily as a result of soil creep and slope wash. The colluvium consists principally of highly plastic, moderately to highly expansive, medium stiff to very stiff, clay and sandy clay that contains a small amount of naturally occurring organic material derived from vegetation (Harding Lawson 1993b).

Alluvial Deposits. The refinery's tank farm area adjoining Avenue A is underlain by alluvial deposits, as delineated by Dibblee (1980). Borings made adjacent to the intersection of refinery roads Avenue A and 9th Street by Harding Lawson (1992a) penetrated predominantly clayey materials to a depth of about 58 feet, where mudstone bedrock was reached. Sand layers up to 5 feet thick were encountered locally. The clays were described as soft to medium stiff. Groundwater was reached at depths of 5 to 9.5 feet.

Engineered Fills. Extensive cutting and filling was done preparatory to constructing the Benicia Refinery. The excavated native soils and bedrock were placed as compacted fills in lower areas. The fills consist of sandy clay, with generally abundant rock fragments and typically are stiff to very stiff. In general, the fill is moderately to highly expansive, but is strong and only slightly to moderately compressible (Harding Lawson 1993b).

Geologic Resources

Mineral Resources. Clay shale in the Chico/Panoche Formation has, in past years, been used in the manufacture of brick (Weaver 1949). There is an essentially unlimited volume of clay shale present at a variety of locations in the region.

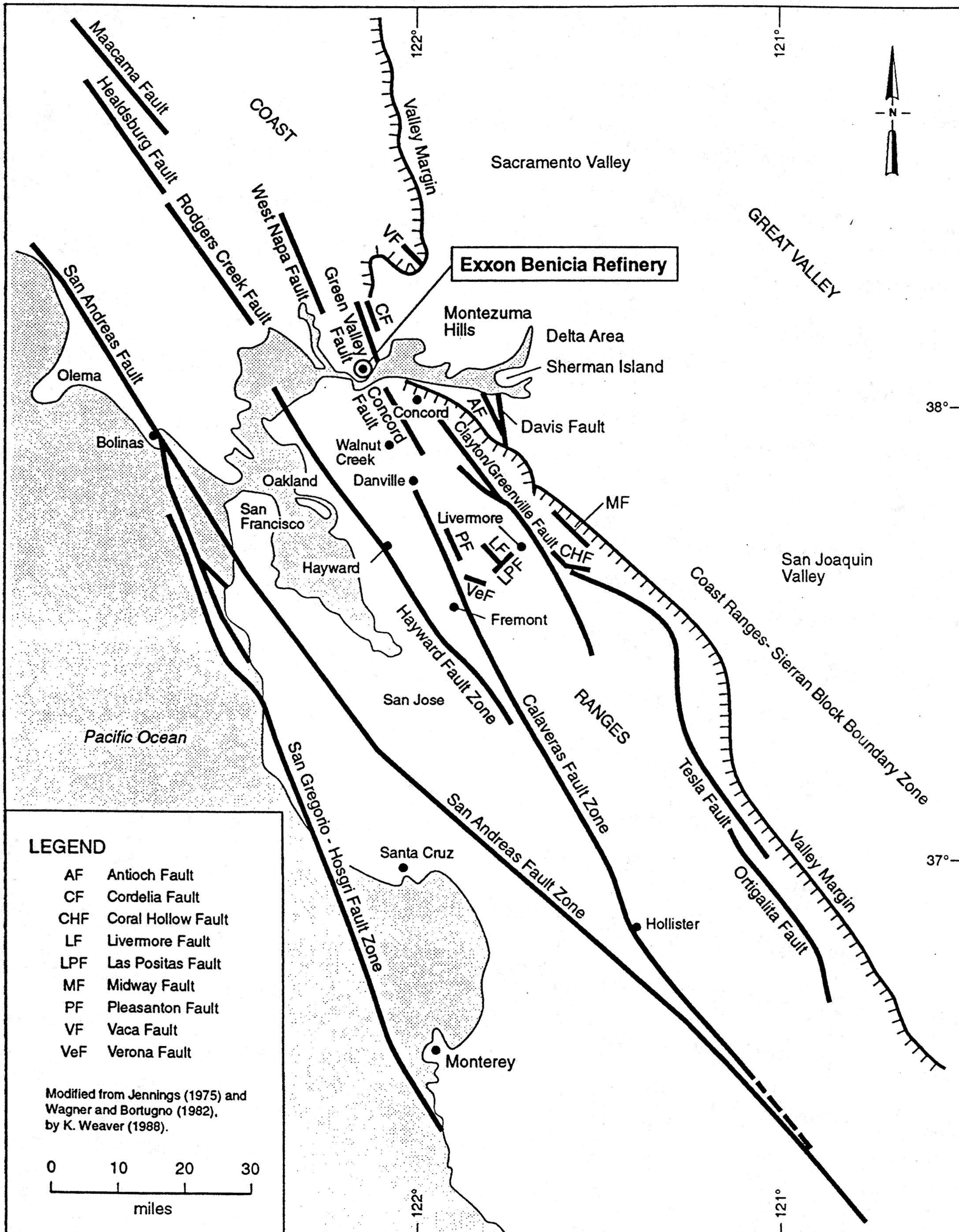
Paleontologic Resources. Poorly preserved fragments of fossil molluscs possibly belonging to the genus *Venericardia* have been found in the Chico/Panoche Formation near Weldon Canyon, in the Vaca Mountains (Weaver 1949). However, no fossil "finds" have been reported on the refinery property or elsewhere in the Benicia area.

Unique Geologic Features. The proposed project would be located in an area that has been extensively modified by cutting and filling. The Chico/Panoche Formation is not noted for its unique or scientifically valuable geologic features, and no such features are reported to be present at the site or in the general vicinity.

Faults and Seismicity

Regional Earthquake Sources. Numerous active faults are present in the San Francisco Bay region. Regional seismic sources capable of producing earthquakes that might cause strong ground motions at the Benicia Refinery include the Green Valley-Concord fault, located 2 miles to the northeast; the West Napa fault, located 10 miles to the northwest; the Rodgers Creek fault, located 18 miles to the northwest; the Hayward fault, located 13.5 miles to the southwest; and the San Andreas fault, located 30 miles to the southwest (Figure 4.9-1). The estimated moment magnitudes (M_w) of the maximum earthquakes for these faults are provided in Table 4.9-1. A map prepared by the California Division of Mines and Geology for use by Caltrans (Mualchin and Jones 1992) indicates that a maximum earthquake on the Hayward fault or the Concord-Green Valley fault would create the greatest ground shaking at the Benicia Refinery. This shaking could produce a horizontal ground acceleration of approximately 0.4 g[2] in the project area. To put this in perspective, the maximum ground

[2] Ground acceleration is measured in terms of gravity or "g". Gravity causes accelerations of 32.2 feet/second^2.



Project No. 93C0336A	Exxon Clean Fuels Project	FAULTS OF THE SAN FRANCISCO BAY REGION	Figure 4.9-1
Woodward-Clyde Consultants			

93C0336A-0600/073093

TABLE 4.9-1

POTENTIALLY SIGNIFICANT EARTHQUAKE SOURCES

Fault	Distance from Project Site (miles)	Maximum Probable Earthquake (moment magnitude[1])
Green Valley - Concord	2	6.9
West Napa	10	6.5
Rodgers Creek	18	7
Hayward	13.5	7
San Andreas	30	8

Source: Wesnousky 1986; Working Group on California Earthquake Probabilities 1990.

[1] Moment magnitude is a measure of the actual energy generated by an earthquake. This method of expressing earthquake magnitude has replaced the Richter scale, which measured the earthquake magnitude in terms of the reaction of measuring instruments. Up to a magnitude 7, moment magnitude and Richter magnitude are similar.

accelerations observed in the San Francisco Bay Area during the Loma Prieta earthquake of 1989 were on the order of 0.2 g.

__Historic Earthquakes Felt in the Project Area__. The magnitude 7.1 Loma Prieta earthquake of October 17, 1989 produced effects equivalent to Intensity VI on the Modified Mercalli (MM) scale in the project area (McNutt and Toppozada 1990). A description of the Modified Mercalli scale is provided in Table 4.9-2. Many historic earthquakes have produced effects of this intensity or greater in the Benicia area and throughout the San Francisco Bay Region. The Mare Island earthquake of March 31, 1898, produced effects equivalent to MM Intensity VII in the project area (Toppozada et al. 1981). The Hayward earthquake of October 21, 1868, produced MM VII to VIII effects in the project area (Toppozada et al. 1981). The strongest felt effects in the Benicia area in historic time, which reached MM VIII to IX, were produced by the San Francisco earthquake of April 18, 1906 (Toppozada and Parke 1982).

__Local Faults__. The general area in which the Exxon Benicia Refinery is located is traversed by several unnamed bedrock faults that probably were formed millions of years ago. The Sulphur Springs Mountain thrust fault, which is believed to traverse the valley that borders the refinery property on the east, is not known to be active. The activity of the Southampton and Franklin faults, located 3 and 5 miles to the west, respectively is questionable. None of these faults have been classified as active by the California Division of Mines and Geology (Bortugno 1982). To be considered an active fault, there must be evidence of fault rupture within the past 11,000 years.

4.9.2 Impacts and Mitigation

__Significance Criteria__

A geologic impact was considered potentially significant if it could potentially result in the following:

1. Surface faulting causing disruption of pipelines and/or rupture and spilling of tanks

TABLE 4.9-2

MODIFIED MERCALLI INTENSITY SCALE (Abridged)

I	Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel scale)
II	Felt only by a very few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II Rossi-Forel scale)
III	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing automobiles may rock slightly. (III Rossi-Forel scale)
IV	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows and doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing automobiles rocked noticeably. (IV to V Rossi-Forel scale)
V	Felt by nearly everyone, many awakened. Some windows, dishes, etc. broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel scale)
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel scale)
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; some chimneys broken. Noticed by persons driving automobiles. (VIII Rossi-Forel scale)
VIII	Damage slight in specially designed structures; considerable in ordinary buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water levels. Persons driving automobiles disturbed. (VIII to IX Rossi-Forel scale)
IX	Damage considerable in specially designed structures; well-designed structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations; ground racked conspicuously. Underground pipes broken. (IX+ Rossi-Forel scale)
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel scale)
XI	Few, if any masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and landslips in soft ground. Rails bent greatly.
XII	Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown upward into air.

2. Strong ground shaking, causing toppling of towers and release of contents

3. Seismically induced ground failure causing collapse or disruption of refinery facilities

4. Slope failure (landslides) causing collapse or disruption of refinery facilities and/or loss of access for emergency vehicles

5. Differential settlement leading to tilting and toppling of towers and/or rupture of tanks

6. Erosion resulting in concentrated runoff of rainfall from the proposed new construction

The project was also assumed to result in a significant geologic impact if it could preclude access to rare or unique mineral resources, damage unique geologic features, or destroy scientifically valuable fossils.

Impacts from Surface Fault Rupture

There are no known active faults on the Benicia Refinery property. Therefore, fault rupture is not a credible event that would damage refinery equipment, and no impacts are predicted.

Impact No. 1 **Seismically-induced strong ground shaking is not expected to substantially impact project equipment. This impact is not significant.**

The refinery property, like the entire San Francisco Bay Area, can be expected to undergo strong ground motion as a result of major earthquakes on the Hayward, Green Valley-Concord, San Andreas, and other faults in the region. As part of the project, final design would be preceded by geotechnical and earthquake engineering studies. The results of these studies would be used by the structural engineer to ensure that geologic impacts and seismic hazards are avoided or reduced. In accordance with the Uniform Building Code, project equipment would be designed to withstand ground accelerations that have a 10 percent probability of being exceeded in 50 years; in other words, ground accelerations that are expected to occur on the average of once every 475 years.

The equipment proposed for the project can be grouped into the following categories:

- Pressure vessels
- Heat exchangers and vessels
- Heaters (including furnaces)
- Pumps, valves, and compressors
- Piping
- Storage tanks

The performance of these categories of equipment in the refining and chemical industry in earthquakes is discussed below. This information is based on proprietary data collected by EQE Engineering Consultants of San Francisco, California, a firm specializing in structural engineering.

It is unlikely that existing or proposed pressure vessels in the Benicia Refinery would be breached in a strong earthquake. The pressure loads for which these vessels are designed are typically much greater than seismic loads that would be caused by large earthquakes. In addition, the design and construction quality of these vessels is closely controlled through the ASME Pressure Vessel Code. Supports for pressure vessels could be impacted by strong ground shaking, causing leaks at piping connections to the vessel. To avoid this impact, connectors would be designed to withstand seismic loading and bends may be placed in piping, as appropriate, to absorb seismic shaking.

Some heat exchangers and vessels in the proposed process units would have large weights and would be elevated above the ground. These pieces of equipment could move enough during a large earthquake to cause leaks at pipe connections. This impact would be avoided by designing foundations and anchor bolts to withstand seismic loads.

The heaters and furnaces associated with the project would have tall stacks with relatively large overturning moments during seismic loading. This equipment could topple in a strong earthquake if not properly designed. Design features to prevent this impact include the use of soil or rock anchors of appropriate strength embedded to sufficient depth to resist the maximum expected overturning or toppling forces.

Pumps, valves, and compressors are considered to be resistant to seismic damage because of the excellent performance of this equipment at refineries and other industrial facilities in past earthquakes. Operating and start-up loads of pumps and compressors typically exceed the loads caused by ground shaking from an earthquake.

Welded steel piping is very flexible and has performed well in past earthquakes at industrial facilities including the Benicia Refinery. Problems related to piping are typically not caused by inertial loads but rather by failure of supports and debris falling on them. Piping can be protected from strong ground motion by properly designed supports, typically reinforced concrete bents.

Storage tanks have a mixed seismic performance history because of their varied sizes and shapes (i.e., height-to-diameter ratio). Damage during an earthquake to tanks with the same design as proposed for the project is typically caused by failure of attached piping which is rigid and cannot withstand movement of the tank or by elephant's foot buckling[3] of the tank wall. Piping could leak at its junction with a tank but would not result in the loss of the tank's contents. Elephant's foot buckling can lead to the loss of the contents of the tank if it is severe enough. Several design and operating factors would reduce the potential for elephant's foot buckling, including maintaining the proper fill height for the tank seismic design, anchoring, and installation of annular rings.

Foundation and structural designs that can withstand the level of ground shaking that could occur at the project site are in common use today. Tall, narrow structures like much of the proposed project process equipment that have used modern foundation designs have withstood

---

[3] Buckling of the tank wall near the bottom.

similar ground accelerations.[4] With foundation and structural design in accordance with current building codes, seismic shaking should not result in significant damage of project facilities that would result in offsite property damage or injury to members of the public.,

Mitigation Measure No. 1

All facilities and equipment will have to be designed to applicable codes and specific geotechnical conditions at the site. Identification of these criteria specific to each facility is developed during design of the facilities. Conformance with these requirements would minimize damage from seismic shaking, and no additional mitigation is proposed.

Impact No. 2 **There is a slight potential for project facilities to be impacted by adverse site or foundation conditions. This impact is not significant.**

Seismically-Induced Liquefaction and Settlement. Strong ground shaking can induce liquefaction in saturated, loose granular soils or fill materials. This can result in settlement of structures built over these materials. A geotechnical evaluation of the proposal project construction areas concluded that foundations would be located on well compacted fill, stiff natural soils, or strong bedrock (Harding Lawson 1993b). These conditions provide good foundation support. Adverse settlement and potential liquefaction impacts are not expected to occur given the site conditions. Additional foundation engineering evaluation and design would be performed during final design to verify site conditions and foundation requirements.

Slope Failure. Strong ground shaking can trigger failure of marginally stable slopes, but the proposed project facilities are not located adjacent to cut or fill slopes. In addition, available data do not indicate the presence of any landslides in the natural slopes within the refinery area. Although slides may have occurred in the hills surrounding the Exxon refinery complex, the proposed project facilities will be located on a flat area within the main process

---

[4] An example of an industrial facility that has recently withstood an earthquake similar to one that could occur in the project area is the PG&E power plant at Morro Bay. That plant, which has an exhaust stack several hundred feet high, is approximately 20 miles from the epicenter of the 1989 Loma Prieta earthquake (Richter magnitude 7). The earthquake did not damage the plant.

block, and a gently sloped, stable area where the fabrication/storage area will be constructed near the Gate 5 parking lot.

Differential Settlement. Differential settlement can occur where structures are placed on weak soils. Proposed project facilities would be located on site conditions that provide good foundation support. Therefore, differential settlement is not expected of equipment foundations or tanks, and no impacts are identified.

Expansive Soils. The fills and colluvial soils on the site are known to be moderately to highly expansive. Expansive soils can cause damage to foundations, pavements and slabs unless appropriately handled during construction. The potential for damage due to expansive soils can be prevented by various means, including lime-treating the soil, covering the expansive soil with an appropriately thick layer of non-expansive soil, construction of moisture barriers, and extending foundations down through the expansive soil and into bedrock. Selection of the appropriate means of dealing with expansive soils for individual project structures would be based on the results of the site-specific geotechnical engineering investigation that would be conducted for final engineering design.

Mitigation Measure No. 2

Impacts of any adverse foundation conditions can be adequately predicted and incorporated into the final design of the project, and no additional mitigation is required.

Impacts to Unique or Valuable Geologic Resources

Impact No. 3 **There are no unique or valuable geologic resources that could be affected by the project. No impacts would occur.**

The Chico/Panoche Formation is not noted for its unique or scientifically valuable geologic features, and no such features are known to be present on the refinery property.

As indicated above, clay shale from the formation has been used in the manufacture of brick. There is no current mining and brick manufacturing activity in the project area. In addition, there is essentially an unlimited supply of clay shale in the region, and this project would not impact this resource.

Mitigation Measure No. 3

No mitigation is required.

Soil Erosion Impacts

Impact No. 4 **Changes in runoff resulting from the proposed project are not expected to significantly increase erosion potential. This impact is not significant.**

Runoff from project facilities would be collected in the existing stormwater sewer system at the refinery. This runoff is discharged to a surge tank and retention pond at the existing wastewater treatment plant. These facilities are large enough to contain the additional runoff caused by covering soils with the proposed project equipment and tanks. The project, during construction, would have to adnore to the General Construction Activity Stormmater Permit, which mandates erosion control measures. No significant erosion impacts would be expected.

Mitigation Measure No. 4

No mitigation is required.

4.9.3 Cumulative Impacts

Impact No. 5 **The project would not contribute to any significant cumulative geologic or seismic impacts. No cumulative impacts would occur.**

There are no foreseen cumulative impacts between this and other related projects. Geologic and seismic impacts are relatively site specific, and would not expect to be additive or cumulative in the sense that the impacts would be anymore sever at any one site or sites when considered collectively.

Mitigation Measure No. 5

No mitigation is required.

4.10 TRAFFIC

The traffic section provides an analysis that describes the existing traffic network and conditions, future conditions without the Clean Fuels project, and the impacts of the project and recommended mitigation. Since the project primarily affects traffic conditions during the anticipated 1994-1995 construction period, the focus of the study is on construction-related impacts. Post-construction and cumulative impacts are also addressed.

4.10.1 Environmental Setting

This section identifies the existing transportation network in the regional and local vicinity of the Exxon Benicia refinery. Automobile, rail, and marine traffic facilities and conditions are described.

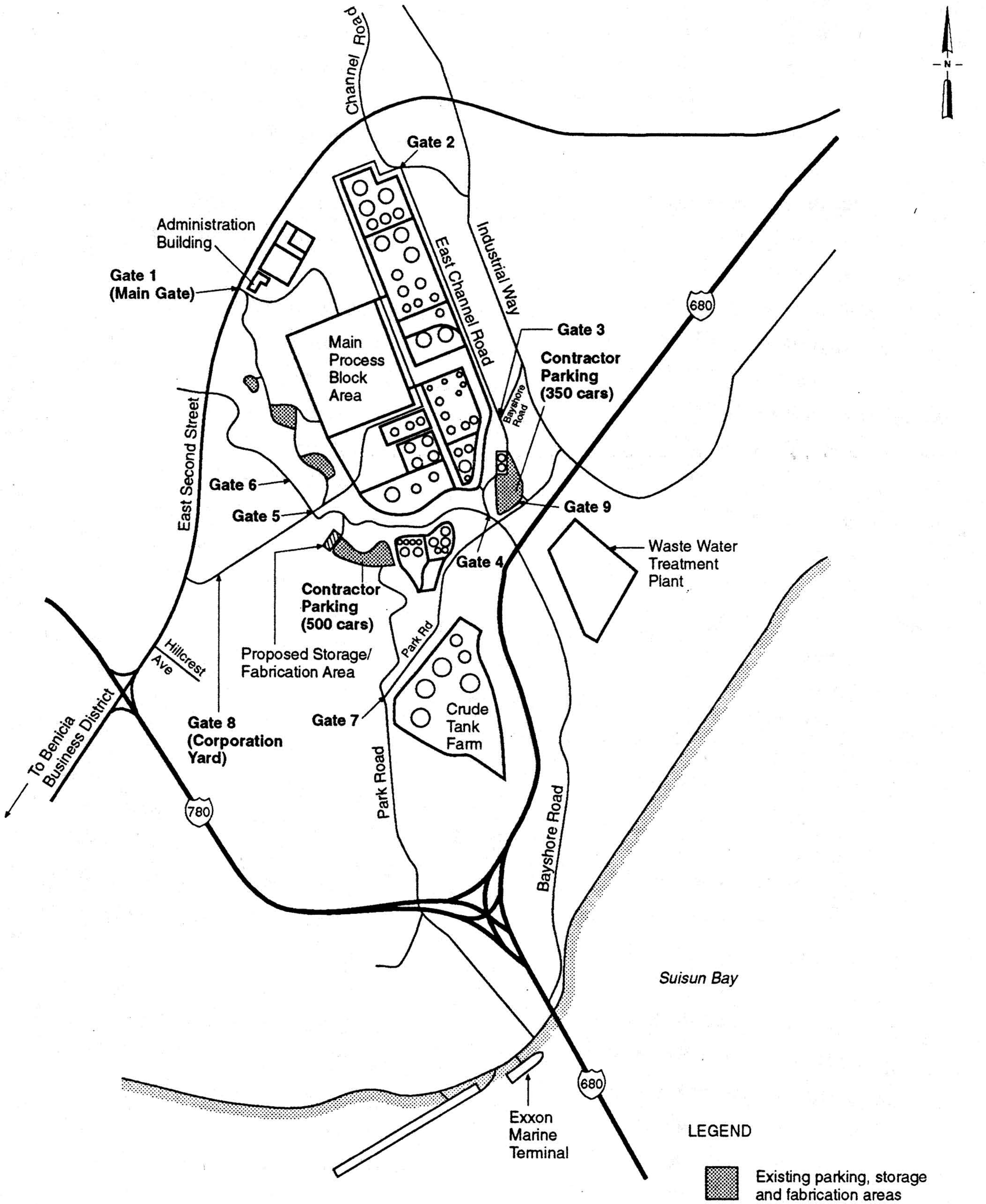
Regional and Local Roadway Transportation Network

Two major freeways as well as several local streets and roads provide traffic circulation in the vicinity of the Benicia refinery. This transportation network, described below, is shown in Figure 4.10-1.

- **Interstate 780** (I-780) is a four-lane, east-west freeway extending from the Benicia-Martinez Bridge westerly to Interstate 80 in Vallejo. A full access interchange is located at East Second Street which provides the most direct access to the project site from I-780.

- **Interstate 680** (I-680) is four-lane, north-south freeway in the project study area. From the Benicia-Martinez Bridge, I-680 extends north to I-80 at Cordelia. Limited access interchanges are located at Bayshore Road (northbound off- and southbound on-ramps) and Industrial Way (southbound off- and northbound on-ramps). A full access interchange is located at Lake Herman Road.

- **East Second Street** is an arterial roadway providing north-south travel in the City of Benicia. East Second Street also provides direct access to the proposed project



Project No. 93C0336A	Exxon Clean Fuels Project	ACCESS AND PARKING AT BENICIA REFINERY	Figure 4.10-1
Woodward-Clyde Consultants			

93C0336A-0600/090293

site. From Lake Herman Road the roadway travels in a southwesterly direction and has two travel lanes. At Rose Drive, East Second Street widens to two travel lanes in each direction with a landscaped raised median. Prior to Hillcrest Avenue, the median ends and East Second Street continues as a four-lane road until reaching I-780.

- **Industrial Way** provides access to the Benicia Industrial Park. Travelling in a north-south direction from East Second Street to south of I-680, this two-lane roadway allows access to warehousing/shipping areas and is traversed by railroad tracks at various locations. Where Industrial Way intersects I-680 there is limited access via a northbound on-ramp and a southbound off-ramp. South of I-680, the roadway turns northeasterly paralleling the freeway until reaching Lake Herman Road.

- **Bayshore Road** extends east from H Street before turning northward under I-680. At I-680, access includes a northbound off-ramp and southbound on-ramp. A two-lane roadway, Bayshore Road terminates just past Park Road. At this point, there is an Exxon gate access.

- **Park Road** parallels I-680 between East Second Street and Bayshore Road. A two-lane roadway, Park Road widens between Industrial Way and Bayshore Road to provide a two-way left-turn lane. South of Bayshore Road, Park Road continues in a southwesterly direction.

- **Rose Drive** provides access to residential areas in northwest Benicia. In the project study area, Rose Drive intersects East Second Street north of the Exxon Refinery. The roadway has one travel lane in each direction with a raised landscaped median.

- **Hillcrest Avenue (Rankin Avenue west of East Second Street)** is oriented in an east-west direction and provides access to residential areas.

Existing Access, Circulation, and Parking at the Benicia Refinery

Project Access and Circulation. As shown in Figure 4.10-1, access to the Exxon Benicia Refinery can be gained from specific roadways within the Benicia Industrial Park. These roadways include East Second Street, Channel Road, Bayshore Road, and Park Road. All access points are controlled by gates which total nine for the entire refinery. From East Second Street access is provided to the Exxon Administration Building via Gate 1. Additional access to Gates 5, 6, and 8 (shared with Benicia Corporation Yard) is also gained from East Second Street. Northeast of the refinery, Channel Road provides access to Gates 2 and 3. Along the southern boundary, Park Road provides access to Gates 7 and 9. Finally, Bayshore Road provides direct access to Gate 4.

Exxon manages and controls all access to the Benicia Refinery. It is noted that access for the proposed construction worker traffic would be limited to Gate 8 from East Second Street and Gate 9 from Park Road. Truck access for the proposed project would be limited to Gate 4 from Bayshore Road (Hammonds 1993a).

Vehicle circulation within the refinery is limited to two-lane internal streets. From Gate 1, access is gained to the refinery's utilities, hydro-cracker, and cat feed hydrofiner. In the southern areas of the refinery, Fifth Street provides access to the cat unit, powerformer, and TGCU areas. Third Street provides access to storage tank areas in the southern portion of the refinery. These internal network of streets are all interconnected to provide complete circulation throughout the refinery.

Parking. Vehicle parking for the proposed construction project would be provided by two existing main surface lots located within the refinery (Figure 4.10-1). A surface lot containing 500 parking spaces is located east of East Second Street and would serve a majority of the proposed construction traffic. Access to the lot would be gained from Gate 8 which shares access with the City of Benicia Corporation Yard. A second surface lot containing 350 parking spaces is located off Park Road and would serve the remaining construction traffic. Access to this lot is provided by Gate 9 (Hammonds 1993b). These existing lots are adequate to serve the project and no new parking lots are proposed.

Other smaller surface parking lots are located within the refinery and the main administrative and visitor parking lots are located off of East Second Street. These parking lots primarily serve permanent Exxon employees or visitors and would not be used by proposed construction traffic.

Existing Traffic Operations on Local Streets and Roads

Intersection LOS Concept. Level of service (LOS) is the primary indicator for traffic operation performance at an intersection. At a signalized intersection, LOS is determined by calculating the volume of conflicting movements at an intersection during one hour and dividing that total by the capacity designed to accommodate those turning movements. The resulting calculations are expressed by ratings which range from LOS "A" to "F". The range describes increasing traffic demand, delays and deterioration of services. Signalized intersection levels of service have been calculated using the Transportation Research Board's (TRB's) Planning Method, as described in the TRB Circular 212 (TRB 1980).

For unsignalized intersections, gap acceptance and reserve capacity criteria are used for level of service analysis. Procedures used for calculating unsignalized intersection levels of service are presented in the 1985 Highway Capacity Manual (TRB 1985). Levels of service at the unsignalized intersections which are controlled by side street stop signs are indicative of the magnitude of the delay incurred by motorists turning at the intersection. Since these calculations ignore the condition of through-traffic flow (which is assumed to proceed freely) a supplemental traffic signal warrant analysis is performed. Thus, while an unsignalized level of service may indicate very long delays for a particular turning movement (i.e., LOS "E" or "F"), traffic conditions are generally not assumed to be unacceptable unless signal warrants are satisfied.

For all-way-stop intersections, current evaluation practices as outlined in the 1985 Highway Capacity Manual allows only a generalized level of service estimate. The methodology comes from limited research in the early 1960s that accounted for fewer variables than modern analysis methods for other types of facilities. Therefore, levels of service for this EIR have been estimated at all-way-stop intersections using the Transportation Research Board Circular 373 (TRB 1991). The method accounts for the number of approach lanes and

and East Second/Corporation Yard are functioning at LOS "D". This level of service refers to the outbound left-turn movement from the minor street onto East Second Street. All other project study intersections are functioning at LOS "C" or better during the AM peak hour. During the PM peak hour, three study locations are experiencing significant congestion. The intersection of East Second/I-780 eastbound ramps is operating at LOS "D" (0.82). The intersection of East Second/I-780 westbound ramps is experiencing significant congestion for the westbound left-turn movement from the off-ramp onto East Second Street and is operating at LOS "F". Lastly, the intersection of East Second/City Corp--Exxon Gate 8 is functioning at LOS "D". All other project study intersections are operating at LOS "C" or better during the PM peak hour.

Signal Warrants. All unsignalized intersections were assessed to determine if peak hour volumes could warrant traffic signalization. The "peak hour warrants" referenced in this section refer to minimum traffic thresholds identified by the U.S. Department of Transportation and Caltrans. When an intersection's peak hour volume exceeds the minimum thresholds, a traffic signal could be warranted. Intersections which qualify for signalization (under peak hour criteria) would require further analyses of accident history, proximity of other intersection/driveways and potential volume increases. All of these factors should be examined before a signal is actually installed. The signal warrant criteria employed for this study are presented in the Manual of Uniform Traffic Control Devices (U.S. Department of Transportation 1986).

Based on the above criteria, one of the existing study intersections would qualify for signalization. The intersection of the East Second/I-780 westbound ramp exceeds the minimum volumes for signalization during the PM peak hour. All other unsignalized intersections would not qualify for signalization at this time.

Existing Traffic Operations on Regional Freeways

The freeway operations analysis for this study focused on ramp junction operations and the approaches to the Benicia-Martinez Bridge and toll plaza. Freeway segments along Interstate 680 and Interstate 780 in the project study area are generally operating at acceptable conditions (LOS C or better). However, during the morning commute period (6:00-9:00 AM) eastbound I-780 can experience congestion at its approach to the Benicia-Martinez Bridge. Similarly, northbound I-680 can experience congestion during the evening commute period (3:00-6:00 PM) from the toll plaza back to Martinez. This is especially true during periods of heavy recreational travel and on Friday afternoons.

The basis for evaluating the freeway ramp junctions is the 1985 Highway Capacity Manual (Transportation Research Board 1985). The following is a brief description of the analysis procedures used to calculate ramp junction level-of-service and is taken from the Highway Capacity Manual.

> *A ramp-freeway junction is an area of competing traffic demands for space. Within the ramp junction area, all merging and diverging movements between the freeway and ramp occur. Upstream freeway demand competes with on-ramp demand in merge areas. Diverge is the maneuver required at an off-ramp. Normally, exiting vehicles must occupy the outside lane(s) adjacent to the ramp requiring a redistribution of through-traffic to the other lanes. The merge, diverge, and freeway volumes are referred to as checkpoint volumes and it is these volumes to which level-of-service criteria are applied.*

There are three types of ramp junction checkpoints:

- Merge checkpoint occurring immediately after an on-ramp
- Diverge checkpoint occurring immediately before an off-ramp
- Freeway checkpoint occurring upstream of an off-ramp and downstream of an on-ramp

Freeway capacity analysis and levels of service assessments are usually conducted for each checkpoint of an interchange system. The number of checkpoints depends on the type on interchange and the overall configuration of the ramps for diverge and merge points. Capacity computations are then conducted for each checkpoint.

Levels of service for study ramp junctions are shown in Table 4.10-2 (Ecclestone 1992; Omni-Means 1993a). As shown in Table 4.10-2, only one ramp junction is experiencing congestion at this time. The ramp junction of the westbound on-ramp from East Second

TABLE 4.10-2

EXISTING RAMP JUNCTIONS LEVEL OF SERVICE

Ramp Location	Checkpoint	Peak Hour Period	Existing Level of Service
EB off to E. Second St.	Freeway	AM	C
	Diverge		C
	Freeway	PM	B
	Diverge		B
EB on from E Second St.	Freeway	AM	C
	Merge		C
	Freeway	PM	C
	Merge		C
WB off to E Second St.	Freeway	AM	B
	Diverge		B
	Freeway	PM	B
	Diverge		C
WB on from E Second St.	Freeway	AM	B
	Merge		B
	Freeway	PM	D
	Merge		D
NB off to Bayshore Rd.	Freeway	AM	B
	Diverge		B
	Freeway	PM	C
	Diverge		C
SB on from Bayshore Rd.	Freeway	AM	C
	Merge		C
	Freeway	PM	C
	Merge		C
SB off to Industrial Way	Freeway	AM	C
	Diverge		C
	Freeway	PM	B
	Diverge		A
NB on from Industrial Way	Freeway	AM	B
	Merge		A
	Freeway	PM	C
	Merge		C

Street to I-780 is functioning at LOS D for both the freeway and merge checkpoints. All other study ramp junctions are functioning at LOS C or better.

Traffic Circulation at the Exxon Benicia Refinery

Field observations indicate that existing traffic operations at Exxon Benicia Refinery gates are functioning at acceptable levels of service with few exceptions. All entrances to and from the refinery are controlled by gate guards and/or attendants, or are locked. This includes Gate 1 from East Second Street and Gate 4 from Bayshore Road. No vehicle queuing or conflicts were observed at these gates during the peak commute hours. Access to Exxon Gate 8 from East Second Street currently shares access with the City of Benicia Corporation Yard. As one of the project study intersections, it has been calculated to operate at LOS "D" during both the AM and PM peak hours. This is the only gate experiencing congestion during the peak hours. All other gates are locked and controlled by Exxon personnel.

Rail Network and Operations

Rail Infrastructure. Existing railroad activity in the project study area includes regional tracks owned by the Southern Pacific Transportation Company and shorter spur tracks which serve the Benicia Industrial Park and Exxon Refinery. The Southern Pacific Transportation Company operates the Sacramento Line which travels between Oakland and Roseville and parallels I-680 southeast of the project site in a north-south direction. These tracks serve both passenger trains (AMTRAK) as well as freight trains. There are also short spur tracks which travel in a northwest direction from the main Southern Pacific (SP) tracks. One set of these tracks (the 700 line) has an at-grade crossing of Park Road just north of Bayshore Road and serves the Benicia Refinery directly as well as other parts of the Industrial Park. Currently, the at-grade crossing at Park Road has no red-flashing warning lights or crossing gates. Another set of railroad tracks (line 745) crosses directly over Park Road immediately south of Industrial Way. Like the Park Road crossing adjacent to Bayshore Road, this is an at-grade crossing with no warning lights or crossing gates. These tracks travel in a northerly direction paralleling Industrial Way and serve the Industrial Park as well as provide sidings used to store rail tank cars. There are three siding tracks approximately 1,000-2,000 feet long that are used by SP to set off and pick up rail tank cars for the Benicia Refinery.

Rail Operations Relative to Exxon. Southern Pacific Transportation Company operates all freight rail services on the SP line to/from the Benicia Refinery. These operations are not constant, but change due to economic factors, customer needs, and railroad convenience/ availability.

Within the Benicia Refinery, rail tank cars (empty or full) are put together in a "switch" to be readied for transport from the refinery. A switch is a number of rail tank cars that are moved around the refinery by Exxon employees using a "track mobile." These switches can number anywhere from one to twenty rail cars depending on the size of the shipment. Conversely, the Benicia Refinery can also contact SP to request a switch of empty cars should they be short. Once a switch has been prepared at the Benicia Refinery, Exxon will contact SP to notify them that the switch is ready to be moved. Exxon typically exports butane and pentane products and imports isobutane products. Petroleum coke, a by-product of the refining process, is also moved by rail.

Southern Pacific will generally move a switch to/from the Benicia Refinery and its main SP line within a one-day time period. Although SP can change its schedule at any time, the schedules are based on crew shift starting and ending times and sometimes the switch can take longer than one day to occur. All switching to/from the Benicia Refinery occurs during the daylight hours between 10:00 AM and 6:00 PM. No switching occurs after dark or on the weekends (Kitz 1993). On a weekly basis, the Benicia Refinery averages 14 rail tank cars. However, there can be peak periods where the number of cars could exceed 70 cars a week. These peaks relate to maintenance periods or operating upset conditions.

It is noted that the at-grade railroad crossing at Park Road just north of Bayshore Road has experienced a train-related accident at least once a year over the past five years. Due to this high ratio, the City of Benicia has requested that this location be improved with railroad crossing gates. The City has requested from Caltrans that the multi-year plan for the administration of improvement funds for this location be advanced from its current 97/98 year. The City would request that crossing gates and warning lights be installed at this location. At this time, the City is waiting for a response from Caltrans (Mustain 1993).

Marine Terminal Operations

Marine port activity related to the Benicia Refinery occurs at the Exxon Liquid Projects Dock located southwest of Army Point in the Carquinez Strait. Crude oil and products necessary to petroleum processing are unloaded at the dock and transferred by pipeline to the refinery. Products produced at the refinery are piped to the dock facilities for loading on vessels. Historical data provided by Exxon on their dock's use indicate that the facility is averaging about 70% occupancy for the last recorded year of 1991. The ship traffic using the facility are shown below, in terms of type of cargo:

1991 Summary	
Crude	121
Intermediates	101
Products	32
Total	**254**

Based on 254 vessels using the Exxon Liquid Products Dock, there is an average of 4-5 vessels per week using the facility.

4.10.2 Impacts and Mitigation

Significance Criteria

The City of Benicia is currently in the process of reviewing a proposed technical update to the Benicia General Plan (Hammer 1993). As part of the technical update, various policies have been proposed in the Circulation Element of the General Plan regarding street network and traffic operations. These policies have not been adopted by the city, but have been applied to this project because they are the subject of serious consideration by the city, and the criteria are more rigorous than any policies contained in the General Plan, adopted in 1977 and revised in 1979. The proposed criteria involving level of service are as follows:

- Work to maintain traffic level of service C at intersections in Benicia, recognizing that lower levels of service may be acceptable in cases where maintaining LOS C would require significant disruption of existing activities or natural features.

- On those freeways in the City that are on the designated Congestion Management Program (CMP) system -- I-780, and I-680 -- the lowest service acceptable is LOS E based on measurement procedures established in the CMP.

The above criteria were used to evaluate significance for long-term impacts (more than 1 year). Impacts that would occur during the peak period of construction were considered short-term. Based on the above criterion, a project study intersection that would degrade below LOS C with project traffic would be considered a significant impact. In addition, any intersection which is LOS "D" or worse and degrades with project traffic below the existing LOS would be a significant impact. For freeway ramps and connectors, a significant impact would be where project traffic caused the level of service to degrade below the Level of Service E.

Approach to the Traffic Impact Analysis

Impacts to traffic are evaluated for both the construction period and long-term operation of the Clean Fuels facilities. The impact of the project was estimated by evaluating how traffic conditions would change during the construction and operation period by adding estimated traffic generated by the project to "background" conditions. Background conditions represent traffic levels *without the project* but with other forecasted growth that is anticipated to occur in the future.

The traffic assessment for the project's construction period includes freeway traffic increases from other project construction in the regional area. At the local intersections in the project area, average population and employment growth will add to the current traffic and this growth defines background traffic conditions.

The background traffic conditions for long-term project operation reflect horizon year 2000 projections as quantified in the Solano County Congestion Management Authority (CMA) transportation model. It should be noted that the horizon year 2000 projections include the proposed (but currently on-hold) Sky Valley project. (Detailed discussion of the year 2000 projection is included at the end of this section).

Future Traffic Conditions Without the Exxon Clean Fuels Project

Methods for Projecting Construction Period Background Conditions. Short-term traffic impacts are identified for background traffic during the construction period. Background traffic growth projections were applied to 1993 peak hour traffic volumes starting at the first quarter of 1994 through the first quarter of 1996 to create a cumulative baseline condition. This time period coincides with the proposed two-year construction period for the Exxon Clean Fuels project.

Growth projections for background traffic have been based on the Association of Bay Area Governments (ABAG) projections for total population and jobs for the subregional area of Benicia (ABAG 1991). Using projections for total population and total jobs for the years between 1990 and 2000, a per year growth rate was established. The ABAG projections include growth associated with the Sky Valley project, which is currently on hold, and therefore the traffic levels projected using this data base are conservative in terms of potentially overstating actual impacts. As calculated, the total population is forecasted to grow at 4.5 percent per year while total jobs are forecasted to grow 3.7 percent per year. Over a two-year period this would equate to a 9 percent growth factor for population and a 7.4 percent growth for jobs. Potentially impacted areas encompass both residential areas along East Second Street as well as the industrial park near I-680, and therefore two separate growth rates were applied to existing peak hour intersection volumes. A 9 percent growth rate was added to study intersections along East Second Street and a 7.4 percent growth rate was added to the study intersections in the industrial park area.

Regional Cumulative Projects Coinciding with Construction of the Exxon Clean Fuels Project. In addition to background traffic growth, other related cumulative projects would affect traffic flows in the study area. These projects are described in Section 3.0. The following describes how specific related and cumulative projects were evaluated for traffic impacts in conjunction with the proposed project.

The Shell Oil Company Clean Fuel project is scheduled to begin construction in the fall of 1993, and the overall project would be completed in 1998/1999, pending project approvals. Based on the Shell Clean Fuel project DEIR (EIP 1993), it would generate 1,590 peak hour trips and those trips affecting traffic volumes in the project study area have been added to cumulative base traffic volumes. It is noted that peak hour traffic volumes generated by the proposed Shell Clean Fuels project would only affect mainline freeway volumes along I-680 and I-780 in the project study area.

Other related cumulative projects regarding clean fuels reformulation include the Pacific Refinery in Hercules, the Unocal Refinery in Rodeo, and the Tosco Avon Refinery in Martinez. At the time of this analysis, there are no established schedules for construction of these projects at these refineries.

The construction of the cogeneration plant at the C & H Sugar refinery in Crockett is anticipated over the period 1993 to 1995, for a planned delivery of electricity to the PG&E system by January 1996. Peak hour traffic volumes from this proposed project have been added into cumulative base volumes. Similar to the Shell Clean Fuels project, only mainline freeway volumes along I-680 and I-780 in the project study area would be affected.

The proposed reformulated fuels and FCC plant upgrade at the Chevron refinery in Richmond would involve construction over a 30-month period, from 1994 to 1996, with a peak workforce of 1,550 workers occurring in June 1995. The traffic analysis contained in this project's Draft EIR indicated no trip assignments or traffic impacts to roads or intersections affected by the Exxon Clean Fuels project (ESA 1993). The area of impact for traffic for these two projects would not be expected to overlap, and no cumulative impacts would occur. The Chevron project was therefore not evaluated for cumulative traffic impacts in this EIR.

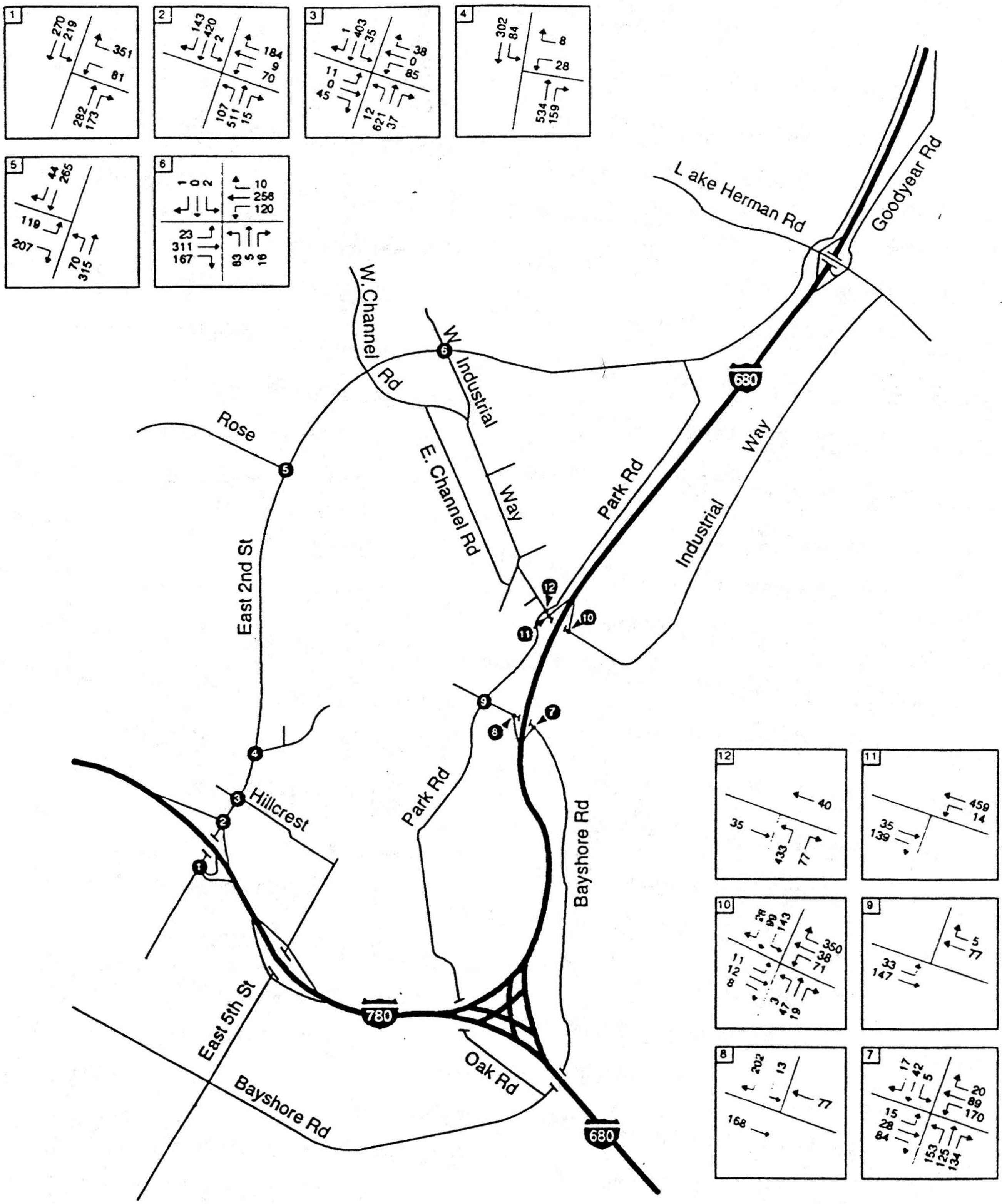
The construction of Exxon's MTBE plant would extend into approximately mid-1994. During the time that the MTBE plant is under construction coincident with construction of the Clean Fuels project (i.e., first and second quarters of 1994), each project would employ about 200 construction workers, for a total of 400. The traffic from the combined workforces would be well below the peak period workforce of 900 for the Clean Fuel project, and therefore would not affect the peak traffic conditions evaluated in this EIR.

A refinery maintenance "turnaround" is planned for sometime during the first half of 1994. This turnaround would last approximately 1-2 months. The maintenance turnaround workforce would peak at 1,500 workers during the day shift. Because a substantial overlap of workforces for the refinery turnaround and other projects would cause significant problems with parking, traffic, and other issues, Exxon has committed to minimizing the construction activities associated with the Clean Fuels and MTBE projects during the turnaround period.

The last major cumulative project that would affect traffic flows in the project study area would be the proposed Benicia-Martinez new I-680 Bridge. The environmental review for this project is currently underway, and a supplemental Draft Environmental Impact Statement/Report is expected in the fall of 1993. If approved, construction is anticipated to begin in late 1995, and would be built in two phases from 1995 to 2005, and from 2005 to 2015. Since this proposed project would not start construction until late 1995 at the earliest, it would not overlap with construction of the Exxon Clean Fuels project, and therefore changes in cumulative traffic volumes were not included in cumulative baseline conditions. However, for post-1995 operation of the Exxon Clean Fuels project, changes in cumulative traffic volumes associated with the new bridge were evaluated.

Cumulative baseline volumes representing existing (1993) conditions with average growth and the above related and cumulative projects added are shown in Figures 4.10-4 and 4.10-5. The volumes shown in these figures do not include traffic from the Exxon Clean Fuels project.

Projected Freeway Ramp Operation Without the Project. With cumulative baseline traffic volumes (i.e., projected traffic growth with related and cumulative projects added, but without the Exxon Clean Fuels project construction traffic), levels of service at some freeway ramp junctions would change. As shown in Table 4.10-3, the eastbound off-ramp from I-780 to East Second Street would decline from LOS "C" to "D" during the AM peak hour and from "B" to "C" during the PM peak hour. The eastbound on-ramp from East Second Street would change from "C" to "D" during the AM peak hour. At the westbound off-ramp to East Second Street, LOS would change from "B" to "C" during the AM peak hour and "C" to "D" during the PM peak hour. Finally, the westbound on-ramp from East Second Street would change from LOS "B" to "C" in the AM peak hour and "D" to "E" during the PM peak hour.

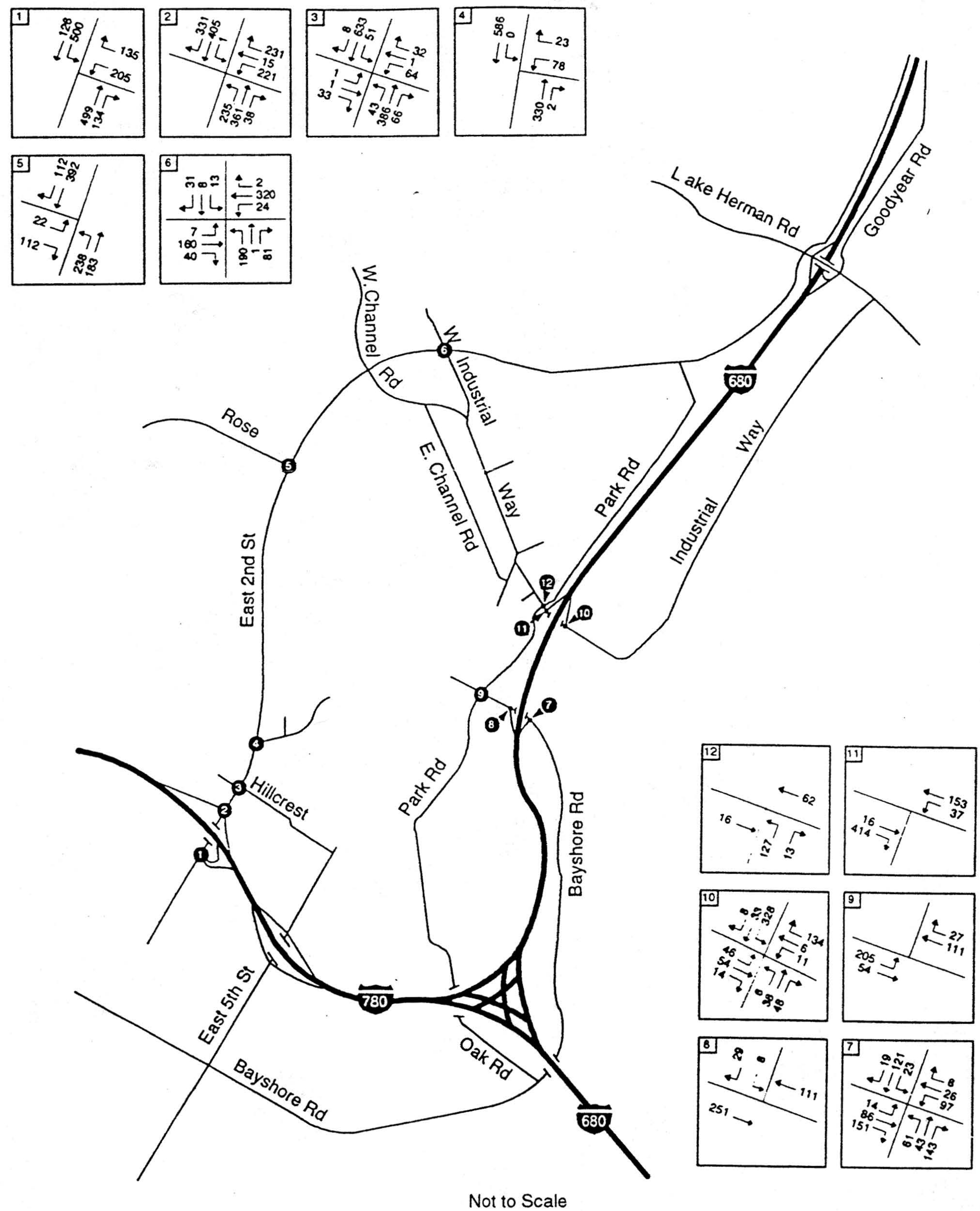


Not to Scale

Source: Omni-Means

Project No. 93C0336A	Exxon Clean Fuels Project	EXISTING AND CUMULATIVE BASE A.M. PEAK HOUR VOLUMES	Figure 4.10-4
Woodward-Clyde Consultants			

93C0336A-0006/072793



Source: Omni-Means

Project No. 93C0336A	Exxon Clean Fuels Project	EXISTING AND CUMULATIVE BASE P.M. PEAK HOUR VOLUMES	Figure 4.10-5
Woodward-Clyde Consultants			

93C0336A-0006/072793

TABLE 4.10-3

PROJECTED RAMP JUNCTION LEVEL OF SERVICE DURING THE CONSTRUCTION PERIOD WITHOUT THE PROPOSED PROJECT

Ramp Location	Checkpoint	Peak Hour Period	Level of Service
EB off to E. Second St.	Freeway Diverge	AM	D D
	Freeway Diverge	PM	B C
EB on from E Second St.	Freeway Merge	AM	D D
	Freeway Merge	PM	C C
WB off to E Second St.	Freeway Diverge	AM	B C
	Freeway Diverge	PM	E E
WB on from E Second St.	Freeway Merge	AM	B C
	Freeway Merge	PM	F E
NB off to Bayshore Rd.	Freeway Diverge	AM	B C
	Freeway Diverge	PM	C C
SB on from Bayshore Rd.	Freeway Merge	AM	D C
	Freeway Merge	PM	C C
SB off to Industrial Way	Freeway Diverge	AM	C C
	Freeway Diverge	PM	B A
NB on from Industrial Way	Freeway Merge	AM	B A
	Freeway Merge	PM	D C

Along I-680, only the northbound off-ramp to Bayshore Road would change from LOS "B" to "C" during the AM peak hour.

Projected Intersection Operation Without the Project. With cumulative baseline traffic volumes, intersection levels of service would be very similar to existing conditions. As shown in Table 4.10-4, two intersections would be affected by increases in cumulative background traffic. The intersection of East Second/Industrial Way would change from LOS "C" to "D" during the AM peak hour. The Bayshore/I-680 northbound off-ramp would change from LOS "A" to "B" during the AM peak hour. All other project study intersections would remain unchanged from existing conditions.

Projected Signal Warrants Without the Project. The intersection of East Second/I-780 westbound ramps would continue to exceed the minimum peak hour volumes required for signalization with cumulative baseline volumes.

Construction Workforce and Trip Generation

Construction Workforce. The construction workforce for the Exxon Clean Fuels project would remain under 200 workers through the second quarter of 1994, and then increase to about 400 workers during the third quarter of 1994 and reach 750 workers by the first quarter of 1995. The construction workforce is projected to reach its peak of almost 900 workers by the second quarter of 1995 and continue at this level through the third quarter of 1995 (refer to Figure 2-12) (Hammonds 1993c); therefore, the peak construction period would last six months.

Construction worker trip generation rates were based on the peak number of workers and their expected arrival and departure times. An average vehicle ridership of 1.1 (consistent with Bay Area averages) was assumed for trip generation purposes. This would represent a minimum amount of ridesharing and transit usage.

As calculated, the total peak construction workforce would generate 819 AM peak hour vehicle trips (inbound) and 819 PM peak hour trips (outbound). Discussion with Exxon staff indicate that the workforce would arrive at the site by 8:00 AM and leave the site at

TABLE 4.10-4

PROJECTED CONSTRUCTION PERIOD INTERSECTION LEVELS OF SERVICE WITHOUT THE PROPOSED PROJECT (VOLUME/CAPACITY (V/C) RATIOS AT SIGNALIZED LOCATIONS)[1,2,3]

Intersection	AM Peak Hour	PM Peak Hour
1. East Second/I-780 EB Ramps	B(V/C = 0.62)	D(V/C = 0.89)
2. East Second/I-780 WB Ramps	D ---	F ---
3. East Second/Rankin Way-Hillcrest	A(V/C = 0.37)	A(V/C = 0.34)
4. East Second/Corporation Driveway	D ----	D ----
5. East Second/Rose	A(V/C = 0.26)	A(V/C = 0.40)
6. East Second/Industrial Way	D ----	C ----
7. Bayshore/I-680 NB off-ramp	B ----	A ----
8. Bayshore/I-680 SB on-ramp	A ----	A ----
9. Bayshore/Park	B (7.9 secs.)	B (5.1 secs.)
10. Industrial Wy./I-680 NB on	A ----	A ----
11. Industrial Wy./I-680 SB off	A ----	A ----
12. Industrial Wy./Park	C (14.7 secs.)	B (4.8 secs.)

[1] Transportation Research Board, Interim Materials on Highway Capacity, Circular 212, June 1980.

[2] Approximate average vehicle delay for all-way-stop intersections is shown in seconds.

[3] A volume/capacity ratio cannot be calculated for an unsignalized intersection.

5:00 PM. Therefore, it is assumed that the employees would arrive at work between 7:30-8:30 AM and leave from the site between 4:30 and 5:30 PM. Construction trip generation is summarized in Table 4.10-5.

Truck Delivery Traffic. Daily truck deliveries to the project site would be at a peak during the first six months of construction with up to 30 trucks per day. These truck deliveries would add up to 60 one-way truck trips per day (50% inbound, 50% outbound), which were added to the overall construction traffic volumes.

Trip Distribution. Construction employee traffic distribution has been estimated based on previous traffic analyses conducted for clean fuel projects (EIP Associates 1993). It is very likely that the proposed Exxon Clean Fuels project would draw on the same contractor work forces as those proposed for other similar projects in the greater Bay Area. Some revisions have been made to the overall worker distribution to account for those workers coming to and from I-780 via the Carquinez Bridge rather than I-680 via the Benicia-Martinez Bridge. The proposed project's vehicle distribution is estimated as:

60% to/from the south on I-680 (Benicia-Martinez Bridge)
17% to/from the north on I-680
20% to/from the west on I-780
3% internal to the City of Benicia

Project generated vehicle trips were added to existing plus cumulative base volumes and the results are shown in Figures 4.10-6 and 4.10-7.

Regional Freeway Construction Period Impacts and Mitigation

Freeways/Benicia-Martinez Bridge. The project will add construction-related traffic to local freeways and the Benicia-Martinez Bridge.

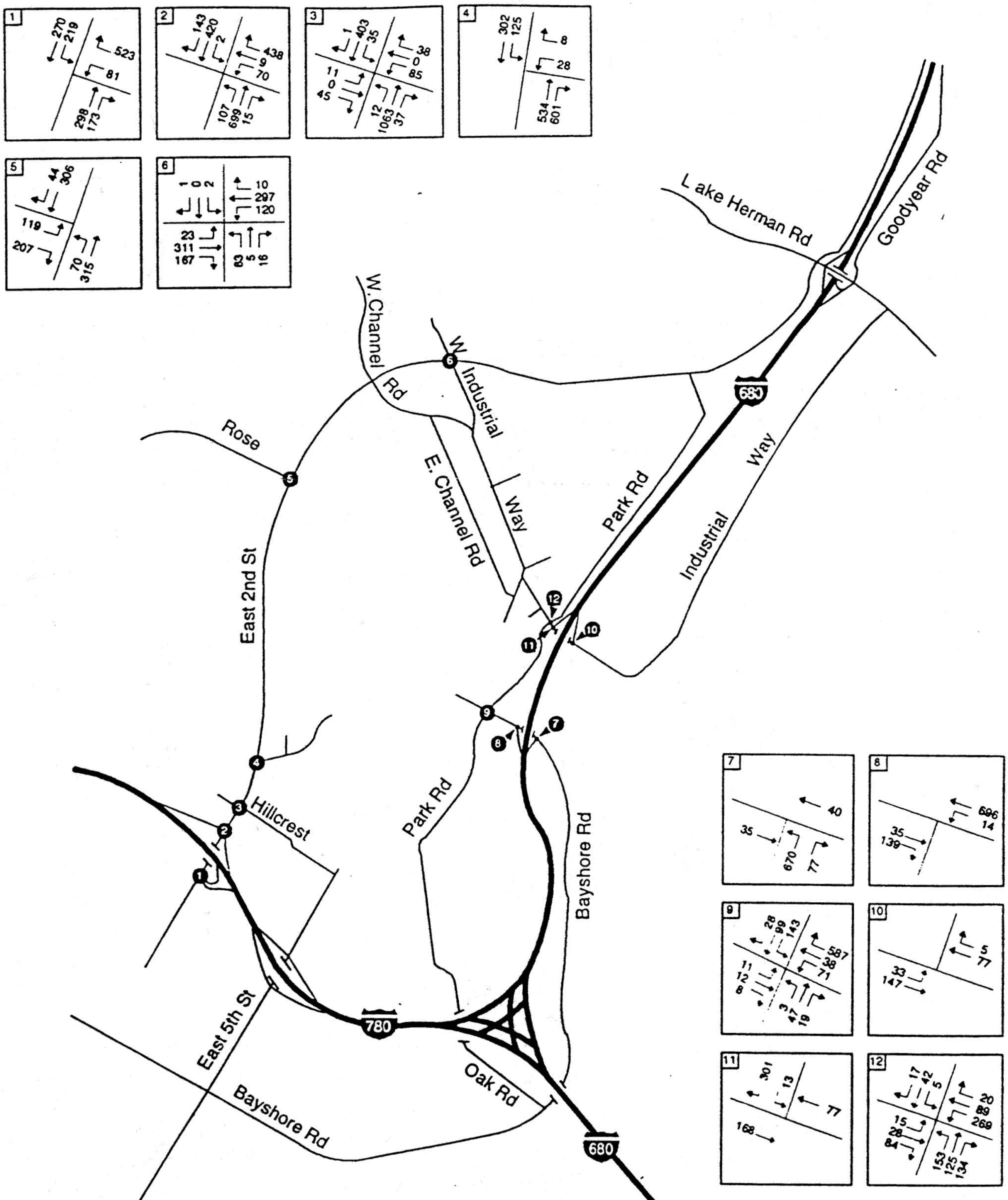
TABLE 4.10-5

PROJECT TRIP GENERATION DURING THE PEAK 6 MONTH CONSTRUCTION PERIOD[a]

Workers	AVR	AM Construction Peak Hour[b]		PM Construction Peak Hour[b]	
		IN	OUT	IN	OUT
900	1.1	819	0	0	819

[a] Expected peak trip generation would occur for approximately 6 months of the total 2-year construction period.

[b] AM construction peak hour is 7:30-8:30 and PM construction peak hour is 4:30-5:30.

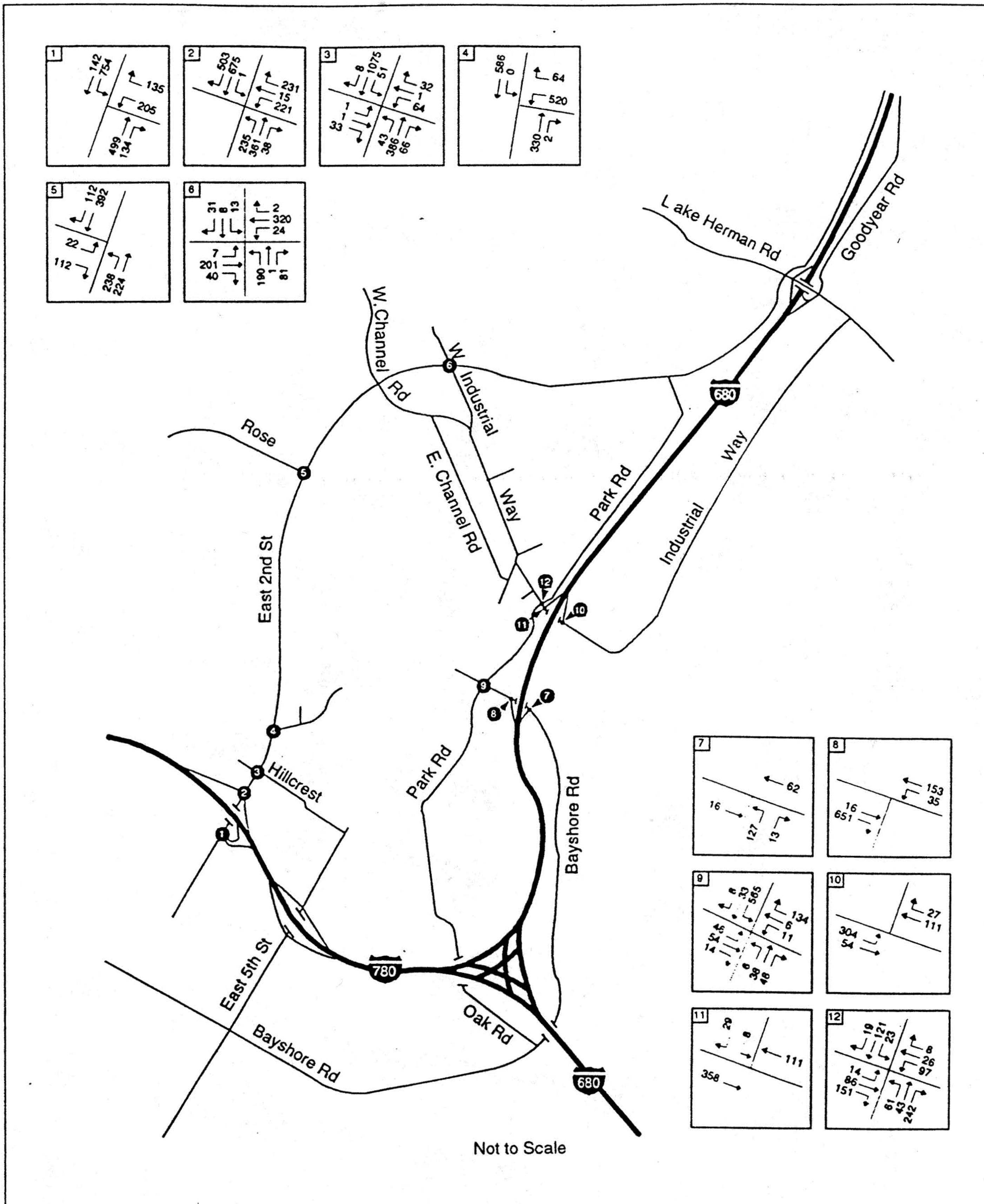


Not to Scale

Source: Omni-Means

Project No. 93C0336A	Exxon Clean Fuels Project	CUMULATIVE BASE AND PROJECT A.M. PEAK HOUR VOLUMES	Figure 4.10-6
Woodward-Clyde Consultants			

93C0336A-0006/072793



Source: Omni-Means

Project No. 93C0336A	Exxon Clean Fuels Project	CUMULATIVE BASE AND PROJECT P.M. PEAK HOUR VOLUMES	Figure 4.10-7
Woodward-Clyde Consultants			

93C0336A-0006/072793

Impact No. 1 **Construction workers will travel to and from the Benicia Refinery on local freeways, including the Benicia-Martinez I-680 Bridge, but these additional vehicles will be travelling in the off-peak direction. This impact is not significant.**

During the AM peak hour, the project would add 491 vehicle trips to the Benicia-Martinez Bridge. These project trips would be travelling in the off-peak direction (northerly) towards the project site. Once past the toll plaza, 254 project trips would travel to East Second Street via I-780 and 237 project trips would travel to Bayshore Road via I-680 to reach the project site. During the PM peak hour, the situation would be reversed. Project- related vehicle trips would be travelling in an eastbound direction from East Second Street via I-780 and in a southbound direction from Bayshore Road via I-680. As during the AM peak, project trips would be travelling in the off-peak direction (southerly) during the PM peak hour. While these additional project trips would add to existing and cumulative base traffic volumes, the effects would not be considered significant since added trips are in the off-peak direction.

Mitigation Measure No. 1

No mitigation is required.

Freeway Ramp Junctions That are not Significantly Impacted. With cumulative baseline plus project traffic volumes, levels of service at some freeway ramp junctions would change, but not significantly.

Impact No. 2 **With project traffic, operation at three of the four I-780/East Second Street ramp junctions would degrade by one level of service but would not decline below LOS "E." At all eight ramp junctions of the I-780/Bayshore Road and I-780/Industrial Way interchanges, no junction would degrade below LOS "D." LOS "E" is the minimum acceptable operating condition in accordance with Solano County's CMP criteria. These impacts are therefore not significant.**

As shown in Table 4.10-6, the eastbound on-ramp from East Second Street would change from "C" to "D" during the PM peak hour.

TABLE 4.10-6

FUTURE RAMP JUNCTION LEVEL OF SERVICE WITH THE PROPOSED PROJECT

Ramp Location	Checkpoint	Peak Hour Period	Existing + Project Level of Service
EB off to E. Second St.	Freeway Diverge	AM	D D
	Freeway Diverge	PM	B C
EB on from E Second St.	Freeway Merge	AM	D D
	Freeway Merge	PM	C D
WB off to E Second St.	Freeway Diverge	AM	B C
	Freeway Diverge	PM	E E
WB on from E Second St.	Freeway Merge	AM	B C
	Freeway Merge	PM	F F
NB off to Bayshore Rd.	Freeway Diverge	AM	B C
	Freeway Diverge	PM	C C
SB on from Bayshore Rd.	Freeway Merge	AM	D C
	Freeway Merge	PM	C D
SB off to Industrial Way	Freeway Diverge	AM	C C
	Freeway Diverge	PM	B A
NB on from Industrial Way	Freeway Merge	AM	B A
	Freeway Merge	PM	D D

Along I-680, the southbound on-ramp from Bayshore Road would change from LOS "C" to "D" during the PM peak hour. The northbound on-ramp from Industrial Way would change from LOS "C" to "D" during the PM peak hour. All other ramp junction locations would remain unchanged from cumulative base conditions.

None of these ramp junctions would decline below LOS "E." Based on the Solano County Congestion Management Program (CMP) criteria that the lowest acceptable LOS is "E," there would be no significant degradation in traffic operations.

Mitigation No. 2

No mitigation is required.

Freeway Ramp Junctions that are Significantly Impacted

Impact No. 3 **With the addition of project construction traffic, the westbound ramp merge from East Second Street to I-780 would change from LOS "E" to "F." This is a significant impact.**

With the addition of project construction traffic, the eastbound ramp merge from East Second Street would change from LOS "E" to "F" during the PM peak hour. This is the only freeway ramp that would function below LOS E as a result of construction traffic.

Mitigation Measure No. 3

There are several traffic mitigation options that can be applied to improve the levels of service at this ramp juncture. The following measure should be applied by Exxon in coordination with the City of Benicia to maintain acceptable levels of service during the peak construction period, or as long as intersection operations are degraded by construction traffic to unacceptable levels:

- Exxon coordination of the construction process should include provision of biweekly employment and truck activity projections to the City Traffic Engineer.

- Projected traffic levels should be reduced by some or all of the following measures:

  a. Stagger work hours to reduce traffic volumes during the peak daily periods.

  b. Provide traffic control personnel at the affected intersection during the peak hours.

  c. Provide temporary traffic control measures including signals, signing, striping, etc.

  d. Use alternative Exxon access points to disperse project traffic.

The above measures should be applied as appropriate to construction traffic in consultation with the City Traffic Engineer to achieve a level of service of "E."

<u>Local Intersection Construction Period Impacts and Mitigation</u>

<u>Study Locations That Are Not Significantly Impacted</u>. All project study intersections would experience increases in traffic due to the proposed project. However, six of these locations would continue to function at acceptable levels of service during the peak hours (Table 4.10-7). At three locations, the operation would degrade to LOS "D" but this degradation would only occur during the peak six months of construction activity.

<u>Impact No. 4</u> **Traffic would increase at nine local intersections, six of which would continue to function at acceptable levels of service, and three of which would degrade temporarily to LOS "D." This is not a significant impact.**

TABLE 4.10-7

FUTURE INTERSECTION LEVELS OF SERVICE WITH THE PROPOSED PROJECT (VOLUME/CAPACITY (V/C) RATIOS AT SIGNALIZED LOCATIONS)[1,2,3]

Intersection	AM Peak Hour	PM Peak Hour
1. East Second/I-780 EB Ramps	C(V/C = 0.78)	F(V/C = 1.06)
2. East Second/I-780 WB Ramps	E ---	F ---
3. East Second/Rankin Way-Hillcrest	A(V/C = 0.53)	A(V/C = 0.50)
4. East Second/Corporation Driveway	E ----	F ----
5. East Second/Rose	A(V/C 0.27)	A(V/C = 0.40)
6. East Second/Industrial Way	D ----	D ----
7. Bayshore/I-680 NB off-ramp	D ----	A ----
8. Bayshore/I-680 SB on-ramp	B ----	A ----
9. Bayshore/Park	C (17.5 secs.)	C (12.5 secs.)
10. Industrial Wy./I-680 NB on	A ----	A ----
11. Industrial Wy./I-680 SB off	A ----	A ----
12. Industrial Wy./Park	D (28.9 secs.)	B (6.7 secs.)

1 Transportation Research Board, Interim Materials on Highway Capacity, Circular 212, June 1980.

2 Approximate average vehicle delay for all-way-stop intersections is shown in seconds.

3 A volume/capacity ratio cannot be calculated for an unsignalized intersection.

The intersection of East Second/Rankin Way-Hillcrest would continue to operate at LOS "A" during both the AM and PM peak hour. Similarly, the intersection of East Second Street/ Rose would operate at LOS "A" during the same time periods. The Bayshore/I-680 SB on-ramp would remain unchanged at LOS "B" and "A" during the AM and PM peak hour. The intersection of Bayshore/Park would change from LOS "B" to "C" during both the AM and PM peak hour. The two intersections of Industrial Way at the I-680 NB on-ramp and SB off-ramp would continue to function at LOS "A" during both the AM and PM peak hours. These intersection levels of service are acceptable (better than LOS "D") and the project construction traffic is not a significant impact.

At East Second/Industrial, the PM peak hour operation would degrade from LOS "C" to LOS "D." At the Bayshore/I-680 northbound off-ramp, AM peak operation would degrade from LOS "C" to LOS "D." These level of service degradations would only occur during the peak six months of construction activity. Due to the temporary nature of these LOS "D" conditions, these impacts are not considered significant.

Mitigation No. 4

No mitigation is required.

Study Locations That Are Significantly Impacted. The remaining study intersections of East Second/I-780 WB ramps, East Second/Corp. Yard-Exxon Gate 8, East Second/Industrial Way, Bayshore/I-680 NB off-ramp, and Industrial Way/Park would all experience significant transportation impacts due to the project's construction traffic. Where feasible, appropriate mitigation measures have been recommended to restore acceptable traffic flows.

Impact No. 5 **With project construction traffic, the intersection of East Second/I-780 EB ramps would operate at LOS "F" during the PM peak hour. This is a significant impact.**

Construction traffic would significantly change the levels of service at specific project study intersections. As shown in Table 4.10-7, the intersection of East Second/I-780 EB ramps would change from LOS "B" (0.62) to "C" (0.78) during the AM peak hour and from

LOS "D" (0.89) to "F" (1.06) during the PM peak hour. Additional project construction traffic would add to the southbound left-turn movement from East Second Street to the eastbound on-ramp to I-780 causing intersection levels of service to degrade to LOS "F" during the PM peak hour.

<u>Mitigation Measure No. 5</u>

Ramp operation at East Second/I-780 can be mitigated through application of mitigation measure No. 3. No additional mitigation is required.

<u>Impact No. 6</u> **With project construction traffic, the intersection of East Second/I-780 WB ramps would change from LOS "D" to "E" during the AM peak hour and continue to function at LOS "F" during the PM peak hour. This is a significant impact.**

Project construction traffic would continue to add to peak hour volumes that already exceed the minimum levels required for signalization consistent with existing and cumulative base volumes. As stated in the existing setting section, the City of Benicia is in the process of designing a traffic signal installation for this location. At this time, the actual installation of a signal at this location has not been scheduled.

<u>Mitigation Measure No. 6</u>

If the City installs the planned signal at the East Second/I-780 westbound ramps intersection prior to start of construction of the Clean Fuels project, levels of service would not be significantly impacted, and no additional mitigation is required. If the signal is not installed prior to construction, the use of mitigation measure No. 3, applied to AM peak period traffic, would mitigate this impact. No further mitigation is required.

Impact No. 7 **With project construction traffic, the intersection of East Second/Corp. Yard--Exxon Gate 8 would operate at LOS "E" during the AM peak hour and LOS "F" during the PM peak hour. This is a significant impact.**

The intersection of East Second/Corp. Yard--Exxon Gate 8 would change from LOS "D" to "E" during the AM peak hour and LOS "D" to "F" during the PM peak hour. Project construction traffic would add significantly to inbound and outbound peak hour volumes at this location. During the AM peak hour, Exxon does not open Gate 8 until 8:00 AM. Field observations have shown that inbound construction traffic can form queues during this time. Traffic increases would also be evident during the PM peak hour in combination with the existing Benicia Corporation Yard traffic. With the proposed project, there would be major delays for outbound left-turn movements with only one outbound lane.

Mitigation Measure No. 7

Several traffic measures were investigated to determine if the intersection of East Second Street/Corporation Yard Gate 8 could be mitigated to levels of insignificance. This would require improving the predicted PM LOS "F" with the Clean Fuels construction traffic to at least LOS "E." The following mitigation process is recommended.

- The Corporation Yard driveway should be widened to allow one inbound and one outbound lane plus a two-way left-turn lane. This center lane could be controlled to allow two inbound lanes during the AM peak hour and two outbound lanes (separate left-turn and right-turn lanes) during the PM peak hour.

- Exxon's Gate 8 should be opened by 7 AM to reduce queuing by inbound construction employees.

- To maintain LOS "E" conditions for the outbound driveway traffic at Gate 8, Exxon traffic would need to be limited to 25% of the levels described for the project. The mitigation measures specified in Mitigation Measure No. 3 should be applied as necessary, as well as the following:

- Limit outbound PM peak hour traffic at Gate 8 to right turns only.

<u>Signal Warrants</u>. Both the intersections of East Second/I-780 westbound ramps and East Second/Corp. Yard--Exxon Gate 8 would exceed the minimum volumes required for signalization during the PM peak hours. All other project study intersections would not qualify for signalization at this time.

The city plans to install a signal at East Second/I-780 westbound ramps, and measures are proposed (mitigation measure No. 7) to mitigate traffic at the East Second/Corporation Yard--Exxon Gate 8 intersection.

<u>Construction Access and Parking Impacts and Mitigation</u>

There are two access points into the refinery for construction workers: from East Second Street via the Benicia Corporation Yard--Exxon Gate 8, and from Park Road at Exxon Gate 9 between Bayshore Road and Industrial Way. The surface parking lot from Exxon Gate 8 has approximately 500 spaces and the surface lot located off Park Road at Gate 9 has about 350 spaces. These spaces are in addition to parking for existing operations personnel. Based on a projected trip generation of 819 vehicles during the peak hour, there would be a parking surplus of 31 spaces, and no impact is identified.

Appropriate mitigation measures have been suggested for the East Second/Corporation Yard--Exxon Gate 8 (see mitigation measure no. 7). The Park Road/Gate 9 intersection would operate at satisfactory levels of service, although additional construction trips would be added to Park Road adjacent to the Southern Pacific railroad crossing just north of Bayshore Road (Railroad Section crossing 130). As stated in the project setting, this location has already experienced train related accidents and project construction traffic would exacerbate the problem.

<u>Impact No. 8</u> **An increase in project construction traffic along Park Road would increase the potential for train-related accidents at Southern Pacific's at-grade railroad crossing 130. This is a significant impact.**

Mitigation Measure No. 8

To reduce the potential for train-related accidents at this location the following measures are recommended.

- Prior to project initiation, Exxon should coordinate with the City of Benicia, Southern Pacific, Caltrans, and Public Utilities Commission regarding installation of flashing warning lights and automatic crossing gates at this location. It is noted that the City of Benicia has already requested funding from Caltrans to start the process (Mustain 1993). Participation by Exxon could accelerate the schedule for installation.

- Consistent with mitigation for Exxon's MTBE project, in the event that the railroad crossing is not in place by the start of construction, Exxon should use flaggers at the crossing during working hours to stop traffic when trains approach the crossing.

Construction Truck and Material Delivery Impacts and Mitigation

During construction of the proposed project, daily truck deliveries to the project site would be at a peak during the first six months of construction with about 30 trucks per day. These truck deliveries would add an average of 60 one-way truck trips per day (50% inbound, 50% outbound). It is not anticipated that any of the truck deliveries would involve oversized vehicles. However, should such vehicles be necessary, then travel would be governed by special state and city regulations.

<u>Impact No. 9</u> **The delivery of construction material to/from the site could impact residential areas along East Second Street as well as add to pedestrian and vehicle delays in the area. This impact is not significant.**

<u>Mitigation Measure No. 9</u>

In response to potential traffic delays and safety problems along East Second Street associated with truck deliveries the following measure is recommended:

- Truck deliveries to the project site should use I-680, exit at the Benicia Industrial Park exit and will enter the refinery from Bayshore Road via Exxon Gate 4.

Oversized or overweight loads will require special permits from state and local transportation and public works authorities. Any permits for oversized or overweight loads will specify appropriate delivery routes and times for allowed travel. Exxon and their contractors must obtain these permits and adhere to these requirements, and no additional mitigation is required.

<u>Construction Cumulative Impacts and Mitigation</u>

<u>Impact No. 10</u> **Exxon has committed to minimizing the construction activities for the Clean Fuels project during a planned refinery maintenance turn-around. This commitment would avoid cumulative construction impacts.**

The maintenance turnaround would generate approximately 1,364 vehicle trips inbound during the AM peak hour and 1,364 vehicle trips outbound during the PM peak hour. In comparison, the proposed Exxon Clean Fuels project (with a peak of 900 workers) would generate 819 trips inbound and outbound during the peak hours, respectively. These two projects, when combined, would cause significant intersection impacts, and there would be insufficient parking at the refinery for all workers. The ongoing construction of the MTBE project would further compound the magnitude of these impacts. For those reasons, Exxon has committed to reduce construction activities on refinery projects (both Clean Fuels and

MTBE) during the short turnaround period. This commitment avoids having the Clean Fuels project contribute construction traffic during the turnaround activities.

Mitigation Measure No. 10

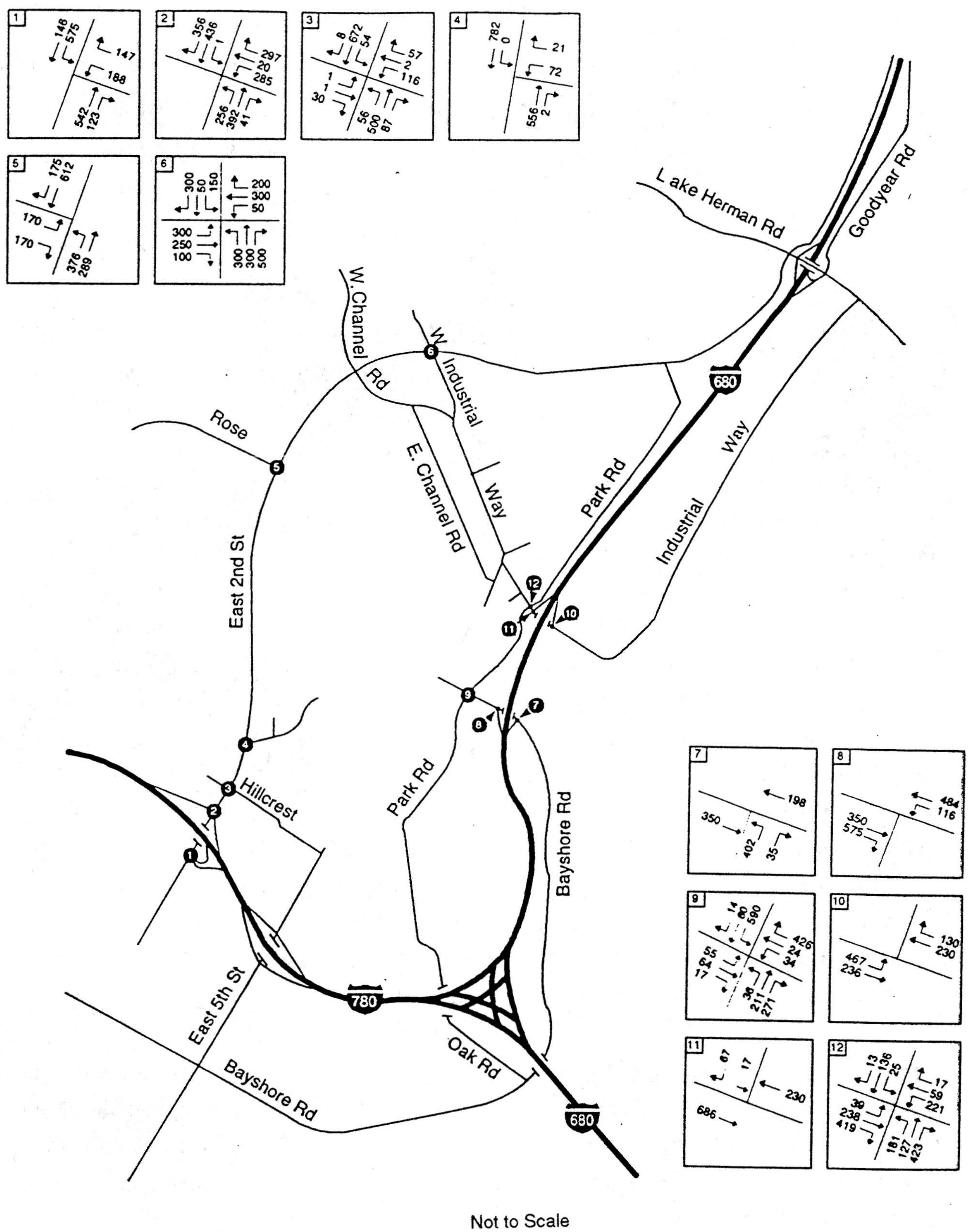
The following measure is recommended to avoid any cumulative impacts related to the planned maintenance turnaround:

- Exxon's commitment to substantially reduce the Clean Fuels workforce for 1 to 2 months during the turnaround maintenance period should be carried out in consultation with the city, and the city should monitor compliance during this period.

Long-Term Operational Traffic Impacts and Mitigation

Methodology for Estimating Future Baseline Conditions. Future baseline traffic conditions for the horizon year 2000 were provided through transportation model output from the Solano County Congestion Management Authority (CMA) (Harms 1993). This model update includes proposed land uses consistent with the City of Benicia projections as well as the proposed Sky Valley Residential project. It is noted that the Sky Valley project schedule is currently unknown because planning for this development is on hold (Hammer 1993). Therefore, the horizon year 2000 analysis for traffic impacts would likely be a worst-case scenario. The year 2000 study year was selected as it represents a planning year that is consistent with the CMA model, and represents the earliest planning year for which traffic forecast modeling could be conducted after start of operations.

Consistent with Solano County CMA model output, only PM peak hour link volumes were available for analysis. The methodology employed was to compare the change between the model output base year (1987) and future horizon year (2000). This change was then applied to existing 1993 traffic volumes and analyzed. Mainline freeway volumes were taken directly from year 2000 model output. Impacts were evaluated based on the contribution of traffic by Exxon employees and trucks to the projected year 2000 conditions. Horizon year 2000 traffic volumes are shown in Figure 4.10-8, and are evaluated in the following subsections.



Source: Omni-Means

Project No. 93C0336A	Exxon Clean Fuels Project	HORIZON YEAR 2000 CUMULATIVE P.M. PEAK-HOUR VOLUMES	Figure 4.10-8
Woodward-Clyde Consultants			

93C0336A-0600/083093

Year 2000 Freeway Ramp Operation Without the Project. With year 2000 volumes, levels of service at some freeway ramp junctions would change. As shown in Table 4.10-8, the eastbound on-ramp from East Second Street to I-780 would operate at LOS "E" during the PM peak hour.

Along I-680, the northbound off-ramp to Bayshore Road would operate at LOS "D" during the PM peak hour. At the southbound off-ramp to Industrial Way the operation would be LOS "C." Finally, the northbound on-ramp from Industrial Way to I-680 would operate at LOS "E."

Year 2000 Intersection Operations Without the Project. As shown in Table 4.10-9, year 2000 volumes without the Clean Fuels project would significantly change study intersection levels of service during the PM peak hour compared to existing conditions. The most affected intersections would be:

- East Second/I-780 eastbound ramps would function at LOS E in the PM peak.
- East Second/I-780 westbound ramps would function at LOS F during the PM peak.
- East Second/Industrial Way would operate at Los F during the PM peak.
- Bayshore/Park would experience significant vehicle delays and queuing.
- Industrial Way/Park could be significantly impacted by the Sky Valley project, if approved.

Signal Warrants Without the Project. The intersections of East Second/I-780 westbound ramps, East Second/Industrial Way, Bayshore/Park, and Industrial Way/Park would all exceed (without the Clean Fuels project) the minimum volumes required for signalization during the PM peak hour. All other project study intersections would not qualify for signalization with horizon year 2000 volumes.

Long-Term Impacts of the Clean Fuels Project

TABLE 4.10-8

HORIZON YEAR 2000 RAMP JUNCTION LEVEL OF SERVICE

Ramp Location	Checkpoint	Peak Hour Period	Existing + Project Level of Service
EB off to E. Second St.	Freeway Diverge		
	Freeway Diverge	PM	C C
EB on from E Second St.	Freeway Merge		
	Freeway Merge	PM	C D
WB off to E Second St.	Freeway Diverge		
	Freeway Diverge	PM	E E
WB on from E Second St.	Freeway Merge		
	Freeway Merge	PM	D E
NB off to Bayshore Rd.	Freeway Diverge		
	Freeway Diverge	PM	D D
SB on from Bayshore Rd.	Freeway Merge		
	Freeway Merge	PM	D D
SB off to Industrial Way	Freeway Diverge		
	Freeway Diverge	PM	C C
NB on from Industrial Way	Freeway Merge		
	Freeway Merge	PM	D E

TABLE 4.10-9

HORIZON YEAR 2000 INTERSECTION LEVEL OF SERVICE (VOLUME TO CAPACITY (V/C) RATIOS AT SIGNALIZED LOCATIONS)[1,2,3]

Intersection	PM Peak Hour
1. East Second/I-780 EB Ramps	E(V/C = 0.97)
2. East Second/I-780 WB Ramps	F ---
3. East Second/Rankin Way-Hillcrest	A(V/C = 0.40)
4. East Second/Corporation Driveway	E ----
5. East Second/Rose	B(V/C = 0.66)
6. East Second/Industrial Way	F ----
7. Bayshore/I-680 NB off-ramp	E ----
8. Bayshore/I-680 SB on-ramp	C ----
9. Bayshore/Park	D (29.9 secs.)
10. Industrial Wy./I-680 NB on	E ----
11. Industrial Wy./I-680 SB off	C ----
12. Industrial Wy./Park	F (not measurable)

[1] Transportation Research Board, Interim Materials on Highway Capacity, Circular 212, June 1980.

[2] Approximate average vehicle delay for all-way-stop intersections is shown in seconds.

[3] A volume/capacity ratio cannot be calculated for an unsignalized intersection.

Impact No. 11 **Traffic related to operation of the Clean Fuels project would not measurably change future traffic operations. There would be no long-term traffic impacts.**

By the year 2000, the proposed Exxon Clean Fuels project would be completed. Exxon anticipates the need for 15-30 permanent employees (Exxon 1993b). This would generate a maximum of 27 vehicle trips inbound during the AM peak hour and 27 trips outbound during the PM peak hour (assuming all are on the day-shift). This increase in vehicle trips would not be measurable within the daily fluctuations of traffic flow. There would be an increase in raw material truck deliveries of 28 trucks per year to the refinery delivering massive nickel, nickel moly, nickel/aluminum, titanium/vanadium, Dowtherm/calorin HT, and Flexsorb HP. On a daily basis, this would not be measurable. Finally, there would be a weekly increase of 9 truck trips (1.3 trucks per day) of ammonia to the refinery. This would equate to 2-3 one-way truck trips per day and would also not be measurable. No impacts are identified for long-term operation of the project, and no additional mitigation is required.

Rail and Marine Traffic Impacts

Operation Impacts. During operation of the proposed Exxon Clean Fuels project, it is anticipated that rail shipments of butanes/pentanes might increase by about eight rail cars per day. The number of trains would not change. No impacts are identified, and no mitigation is required.

Rail-related conflicts with traffic at the Park Road Crossing were identified previously under Impact No. 5.

Marine Terminal Impacts

No increase in marine tanker shipments are projected as a result of the proposed Exxon Clean Fuels project at this time. However, given the global economy, customer needs, and demand for oil, marine activity could change in the future. As a result of Marine activity, no additional vehicle trips would be generated beyond those already occurring. No impacts or mitigation were identified.

4.11 SOCIOECONOMICS

4.11.1 Environmental Setting

Study Area

The study area for socioeconomic impact evaluation encompasses the nine-county Bay Area.[1] This area is anticipated to supply the majority of the workers who would be needed to construct the project. This is also the area into which non-local workers (if any are needed) would relocate for the duration of the project. For the most part, data are reported for entire counties or primary metropolitan statistical areas (PMSAs), and where appropriate, data are presented for individual communities, including Benicia.

Population

According to the 1990 Census, the Bay Area contained a total population of about 6.02 million people. By 1993, the Bay Area population is estimated to have increased to about 6.33 million (California Department of Finance 1993). Table 4.11-1 reports the distribution of the 1990 population by PMSA. The Vallejo-Fairfield-Napa PMSA, which includes both the project site and Solano County, accounted for about 7.5 percent of the Bay Area population in 1990. Projections indicate that this population would increase by about 16 percent by the year 1995, at a rate greater than other parts of the Bay Area (Association of Bay Area Governments [ABAG] 1992).

In 1990, the City of Benicia had a population of 24,446, which increased by about 56 percent over the 1980 level, at an average annual growth rate of 5.6 percent. This was greater than the average annual growth rate of 4.5 recorded in Solano County as a whole. The 1990 population of Benicia was contained in about 9,240 households, and average household size was 2.64 persons, which was smaller than the average for Solano County. ABAG Projections (1992) indicate that the City's population will grow to 29,900 by the year 1995, and to 42,900 by 2010. This projected population growth would result from both natural increase

[1] The nine San Francisco Bay Area counties are Solano, Contra Costa, Alameda, Santa Clara, San Mateo, San Francisco, Marin, Sonoma, and Napa.

TABLE 4.11-1

SOCIOECONOMIC CHARACTERISTICS OF THE STUDY AREA

PMSA/County/City	Population (1990)	Population (1995)	Employed Residents (1990)	Employed Residents (1995)	Total Jobs (1990)	Total Jobs (1995)	Construction Jobs (1990)	Construction Jobs (1995)
Solano	340,421	405,100	162,219	194,900	119,440	137,230	9,710	9,460
Benicia	24,446	29,900	14,896	17,000	10,870	12,870	NA	NA
Oakland PMSA	2,082,914	2,232,500	1,057,812	1,089,200	923,490	941,850	NA	NA
San Francisco PMSA	1,603,678	1,662,850	872,498	864,500	1,006,140	1,016,360	NA	NA
San Jose PMSA	1,497,577	1,588,750	812,345	815,500	861,470	849,900	NA	NA
Santa Rosa-Petaluma PMSA	388,222	426,800	194,387	209,600	155,290	177,010	NA	NA
Vallejo-Fairfield-Napa PMSA	451,186	522,300	214,902	237,500	168,050	181,360	NA	NA
All Bay Area	6,023,577	6,433,200	3,151,944	3,216,300	3,114,440	3,166,480	168,120	154,760

Source: ABAG Projections 1992, and Recession Update December 1992.
PMSA: Primary Metropolitan Statistical Area.
NA: Data not collected at PMSA level.

and immigration of new residents, and is estimated by ABAG based on information on available developable land and the applicable zoning designations, and known constraints on growth that apply to Benicia. It represents the expected or most likely growth scenario; however, it should not be viewed as a growth level that would necessarily be achieved.

Housing

The Department of Finance estimates of housing in California counties indicate that the nine-county Bay Area contains a total of 2.42 million housing units as of January 1993. Of these units, about 2.31 million are occupied and the average vacancy rate is about 4.78 percent, although it varies from a high of 7.07 percent in Sonoma County to a low of 3.61 percent in San Mateo County. Solano County has a total of 125,403 housing units of which 119,703 are occupied, and the County's vacancy rate is 4.54 percent. The City of Benicia contains about 9,587 housing units, of which 9,208 are occupied. The housing vacancy rate is 4 percent, which is less than the rate (5 percent) at which supply and demand of housing are considered balanced.

Short-term accommodations are available in the study area largely in the form of hotel and motel rooms. Among members of the California Hotel and Motel Association, there are over 42,700 motel and hotel rooms in the San Francisco Bay Area. Additional accommodations are available in non-member hotels and motels.

Employment and Labor Supply

The California Department of Finance, Employment Development Division preliminary estimates for April 1993 indicate that the study area has a civilian labor force of 3.2 million of which 0.2 million or about 6 percent are unemployed (Table 4.11-2). While the labor force has been growing, the growth has been slower in the last few years because fewer individuals are entering the workforce due to the recession and the unavailability of jobs.

ABAG data on employed residents and the total number of jobs in the Bay Area indicate that there are more employed residents than jobs in the region by 37,504 (in 1990). By 1995, this difference is anticipated to increase to 49,820 as more workers enter the workforce while jobs

TABLE 4.11-2

LABOR SUPPLY IN THE BAY AREA
April 1993

Primary Metropolitan Statistical Area	Civilian Labor Force	Workers Unemployed
Oakland	1,116,400	63,635
San Francisco	879,200	47,477
San Jose	817,800	49,068
Vallejo-Fairfield-Napa	212,200	16,764
Santa Rosa-Petaluma	219,300	13,158
Total	3,244,900	190,102

Source: Employment Development Division 1993.

do not grow at a comparable rate (the job growth rate is projected to be 1.3 percent per annum between 1990-2000).

Based on the U.S. Census, there were approximately 188,269 construction trades workers who resided in the Bay Area in 1990 (Table 4.11-3). According to ABAG, there were about 168,000 construction jobs in the Bay Area during that year. This suggests that there are about 20,000 construction workers available in excess of regional jobs. The current recession may have further reduced the number of construction jobs, so that the surplus of construction workers is likely larger than reported above for 1990. Other studies indicate that the surplus is as high as 32,700 in 1993 (EIP 1993).

Data on Solano County and Benicia parallel the patterns observed for the entire Bay Area. In 1990, both Benicia and Solano County contained more employed residents than jobs, and ABAG Projections indicate that both areas will continue to export workers in 1995. The County is expected to record the highest job growth of all Bay Area counties between 1990 and 2005. As of April 1993, the Vallejo-Fairfield-Napa PMSA (which includes Solano County) had a civilian labor force of 219,300 of which 7.9 percent or 16,764 persons were unemployed.

Some of the craft trades that would be needed to construct the project include boilermakers, carpenters, electricians, pipefitters, millwrights, and iron workers. Based on the 1990 Census, there are about 16,000 electricians; 570 millwrights; 12,000 pipefitters, plumbers, and steamfitters; and 6,600 sheet metal and structural metal workers in the nine-county Bay Area. A study of the availability of critical craft tradepersons for the Chevron Reformulated Fuels Project was conducted by Bechtel in 1992 (Chevron 1993). This study involved contacting relevant union locals in the Bay Area for membership and craft trades worker availability information. The results of this study indicate that there are about 4,300 electricians (three union locals), 3,074 pipefitters (three union locals, with one in Solano County), 1,025 millwrights, about 1,200 iron workers, and 650 boilermakers (one union local each). The unemployment rate was found to vary with craft but was about 20 percent on an average for all crafts.

TABLE 4.11-3

LABOR SUPPLY IN BAY AREA COUNTIES - 1990

County	Total Labor Supply	Construction Workers
Alameda	640,491	36,508
Contra Costa	404,397	31,543
Marin	125,591	8,289
Napa	52,773	3,958
San Francisco	386,512	16,620
San Mateo	355,559	20,978
Santa Clara	803,154	41,764
Solano	151,175	11,187
Sonoma	193,578	17,422
Bay Area	3,111,783	188,269

Source: U.S. Census, STF3, P77 for the nine Bay Area Counties.

In sum, data for the Bay Area and Solano County indicate that there is a large labor pool, including construction trades workers, in the region. Given the slow economic recovery at national, state, and regional levels, unemployment rates are projected to remain high, and the current surplus of construction labor over construction jobs is likely to persist in the future in the Bay Area. Additional labor is available in the greater Sacramento area and Stockton, which are both within easy commuting distance of the project site.

4.11.2 Impacts and Mitigation

Significance Criteria

CEQA notes that an EIR may include social or economic information in any form; however, an economic or social change by itself is not to be considered a significant effect on the environment. The guidelines explain the manner in which socioeconomic information may be used in an environmental document.

- Social or economic changes may be analyzed and presented to trace a cause and effect chain which leads to a physical change.

- Social or economic changes may be used to determine the significance of the physical changes caused by the project.

- Social, economic, and housing factors should be provided in the EIR or in some other document in support of the EIR so that decision makers on the project can use this information together with technological and environmental factors to decide whether changes in a project are feasible to reduce or avoid significant effects on the environment identified in the EIR.

Therefore, in the analysis of socioeconomic impacts for the proposed project, which is presented below, only the socioeconomic changes triggered by the project are discussed and an evaluation of the significance of the impact(s) is not provided. The analysis focuses on the following:

- Will the project attract people to an area and expose them to hazards found there? (CEQA Section 15126a)
- Will the project induce substantial growth or concentration of population? (CEQA Appendix G(k))
- Will the project displace a large number of people? (CEQA Appendix G(m))
- Will it alter the location, distribution, density, or growth rate of the human population of an area? (CEQA Appendix I(II.11))
- Will it affect existing housing, or create a demand for additional housing? (CEQA Appendix I(II.12))

<u>Construction Impacts</u>

<u>Impact No. 1</u> **Construction of the proposed project would, on average, result in 500 construction jobs for two years, and 880 jobs at its peak for six months in 1995. This would constitute a beneficial economic impact for the region.**

The project is proposed for construction over a 2 year period from 1994 to 1996. An average construction workforce of about 500 workers would be needed. At the peak construction period, which is anticipated to last about 6 months in 1995, about 880 construction workers would be needed. A third (33 percent) of the required construction workforce is likely to consist of pipefitters. Other craft trades that would be needed include boilermakers, electricians, iron workers, millwrights, and carpenters, with each accounting for 8 to 10 percent of the workforce. The remaining workforce would comprise other trades and laborers.

As reported in Section 2.9.1 above, the San Francisco Bay Area contains a civilian labor force of about 3.2 million, of which about 188,000 are construction workers. If this figure remains constant, when the construction at the project reaches a peak of 880 workers (in 1995), approximately 0.5 percent of the Bay Area construction workforce would be required at the site. The Bay Area has historically and is projected in the future to contain fewer construction jobs than available construction workers. From the 1990 data reported in Section 4.11.1, there are an estimated 20,000 construction workers in excess of regional construction jobs. Therefore, these data and the projected unemployment rate in the state and region suggest that regional labor supply would be adequate to meet the construction labor requirements of the project and that the project would not limit the availability of workers for other projects. As noted earlier, additional labor is available in the greater Sacramento area and Stockton. Both of these areas are within commuting distance of the project and could also provide labor.

Based on proportions noted earlier, about 165 pipefitters on an average and 290 at peak would be needed at Exxon Benicia for the project. The Bay Area contains about 12,000 pipefitters, steamfitters, and plumbers, of which (based on a 20 percent unemployment rate) about 2,400 are available at a given time. If the availability of pipefitters from the Bechtel study is examined, it appears that there are about 1,137 pipefitters available in the Contra Costa - Solano area (Chevron 1993). The project requirements could be easily met by the available workers. Project construction would, on average, require about 40 to 50 workers in five other craft trades, with 70 to 90 workers at peak. Availability of workers in these trades (based on an average unemployment rate of 20 percent) ranges from 130 to 240 workers in each craft trade. There is therefore adequate regional supply to meet the project-specific demand. The project's requirements for construction workers can be met by local available labor and no significant demand for nonlocal construction labor is anticipated. The project would be an economic benefit to the region.

Mitigation Measure No. 1

No mitigation is required.

<u>Impact No. 2</u> **With adequate labor available within commuting distance of the project site, the project would not cause a significant influx of nonlocal population or create a demand for housing. This impact is not significant.**

Given that adequate labor is available within commuting distance of the project, the project would not create demand for additional housing because construction workforce requirements would primarily be met by local workers who would commute to the site from their existing homes. As nonlocal workers would not be required, the project would not cause a noticeable influx of nonlocal population or the resultant demand for housing. The project is not expected to result in any measurable changes in the regional population.

<u>Mitigation Measure No. 2</u>

No mitigation measures are necessary because project construction would not affect population, housing, and employment in the region.

<u>Operation Impacts</u>

<u>Impact No. 3</u> **Project operation would increase permanent employment at the refinery by 30 jobs. This would be a beneficial economic impact. There would be no impacts on population and housing in Benicia.**

The operation of the new facilities would require 30 new permanent employees at the Exxon Benicia Refinery. These new employees would likely be hired out of the Bay Area regional labor pool. Even if some of these employees were hired from outside the region, their relocation into the region would not cause a substantial change in the Bay Area population or place an excessive demand on housing given the size of the housing market in the region and Benicia.

In the worst-case condition that all 30 new employees were to move to Benicia, based on an average household size of 2.61 persons (average for the Bay Area counties), the total population of the city would increase by 78 persons, which represents a 0.32 percent increase over the city's 1990 population. Assuming one housing unit per employee household, 30 units would be needed. These would constitute about 8 percent of the vacant housing units available in the city.

Mitigation Measure No. 3

No mitigation measures are required because project operations would not result in impacts to population, housing, and employment in the region or in Benicia.

4.11.3 Cumulative Impacts

Impact No. 4 **The proposed project, along with other planned/proposed projects in the region, would create approximately 9,000 to 10,000 construction jobs over a period of two years in 1994-1996. This magnitude of workforce is available and this would constitute a beneficial effect given the recent unemployment levels in the Bay Area. This would be a beneficial economic impact.**

Other projects planned or proposed in the area that would be affected by the proposed project are described in Section 3.0. Table 4.11-4 lists foreseeable projects that could potentially have cumulative socioeconomic impacts with the proposed project. Other projects listed in Section 3.0 would be completed before construction of the proposed project begins. Due to the overlapping schedules of these projects, collectively the projects could result in 9,000 to 10,000 construction jobs.

As noted above, the San Francisco Bay Area contains a large civilian labor force. Additional labor is available in adjacent counties. Of the labor available in the Bay Area, about 188,000 are construction workers and an estimated 20,000 to 30,000 of these construction workers are unemployed at any time. This availability is expected to persist in the future given the slow recovery at the state and regional levels. The labor on these projects collectively would account for 5.3 percent of the resident construction workers in the Bay Area. The projects collectively would reduce the unemployment rate among regional construction workers. If the availability of workers in the six major crafts trades (needed for clean fuels projects) is

TABLE 4.11-4

PROPOSED/PLANNED PROJECTS

Project	Tentative Construction Schedule	Approximate Number of Construction Workers Required at Peak
Chevron Clean Fuels	1994-96	1000
TOSCO Clean Fuels	1994-96	1000
Shell Clean Fuels and other improvements	1993-98	1750
Unocal Clean Fuels	1994-96	1000
Crockett Cogeneration Plant	1993-95	300
Benicia Bridge Expansion	1995-2015	2000-3000
Exxon NOx Reduction Modifications	1994-97	NA
Other Exxon Projects	1994-96	1000
Exxon Clean Fuels	1994-96	880

examined for the Bay Area, it is noted that some shortage may occur with respect to certain crafts trades. If the construction peak of all five clean fuels projects were to coincide, a total of about 1,500 pipefitters would be needed (about 290 for each project). From the Bechtel study, it appears that there are about 1,140 pipefitters unemployed at any time (three union locals only). From the U.S. Census there are about 2,400 available pipefitters and steamfitters (20 percent of 12,000) in the Bay Area. The cumulative demand of 1,500 pipefitters would be very close to the available supply. Similar near-shortages could occur with respect to boilermakers, millwrights, and iron workers. However, since the Bay Area would be able to supply the bulk of the demand, and additional labor is available within commuting distance in the Sacramento Area, it is unlikely that the projects cumulatively would result in any significant influx of nonlocal workers, although some temporary immigration of construction workers in response to available job opportunities is likely.

Mitigation Measure No. 4

No mitigation is necessary because the project would not have an adverse cumulative socioeconomic impact.

4.12 PUBLIC SERVICES AND UTILITIES

4.12.1 Environmental Setting

Fire and Police Protection

There are two type of incidents that are of concern to the Benicia Fire Department in relation to the Exxon Refinery. The first would be incidents that occur on the refinery site, and the second would be incidents related to the refinery that occur outside the refinery boundaries but within city limits. These incidents could include rail accidents, spills of hazardous materials or similar accidents. While fire protection within the refinery is a joint responsibility of Exxon and the City, fire protection for incidents that occur outside the refinery is the responsibility of the Benicia Fire Department.

Primary fire protection at the refinery is provided by the refinery fire brigade, which is composed of 40 firefighters with advanced fire fighting training and a 28-member heavy rescue squad who are trained Emergency Medical Technicians (EMTs). In addition, all technicians and operating team supervisors at the refinery are trained in industrial fire fighting. Fire fighting equipment at the refinery includes two engines, one aerial ladder, one foam tender/rescue squad, two brush units, a conventional pickup, a trailer-mounted 5000 gpm pump, two 5-inch hose trailers, and one 3-inch hose trailer. Fire suppression water is provided to the refinery by the City Water Division, which is supplied to a break tank. From the break tank, water is pumped into the refinery's fire water system. There are three main pumps capable of delivering a flow of approximately 10,000 to 15,000 gallons per minute. In the event of interruption of the city water supply, Exxon stores approximately 1 million gallons in a fire water pond that is available to the refinery fire water system. The water pressure is maintained at 130 psi, well above normal municipal and domestic and fire fighting water pressure levels. Deluge systems are provided for fire suppression at the tanks.

The refinery also has a foam fire suppression system. This system includes two 1000-gallon foam trailers, foam barrels on each of the fire trucks, and a tender truck that services the foam units on the trailers and engines. There is a dedicated foam system at the refinery's marketing terminal and crude dock, with 14,000 gallons of foam in storage. The refinery has a piped system for foam, and the 25 fire monitors (turret mounted nozzles used for fire suppression) have both water and foam barrels, and are located throughout the refinery. Backup fire protection assistance is provided by the City of Benicia Fire Department and by fire brigades at other nearby refineries.

Exxon informs the Benicia Fire Department of all emergency situations in accordance with a written protocol between Exxon and the Fire Department. There is a direct line between the refinery and the Department dispatcher. According to protocol, the Benicia Fire Department is informed immediately of any fire or hazardous material release that is not quickly controlled by the operating personnel at the site of the fire or release. In the event of an emergency requiring the assistance of the Benicia Fire Department, its fire fighting personnel would enter the refinery either through the main gates on East Second Street or through Gate 5, a special access gate near the Corporation Yard on the east side of the refinery. An Incident Command Structure and protocol have been established between Exxon and the Department to coordinate joint responses to refinery emergencies. Exxon has two mutual aid agreements for fire fighting with other agencies. The County mutual aid agreement involves Exxon and all municipal fire departments (11 in all) in Solano County and is designed to assist all participating agencies in emergencies. The second mutual aid agreement is with other refineries and petrochemical industries in the region through participation on the Petrochemical Fire Prevention Committee. Under this agreement, the nine participating petrochemical fire departments meet monthly and also conduct a monthly drill.

The Benicia Fire Department currently employs 23 firefighters, seven paramedics, three chief officers, one Emergency Medical Services Coordinator, one Fire Prevention Specialist, one part-time Citizen Assistance Officer, and one full-time and one part-time clerical staff. The Department maintains at least eight fire fighting personnel on duty at all times. Average response time within the Benicia City limits is approximately 5 minutes. About 70 percent of the calls received pertain to emergency medical services.

Services are provided to the incorporated areas of Benicia out of two fire stations. The larger facility is Station 1, which is located about 1.5 miles southwest of the Benicia Refinery on Military West Road; Station 2 is a smaller facility located about 2 miles west of the refinery on Hastings Drive. Five firefighters are stationed at Station 1, which receives approximately 1,500 calls per year. Equipment includes one engine, a rescue squad, a reserve engine, a ladder truck, a water tender, a brush fire truck, a command vehicle, and a paramedic squad. Station 2 consists of three firefighters on duty, one engine, two brush fire trucks, two utility vehicles, and one reserve rescue unit. Station 2 responds to about 500 calls per year. These two fire stations provide Benicia with fire suppression, fire prevention, paramedic, and disaster preparedness services. In addition, the Benicia Fire Department's capabilities are augmented by mutual aid agreements with Solano County and the State Office of Emergency Services, and by about 20 active volunteer firefighters which have been trained and equipped by the Benicia Fire Department.

The Benicia Fire Department is currently unable to accommodate any additional staff or equipment due to limited facilities. The Department maintains that its service area (13.5 square miles) is large in relation to the current resources and station locations; however, up to approximately 25 percent more calls could be accommodated by the Department with existing staffing and equipment (Hanley, 1993).

Joint training for the refinery firefighters and the Benicia Fire Department is conducted locally on a regular basis. In addition, the refinery annually sponsors hazardous materials related training for city firefighters. The refinery also assists the Department in obtaining equipment and supplies needed for hazardous materials incidents.

Security at the Benicia Refinery is provided 24 hours a day by Allied, a private security contractor. Allied security guards are stationed at eight posts throughout the facility. In the event of a major security problem or if law enforcement services are needed, Exxon's shift supervisor is responsible for seeing that the City of Benicia Police Department is notified by Exxon or Allied Security staff. The City's police station is located on East L Street, approximately 1.5 miles southwest of the Benicia Refinery. The Department employs 33 officers and about 15 administrative and support personnel. For routine calls, response time to the refinery averages about 3.5 minutes.

Hospitals and Emergency Health Services

The closest emergency medical facility to the Benicia Refinery is the Benicia Convenient Medical Care Clinic on Southhampton Road located about 2 miles from the refinery. This facility provides urgent care. For more serious injuries and trauma, the closest hospital to the refinery is the Sutter-Solano Medical Center, located about 12 miles northwest of Benicia in the City of Vallejo. This medical center has 108 beds; an emergency center; and medical, surgical, critical care, and intensive care units. The Benicia Fire Department employs seven paramedics. The Benicia refinery has 24 volunteers trained as Emergency Medical Technicians to respond to on-site emergency incidents. The refinery also employs a nurse who works on site during the day shift.

Water Supply

The Benicia Refinery obtains its water supply for industrial, fire suppression, and potable use from the City of Benicia Water Division. The Solano County Flood Control and Water Conservation District supplies water to the Division from the California State Water Project through the North Bay Aqueduct. The Water Division is currently contracted to supply 11 million gallons per day (mgd) of raw water to the refinery for industrial use. Of this 11 mgd, the refinery uses approximately 5 mgd, or about 45 percent of the water allocated by contract with the City. Over the last several years, the refinery has decreased its overall water use by about 11 percent through successful water reuse and conservation measures. The Water Division supplies about 7,500 gallons of water per day to the refinery for domestic or potable uses.

The Water Division supplies water for fire suppression throughout the City. Water for fire suppression is treated water which is distributed in three pressure zones. The Benicia Refinery is located in Pressure Zone I. Although adequate water pressure is not maintained in fire suppression mains in some portions of Zone I (this problem is to be rectified by early 1994), the refinery is not affected by this because fire suppression water delivered by the Water Division is stored in on-site tanks and distributed under a pressure of 130 psi within the refinery via on-site pumping. State-of-the-art techniques for fighting chemical or other types of industrial fires involve the use of fire suppression foams in addition to water.

Wastewater Treatment and Storm Water Drainage

The raw water supplied to the refinery by the Water Division is pumped from the Benicia Water Treatment Plant to an on-site treatment plant at the refinery. It is then treated and used primarily for steam generation, circulation through cooling towers, and in process units. The on-site treatment plant provides an average of 2.5 mgd of treated water for use in refinery processes.

The on-site wastewater treatment plant treats wastewater from the refinery operations and storm water runoff from process areas. The plant receives wastewater from a number of on-site sources, including processing units, boiler blowdown, cooling water blowdown, ballast water, and boiler condensate. The wastewater is treated and discharged under the Benicia Refinery's National Pollutant Discharge Elimination System (NPDES) permit to Suisun Bay. Storm water from non-process areas at the refinery is collected and discharged without treatment through four outfalls which are monitored for water quality. These outfalls are also permitted under the refinery's NPDES permit. A more detailed discussion of the refinery's wastewater treatment plant, its capacity and operations, and discharge limitations is provided in Section 4.6, Surface Water Hydrology and Quality.

Wastewater generated from domestic uses at the refinery is discharged to the Benicia Wastewater Treatment Plant. The refinery currently generates approximately 7,500 gallons per day (0.0075 mgd) of domestic wastewater, which represents a small fraction of the total wastewater received at the City's treatment plant. Dry weather flows to the City's plant are approximately 2.5 mgd and wet weather flows are about 2.72 mgd. The total capacity of the City's treatment plant is 4.5 mgd. During dry weather, the plant operates at approximately 80 percent of capacity (ENSR 1993).

Power Supply

All of the electricity used at the refinery is supplied by Pacific Gas & Electric (PG&E). The refinery leases a portion of the Bahia substation, located off East Second Street at the refinery, for electricity supply. PG&E delivers 230 kilowatts (kV) to the refinery through their transmission system to the Bahia substation. Current refinery operations require approximately 50 megawatts per day.

well within the Department's current response capability given the support for hazardous material related training, equipment, and supplies provided by the refinery. Since the proposed project would not introduce a new accident scenario or new chemical compounds, or adversely affect the Benicia Fire Department response capability, the project would not result in an impact to fire protection services.

With respect to police protection, the proposed project would result in a small increase in operating personnel (approximately 15 to 30) at the refinery; therefore, the project is not expected to affect the Benicia Police Department's staff levels, services, or response capabilities.

Mitigation Measure No. 1

No mitigation is required.

Hospital and Emergency Health Services

No impacts are predicted to hospital or emergency services as a result of the project. The proposed project would not introduce a new type of accident scenario, and existing hospital and emergency health services are adequate to handle the 15 to 30 additional employees that would be added to the refinery's existing operations work force of 382 full- and part-time employees. The proposed project would not require an increase in emergency response capability of the refinery or of the other emergency response providers.

Water Supply

Impact No. 2 **The project would require additional water for process and cooling equipment. The increase in water use is within the refinery's allocated water supply. This impact is not significant.**

The proposed project would require an increase of 217 gallons per minute (0.312 mgd) of raw water to supply the new facilities. This additional water would be required for the following uses:

- Cooling water for miscellaneous pumps, compressors, and analyzers;

- Cooling water for small rundown coolers (most services will be air cooled with fan coolers); and

- Steam for hydrogen production in the existing Hydrogen Reformer furnaces.

No significant amount of water is needed to produce steam, since hot oil is being used as the heat transfer fluid for new units (Exxon 1993). As stated previously, the refinery currently obtains approximately 5 mgd of raw water from the Water Division. The increased water usage required by the project modifications of 0.312 mgd would represent a 6 percent increase over current water use. Total water use following completion of the proposed project would be about 5.3 mgd, which is well within the 11 mgd allocated to the refinery the Water Division. The 1968 agreement with Exxon allows for a gradual increase in delivery from 3,374 acre-feet to 12,314 acre-feet. The city is 25 years into their 40-year agreement. If a straight-line increase had occurred, Exxon would currently be allotted 8,962 acre-feet per year. As Exxon is currently using only approximately 5,000 acre-feet per year, this increase of 174 acre-feet is well within the additional 3,962 acre-feet available to Exxon per the Agreement (Mustain 1993). The 1992 Vallejo Water agreement provides Benicia annually with up to an additional 4,400 acre-feet of water. With only a 35 percent delivery of North Bay Aqueduct water, the city can meet the projected demand without drawing on their Lake Berryessa reserve supply. The city has adequate reserves to meet the water demands of the project, and no significant impact on the Water Division's water supply services would occur.

<u>Mitigation Measure No. 2</u>

No mitigation is required.

<u>Wastewater Treatment and Storm Water Drainage</u>

<u>Impact No. 3</u> **The project would result in a negligible increase in domestic wastewater sent to the City's treatment plant. This impact is not significant.**

The addition of 15 to 30 employees following construction of the project would increase domestic wastewater routed to the City of Benicia's Wastewater Treatment Plant by a negligible amount. This change would not measurable affect the plant or treatment system, and would not be significant. This increase in wastewater would be equivalent to the addition of 2.1 dwelling units.

Impacts of changes in the refinery's process wastewater and stormwater flows to the treatment plant are addressed in Section 4.7.

<u>Mitigation Measure No. 3</u>

No mitigation is required.

<u>Power Supply</u>

<u>Impact No. 4</u> **The project would increase the quantity of electricity used at the refinery. The required electricity can be supplied by PG&E to the refinery, and Exxon has proposed substation modifications to distribute power to the proposed new equipment. This impact is not significant.**

The proposed project would require an additional 13 megawatts of electricity for its new and modified facilities. Additional details on electricity required for the proposed project are provided in Section 2.6, Project Description. This represents a 25 percent increase over the current refinery usage of 50 megawatts. Exxon leases a portion of the Bahia substation for refinery use, and PG&E has indicated that there is sufficient capacity within the utility's 230 kV transmission system to deliver the additional 13 megawatts required for the proposed project with no required system changes other than electrical load leveling at the time of the project start-up. Exxon would have to make modifications at an existing medium voltage substation and add a new low-voltage substation at the main process block area to distribute the electricity to the new and modified facilities. These required electrical substation additions and modifications have been proposed by Exxon as part of the project, and no adverse impacts to power supply are predicted.

Energy use is also evaluated in Section 4.16.

Mitigation Measure No. 4

No mitigation is required.

Waste Generation and Disposal

Impact No. 5 **The project would generate additional solid waste, which could be recycled within the refinery and by outside vendors, thus avoiding sending additional waste to landfills. No impacts would occur.**

The proposed project would generate about 373,000 pounds of additional solid waste per year, representing an increase of about 0.4 percent over current solid waste generation. However, about 95 percent of this waste would be spent catalyst, which is currently recycled by off-site vendors, through regeneration or reclamation. The remaining 5 percent of the solid waste would be generated by the cleaning of heat exchangers, which would produce about 20,000 pounds of sludge per year. The sludge would be recycled to the refinery's coker unit, where it would be refined into fuel and other products. Therefore, there would be no impact from the proposed project on waste disposal services and landfill capacity.

In summary, the proposed project would have no significant impacts on public utilities and services in the project area. The proposed project does not trigger any of the significance criteria defined under CEQA. The project would not extend a sewer trunk line with capacity to serve new development; breach published national, state, or local standards relating to solid waste or litter control; or result in a need for new systems, or substantial alterations to any of the utilities, including power or natural gas; communication systems; water; sewer or septic tanks; storm water drainage; and solid waste generation and disposal.

4.13 VISUAL RESOURCES

4.13.1 Environmental Setting

The northeast portion of the City of Benicia, developed as an industrial park, is the setting for the existing Exxon refinery and proposed Clean Fuels project. This industrial park is in a small valley flanked by undeveloped hills located above the Suisun Bay. The topography of the area and the undeveloped Exxon property that borders the refinery enhances the visual and physical separation between the industrial park and residential areas of Benicia.

The Benicia Refinery is a focal point and has been the dominating visual feature in the industrial park since it was built in 1969. The main refinery process and storage areas are located on terraced slopes that descend from East Second Street towards the Carquinez Strait. Structures are painted light colors ranging from yellow-gold to blend with dry season grassland colors to forest green intended to mimic tree color and to blend into the haze from distant viewpoints. From the main entrance on East Second Street views include well-maintained administration and training areas with parking areas bordered by trees and shrubs. The process block is visible in the valley down below. Motorists traveling on I-680 have clear views of the process area, including low storage tanks, towers, pipes, and other refinery process equipment.

Motorists approaching Benicia from the south on the Benicia-Martinez Bridge have clear views of the refinery storage tanks on the ridges above the industrial basin, but the hills there block the view of the refinery itself. Most of the refinery is hidden from view from eastbound drivers on I-680 except for partial views of towers and the north flare which are visible between hills near the highway summit west of Lake Herman. The refinery is most visible beyond the summit, from Benicia's northeast gateway on I-680 near Lake Herman Road. Benicia's entire industrial area is visible from this vantage point on I-680. To the east, the topography opens up, expanding the view to include Suisun Bay and Mt. Diablo.

From Rose Drive, northwest of the refinery, the foreground view includes the main process block, with views of Mount Diablo across the Carquinez Strait. From the Hillcrest neighborhood near St. Dominic's cemetery to the eastern edge of Southhampton there are occasional views of the refinery. From the residential areas to the southwest of the refinery, views are restricted to the first tier of homes because the topography and other homes create a visual screening.

4.13.2 Impacts and Mitigation

Significance Criteria

Project impacts were considered significant if CEQA criteria were met, or if the project conflicted with the policies in the Scenic Highways Element in the Benicia General Plan. According to CEQA guidelines, an impact is considered significant if the scenic views or vistas from existing residential or public lands are changed, if the project changes the scale or character of the general project area, or if the project results in a new source of light or glare. Within the Benicia General Plan, the Scenic Highways Element visual resources policy is written as follows:

- "Every effort will be made to preserve key scenic resources identified in the Scenic Highways Element," and

- "The City should control uses of land at each of the four city gateways and should enhance these gateways to strengthen Benicia's identity."

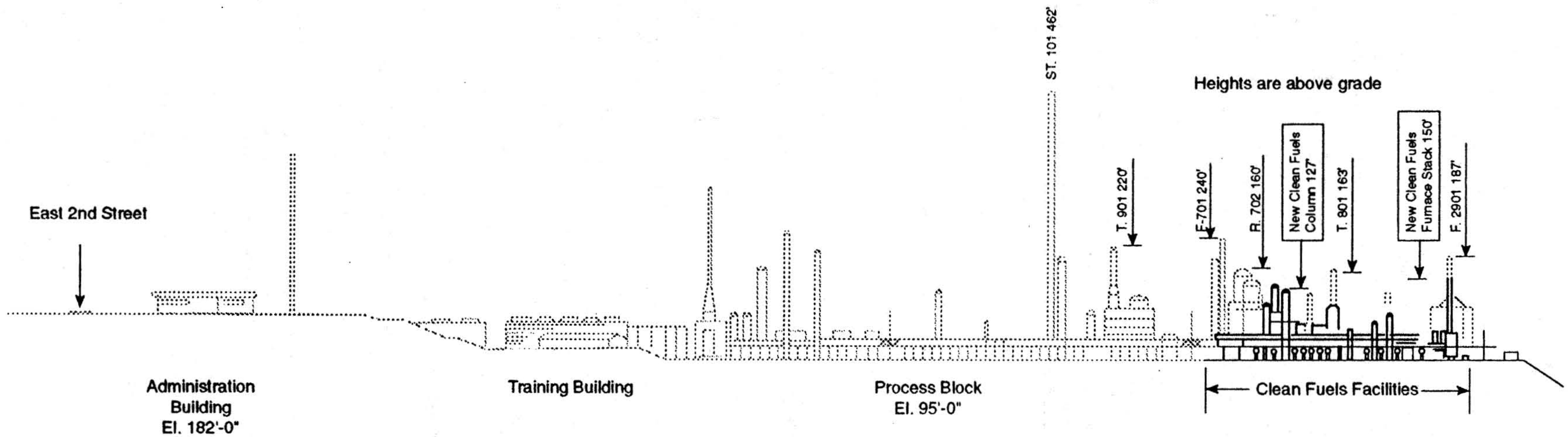
Visual impacts of the project to surrounding areas were evaluated based on the amount of contrast added to the existing landscape by proposed structures, and viewer sensitivity. If the project would create little visual contrast with the existing landscape and there are few viewers, or if the landscape or visual features are not memorable, scenic, or otherwise notable, the impact was considered low and not significant. If the project would create substantial contrast with the existing landscape and many people who are interested in the view could see the facility, the impact was considered high and significant.

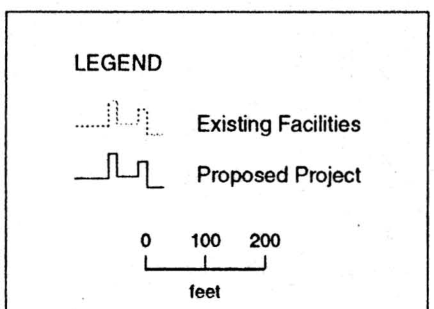
Viewer Sensitivity

The proposed Clean Fuels project would be constructed and operated entirely within the existing process block at the Exxon Refinery, with the exception of the storage and fabrication area near the Gate 5 parking lot. The project would expand the existing industrial appearance of the refinery within the process block and create a new graded fabrication and storage area. The process block Clean Fuels area, currently being used for equipment storage, comprises approximately 500 feet by 300 feet of the process area. The Clean Fuels equipment would include a 150-foot-tall furnace stack and a 127-foot-tall column built at 95 feet above sea level. The existing main stack, also at a base elevation of 95 feet, is 462 feet tall.

Impact No. 1 **The Clean Fuels project would add new equipment and facilities to the industrial portion of the refinery. This change would not substantially alter the visual contrast or character of the setting. This impact is not significant.**

The views from the existing residential areas would include an expanded industrial appearance within the process area of the existing refinery. The form, line, color, and texture of the views of the refinery would be consistent with existing conditions. The height of stacks and columns associated with the Clean Fuels project is below the existing average column height at the refinery. Figure 4.13-1 shows the elevation of the proposed project facilities to be added to the existing refinery. The views of Mt. Diablo from the residences northwest of the refinery on Rose Drive will not be obstructed by the proposed project. From the Hillcrest neighborhood and Southhampton the views of the refinery will include new structures within the process block, but the foreground and distant views of the grassland hills surrounding the industrial basin would not change. Figure 4.13-2 shows the view of the refinery with the proposed project from the Hillcrest neighborhood. Figure 4.13-3 shows the view of the refinery with the proposed project from the Rose Drive area with a partial view of Mt. Diablo in the extreme right portion of the photo. Most of the people viewing the Benicia Refinery from their homes in the Hillcrest neighborhood are concerned with the views from their property; therefore, viewer sensitivity to the refinery landscape is considered high.





Project No. 93C0336A	Exxon Clean Fuels Project	ELEVATION LOOKING EAST AT REFINERY WITH CLEAN FUELS FACILITIES	Figure 4.13-1
Woodward-Clyde Consultants			

93C0336A-0600/090193

Views from the residential areas surrounding the refinery would include added facilities only in the process area within the refinery. However, the proposed project would not create visual contrast with the existing views. The proposed project does not alter the view in character, scale, line, form, or texture, and the scenic views of Mt. Diablo would not be altered. Although viewer sensitivity is high, the impacts to the residential area views are not considered significant since the visual character of the setting will not be altered.

The proposed project would be viewed by motorists traveling on I-680. The increased industrial appearance would not contrast with the existing views; however, because the Benicia General Plan designates I-680 between Morrow Lane and the Benicia Bridge as a scenic route, viewer sensitivity is considered high.

Mitigation Measure No. 1

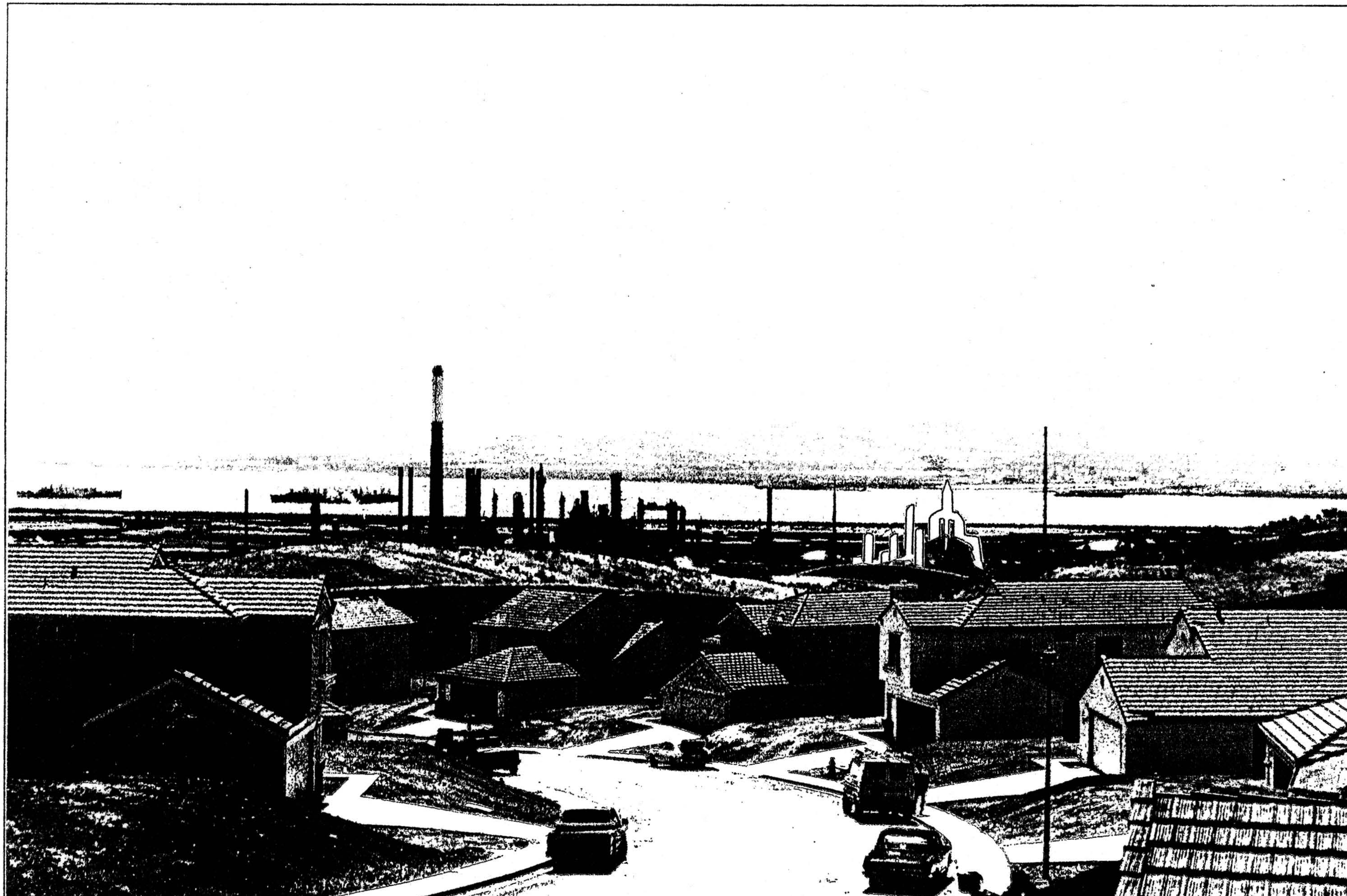
To ensure that views of the proposed project would not contrast with the existing character of the refinery views, new equipment and facilities should be painted nonreflective colors, using the existing yellow-gold and forest green color scheme.

Impact No. 2 **Lighting of the Clean Fuels facilities would expand the existing light and glare. The refinery is already illuminated, and the Clean Fuels project would not substantially change existing light and glare conditions. This impact is not significant.**

The main process block area and associated facilities at the refinery are lighted, since refinery processing is generally conducted continuously. The proposed Clean Fuels facilities would also include lighting for worker safety. This would result in an expanded new source of light and glare. The new lighted area would appear as an expansion of approximately 3 acres within the existing 46-acre main process block. This expanded lighted area would not significantly alter the appearance or contrast of the site at night.

Project No. 93C0336A	Exxon Clean Fuels Project	REPRESENTATIVE VIEW OF THE PROPOSED FACILITY FROM EAST FIFTH STREET	Figure 4.13-2
Woodward-Clyde Consultants			

93C0336A-0600/090193



Project No. 93C0336A	Exxon Clean Fuels Project	REPRESENTATIVE VIEW OF THE PROPOSED FACILITY FROM PANORAMA DRIVE LOOKING EAST	Figure 4.13-3
Woodward-Clyde Consultants			

93C0336A-0600/090193

Mitigation Measure No. 2

New light and glare at the refinery is unavoidable, given the nature of the round-the-clock refinery operations. The lighting for the Clean Fuels facilities should be directed in a downward direction and shielded when appropriate. The lamps should be painted with a non-reflective paint.

Impact No. 3 **Construction of fabrication and storage areas associated with the Clean Fuels project and other refinery projects could potentially impact views of the refinery by encroaching upon the grassland buffer between residences and the refinery. This is not a significant impact.**

The proposed new, graded storage area (approximately 100′ x 50′) to be constructed adjacent to the Gate 5 parking lot would be visible from the northeast, the Hillcrest neighborhood. The existing view includes grassland bordering a refinery parking lot. The graded fabrication and storage area is within the overall refinery complex and would not substantially change the line, texture, form, or character of views of the refinery.

Mitigation Measure No. 3

The foreground views of the fabrication and storage areas should be visually screened consistent with the mitigation measures recommended for biological resources in Section 4.16. The screening effect of the native plant border would minimize this potential impact.

4.13.3 Cumulative Impacts and Mitigation

<u>Impact No. 4</u> **New, related facilities planned at the refinery would expand the industrial appearance of the overall complex. This change would not substantially impact visual resources. This is not a significant impact.**

Other projects planned at the Benicia Refinery are either new or expanded processing units (e.g., MTBE plant), new storage tanks, or graded parking, fabrication, and staging areas. These projects would be located within the existing refinery complex, and would not expand industrial operations outside of the processing and tank storage areas. New processing facilities would be painted in the color scheme of the existing refinery and would not represent any overall significant changes in the industrial appearance of the complex. The graded parking, fabrication, and staging areas are adjacent to the refinery complex, and would not significantly change the overall view of the plant. Some of the staging and laydown areas would be visible, and would incrementally add to the overall extent of disturbed, graded areas surrounding the main processing and tank storage facilities, but this impact is not significant.

<u>Mitigation Measure No. 4</u>

No mitigation is required.

4.14 CULTURAL RESOURCES

4.14.1 Environmental Setting

Cultural Background

Archaeological Background. The proposed project is located in the Delta subregion of the Central Valley of California. As demonstrated by the record of human occupation, this area has been a focal point of cultural evolution and population migration. The earliest occupation sites and human graves that have been identified in the region date to approximately 5,000 years ago. These sites are invariably deeply buried, a result of the extensive deposition of alluvium that accompanied the rise in sea level over the past 15,000 years. Evidence of earlier human use of the area may be obscured by alluvial deposition (Moratto 1984).

An apparent population increase took place in the Delta subregion after about 2,500 years before present (B.P.), reflected in the notable increase in the number of archaeological sites known to have been initially occupied 2,500 to 2,000 years ago. This probably was directly related to the establishment and expansion of Delta and bayshore marshlands (Bickel 1978). The archaeological record shows the spread and retreat of particular sets of material culture traits and patterns suggesting dynamic patterns of population movement and changing relationships between neighboring groups in the Delta subregion over the last 2,000 to 3,000 years of prehistory. Possible shifts in tribal centers also took place in the late eighteenth century in response to the arrival of Spanish missionaries and other non-native people (Bennyhoff 1977).

Ethnographic Background. The lower portions of the Sacramento River, including Benicia, were inhabited by the indigenous Patwin Peoples. Patwin refers to a culturally and linguistically similar group of independent triblets, each composed of one or two permanent villages (some reaching a total population of over 1,000) and several smaller seasonal camps. The Patwin peoples maintained close relationships with the Pomo, which involved both trade and shared resources. Subsistence was obtained through planned, strategic hunting and plant food gathering. In addition to the ubiquitous acorn, a wide variety of seeds, roots, and fruits were utilized. Large weirs were constructed across the Sacramento River to collect salmon and sturgeon. Many other animals - elk, deer, antelope, bear, waterfowl, turtles, and small mammals - were also hunted. Material culture included twined and coiled baskets; tule balsa boats; flaked and groundstone tools; wooden bows, arrows, mortars, and small tools; and bone and shell artifacts. The Patwin population diminished sharply upon the incursion of non-indigenous peoples due to missionization, punitive military expeditions, confrontations with ranchers, and disease (Johnson 1978: 350-360).

Historic Background. Benicia was founded on General Mariano Vallejo's Rancho Suscol, and was deeded in 1846 to Dr. Robert Semple and Thomas Larkin, who laid out the town. First named Santa Francisca after the General's first wife, the town was renamed Benicia (which was Senora Vallejo's middle name) when Yerba Buena was named San Francisco. Benicia was a successful port serving the Gold Rush period, and in 1853-54 it was briefly the state's third location for the capitol. The army established a post in 1849, which became the Benicia Arsenal in 1851. A portion of the arsenal, which was closed in 1962, is in the hills surrounding the Exxon Refinery (Office of Historic Preservation 1990).

In addition to military functions, Benicia's role in California history is closely tied to its strategic commercial location on the Carquinez Straits. Benicia served as a trade and transportation center for agricultural and industrial goods between the regions of California. The Turner/Robertson shipyard, established in 1882, constructed 228 vessels before its closure in 1918. A ferry was established between Benicia and Martinez that operated for 115 years until the highway bridge was completed in 1962.

The Benicia Refinery was established in 1969. Its role in the local economy continues the themes of commerce and goods transportation which shaped Benicia's history.

Archival Records Research

In January 1993, a records search for previously recorded archaeological sites and previous cultural resource surveys in and adjacent to the project area was conducted through the Northwest Information Center of the California Archaeological Inventory, at Sonoma State University (file number 90-209). No previously conducted cultural resource surveys or recorded archaeological sites exist within one mile of the project site. The nearest known cultural resource is CA-SOL-265H, the former location of a house that dated to 1913 but burnt in 1941. The site is adjacent to the southern boundary of the refinery property.

Site Reconnaissance

The need for cultural resource surveys of the project site was determined through consideration of the current land use and construction of specific project facilities that would require subsurface disturbance. Most subsurface disturbance associated with the Clean Fuels project lie in areas where there is fill on top of the bedrock (HLA 1992a). Any subsurface activity confined to fill areas has no potential to impact prehistoric or historic cultural resources, so additional reconnaissance there is not warranted.

The only area not located on fill where construction could disturb surface or subsurface resources is the area proposed for grading, located adjacent to the existing Gate 5 parking lot just south of the refinery complex and process block/tank storage area (Figure 2-2). Archaeological reconnaissance was conducted in this area on July 7, 1993. The surveyed area is a rectangular plot measuring approximately 550 feet north-south and 130 feet east-west. It was surveyed using four, 35-foot-wide, north-south transects. The area appears to have been lightly graded and is partially covered with mixed grasses, affording a visibility level of approximately 50 percent. No historic or prehistoric resources were observed during the survey.

4.14.2 Impacts and Mitigation

Significance Criteria

Appendix K, Section III of CEQA's Statutes and Guidelines states that "if a project may cause damage to an important archaeological resource, the project may have a significant effect on the environment." Following this, the threshold of significance for cultural resources would be any action that would cause damage to an archaeological resource which meets one or more of the criteria outlined in Appendix K, Section III. For example, subsurface construction activity (such as grading or excavation) within native soil, which might disrupt a prehistoric or historic archaeological site or a property of historic or cultural significance to a community or ethnic or social group, would represent a potentially significant impact.

Cultural Resource Impacts and Mitigation

Based on the archaeological inventory, the recent history of development (including fill) on the site, and archaeological reconnaissance, no known cultural resources would be affected by excavation and construction activities associated with the project. As noted above, most of the subsurface impacts associated with the Clean Fuels project lie in areas where there is fill on top of the natural surface (HLA 1992a); any subsurface activity confined to fill areas has no potential to impact prehistoric or historic cultural resources. The grading of the area adjacent to the existing parking lot south of the refinery has been surveyed for cultural resources with negative results, and no impacts to cultural resources are apparent.

Inadvertent Discovery of Archaeological Deposits

Impact No. 1 **There is an unknown, but low potential for buried cultural resources to be encountered during project excavation, grading, or other subsurface construction activities. This impact is considered potentially significant.**

Although no cultural resources have been identified in the project area, it is possible that historic activities or natural deposition of alluvial soils may have obscured evidence of them. The significance of this impact, if any, cannot be predicted at this time, but mitigation should be applied in the event such an impact were to occur.

Mitigation No. 1

If unanticipated cultural resources (historic or prehistoric artifacts, concentrations of bivalve shell, burnt or unburnt bone, stone features, etc.) were to be uncovered during grading or construction activities, work should be halted and a qualified archaeologist should be consulted for an on-site evaluation. If human remains are found on the site, the California

State Legal Code mandates that the Coroner of Solano County and the Native American Heritage Commission be contacted immediately.

4.14.3 Cumulative Impacts and Mitigation

Because the project has no anticipated impact on cultural resources, this project will not contribute to cumulative effects on cultural resources in the region. No impacts are anticipated.

4.15 BIOLOGICAL RESOURCES

4.15.1 Environmental Setting

This section addresses direct impacts to biological resources, as well as indirect impacts of project emissions on the terrestrial and aquatic system adjacent to the project site.

Plant Communities and Wildlife

Vegetation has been cleared from the main process block and tank farms where the project would be located. Grasslands cover most of the rest of the remaining refinery property. These grasslands are dominated by non-native species including wild oates (*Avena sp.*), brome, (*Bromus sp.*), and fescues (*Festuca sp.*). Forbes such as Italian thistle (*Carduus pyconcephalus*), wild radish (*Raphanus satinvus*), and anise (*Anethum graveolens*) are also present. Native species observed in the grasslands include lupine (*Lupinus sp.*), blue dick (*Brodea puchella*) and California poppy (*Eschscholtzia californica*).

The Sulphur Springs channel crosses the southern boundary of the refinery. This area is vegetated with sedge and rush species common to slow-moving waterways. One on-site drainage which feeds the Sulphur Springs Creek has been colonized by beavers and river otters (Botti 1993). The dam constructed by the beaver population is visible from the southeast gate to the facility. The pond created by the beaver dam is not in the vicinity of the proposed project. One other drainage on the site, located upgradient from the beaver pond, contains hydric soils and emergent vegetation characteristic of a seasonal wetland. Other drainage swales within the project area are dominated by eucalyptus trees, poison oak (*Toxicodendron diversiloba*), coyote brush (*Baccharis pitularis*) and a few willow trees (*Salix sp.*).

The non-native grassland which occurs in the general area of the Benicia Refinery does not have significant woodland or scrub cover. Use of the area by wildlife is limited to grassland species including blacktail jackrabbits (*Lepus californica*), ground squirrels (*Spermophila beechyii*), coyotes (*Canis latrans*) red-tailed hawk (Buteo jamaicensis), American kestrel (Falso sparvensis).

4.15.2 Impacts and Mitigation Measures

Significance Criteria

An impact is considered significant to biological resources if:

- Habitat of any rare or endangered plant or animal species is degraded
- Rare or endangered plants or animals are displaced
- Jurisdictional wetlands are lost
- Animal migration or movement is inhibited
- Habitat for fish, wildlife, or plants is substantially degraded

Sensitive plant and animal species receive legal protection by federal and state laws such as the Federal Endangered Species Act (FESA), California Endangered Species Act (CESA), CEQA, or through policies issued by federal or state agencies. Loss of a species or its habitat is considered a "take," which means to harass, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Sensitive habitats are habitats that, because of human activities are becoming more restricted in California. Sensitive habitats may also include those habitats which could support plant or animal species listed as threatened or endangered by the state or federal government.

Construction-Related Impacts and Mitigation

Construction of the project would involve site clearing, grading, and excavation activities. The following describes the potential for these activities to impact biological resources.

Impacts to Sensitive Species. Consultation with biologists from California Department of Fish and Game (CDFG), and a search of the California Natural Diversity Database indicate that threatened or endangered wildlife, plants or habitats are not known to exist on the project site or in the general vicinity of the refinery. In addition, threatened or endangered species or habitats were not identified in the region during surveys conducted in 1988 and 1991 at the Benicia Refinery. A reconnaissance of the Clean Fuels project site was conducted in

1993 by Woodward-Clyde Consultants biologists, and no threatened or endangered or other protected species were observed.

Impacts from Construction of Clean Fuels Process Facilities. Project construction in the process block would occur in paved or gravel-covered areas which do not support vegetation or wildlife habitat. Project construction within the process block would have no impact on any sensitive biological species.

Impacts from Construction of the Fabrication/Laydown Area. Exxon has proposed that an area adjacent to the Gate 5 parking lot be graded and used for Clean Fuels construction staging activities. This action has the potential to impact biological resources.

Impact No. 1 **Construction of the fabrication/laydown area associated with the Clean Fuels project could potentially degrade biological resources. This is a significant impact.**

The grading for this area is adjacent to sensitive biological resources, and grading or erosion could potentially cause a significant impact. The fabrication laydown area is approximately 150 feet by 50 feet and currently supports grassland. Its location is shown on Figure 2-2. Field visits to the area confirmed that the drainage west of this site has wetland characteristics including hydric soils and wetland plant species (*Typha, Eleocharis sp.*, and water cress). This drainage feeds the beaver pond on the refinery property, and eventually converges with Sulphur Springs Creek. The drainage area is less than one acre in size. It would not be filled or directly impacted as a result of the proposed project. However, indirect impacts to the drainage area could potentially occur as a result of the proposed grading and fabrication/ laydown uses of the area, including impacts to water quality, hydrology, and habitat. Potential degradation of this resource is considered a significant, but avoidable, impact.

Mitigation Measure No. 1

Contact with CDFG biologists suggests at least a 20-foot setback from the drainage and construction of a berm to prevent runoff from the laydown/fabrication area from inundating the drainage, is necessary. Additional design measures such as sloping the site so that runoff from the laydown/fabrication area does not flow into the drainage is also recommended. CDFG suggests that mitigation should include cluster planting of native riparian species between the west border of the proposed laydown/fabrication area and the eastern edge of the wetland area. Suggested plants include clusters of sycamore, willow, and live oak trees to create an overstory, and California rose and coyote brush to create a low-growing understory habitat. To ensure that no construction activities occur at this site, staking, temporary fencing, hay bales, or an equivalent-type of temporary barrier should be placed prior to construction at the top of the drainage slope, at least 20 feet back from the drainage. This mitigation measure would reduce impacts to an insignificant level.

Indirect Impacts

This section provides an environmental assessment of the potential indirect impacts of project emissions on the terrestrial and aquatic ecosystem adjacent to the project site. The approach and terminology used in this assessment are similar to those in ecological risk assessments as described by the EPA (1989) for assessment of ecological risk at Superfund hazardous waste sites. However, for the purposes of this EIR, the following section represents a screening level assessment of the potential ecological effects of operation of the Clean Fuels project.

The basic goal of this ecological assessment is to evaluate the chemicals of concern and their potential impact to the ecosystem. It is an appraisal of the effects of these chemicals on natural vegetation and fish and wildlife.

To understand how the chemicals of concern affect an ecosystem, the ecosystems that are to be evaluated need to be characterized. The following criteria are generally used to define ecosystems.

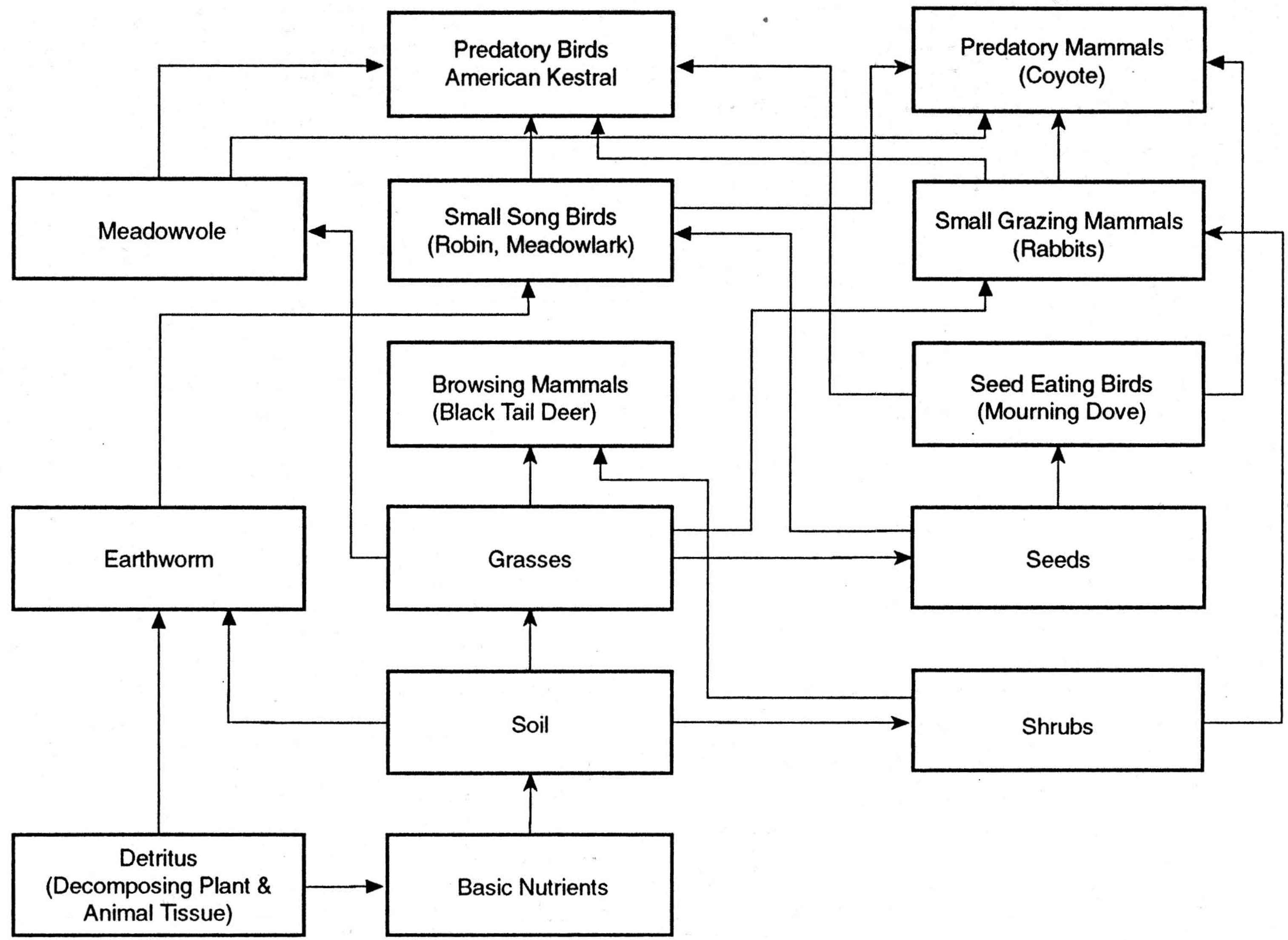
- Species composition and diversity
- Nutrient and energy flows between organisms and the environment
- Rates of biological production, consumption, and decomposition

Energy and matter flow through ecosystems by means of food webs or chains. Primary producers (green plants) that convert sunlight and other raw elements to energy are at the base of the food chain, while consumers such as raptors and coyotes are at or near the top of the food chain. The food webs used for this evaluation are shown in Figures 4.15-1 (terrestrial) and 4.15-2 (aquatic) and were selected to represent the species of plants and animals that were observed or expected to occur in the project area.

Ecosystems. Each ecosystem has a unique combination of physical, chemical, and biological characteristics that influence how it will respond to chemicals of concern (EPA 1989). The coastal hills and annual grasslands surrounding the project site contain two ecosystems: a terrestrial ecosystem and a freshwater ecosystem. The terrestrial system includes upland annual grass habitat composed of native and introduced annual herbaceous species, and riparian wetland habitat which supports woody and herbaceous perennial species. The freshwater ecosystem includes a pond created by a beaver dam within a drainage on the refinery property.

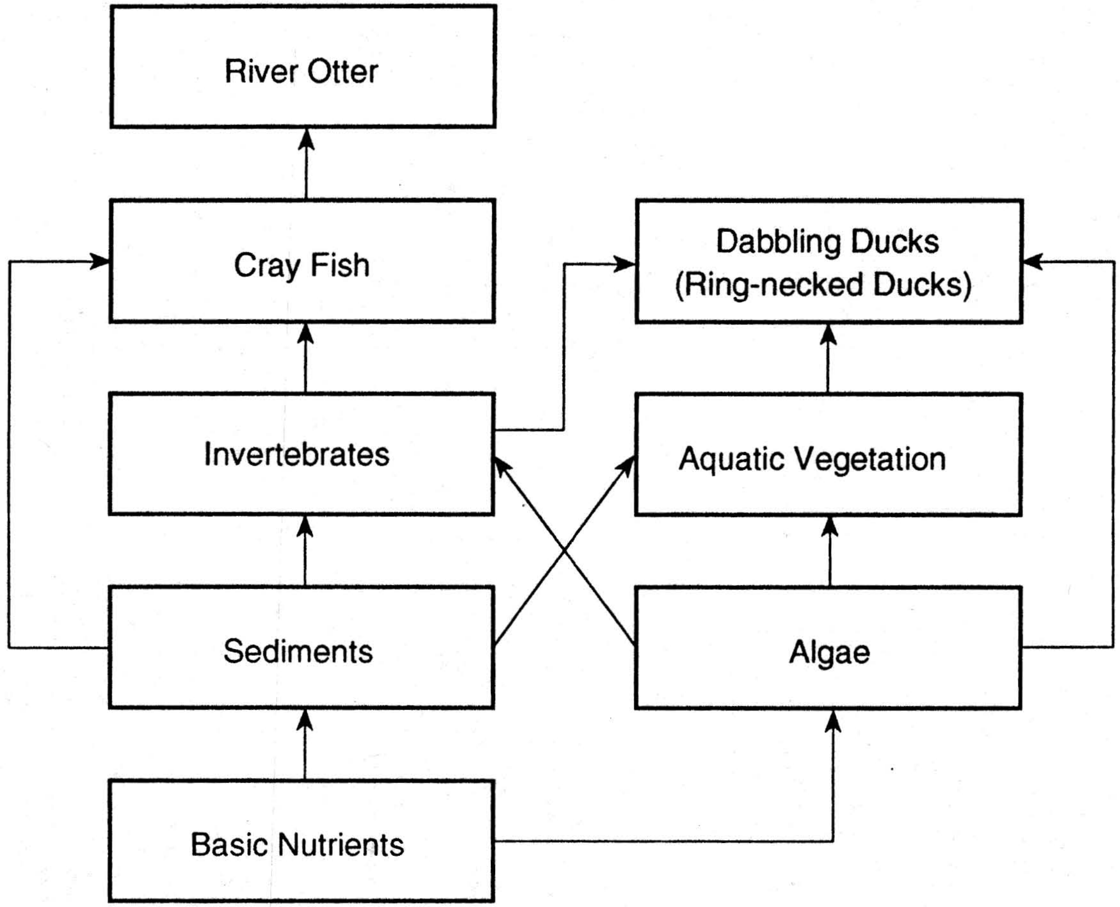
Exposure Pathways. An exposure pathway is the link between an emission and a receptor. Pathways depend on the media that contains the chemicals of concern (e.g., surface water, soils, air, and biota). Exposure to these media could occur from direct contact or indirectly through a food chain. A conceptual model of pathways of exposure to wildlife at the Benicia refinery is shown in Figure 4.15-3. An integral step in the identification of pathways is the identification of receptors. These are individual species, populations, or communities of primary interest when evaluating the potential effects of the chemical of concern. Often the receptors are species found onsite that warrant special consideration due to federal or state legal protection, or species considered essential or indicative of a habitat.

According to the human health risk data, the upland areas surrounding the Benicia Refinery would receive concentrations of chemicals of concern that would be higher than Bay Shore concentrations. For this reason, endpoints and pathways were selected from the upland areas that conformed to observations of animal and plant life in the project area and other available data. In particular, the occurrence of any federal or state designated threatened or endangered species was considered when selecting food chains; however, field observations and a search of the California Natural Diversity Data Base did not indicate the presence of such species



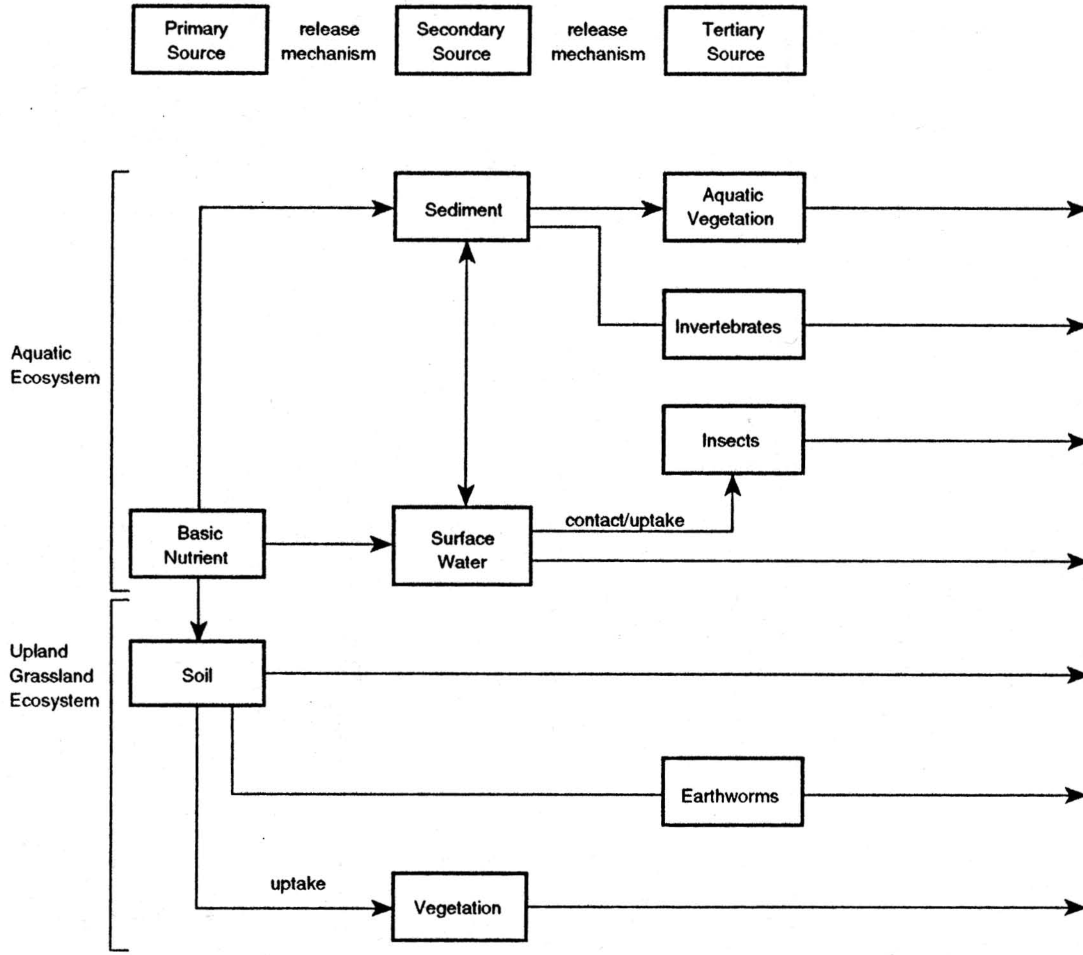
Project No. 93C0336A	Exxon Clean Fuels Project	UPLAND GRASSLAND FOOD WEB EXXON CLEAN FUELS PROJECT	Figure 4.15-1
Woodward-Clyde Consultants			

93C0336A-0516/083093



Project No. 93C0336A	Exxon Clean Fuels Project	AQUATIC FOOD WEB EXXON CLEAN FUELS PROJECT	Figure 4.15-2
Woodward-Clyde Consultants			

93C0336A-0516/083093



	Beaver	Earthworms	Vole	River Otter	Coyote	Robin	American Kestrel	Black-tailed Deer
Aquatic Vegetation	DC, DI							
Invertebrates				DI				
Insects	DC, DI							
Surface Water	DC, DI			DC, DI				
Soil		DC, DI	DC, II	DC, II	DC	DC, II	DC	DC, II
Earthworms			DC, DI		II	DI	DI	
Vegetation		DC	DC, II		DC, II	DC, DI	DC, II	DC, DI

LEGEND

DC - Direct Contact
DI - Direct Ingestion
II - Indirect Ingestion

Project No. 93C0336A	Exxon Clean Fuels Project	CONCEPTUAL SITE MODEL FOR ECOLOGICAL ASSESSMENT	Figure 4.15-3
Woodward-Clyde Consultants			

93C0336A-0516/083093

in the upland area. Although species of concern occur within the Bay Shore areas of Suisun Bay and the Carquinez Strait, these habitats would receive much lower concentrations from the project than the upland areas. Therefore, analysis of the upland areas provided a worst-case analysis of maximum exposure. The final assessment endpoints were selected to accurately reflect the affected organisms on the site and the potential for the chemicals of concern to move within the ecosystem.

Species selected as assessment endpoints are considered "indicator" species. Indicator species are representative of the wildlife species most likely to use the site and surrounding area, and were selected as assessment endpoints to evaluate the potential impacts and potential ecological risks the project may pose. Selection of species for this assessment was based on their potential for exposure and the availability of toxicity data.

Four species were ultimately selected as assessment endpoints. These are coyote (*Canis latrans*) and a predatory bird (raptor) in the grassland ecosystem, and dabbling duck (*Anas* sp.) and river otter (*Lutra candensis*) in the freshwater ecosystem. These site-specific indicator species were chosen from among species observed (directly or indirectly) at the site. These species are representative of the ecosystem-at-large because their position on the food chain places them at the greatest risk for bioaccumulation of the chemicals of concern. The habitats, diet, geographic range of the species, and other characteristics are described below.

Coyote. A medium-sized, dog-like carnivore, coyotes commonly occur throughout California. Common prey includes jackrabbits (*Lepus* spp.) and cottontails (*Sylvilagus* spp.) which are supplemented with small mice and ground squirrels. Coyotes also consume fruits, berries, insects and carrion (Jameson and Peeters 1988).

Predatory Bird (American kestrel). Predatory birds such as hawks and owls are typical species found in upland grassland habitats (Peterson 1961). Two American kestrels were observed at the Benicia refinery during site visits. Common prey include small song birds and small mammals, including mice and shrews.

River Otter. River otters are one of the largest members of the weasel family. Found in the west from the Cascades through the Sierra Nevada, Central Valley, Delta region and in major drainages in the Coast Ranges north of San Francisco, river otters feed on crayfish, frogs, fish and shellfish (Jameson and Peeters 1988). An adult female river otter, with young, was observed by Department of Fish and Game biologists at the pond on the refinery property (Botti 1993).

Dabbling Duck. Dabbling ducks include mallards, northern shovelors, cinnamon teals and other species which typically skim food from the water surface or feed in the shallows by tipping forward to submerge their heads and necks. Dabbling duck diets include seeds and shoots of sedge grasses and other aquatic vegetation (Ehrlich 1989).

Chemicals of Concern. The selection of the chemicals of concern for the ecological assessment is different than the selection of chemicals for human health assessment. The ecological assessment is predominately concerned with those chemicals that will be absorbed or ingested into non-human biota, specifically chemicals that have made their way onto or into the upper layers of soil or surface water.

The chemicals of concern for this analysis were selected based on air quality modeling data from the human health risk assessment (reported in Section 4.4). The health risk assessment air quality model identifies several heavy metals that would be attached to particulate matter that may be emitted from project facilities. Although some of this material would be so fine that it would remain suspended in the air, some of the particulate matter would be heavy enough to settle out onto the land surface. Chemicals of concern were selected for their known toxicity to biota, and the availability of scientific research examining their toxicity in ecosystems and species similar to those present at the Benicia Refinery.

The chemicals of concern for the freshwater ecosystem are:

- Arsenic (As)
- Cadmium (Cd)
- Chromium VI (Cr VI)
- Copper (Cu)
- Lead (Pb)
- Mercury (Hg)

The chemicals of concern in the terrestrial ecosystems are:

- Arsenic (As)
- Cadmium (Cd)
- Chromium VI (CrVI)
- Lead (Pb)
- Mercury (Hg)

Arsenic (As). Arsenic is the 20th most abundant element in the earth's crust, 14th most abundant element in seawater, and the 12th most abundant element in the human body (Eisler 1988). It is a known teratogen and carcinogen for humans; however, its status is not clear in other mammals. Some evidence indicates that the element may be essential or even beneficial to organisms. Organisms deprived of arsenic exhibit poor growth, reduced survival and decreased reproduction. Low doses can stimulate growth and development in some species of plants and animals. Animal cells concentrate arsenic which can utilize the cellular pathways for phosphorus; however, arsenic does not biomagnify through the food chain. Although chronic toxicity values for waterfowl or small mammals are not available, these organisms experience acute toxicity at dietary levels of 17.4-47.6 milligram per kilogram (mg As/kg) and 2.5-33 mg As/kg, respectively. Large mammals have documented chronic tissue toxicity concentrations of 2 mg As/kg (fresh weight) (Eisler 1988). Surficial soil and water concentrations of arsenic in the project region are estimated to be 7.28 µg/kg. This value was used as the estimated tissue concentration of arsenic which was compared to the levels of arsenic documented in the literature to pose a risk to the indicator species.

Cadmium (Cd). There is no evidence that this relatively rare heavy metal is biologically essential or beneficial (Eisler 1985a). It is a known teratogen (causes birth defects) and carcinogen (causes cancer), most likely a mutagen (causes mutation to DNA), and causes severe harm to organisms. It is known to bioaccumulate, but biomagnification in the food chain occurs only at the lowest trophic levels. Aquatic life is most sensitive, with chronic concentrations of cadmium measured at 4.5 µg/l in the medium. Other wildlife, including waterfowl, and most mammals are sensitive to cadmium at dietary concentrations of about 100 µg Cd/kg (Eisler 1985a). Surficial soil and water concentrations of cadmium in the project area are estimated to be 3.99 µg/kg.

Chromium VI (CrVI). Chromium VI is an essential trace element for humans and a few other species that have been scientifically tested; however, the data is incomplete for other organisms. Chromium VI is a teratogen, carcinogen, and mutagen at high concentrations. It is not known to bioconcentrate in organisms or biomagnify in food chains. Saltwater aquatic organisms are sensitive to chromium in concentrations greater than 5 µg/l, while chronic toxicity tissue concentrations have been documented for mammals at around 200 µg/kg (Fresh Weight) (Eisler 1986). For this assessment, the estimated concentration of chromium VI in surficial soils, based on the human health risk assessment, is 4.90 µg/kg.

Copper (Cu). Copper, although classified as a heavy metal, is also a micronutrient essential for plant growth (Adriano 1992). Plants have been able to adapt to excessive concentrations of copper in the environment. Terrestrial plants have been documented to become resistant to excessive copper found in soils adjacent to copper mines (Moriarty 1990). However, copper is toxic to most aquatic organisms when present in sufficient concentrations (Cairns et al. 1981). Minks (used in this assessment as a surrogate species for river otter) showed signs of toxicity at 300 µg/L in freshwater systems. Because of the potential for copper to have a greater negative impact on aquatic ecosystems, this assessment evaluated copper's impacts only on the freshwater ecosystem. The estimated concentration of copper in the water, was 44.71 µg/L. Copper is not known to appreciably biomagnify in the food chain.

Lead (Pb). Lead is neither essential nor beneficial to living organisms and is potentially toxic in most of its chemical forms (Eisler 1988). Total concentrations of several hundred ppm lead in soils are usually required before plants exhibit adverse effects such as growth inhibition or reduced photosynthesis (Eisler 1988). Only a small portion of lead in soil becomes incorporated into plant foliage, and much of the lead contamination detected in biota is often due to aerial deposition. Food chain accumulation of lead is uncommon in terrestrial species (Eisler 1988b). Based on data from the human health risk assessment, soil and water concentrations of lead are estimated to be 33.11 µg/kg.

Mercury (Hg). Mercury has no known biological function and is capable of bioconcentration and biomagnification through a food chain. Mercury is chronically toxic to aquatic life at concentrations greater than 0.02 µg/L, to waterfowl at concentrations greater than

500 micrograms per kilogram (µg/kg) (diet), and to some herbivores at concentrations greater than 1,000 µg/kg diet (Eisler 1987a). Mercury is known to biomagnify in food chains.

The concentration of mercury in surficial soils and in fresh water in the project area was estimated to be 3.54 µg/kg based on the health risk assessment modeling. However, to account for potential biomagnification in the food chain, the concentration taken from the health risk assessment was multiplied by a total concentration factor of 111 for the food chain. Therefore, a concentration of 0.39 mg/kg was used as the prey concentration in the chemical intake calculations in the following section.

Chemical Intake. Chemical intake in wildlife can be estimated based on intake of prey or incidental ingestion of soil or surface water (as a percentage of prey consumed). Chemical intake from prey or soil or surface water can be estimated using the following equation:

chemical dose$_{(prey)}$[milligram per kilogram-body weight per day (mg/kg-bw/day)]=

$$\frac{\text{chemical concentration (mg-chemical/kg-prey) x prey intake (kg/day)}}{\text{body weight (kg-bw)}}$$

This equation also may be used to derive threshold dietary levels based on a no-observable-effects-levels (NOEL) dose, i.e.,

NOEL diet (mg-chemical/kilogram-prey) =

$$\frac{\text{NOEL dose (mg/kg-bw/day) x body weight (kg-bw)}}{\text{prey intake (kg-day)}}$$

This equation was used to interpret diet or residue information presented in the literature for laboratory or wildlife animals. To generate an estimate for this assessment, chemical concentrations in prey animals and vegetation were assumed to be the same as the surficial soil or water concentrations. Chemical intake values were calculated using the above equations and the chemical concentrations from the health risk assessment provided in Section 4.4. To assess the potential impact of chemicals of concern to ecosystems adjacent to the refinery, the chemical intake for each species was compared to documented no observed effect levels (NOEL).

Uncertainties and Assumptions. The scope of this ecological assessment is limited, as ecological endpoints and indicator species were selected to be representative of the ecosystem. However, the very nature of selecting indicator species and ecological endpoints is based on suppositions and generalizations. Although the intent of this assessment is to encompass the ecosystem, the process focuses on the behavior of a selected few species.

Although, the assessment uses estimated data from the health risk assessment, it is strictly a qualitative assessment of the potential impact of chemicals of concern on the ecosystem. Environmental biota samples were not collected, and the assessment was conducted on the projected effects of the expansion of the refinery.

The only exposure route evaluated was ingestion. The assumption was made that potential exposure of the ecological receptors to the chemicals of concern through inhalation or dermal absorption was not as significant as the potential exposure through ingestion. Failure to evaluate additional exposure routes may result in an underestimation of risk. The calculations also assume that the feeding range of the indicator species is limited to the refinery site. This would generally not be the case for larger mammals and birds, and this assumption may result in an over-estimation of the effects.

Documented NOELs for each indicator species and chemicals of concern were not available in some instances. Extrapolation from scientific studies of other, related species were used in these instances. This can result in an overstatement or understatement of the effects. The NOELs used in the chemical intake calculations were based on the following assumptions:

- The NOEL used for cadmium in raptor species was 0.20 mg/kg. This number is 1,000 times smaller than the toxic level listed for mallard ducks (Eisler 1985a). This assumption is conservative and may result in an overstatement of risk.

- The NOEL for coyote exposure to cadmium is 1,000 times smaller than the effects noted in mammals (Eisler 1985). This conservative assumption may result in an overstatement of risk.

- The NOEL used for chromium and arsenic exposure in raptor species was taken from data recorded in chickens (Eisler 1986). This may result in an under-estimation of risk.

- The NOEL for coyote for the exposure to chromium, lead, arsenic, and mercury were based on data collected for dogs.

- The NOEL applied for river otter exposure to chromium is 100 times less than documented NOELs for laboratory rats.

- NOEL data for shrews was used to establish an NOEL for river otter for lead exposure. This assumption may result in either an understatement or overstatement of risk.

- Small-mammal NOEL values from Eisler (1988) were used for river otter arsenic NOEL values.

- River otter NOEL values were taken from toxicity data collected for mink.

Food chain pathways were used to evaluate the potential effects of the chemicals of concern on the indicator species and ecological endpoints. These food chain pathways were selected to be representative of the food webs in the ecosystems evaluated and they were simplified in order to evaluate the effects of the chemicals of concern on the ecosystems effectively. However, the two ecosystems (fresh water and upland grassland) have more complex food webs than the food chain pathways indicate.

<u>Impact No. 2</u> **The estimated chemical exposure to target ecosystem species is well below the "no observed effect level." This impact is not significant.**

Table 4.15-1 provides the estimated intake of chemicals of concern emitted from the project by the target species evaluated in this assessment. The table also provides the no observed effect level (NOEL) for each chemical. As indicated in the table, the estimated chemical exposure associated with the project is well below the NOEL for every chemical.

<u>Mitigation Measure 2</u>

No mitigation is required.

4.15.3 Cumulative Impacts

The project would have no direct or indirect impact on biological resources. Therefore, it would not contribute to regional biological effects of past, present, and foreseeable future projects.

TABLE 4.15-1

CALCULATED NO OBSERVED EFFECT LEVEL IN DIET AND ESTIMATED CHEMICAL INTAKE FOR INDICATOR SPECIES AT EXXON BENICIA REFINERY (Page 1 of 2)

Species	Estimated Weight (kg)	Estimated Prey Intake (kg/day)	Calculated Chemical Intake (mg/kb-bw/day)	NOEL Diet (mg/kg)
ARSENIC				
Coyote	16[a]	0.65[d]	2.36×10^{-5}	29.54
Kestrel	0.12[b]	0.04[b]	2.76×10^{-4}	4.35
Dabbling duck	1.0[b]	0.1[e]	8.28×10^{-5}	1.45
River otter	7.5[c]	1.0[a]	1.1×10^{-4}	18.75
CADMIUM				
Coyote	16	0.65	1.6×10^{-4}	4.92
Kestrel	0.12	0.04	1.33×10^{-3}	0.6
Dabbling duck	1.0	0.1	3.99×10^{-4}	200
River otter	7.5	1.0	5.32×10^{-4}	11.48
CHROMIUM				
Coyote	16	0.65	1.99×10^{-4}	147.69
Kestrel	0.12	0.04	1.63×10^{-3}	0.30
Dabbling duck	1.0	0.1	4.90×10^{-4}	1.45
River otter	7.5	1.0	6.54×10^{-4}	13.50
COPPER				
Coyote	16	0.65	1.8×10^{-3}	NA
Kestrel	0.12	0.04	1.49×10^{-2}	NA
Dabbling duck	1.0	0.1	4.47×10^{-3}	ND
River otter	7.5	1.0	5.96×10^{-3}	97.50

TABLE 4.15-1

CALCULATED NO OBSERVED EFFECT LEVEL IN DIET AND ESTIMATED CHEMICAL INTAKE FOR INDICATOR SPECIES AT EXXON BENICIA REFINERY (Page 2 of 2)

Species	Estimated Weight (kg)	Estimated Prey Intake (kg/day)	Calculated Chemical Intake (mg/kb-bw/day)	NOEL Diet (mg/kg)
LEAD				
Coyote	16	0.65	1.35×10^{-3}	307.69
Kestrel	0.12	0.04	1.1×10^{-2}	330
Dabbling duck	1.0	0.1	3.31×10^{-3}	17.40
River otter	7.5	1.0	4.42×10^{-3}	150
***MERCURY**				
Coyote	16	0.65	1.2	3.36×10^{-5}
Kestrel	0.12	0.04	0.13	0.3
Dabbling duck	1.0	0.1	3.90×10^{-2}	9.0
River otter	7.5	1.0	0.052	5.55

*To account for bioconcentration in the food chain, soil and water concentrations taken from the Health Risk Assessment data were multiplied by 111 (bioconcentration factor for soil → small mammal → predator food chain): 3.5×10^{-3} mg/kg x 111 = 0.390 mg/kg.

[a]Jameson and Peeters (1988).
[b]Dunning (1993).
[c]Mason and MacDonald (1985).
[d]Knowlton (1993).
[e]Palmer (1988).

NA - Not applicable
ND - No pertinent data available for calculation on NOEL diet

4.16 ENERGY

This section describes the existing use of energy at the Benicia Refinery, and energy use with the Clean Fuels project.

4.16.1 Environmental Setting

Petroleum refining is an energy intensive activity, as it requires considerable heat to process crude into marketable products, primarily gasoline. For example, heat is required for refining processes such as fractionation or distillation, where crude oils and other hydrocarbon streams are essentially boiled, and the vapors separated into various process streams. Hydrocarbon cracking, hydrotreating, and other basic processes used at refineries require substantial energy consumption due to the high heat rates necessary for reactions to occur. Other equipment such as compressors and pumps also require significant energy to create the high pressures present in reaction vessels and to transfer the crude, process streams, and products between and within the refinery facilities.

There are a number of sources of energy at refineries. Exxon uses refinery gases, utility-supplied natural gas, and electricity to run the Benicia Refinery. Refinery gases consist of hydrocarbon gases such as methane, butane, and propane. These "light end" gases are a product of processing the crude oils, and Exxon uses them to fire the refinery heaters, furnaces, and boilers. The amount of light ends that are produced at a refinery will vary, depending on the specifications of the gasoline or other products that are being produced. The availability of light ends to power the refinery will also fluctuate, as the demand to sell some gases may significantly increase seasonally, such as propane during the winter. To supplement the refinery fuel gas system, Exxon uses natural gas, supplied by Pacific Gas & Electric Company (PG&E). In general, the use of natural gas is minimized as it is usually more economical to use refinery gases.

The Benicia Refinery currently uses approximately 52 megawatts (MW) of electricity. All of this electricity is provided by PG&E. PG&E supplies electricity to the refinery via the utilities transmission network to the Bahia substation, located off East Second Street. Exxon leases a portion of this substation and steps the 230 kilovolt (KV) power down to lower distribution voltages at the substation. Electricity is then distributed within the refinery to equipment and smaller substations that further step down and distribute electricity as needed. A more detailed description of the refinery's electrical supply and distribution system is provided in Section 2.6.4.

4.16.2 Impacts and Mitigation

Significance Criteria

CEQA requires that EIRs include a discussion of the potential energy impacts of proposed projects, with emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy. Significant effects are specifically defined in CEQA as those that:

- Encourage activities that result in the use of large amounts of fuel, water, or energy
- Use fuel, water, or energy in a wasteful manner

Natural Gas Consumption

No impacts are predicted related to the project's consumption of natural gas. Operation of the Clean Fuels project will result in the production of more pentane. A consequence of the reformulated fuels specifications is that pentane cannot be used in large amounts as a gasoline blending stock. This fuel will therefore be available in greater quantity to use in the Benicia Refinery's fuel gas system, and Exxon does not expect to increase the use of natural gas as a supplementary fuel. It is foreseeable that there may be periods of time when sufficient refinery fuel gases are not available and the rate of natural gas use increases, but this is not expected to occur over the long term, and no impacts are identified.

Electricity Consumption

As reported in Section 2.6.4, the Clean Fuels project will increase electricity use at the refinery by approximately 13 MW, a 25 percent increase over the current base load. Exxon has proposed substation and distribution facilities and equipment that can adequately deliver the electricity to the Clean Fuels project. The refinery is supplied with electricity directly from PG&E's existing 230 KV transmission system, and no changes to the utility's electrical equipment are required. Therefore, the project would have no impacts to electrical transmission and distribution equipment outside of the refinery.

The Clean Fuels project would increase the rate of consumption of electricity, and this is discussed as follows:

Impact No. 1 **Operation of the Clean Fuels facilities will increase the rate of electricity consumption. This impact is not significant.**

The 13 MW electrical demand for the Clean Fuels project can be adequately supplied by PG&E to the Benicia Refinery. PG&E staff contacted for this EIR indicated that this demand could be met through the utility's existing power supply and transmission network (Calvert 1993). PG&E would investigate the specific requirements for power supply during the final design of the project, but no significant impacts related to providing this power were foreseen.

The use of energy is specifically for processing crude oil into petroleum products, primarily gasoline. Due to the cost of refining, nearly all components of crude oil are captured and produced into a marketable product. Energy is a substantial cost of refining and is minimized through the conservation and reuse of heat for various petroleum processing streams. Since a primary goal of petroleum refining is to produce the maximum amount of gasoline possible, which has one of the highest heat or energy contents of all petroleum products, energy content of a petroleum processing stream is conserved to the extent that is feasible and cost efficient. The Clean Fuels project will allow Exxon to manufacture reformulated fuels in accordance with applicable regulations, and the project would not result in the inefficient or wasteful use of energy resources.

Mitigation Measure No. 1

No mitigation is required.

4.16.3 Cumulative Impacts

<u>Impact No. 2</u> **Reformulated fuels and other related projects will not have a net cumulative impact to electrical demand. This is not a significant impact.**

Other related projects in the regional area, described in Section 3.0, include reformulated fuels projects at other Bay Area refineries, related projects at the Exxon Benicia Refinery, and a proposed cogeneration plant at the Crockett C & M sugar plant. All of the reformulated fuels projects will require additional electricity, although some refineries (Shell Martinez Manufacturing Complex and Pacific Refining in Hercules) include new power plants that will offset new electrical needs. The known electrical requirements for each of the major related projects is as follows:

Project	**Net New Electricity Demand**
Exxon Clean Fuels	13 MW
Chevron Reformulated Gas and FCC Plant Upgrade	20 MW
[1]Shell Clean Fuels	(-5 to 20 MW)[2]
Pacific Refining	0
TOSCO Reformulated Fuels	Unknown
Unocal Reformulated Fuels	Unknown
Exxon MTBE Plant	0.5 MW
Exxon NO_x Reduction Project	0.7 MW
Total Net Demand	-5.3 to +9.7 MW

As a result of reformulated fuels modifications at regional refineries, and the other related projects listed above, there will be a range in demand on the PG&E system from a decrease of -5.3 MW to an increase of 9.7 MW over the next four years (1994 to 1997) as these projects are brought on line.

[1] Shell's proposed cogeneration plant will produce electricity in excess of the needs of their clean fuels project, which will offset existing electrical demand by 5 to 20 MW.

The C & H sugar plant cogeneration plant will produce 240 MW of electricity for use at the sugar plant and for sale to the PG&E system. The addition of this new cogeneration facility will more than offset the net electrical requirements of the refinery projects. No significant cumulative impacts for electrical requirements are anticipated.

The Exxon Clean Fuels project is not expected to require any substantial amounts of additional natural gas, as most project gas requirements will be met through the increased production of pentane and the existing refinery fuel gas system. The Exxon Clean Fuels project will therefore not contribute to cumulative impacts of natural gas consumption.

Mitigation Measure No. 2

No mitigation is required.

4.17 GROWTH INDUCEMENT

4.17.1 CEQA Requirements

CEQA Guidelines [Section 15126(g)] specify what should be considered a growth-inducing impact of a proposed project. The guidelines state:

> *Discuss the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment. Included in this are projects which would remove obstacles to population growth . . . Increases in the population may further tax existing community service facilities so consideration must be given to this impact. Also discuss the characteristic of some projects which may encourage and facilitate other activities that could significantly affect the environment, either individually or cumulatively. It must not be assumed that growth in any area is necessary beneficial, detrimental, or of little significance to the environment.*

Based on these guidelines, the following criteria are evaluated for growth-inducing impacts:

- Would the project cause economic (job) or population growth?
- Would the project foster or facilitate growth?
- Would the project remove obstacles to growth?
- Would the project directly or indirectly affect growth?
- Would the project-related growth adversely affect the environment?

The discussion of growth-inducing effects of the proposed project addresses the potential for the project to directly or indirectly cause population growth and job growth by facilitating it or removing any existing obstacles to growth in the local area and the region.

4.17.2 Growth Inducing Employment Impacts

As discussed in Section 4.11, the construction of the proposed project would create an average of 500 jobs in the region for 2 years, with a six-month peak of 880 construction jobs. Given the size of the Bay Area civilian labor force, especially the construction trades labor force (about 188,000 resident construction workers in the Bay Area as of 1990), these 500 to 880 jobs would represent a beneficial but insignificant temporary effect because these would employ about 0.3 percent of the Bay Area construction workers.

Indirect employment impacts would be generated through the multiplier process. The indirect or multiplier effect refers to indirect employment and earnings created in a region due to an initial investment. As the directly employed 500 construction workers spend their income on goods and services, and construction materials and equipment are purchased and/or rented by the refinery, this expenditure increases the demand for goods and services, and businesses that provide these goods and services hire more workers to meet this increased demand. Based on employment multipliers developed by Association of Bay Area Governments in its 1987 input-output model for the Bay Area, it is estimated that about 435 indirect jobs would be created in the Bay Area by 500 direct construction jobs. This estimate is based on a Type I multiplier which assumes that the regional economy is "open", i.e., some of the income is to be spent outside the region. If a Type II multiplier is used, which assumes that the economy is "closed" and there is no leakage of income from the economy, the indirect and induced employment would be larger, around 2,375 jobs.

Project operations would create 30 new operations jobs at the refinery. Using the ABAG Type I multiplier for petroleum refining, the project would indirectly trigger the creation of about 35 jobs in the Bay Area. Using a Type II multiplier, the indirect employment associated with project operations would be about 168 jobs.

Both direct and indirect jobs created by the project would benefit the region. Construction phase employment effects would be short-term, and indirect effects are likely to be smaller than the estimate because typically there is a time lag before support/service jobs are actually created, and if the construction phase is not very long, these jobs may not be created. Operations employment effects would be long-term, but the total of about 200 jobs (30 direct and 168 indirect jobs) would be a small, beneficial effect for the region. The addition of these jobs would not create a significant change in the regional or local economy.

4.17.3 Growth-Inducing Population Impacts

For reasons presented in Section 4.11, the direct construction and operation jobs at the refinery are likely to be filled by persons hired out of the regional labor pool, and immigration of non-local workers and their dependents in response to these jobs, is not anticipated. Therefore population growth due to immigration should not occur.

Indirect employment triggered by the project is also not anticipated to lead to influx of non-local workers. This is because new jobs could be filled by existing unemployed or under-employed persons in the region. As of May 1993, the average unemployment rate in the nine Bay Area counties was 6.5 percent (210,300 unemployed persons), and is projected to peak in late 1993 and early 1994 to begin a slow trend down in mid- to late-1994 (Perron 1993). In the same month, the unemployment rate for Solano County was 8.7 percent with about 14,100 persons unemployed (Gonzales 1993). Besides indirect jobs typically tend to be low wage, and workers do not typically migrate in response to low paid jobs. Little if any regional population growth would be caused by the project.

4.17.4 Growth Inducing Impacts of Refinery Output

The proposed modifications would not result in increased output of gasoline and other products. As a consequence, no new refinery output or by-product-using industries are likely to be attracted to the region to be close to the refinery. Also, no changes in the number of existing users of refinery products are anticipated. Therefore the project would not induce industrial growth in the region.

In sum, the project is not expected to be job or population growth inducing or likely to cause changes to the industrial base of the region.

4.18 SIGNIFICANT ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

The California Environmental Quality Act requires that an EIR identify those impacts that cannot be avoided. Unavoidable impacts are those where no mitigation can be identified that results in avoidance of an impact or reduction of the magnitude of the impact to a level that is less than significant. The single impact that is unavoidable are described below.

4.18.1 Air Quality

All air quality impacts are avoided or mitigated to levels of insignificance except for short-term construction emissions of NO_x and PM_{10}. A mitigation measure consisting of requiring construction contractors to use equipment where feasible that meets Best Available Control Technology specifications would reduce this impact. With this mitigation, it is expected that there would still be short-term periods when emissions of these pollutants exceed applicable criteria and standards. This impact would be limited to the construction period.

5.0
ALTERNATIVES

5.1 INTRODUCTION

The California Environmental Quality Act (CEQA) requires an EIR to describe and evaluate a reasonable range of alternatives to the proposed project. The purpose of the analysis is to evaluate alternatives that may eliminate significant environmental impacts. This is done to foster informed decision-making and public participation in the environmental process.

Alternatives considered in the EIR should be feasible and should attain the proposed project's basic objectives. As discussed in Section 2.5, the purpose of the Clean Fuels project is to produce the reformulated gasoline specified in the Federal Clean Air Act Amendments of 1990 and California law. The proposed project would also replace the use of anhydrous ammonia in existing and proposed air pollution control equipment with aqueous ammonia.

An EIR may evaluate an alternative that reduces the proponent's ability to attain all of the project objectives, or an alternative that increases project costs. The range of alternatives studied in an EIR must be broad enough to permit a reasoned choice by decision-makers when considering the merits of a project. The analysis should focus on alternatives that can be reasonably attained and should avoid alternatives that are remote or speculative.

Typically, the CEQA Guidelines require an EIR to evaluate a "no project" alternative and alternative sites for the proposed project. Section 21178.1 of the California Public Resources Code addresses the environmental review of permits for the construction of facilities, processing units, or equipment necessary to produce reformulated gasoline that meets the State's Phase 2 specifications. Paragraph (h) of Section 21178.1 states:

> "No environmental impact report shall include a discussion of a "no project" alternative, nor shall it include a discussion of any alternative sites for the project which are outside of existing refinery boundaries."

As discussed in Chapter 2.0, all of the process equipment associated with the proposed project is designed to produce reformulated gasoline that meets federal and state specifications. The proposed heartcut tower and saturation unit are designed to reduce the benzene content of the gasoline blending stocks produced by the refinery. The C_5/C_6 splitter would reduce the Reid vapor pressure of the gasoline blending stocks. The proposed light cat naphtha hydrofiner would reduce the sulfur and olefin content of the gasoline. The proposed T90 towers would reduce the T90 temperature of the gasoline. The proposed hot oil system, hydrocarbon tanks, and modifications to the hydrocracker unit, hydrogen plant, heavy cat naphtha hydrofiner, and virgin light ends equipment would be required to support the process units added to the refinery to produce reformulated gasoline. The only project feature that would not be required to produce reformulated fuel is the installation of an aqueous ammonia tank to store the aqueous ammonia to be used for emission control equipment.

5.2 ALTERNATIVES IDENTIFIED FOR THE PROPOSED PROJECT

Process units designed to maximize the production of light fuel products (e.g., gasoline, jet fuel, and diesel) from crude oil are already in place at the refinery. The purpose of the proposed project is to add equipment that would modify the gasoline blending stocks already produced in these existing process units. Any other approach to producing reformulated gasoline would require a completely different approach to refinery design. Alternatives that encompass other crude oil processing methods would require complete alteration of the existing refinery at a cost exceeding many hundreds of millions of dollars. The Benicia Refinery is relatively new and the existing process equipment is state-of-the-industry. It is unlikely that complete alteration of the facility would result in significantly different environmental effects than the existing refinery and the proposed project.

The refinery product specifications are defined by federal and state legislation. In order for the Benicia Refinery to remain competitive, it must produce reformulated gasoline. Given the existing refining processes at the facility and the legislated product specifications, there are few technological alternatives available to meeting project objectives. Those alternatives with the potential for meeting project objectives were considered by Exxon during the development of the project design, and include:

- Installation of an extraction or adsorption unit to reduce the benzene content in reformate and light hydrocrackate instead of using a heartcut tower and saturation unit.

- Reprocessing the heavy cut from the T90 towers in the catalytic cracking unit instead of the hydrocracker.

- Installation of a fractionation tower to split the heavy cut from the existing hydrocracker into diesel and jet fuel. This alternative would also require the installation of a saturation unit to further process the jet fuel to reduce its aromatic content in order to meet regulatory specifications.

- Installation of a steam boiler to provide process heat for the heartcut tower and saturation unit instead of the installation of a hot oil system.

- Expansion of existing cooling water system to provide process cooling instead of using air fin coolers.

Because the proposed project has a focused objective, alternatives other than differences in technology are limited. As discussed in Section 5.1, Section 21178.1 of the California Public Resources Code expressly prohibits consideration of the no project alternative and alternative sites outside the refinery property. The process equipment that constitutes most of the proposed project would be located within the existing refinery process block. Other land within the refinery property where this equipment could be located lies to the north and west of the existing process block. These alternative sites would place the proposed process equipment closer to offsite residences than the proposed project, increasing the hazard to these residences. The existing process block is already graded, requiring little additional preparation work for project construction. Location of the project elsewhere on the refinery property would require extensive grading. Placement of the project outside the process block would require longer pipe runs and larger pumps to connect project process equipment and existing refinery equipment. This would increase the potential for accidental spills and increase project emissions.

In addition to the technology alternatives considered by Exxon, two other alternatives were identified during environmental studies of the project. In accordance with CEQA Guidelines, a down-sized project was considered since this could potentially reduce project emissions, generation of wastewater, and visual impacts. Processing only low sulfur crude oil at the refinery was also considered as a project alternative. This would reduce the volume of hydrogen sulfide, an acutely hazardous material, present in existing and proposed refinery equipment at any given time.

5.2.1 Technology Alternatives

Extraction or adsorption unit. This alternative would require the installation of an extraction or adsorption unit instead of a saturation unit to remove benzene from the heartcut fraction of the reformate and light hydrocrackate. An extraction or adsorption unit would has essentially the same heat and water requirements as the proposed saturation unit. Therefore, this alternative would have the same air quality and water quality impacts as the proposed project. An extraction or adsorption unit would be placed in the same location as the proposed saturation unit, and it would be essentially the same size. As a result, other impacts of this alternative, such as visual impacts, would be the same as the proposed project.

Reprocess T90 Heavy Cuts in Catalytic Cracking Unit. This alternative would require the installation of a new satellite reactor for the existing catalytic cracking unit in order to process the increased input to the unit. The use of two reactors is not a proven technology for catalytic cracking units. To ensure reliable, safe operation of this type of modification, it would be necessary to construct a pilot unit to confirm the design.

This alternative would have many of the same impacts as the proposed project. Heat requirements for processing the heavy cuts from the T90 towers in the catalytic cracking unit would be the same as for processing this material in the hydrocracker unit; therefore, criteria and air toxic pollutant emissions would be essentially the same for the alternative as for the proposed project. This means that air quality and public health risk impacts for the alternative would be the same as for the proposed project. This alternative would not substantially alter project construction or operation requirements relative to the proposed project; therefore, traffic and socioeconomic impacts would be the same. The alternative would require the addition of more process equipment than the proposed project. This would increase the visibility of the project to a minor degree and also increase the number of noise sources in the refinery.

A catalytic cracking unit is inherently more hazardous than a hydrocracker. The hydrocracker is a closed system. On the other hand, a catalytic cracking unit requires the introduction of air to a vessel in the unit to regenerate the catalyst. Pressure imbalances between the reactor and regeneration vessel could result in the intrusion of air into the reactor, leading to a major explosion. Modification of the existing catalytic cracking unit using relatively unproven technology could increase the potential for the occurrence of this major hazard. Increasing the throughput of the existing hydrocracker would not substantially alter the hazards associated with that unit.

Production of Diesel and Jet Fuel from Hydrocracker Bottom Cut. In the existing refinery, the bottom cut from the hydrocracker is reprocessed in the hydrocracker to produce lighter fuel products. The proposed project also calls for reprocessing the heavy cuts from the proposed T90 towers in the existing hydrocracker. This would require modifications to the hydrocracker to handle the increased throughput to this unit.

Under this alternative, the bottom cut from the hydrocracker would not be reprocessed. Instead, this cut would be put through a new fractionation column to produce diesel and jet fuel. In order to meet regulatory specifications for jet fuel, it would also be necessary to install an additional saturation unit to reduce the aromatic hydrocarbon content of the fuel.

This alternative would require the installation of additional process heaters for the fractionation column and saturation unit. This would increase criteria pollutant emissions, particularly NO_x and SO_x, relative to the proposed project. Because this alternative would add valves, flanges, and pumps to the project, it would increase fugitive emissions of air toxics. This alternative would increase the number of noise sources at the refinery relative to the proposed project because it would require more pumps and heaters. Construction-related traffic would also increase relative to the proposed project because of the addition of more process equipment. The alternative would add towers and stacks to the project, increasing its visibility to a minor extent.

Expansion of Refinery Steam System. In this alternative, steam would be used to provide heat to the proposed new process equipment instead of a hot oil system. Expansion of the existing steam system at the refinery would require the construction of a new boiler with essentially the same heat output as the heater proposed for the new hot oil system.

This alternative is essentially the same as the proposed project except that heat would be conveyed to the new process equipment by steam rather than by hot oil. The alternative would have the same impacts as the proposed project except that it would generate more wastewater. As discussed in Chapter 2.0, the hot oil would be contained in a closed system and would be recycled. Water used in the production of steam builds up minerals over time and a small portion of the water must be continuously discharged (blowdown) and replaced with fresh water to prevent a build up of these minerals to a point that they would begin fouling boiler and heat exchanger equipment. This would increase the water use of the refinery and the production of wastewater relative to the proposed project.

Expansion of Existing Cooling Water System. The proposed project equipment requires cooling for some process streams. Under the proposed project, this cooling would be provided by air through fin coolers. This alternative would replace the fin coolers with an expansion of the existing cooling water system. This would not change any of the potential impacts of the proposed project and would require additional water. As in the case with the steam system, a small portion of the cooling water must be continuously discharged and replaced with fresh water to prevent mineral build up. Therefore, this alternative would also increase the amount of wastewater generated by the project.

5.2.2 Down-Sized Project

With this alternative, proposed process equipment would be scaled down in size so project throughput would be reduced. This does not mean that the overall refinery throughput would decrease. Existing process equipment would have to continue to operate at about its current throughput to avoid plugging or equipment failure[1]. Therefore, a portion of the refinery

[1] Throughput on much of the process equipment is critical to maintaining proper heat balance. For example, petroleum is typically heated in a refinery by carrying it through a heater or heat exchanger in small diameter pipes or tubes. The petroleum in the pipes takes up much of the heat, preventing damage to the pipes. At low enough flow rates, the petroleum would not afford adequate protection, and the pipes would heat up to a point where they

gasoline stock would meet the reformulated fuel requirements and a portion would be non-reformulated fuel. The non-reformulated fuel could not be sold in California, and the refinery would likely have to seek overseas markets for this fuel.

Down-sizing the project would not eliminate any process equipment, but rather scale-down individual process components. This is done primarily by means such as using smaller diameter pipes and valves, pumps with less horsepower, smaller vessels, and smaller diameter fractionation towers rather than by eliminating equipment.

This alternative would result in a reduction in emissions of criteria and toxic air pollutants. It may also result in a reduced need for shipping pentane offsite because less would be produced. All other potential project impacts would remain essentially the same.

5.2.3 Process Only Low Sulfur Crude Oil

Under this alternative, the Benicia Refinery would process only very low sulfur "sweet" crude. This crude would contain a maximum of 0.1 percent sulfur. By comparison, the Benicia Refinery currently processes primarily Alaska North Slope crude which has a sulfur content of about 1.2 percent.

This alternative would still require the installation of all of the proposed process equipment. This equipment is necessary to produce reformulated fuels regardless of the sulfur content of the crude oil.

The use of only low sulfur crude oil would reduce SO_x emissions from the refinery. There would still be sufficient sulfur in the average shipment of sweet crude for hydrogen sulfide to be generated by the refinery; however, the volume of hydrogen sulfide in a given process unit would be significantly less than with the use of higher sulfur crudes such as Alaska North Slope crude. Since sulfur compounds are a principal source of odor from the refinery, the reduction in sulfur handling would reduce the potential for odors from the facility. The concentration of hydrogen sulfide offsite would also be potentially less in the event of a major accident involving the release of gas since there would be less total volume present.

---

failed.

West Coast refiners importing sweet crude oil can be categorized into two general groups: companies that process sweet crude that they own (equity production) and companies that do not own sweet crude production and purchase this crude to supplement their base supplies when it is available on the spot market at an appropriate price. Many refiners import sweet crudes as small percentages of their crude supplies. However, in all cases this sweet crude is used in refineries designed to process relatively sour crudes.

A refinery forced to rely on a base load of imported sweet crude acquired at market prices is at a fundamental economic disadvantage in the West Coast market place where all of its competitors have access to lower cost domestic crude supplies with higher sulfur content, which are in surplus at or below world parity prices. If this were not the case, refineries would routinely rely on sweet crude supplies to produce low sulfur finished products. In order for a refinery on the West Coast to compete effectively in the market place on a long-term basis processing sweet crudes, the sweet crude supplies would have to be acquired at a discount to their prevailing market prices. This is not possible.

Sweet crude oils are produced throughout the world, but there are only a limited number of sources available to the Benicia Refinery. Domestic sweet crudes are refined locally near the production point and are not available to the Benicia Refinery. South American production of sweet crude is relatively small and most of it is used in the country of origin or Brazil which is a net importer of about 700,000 barrels/day of crude. Shipping costs make North Africa and West Africa sweet crudes inaccessible to the Benicia Refinery. Production of sweet crude from the North Sea is too small to represent a reliable source for the refinery. Pacific Rim producers are the only source of sweet crude that have sufficient production and are close enough to the refinery to be reasonably considered as supplies of a base load of crude. The Pacific Rim is a net buyer of crude oil and demand for sweet crude is increasing. At the same time, overall production of this high quality crude is in decline. Many industry experts are forecasting that eastern Asia will cease to be an exporter by the late 1990s.

Most of the Pacific Rim sweet crude that is of a suitable quality for use in the Benicia Refinery and is available in sufficient quantities to be considered for a base supply is among the highest priced crudes in the world. Prices for this crude are established on a retroactive basis so as to achieve the highest possible price. In other words, the oil is shipped to the customer prior to the price being set. Depending on timing, this may mean that the customer processes the oil prior to knowing its cost. This makes economic planning impossible if sweet crude is used as a base load for a refinery. Generally, buyers only use this supply of sweet crude as a supplement to enhance the yield of their base load crude.

In conclusion, it is not economically feasible for Exxon to obtain a long-term supply of sweet crude. Supplies of this type of crude that are the right quality for the refinery are limited. If a long-term supply could be obtained, its cost would be prohibitive. Therefore, this potential alternative does not meet the basic objective of the proposed project to allow Exxon to produce clean fuels and the alternative must be rejected.

5.3 CONCLUSIONS

All of the identified alternatives would have greater environmental impacts than the proposed project except for down-sizing the project. Down-sizing the project would result in the production of a substantial volume of gasoline that would not meet federal and state reformulated fuel specifications. This gasoline would have to be sold outside the United States or further processed at another refinery to meet the reformulated fuel specifications. This alternative would place the Benicia Refinery at a substantial competitive disadvantage and may jeopardize the economic viability of the facility.

Down-sizing the project would not produce substantial environmental benefits. It would reduce emissions of criteria and air toxic pollutants. However, the amount of these pollutants emitted by the proposed project is relatively small and would not result in significant air quality impacts. Because the environmental benefits of this alternative would be small and it could cause the facility to cease operations, it was eliminated as a viable alternative to the proposed project. Therefore, the conclusion of the Alternatives Analysis is that the proposed project is the environmentally superior alternative.

6.0
REFERENCES

Adriano, D.C. 1992. Biogeochemistry of trace metals. Lewis Publishers.

AIHA/ORC. 1988. Emergency Response Planning Guidelines. American Industrial Hygiene Association and the Organization Resources Counselors, Inc. 1988-1990.

Air and Waste Management Association (AWMA). 1992. Air Pollution Engineering Manual.

American Institute of Chemical Engineers, Center for Chemical Process Safety (AIChE). 1989. Guidelines for Chemical Process Quantitative Risk Analysis.

American Petroleum Institute. 1989. Reported Fire Losses in the Petroleum Industry for 1988. Washington, D.C.

Amoore, J.E., and E. Hautala. 1983. Odor as an Aid to Chemical Safety: Thresholds Compared to Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution. Journal of Applied Toxicology, Vol. 3, No. 6, pp. 272-289.

Association of Bay Area Governments (ABAG). 1991. Recession Update - Projections 92, Forecasts for the San Francisco Bay Area to the Year 2010.

Association of Bay Area Governments (ABAG). 1992. Projections 1992 including Recession Update. December.

Bay Area Air Quality Management District (BAAQMD). 1985, revised 1991. Air Quality and Urban Development Guidelines for Assessing Impacts of Projects and Plans. San Francisco, California.

Bay Area Air Quality Management District (BAAQMD). 1991a. Base Year 1987 Emissions Inventory Summary Report. San Francisco, California. October.

Bay Area Air Quality Management District (BAAQMD). 1991b. Bay Area 1991 Clean Air Plan, Volume IV. San Francisco, California.

Bay Area Air Quality Management District (BAAQMD). 1992a. Toxic Air Containment Control Program: Annual Report, 1992. Vols. I-III.

Bay Area Air Quality Management District (BAAQMD). 1992b. BAAQMD CTG Refinery Emission Factors (December 23, 1992 revision). San Francisco, California.

Bay Area Air Quality Management District (BAAQMD). 1993a. Personal communication from Patricia Ann Holmes to Stephen Brown, ENSR. March.

Bay Area Air Quality Management District (BAAQMD). 1993b. Personal communication from Brian Bateman to Joan Lampheir, City of Benicia. June.

Bay Area Air Quality Management District (BAAQMD). 1993c. Personal communication from Brian Bateman to John Koehler, Woodward-Clyde Consultants. July 21.

Bay Area Air Quality Management District (BAAQMD). 1993d. Personal communication from William Taylor to David Weintraub, Woodward-Clyde Consultants. June 24.

Benicia, City of. 1979a. City of Benicia General Plan.

Benicia, City of. 1979b. Noise Element of the City of Benicia General Plan.

Benicia, City of. 1992. Chapter 8.20, Benicia City Code. Noise Regulations.

Benicia, City of. 1993. Ordinance No. 93-3 N.S. Zoning Ordinance Amendments Related to Industrial Uses and Nonconforming Uses (ZO 92-1). Adopted by City Council Resolution. January.

Bennyhoff, J.A. 1977. Ethnogeography of the Plains Miwok. Dais: University of California, Center of Archaeological Research at Davis, Publications 5.

Bickel, P.M. 1978. Changing Sea Levels Along the California Coast: Anthropological Implications. The Journal of California Anthropology 5(1):6-20.

Bortugno, E.J. 1982. Map showing recency of faulting: California Division of Mines and Geology Regional Geologic Map Series, Map No. 2A, sheet 5 of 5. Scale 1: 250,000.

Botti, F. (Biologist, California Department of Fish and Game, Region 3). 1993. Personal Communication with Woodward-Clyde Consultants.

Cairns, J., K.L. Dickson, and A.W. Maki. 1981. Estimating the hazard of chemical substances to aquatic life. ASTM. STP 657. Philadelphia, PA.

California Air Pollution Control Officers Association (CAPCOA). 1990. Air Toxics "Hot Spots" Program: Risk Assessment Guidelines. July.

California Air Pollution Control Officers Association (CAPCOA). 1992. Air Toxics "Hot Spots" Program: Risk Assessment Guidelines. January.

California Air Resources Board (CARB). 1991. Proposed Regulations for California Phase 2 Reformulated Gasoline. Technical Support Document. October 4.

California Air Resources Board (CARB). 1993. Emission Benefits Analysis - Phase 2 Reformulated Gasoline. CARB Stationary Source Division. January 13.

California Department of Finance. 1993. Population Estimates for California Cities and Counties. Report 93 E-1. May.

California Department of Water Resources (CDWR). 1975. California's Ground Water. Bulletin 118. September.

California Department of Water Resources (CDWR). 1980. Ground Water Basins in California. Bulletin 118-80. January.

California Regional Water Quality Control Board (RWQCB). 1990. TriRegional Board Staff Recommendation for Preliminary Evaluation and Investigation of Underground Tanks. August 10.

California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB). Amended 1991. Water Quality Control Plan. San Francisco Bay Basin Region (2).

California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB). 1993a. Proposed Amendment to the Water Quality Control Plan: Hearing to Consider Adoption of Wasteload Allocation for Copper for San Francisco Bay.

California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB). 1993b. (Obtain lit. cited from T. Cooke)

Calvert, J. 1993. Pacific Gas & Electric Company. Personal communication with Jeff Zimmerman, Woodward-Clyde Consultants. June 22.

Calvert, S., and H.M. Englund, eds. 1984. Handbook of Air Pollution Technology, p. 848. New York: John Wiley & Sons.

Cha, S.S. 1991. Odor Thresholds for Chemicals with Established Occupational Health Standards.

Chevron. 1993. Chevron Reformulated Fuels Project EIR. August.

Clancey, V.J. 1972. Diagnostic Features of Explosion Damage. Sixth International Meeting on Forensic Sciences. Edinburgh, Scotland.

Exxon Research and Engineering Company (ER&E). 1993a. Application for a Use Permit. Benicia Refinery Clean Fuels Project. Vol. II, Health Risk Assessment. Revised. May.

Exxon Research and Engineering Company (ER&E). 1993b. Personal communication from Seon-Hee Shin to Stephen Brown, R2C2. July 9.

Gonzales, G. 1993. Employment Development Department, San Francisco. Personal Communication with Woodward-Clyde Consultants. August.

Hammer, K. 1993. City of Benicia Senior Planner. Personal communication with Woodward-Clyde Consultants. July 11.

Hammonds, S.J. 1993a. Exxon Company, U.S.A. Letter to Joan Lamphier, City of Benicia. April 5.

Hammonds, S.J. 1993b. Exxon Company, U.S.A. Letter to Joan Lamphier, City of Benicia. July 7.

Hammonds, S.J. 1993c. Exxon Company, U.S.A. Personal communication to City of Benicia. June 8.

Hanley, K. 1993. Fire Chief, City of Benicia. Personal communication with Woodward-Clyde Consultants. August.

Harding Lawson Associates (HLA). 1992a. Geotechnical Investigation MTBE Process Equipment Area, Exxon Benicia Refinery.

Harding Lawson Associates (HLA). 1992b. Preliminary soil investigation, methanol tank, Benicia Exxon Refinery.

Harding Lawson Associates (HLA). 1993a. Background Information Included in March 19, 1993 Free Phase Hydrocarbon Recovery Project Request for Proposal. March.

Harding Lawson Associates (HLA). 1993b. Geotechnical and Hydrogeological Evaluation Clean Fuels Project, Exxon Benicia Refinery.

Harms, K. 1993. City of Fairfield Transportation Modeler, Solano County CMA Model Output for the Year 2000. July 6.

Jameson, E.W., and H.J. Peeters. 1988. California Mammals. Berkeley, CA: University of California Press.

Johnson, P.J. 1978. The Patwin. In R.F. Heizer, Vol. ed., Handbook of North American Indians, Vol. 8: California: 350-360. Washington, D.C.: Smithsonian Institution.

Kitz, F. 1993. Southern Pacific Railroad Company, Martinez Yardmaster. Personal communication with Woodward-Clyde Consultants. July 7.

Knowlton, F. 1993. Professor of Ecology, Utah State University. Personal communication with Woodward-Clyde Consultants. June.

Lees, F.P. 1980. Loss Prevention in the Process Industries. Butterworths, London, Boston (ISBN 0-0408-10604-2).

M&MPC (M&M Protection Consultants). 1990. Large Property Damage Losses in the Hydrocarbon-Chemical Industries, a Thirty-Year Review.

Mason, C.F., and S.M. MacDonald. 1985. Levels of Cadmium, Mercury and Lead in Otter and Mink Faeces from the United Kingdom. In The Science of the Total Environment, Vol. 53, pp. 139-146.

McNutt, S.R., and T.R. Toppozada. 1990. Seismological effects of the 17 October 1989 earthquake, In McNutt, S.R., and Sydnor, R.H., eds., The Loma Prieta (Santa Cruz Mountains) California, Earthquake of 17 October 1989. California Division of Mines and Geology Special Publication 104, pp. 11-27.

Moratto, M.J. 1984. California Archaeology. Orlando: Academic Press.

Moriarty, F. 1990. Ecotoxicology. The Study of Pollutants in Ecosystems. Academic Press.

Mualchin, L., and A.L. Jones. 1992. Peak accelerations from maximum credible earthquakes in California. California Division of Mines and Geology, Open-File Report 92-1.

Mustain, V. 1993. City of Benicia, Director of Public Works. Letter to Dan Lovegren, Caltrans Local Programs. April 22.

Natanson, Paul S. 1993a. Exxon Benicia Refinery Clean Fuels Project Community Impact Study. Exxon Research and Engineering Company. May.

Natanson, Paul S. 1993b. Exxon Research and Engineering Company. Letter to Richard Rodkin, Illingworth & Rodkin, Inc. regarding Benicia Clean Fuels Project Noise Report. July.

National Climatic Data Center. 1988. Climatological Data Annual Summary, California. Volume 94, Number 13.

National Climatic Data Center. 1992. Monthly Station Normals of Temperature Precipitation, Heating and Cooling Degree Days, 1961-1990, California.

National Geographic Society. 1987. Field Guide to Birds of North America. Washington D.C.

OES. 1989. State of California Guidance for the Preparation of a Risk Management and Prevention Program. California Office of Emergency Services, November 1989.

Office of Historic Preservation. 1990. California Historical Landmarks. Sacramento, CA: California Department of Parks and Recreation.

Ogden Environmental and Energy Services Co. 1992. Draft Environmental Impact Report. City of Benicia Sky Valley Benicia Specific Plan. July.

Omni-Means. 1993a. Freeway ramp volume counts (unpublished; counts conducted for the Exxon Clean Fuels Project).

Omni-Means. 1993b. Memo to Illingworth & Rodkin regarding traffic data. July 8.

Palmer, ed. 1988. Handbook of North American Birds. Volume 4. Yale University Press.

Perron, D. (Analyst, Employment Development Division, San Francisco). Personal communication with Woodward-Clyde Consultants. June.

Peterson, R.T. 1961. A Field Guide to Western Birds, Second Edition. Boston, MA: Houghton Mifflin Company.

Process Safety Progress. 1993. Vapor Cloud Explosion - Second Update, 1991, Vol. 12, No. 1.

Radian. 1991. Radian Corporation. Air Toxic "Hot Spots" - AB 2588 Health Risk Assessment for the Exxon Benicia Refinery. Final Updated. April.

Risks of Radiation and Chemical Compounds (R2C2). 1993. Public Health Impacts of Air Emissions from the Exxon Clean Fuels Project. R2C2 Project No. 930602. Oakland, CA. July.

San Francisco Estuary Project (SFEP). 1992. Status and Trends Report on Aquatic Resources in the San Francisco Estuary.

Santa Barbara County Air Pollution Control District. 1991. Flare Study, Phase I Report.

Solano County Planning Department. 1992. Solano County Land Use and Circulation Element. Solano County General Plan. August.

Solano County Planning Department, Solano County Mosquito Abatement District, and City of Fairfield Department of Environmental Affairs. 1980. Suisun March Local Protection Program. March.

Stern, A.C., ed. 1976. Air Pollution, Volume III: Measuring, Monitoring, and Surveillance of Air Pollution, pp. 335-336. New York: Academic Press.

Stocky, William D. 1992. Benicia MTBE Unit. Community Noise Assessment. Exxon Research and Engineering Company. April.

Tang, Lila. 1993. Regional Water Quality Control Board, San Francisco Bay Region. Personal communication with Woodward-Clyde Consultants. July.

Thomasson, H.G., F.H. Olmstead, and E.F. LeRoux. 1960. Geology, Water Resources and Useable Groundwater Storage Capacity of Part of Solano County, California. U.S. Geological Survey Water Supply Paper 1464.

Tolman, C.F. 1931. Geology of the upper San Francisco Bay region. California Division of Water Resources Bulletin 28, Appendix D, pp. 311-359.

Toppozada, T.R, and D.L. Parke. 1982. Areas damaged by California earthquakes, 1900-1949. California Division of Mines and Geology Open File Report 82-17 SAC.

Toppozada, T.R, C.R. Real, and D.L. Parke. 1981. Preparation of isoseismal maps and summaries of reported effects for pre-1900 California earthquakes. California Division of Mines and Geology Open File Report 881-11.

Transportation Research Board (TRB). 1980. Interim Materials on Highway Capacity, Circular 212. January.

Transportation Research Board (TRB). 1985. Highway Capacity Manual - Special Report. 209.

Transportation Research Board (TRB). 1991. Interim Materials on Unsignalized Intersection Capacity, Circular 373. July.

U.S. Department of Health and Human Services. 1991a. Toxicological Profile for Arsenic.

U.S. Department of Health and Human Services. 1991b. Toxicological Profile for Chromium.

U.S. Department of Health and Human Services. 1991c. Toxicological Profile for Mercury.

U.S. Department of Transportation. 1986. Manual on Uniform Traffic Control Devices, Revision No. 4. March.

U.S. Environmental Protection Agency (EPA). 1985. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary, Point, and Area Sources. OAQPS. Research Triangle Park, North Carolina.

U.S. Environmental Protection Agency (EPA). 1989. Interim Final Risk Assessment Guidance for Superfund. Volume II. Environmental Evaluation Manual.

U.S. Environmental Protection Agency (EPA). 1991. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary, Point, and Area Sources. Supplement D. OAQPS. Research Triangle Park, North Carolina.

U.S. Environmental Protection Agency (EPA). 1993. Protocol for Equipment Leak Emission Estimates. EPA-453/R-93-026. OAQPS. Research Triangle Park, North Carolina.

U.S. Soil Conservation Service. 1986. Urban Hydrology for Small Watersheds. U.S. Department of Agriculture. Technical Release 55. June.

Walker. 1993. Personal communication with BAAQMD Staff. June 24.

Weaver, C.E. 1949. Geology and Mineral Deposits of an Area North of San Francisco Bay, California. California Division of Mines Bulletin 149.

Webster, D.A. 1972. Map Showing Ranges in Probable Maximum Well Yield from Water-Bearing Rocks in the San Francisco Bay Region, California. U.S. Geological Survey Miscellaneous Field Studies. Map MF-431.

Wesnousky, S.G. 1986. Earthquakes, quaternary faults, and seismic hazard in California. Journal of Geophysical Research v. 91, no. B12, pp. 12,587-12,631.

Wilson, R., and E. Crouch. 1982. Risk/Benefit Analysis. Cambridge, MA: Ballinger Publishing Company.

Woodward-Clyde Consultants. 1991. Metals Source Control and Treatment Assessment Program. Submitted to California Regional Water Quality Control Board.

Woodward-Clyde Consultants. 1993a. Personal communication with Mr. Laurie Cranston, Major Account Representative, PG&E. July 12.

Woodward-Clyde Consultants. 1993b. Personal communication with Ms. Patty Duran, Finance Department, City of Benicia Water Division. July 12.

Woodward-Clyde Consultants. 1993c. Personal communication with Mr. Virgil Mustain, Public Works Director, City of Benicia Public Works Department. July 12.

Working Group on California Earthquake Probabilities. 1990. Probabilities of earthquakes on fault segments in the San Francisco Bay region. U.S. Geological Survey Circular 1053.

7.0 ORGANIZATIONS AND INDIVIDUALS CONTACTED, AND LIST OF PREPARERS

7.1 ORGANIZATIONS AND INDIVIDUALS CONTACTED

The following individuals and organizations were contacted during the preparation of this EIR:

Bay Area Air Quality Management District

Brian Bateman, Senior Air Quality Engineer, Planning
James Cordova, Meteorologist, Planning
Patricia Ann Holmes, Toxicologist
Doug Hall, Supervising Air Quality Engineer
Michael Nguyen, Engineer, Planning
Joseph Steinberger, Environmental Planner
William Taylor, Public Information Officer
Randy Wittorp, Public Information Officer

City of Benicia

Katherine Hammer, Senior Planner, Planning Department
John Bunch, Planning Director, Planning Department
Toni Bertolero, Utility Manager, Public Works Department
Virgil Mustain, Director, Public Works Department
Dan Schiada, Assistant Director, Public Works Department
Patty Duran, Account Clerk 3, Water Division

California Employment Development Division

Doug Perron, Labor Market Analysis

California Air Resources Board

Norma Montez, Air Pollution Specialist

Exxon Research and Engineering Company

Sam McKinzie, Environmental Coordinator
Paul Natanson, Staff Engineer
Seon-Hee Shin, Staff Engineer
William Stocky, Staff Engineer

Exxon Company U.S.A.

Sam Hammonds, Project Manager

Metropolitan Transportation Commission

Chuck Purvis, Sr. Planner/Analyst

Pacific Gas & Electric Company

Laurie Cransten, Major Account Representative
John Calvert, Account Representative

Southern Pacific Railroad Company

F. Kitz, Martinez Yardmaster

San Francisco Regional Water Quality Control Board

Lila Tang, Associate Water Resources Control Engineer

7.2 LIST OF PREPARERS

The following key individuals were involved in the preparation of the EIR:

<u>City of Benicia</u>

John Bunch, Planning Director
Katherine Hammer, Senior Planner
Joan Lamphier (Lamphier & Associates, consultant to City of Benicia)

<u>Woodward-Clyde Consultants</u>

Tom Baily, Senior Responsible Professional
Shabnam Barati, Socioeconomics and Growth Inducement
Karen Boyd, Public Services and Utilities, and Land Use
Terry Cooke, Water Quality
Leo Gentile, Groundwater and Hazardous Waste Contamination
John Koehler, Air Quality and Public Health
Chee Chow Lee, Water Quality
Patricia Berryhill Mosley, Visual Resources and Biology
Bill Martin, Hydrology, Biology, and Assistant Project Manager
Fred Reid, Risk of Upset
James Reyff, Air Quality and Assitant Project Manager
Bill Popenuck, Air Quality
Bill Sylte, Air Quality
Hal Tuchfeld, Groundwater and Hazardous Waste Contamination
Ken Weaver, Geology
David Weintraub, Air Quality
Barbara Voss, Cultural Resources
Jeff Zimmerman, Project Manager and Energy

ENSR Consulting and Enginnering

Steve Brown (R2C2), Public Health Risk
Claudia Gemar, Risk of Upset

Illingworth & Rodkin, Inc.

Rich Rodkin, Noise
Tasos Papidimos, Noise

Omni Means

George Nickelson, Traffic
Peter Galloway, Traffic

ABAG - Association of Bay Area Governments, a regional San Francisco Bay Area planning agency that maintains demographic/census statistics.

API - American Petroleum Institute, who study and establish standards and criteria.

Alkylation Unit - Existing refinery process unit that combines small-molecule hydrocarbon gases produced in the FCCU with a branched-chain hydrocarbon called isobutane, producing a material called alkylate, which is blended into gasoline to raise the octane rating.

Ambient Noise Level - The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.

Aromatic Hydrocarbon - Also referred to as "aromatics," a group of hydrocarbon compounds in which the carbon atoms form a ring structure. Benzene, toluene, and xylene are common aromatic hydrocarbons.

BAAQMD - Bay Area Air Quality Management District, responsible for planning, monitoring, and maintaining/improving regional air quality.

BACT - Best Available Control Technology. BAAQMD determines the most effective air pollution control equipment appropriate for this project.

BLEVE - Boiling Liquid Expanding Vapor Explosion.

BOD - Biochemical Oxygen Demand. The amount of oxygen used by microorganisms in the biological processes that degrade organic matter in water under specific conditions.

BTU - British Thermal Unit. The quantity of heat required to raise the temperature of one pound of water 1°F at sea level.

Bellow Seals - Secondary containment devices which enclose the joint between a valve and piping to prevent leakage in the event that the valve gasket fails.

C_5/C_6 Splitter - A proposed fractionation unit that separates pentane from the pentane/hexane fraction of process stream of the proposed Heartcut tower.

CAAQS - California Ambient Air Quality Standards. State air quality standards established to protect health and public welfare.

CAPCOA - California Air Pollution Control Officers' Association. CAPCOA guidelines are currently used for assessment and determination of public health risks.

COD - Chemical Oxygen Demand. A measure of the organic matter in water or wastewater. COD ranges between 2 and 5 times the BOD.

Catalyst - A substance that speeds up the chemical reaction between other substances without being used up in the chemical reaction. Catalysts gradually accumulate impurities which interfere with their action and must be replaced when they become inefficient.

Caustic - Substances that burn, corrode, or dissolve.

Clarifier - A basin for the removal of suspended material from wastewater by means of gravitational settling.

Criteria Pollutants - Pollutants for which standards have been established (see CAAQS and NAAQS).

Community Noise Equivalent Level, CNEL - The average A-weighted (see dBA below for "A-weighted") noise level during a 24-hour day, obtained after addition to average noise levels of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels in the night between 10:00 pm and 7:00 am.

Cooling Tower Blowdown - Circulating water in a cooling tower that is discharged from the system to reduce mineral build-up in the cooling water.

dB (decibel) - A logarithmic unit for measuring sound intensity. Sound waves, travelling outward from a source, exert a force known as sound pressure (commonly called sound level), measured in decibels.

dBA - Decibel corrected for the variation in frequency response of the typical human ear at commonly encountered noise levels.

Diffuser - Device used at point of wastewater discharge into Carquinez Strait in order to promote rapid dilution of discharge with the receiving water.

Effluent - Water discharged by a facility.

EPA - Environmental Protection Agency.

ERPG - Emergency Response Planning Guidelines. A set of standards used in this EIR to define a point of emergency response and severity.

FCCU - Fluid Catalytic Cracking Unit. A device for splitting large molecules into smaller molecules with the assistance of a catalyst.

Fuel Gas - The gaseous byproduct of the refining process, after hydrogen sulfide impurities have been removed.

GPM - Gallons per minute. A measurement of flow of a liquid.

Heartcut Tower - A fractionation tower or pipestill designed to process the light hydrocrackate and reformate streams that occur at the mid-boiling point fraction.

Heartcut Saturation Unit - Proposed process unit that reacts the heartcut process stream with hydrogen, saturating the benzene to produce cyclohexane.

Hydrocarbons - Compounds made up of carbon and hydrogen atoms.

Hydrocracker - A unit that cracks long hydrocarbon molecules with high pressure under a high-hydrogen content atmosphere.

Hydrogen Sulfide (H_2S) - A gaseous byproduct of petroleum refining operations that is detectable by its "rotten egg" odor in concentrations as small as 3 to 5 parts per billion.

Intrusive Noise - That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content, as well as the prevailing ambient noise level.

Isomerate - A gasoline blending stock having excellent blend qualities including high octane.

L_{dn} (day/night noise level)- The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.

LCN - Light cat naptha (hydrofiner) unit. A process unit designed to remove sulfur from the process stream.

L_{max}, L_{min} - The maximum and minimum A-weighted noise level during the measurement period.

L_{01}, L_{10}, L_{50}, L_{90} - The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.

LOD - Limit of Detection. This is the limit at which a compound can be accurately measured or detected in laboratory analysis.

LOS - Level of Service. LOS ratings for traffic operations range from "A" (free flow) to "F" (most congested).

MEI - Maximum Exposed Individual. The MEI is determined through air quality modeling, and represents the location at which a person could be exposed to the highest concentration of air pollutants for a given period of time.

MGD - Million Gallons per Day. A measurement of flow of a liquid.

MSCFD - Million Standard Cubic Feet per Day. A measurement of flow of a gas.

NAAQS - National Ambient Air Quality Standards. Federal air quality standards established by the EPA to protect health and public welfare.

NPDES - National Pollutant Discharge Elimination System.

Naphtha - A light end hydrocarbon used as a gasoline blending stock.

Naphtha Hydrofiner - Process unit designed to improve the naphtha quality by removing sulfur and nitrogen compounds and by reducing aromatics.

Nitrogen Oxides - Gases, mainly brown nitric oxide (NO) and colorless nitrogen dioxide (NO_2), formed during combustion at high temperatures. They react with sunlight in the atmosphere and are involved in the production of oxidant, a component of smog.

Non-attainment Area - Areas where pollutant concentrations exceed air quality standards; the Bay Area is classified as a non-attainment area for several pollutants.

Olefin - A group of relatively reactive hydrocarbons.

Organic - Of, or relating to, carbon-containing compounds.

PPM - Parts per million. A measure of concentration of a substance (e.g., pollutant) within a medium (e.g., soil or liquid).

PSD - Prevention of Significant Deterioration. Federal program to manage air quality from major new sources in air quality attainment areas.

RWQCB - Regional Water Quality Control Board. Regulatory agency responsible for protection of water quality.

Reformer Unit - A device for upgrading octane levels by changing the shape of hydrocarbon molecules. Hydrogen is a byproduct of the process.

RMP - Risk Management Plans. Federal equivalent (proposed) of the California RMPP.

RMPP - Risk Management and Prevention Plan. A plan that addresses acutely hazardous waste accident scenarios and emergency response measures.

Rupture Discs - Devices installed on tank relief vents to prevent fugitive emissions when liquid is added to a tank; these devices will rupture at a pre-set high pressure to prevent tank damage or explosion.

Separator - Process unit that uses gravity to separate oil from water.

Sludge - A semisolid waste from a chemical or physical process.

Sour Water Stripper - Refinery unit that removes ammonia (NH_3) and hydrogen sulfide (H_2S) from the refinery's wastewater.

T90 Temperature and T90 Tower - T90 refers to the temperature at which 90 percent of the material boils. Proposed T90 towers are units that further fractionate the heavier process streams.

TPY - Tons per year.

TSP - Total Suspended Particulates. The fine solid particles which remain individually dispersed in air.

TSS - Total Suspended Solids. The fine non-settling solid particles in water or wastewater.

Therms - The heating value equivalent of 100,000 Btus.

USGS - United States Geological Survey.

VOC - Volatile Organic Compound. (See definition of **organic**)

APPENDIX A
NOTICE OF PREPARATION AND INITIAL STUDY

This appendix is a copy of the City of Benicia's Notice of Preparation to prepare a Draft Environmental Impact Report on Exxon's Clean Fuels Project, and the initial study.

To: Office of Planning and Research
(Agency)
1400 10th Street, Suite 250
(Address)
Sacramento, CA 95814

Subject: **Notice of Preparation of a Draft Environmental Impact Report**

Lead Agency:

Agency Name: Benicia Planning Deparment

Street Address: 250 East L Street

City/State/Zip: Benicia, CA 94510

Contact: Joan Lamphier, Project Manager

Consulting Firm (if applicable):

Firm Name: Woodward-Clyde

Street Address: 500 12th Street, Suite 100

City/State/Zip: Oakland, CA 94607-4014

Contact: Tom Baily, Director of Environmental Management

The Benicia Planning Department will be the Lead Agency and will prepare an environmental impact report for the project identified below. We need to know the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency will need to use the EIR prepared by our agency when considering your permit or other approval for the project.

The project description, location, and the potential environmental effects are contained in the attached materials. A copy of the Initial Study (☒ is ☐ is not) attached.

Due to the time limits mandated by State law, your response must be sent at the earliest possible date but *not later than 30 days* after receipt of this notice.

Please send your response to Joan Lamphier, Project Manager at the address shown above. We will need the name for a contact person in your agency.

Project Title: Exxon Benicia Refinery Clean Fuels Project

Project Location: Benicia (City (nearest)) Solano (County)

Project Description: (brief) Exxon Company, U.S.A. requests a Use Permit to construct and operate a Clean Fuels Project in response to the 1990 Amendments to the Federal Clean Air Act and California Clean Air Act. The intent is to reformulate gasoline into cleaner burning fuel that will reduce exhaust emissions of criteria and toxic pollutants from existing vehicles. This project would enable the refinery to meet the specifications for reformulated fuels through the installation of additional processing facilities. These facilities would include pumps, compressors, tanks, fractionation towers, reactors and heat sources (i.e. furnaces). The project would be integrated into the existing refinery.

Date: May 21, 1993

Signature: [signature]

Title: Project Manager

Telephone: (707) 746-4280

Reference: California Code of Regulations, Title 14, (CEQA Guidelines) Sections 15082(a), 15103, 15375. *Revised October 1989*

THE CITY OF BENICIA CALIFORNIA

CITY HALL • 250 EAST L STREET • BENICIA, CA 94510 • (707) 746-4200

NOTICE OF PREPARATION
NOTICE OF SCOPING SESSION
ENVIRONMENTAL IMPACT REPORT
FOR THE PROPOSED
EXXON BENICIA REFINERY CLEAN FUELS PROJECT

This letter constitutes a Notice of Preparation and Notice of a Scoping Session for an Environmental Impact Report for the proposed Exxon Benicia Refinery Clean Fuels Project.

PROPOSED PROJECT

Exxon Company, U.S.A. requests a Use Permit to construct and operate the Clean Fuels Project in response to the 1990 Amendments to the Federal Clean Air Act and the California Clean Air Act. The intent is to reformulate gasoline into cleaner burning fuel that will reduce exhaust emissions of criteria and toxic pollutants from existing vehicles. This project would enable the refinery to meet the specifications for reformulated fuels through the installation of additional processing facilities. These facilities would include pumps, compressors, tanks, fractionation towers, reactors, and heat sources (i.e. furnaces). The project would be integrated into the existing Benicia refinery, which is located on a 331-acre site in the City of Benicia in Solano County.

ENTITLEMENTS

In order to proceed with the proposed project, the applicant must obtain a Use Permit form the City of Benicia. The applicant must also obtain the following permits:

- Bay Area Air Quality Management District. Authority to Construct/Permit to Operate.

- California Regional Water Quality Control Board. The applicant may be required to obtain an amendment to the existing NPDES Permit for discharge of treated wastewater into Suisun Bay.

PUBLIC COMMENT

The City of Benicia Planning Department will be the Lead Agency for the preparation of the environmental impact report. All responsible agencies, interested agencies and individuals are invited to submit comments which address environmental concerns resulting from the proposed project's implementation.

Responses to the Notice of Preparation must be received 30 days from receipt of this notice. Written responses should be sent to the City of Benicia Planning Department, 250 East L Street, Benicia, CA 94510, Attention: Joan Lamphier, Project Manager

SCOPING SESSION

A Scoping Session will be held at 7:00 PM on Thursday, June 3, 1993 in the City Council Chambers of City Hall, 250 East L Street, Benicia, California. Interested agencies and individuals are invited to submit oral and written comments which address environmental concerns resulting from the proposed project's implementation.

Interested persons are welcome to review the application materials and files. These materials are available for public review in the Planning Department from Monday through Friday (except legal holidays), 8:30 AM to 5:00 PM. If you have any questions, please call Katherine Hammer, Senior Planner or Joan Lamphier, Project Manager at (707) 746-4280.

EXXON CLEAN FUELS PROJECT - INITIAL STUDY
INTRODUCTION

This document consists of an Initial Study prepared by the City of Benicia Planning Department in accordance with (CEQA) California Environmental Quality Act, Statutes and Guidelines (1992). As required by the CEQA Guidelines, Section 15063, the following documents comprise the Initial Study to determine if the project may have a significant effect on the environment.

Part I: Project Description

Part II: The Initial Study Checklist set forth in the Guidelines for Implementation of the California Environmental Quality Act, which have been adopted by the City of Benicia. The Checklist section relating to each item is followed by a determination of whether there is a potential for significant impacts from the proposed project. In reviewing the Checklist, it should noted that Exxon has not submitted a complete application to the City. Therefore, staff has indicated the need to provide more information to determine if there would be a potential for significant impact in certain technical areas.

Part III: A determination that the project could have a significant impact on the environment, and therefore a focused EIR should be prepared.

Part IV: The Environmental Checklist and Project Summary Sheet submitted by the applicant, Exxon, U.S.A., Benicia Refinery.

Lead Agency: This Initial Study has been prepared by the City of Benicia Planning Department, City Hall, 250 L Street, Benicia, CA 94510. Contact Person: Joan Lamphier, Project Manager (707) 746-4280.

PART I: BACKGROUND AND PROJECT DESCRIPTION

1. Application Number: PRJ 93-1, UP 93-1, EA 93-1

2. Project Name: Exxon Clean Fuels Project

3. Project Location: Exxon Benicia Refinery, 3400 Second Street, Benicia, California, 94510

4. Assessor's Parcel Number: 80-110-03

5. Zoning District: I-G, General Industrial

6. General Plan Designation: General Industrial

Exxon Company, U.S.A. requests a Use Permit to construct and operate the Clean Fuels Project in response to the 1990 Amendments to the Federal Clean Air Act and the California Clean Air Act. The intent is to reformulate gasoline into cleaner burning fuel that will reduce exhaust emissions of criteria and toxic pollutants from the existing vehicle fleet. This project will enable the refinery to meet these specifications for reformulated, cleaner burning fuels through the installation of additional processing facilities. These facilities would include pumps, compressors, tanks, fractionation towers, reactors, and heat sources (i.e. furnaces).

The proposed project would be integrated into the existing refinery. The project description submitted by the applicant follows.

1.0 INTRODUCTION

This document is an application to the City of Benicia for a Use Permit and an application to the Bay Area Air Quality Management District (BAAQMD) for an Authority to Construct/Permit to Operate the Clean Fuels Project (CFP), at the Exxon Company, U.S.A. Benicia Refinery.

The California Air Resources Board (CARB) has developed a comprehensive set of gasoline specifications to achieve reductions in air pollutants from gasoline-fueled vehicles as required by the 1990 Amendments to the Federal Clean Air Act and the California Clean Air Act. This project will enable the refinery to meet these specifications for reformulated, cleaner burning fuels through the installation of additional processing facilities. These facilities will include pumps, compressors, tanks, fractionation towers, reactors, and heat sources (i.e. furnaces), all of which are of the type utilized within the refinery today.

Specifically, the project will require eight new processing facilities, four new furnaces, and four new tanks. The new facilities are planned for construction over a two year implementation schedule and will not increase the present crude capacity of the refinery nor will they increase the amount of fuel products produced by the refinery.

1.1 Regulatory Background

CARB has developed a comprehensive set of new gasoline specifications that require reformulated, cleaner-burning fuels to be used in all motor vehicles by 1996. The specifications are an essential part of CARB's program to reduce emissions from motor vehicles. Their program consists of two fundamental areas:

- The phase-in of low emission vehicles which meet stringent exhaust standards and the development of alternative fuels for use in those vehicles; and,

- The reformulation of gasoline into a cleaner burning fuel that will reduce exhaust emissions of criteria and toxic pollutants from the existing vehicle fleet.

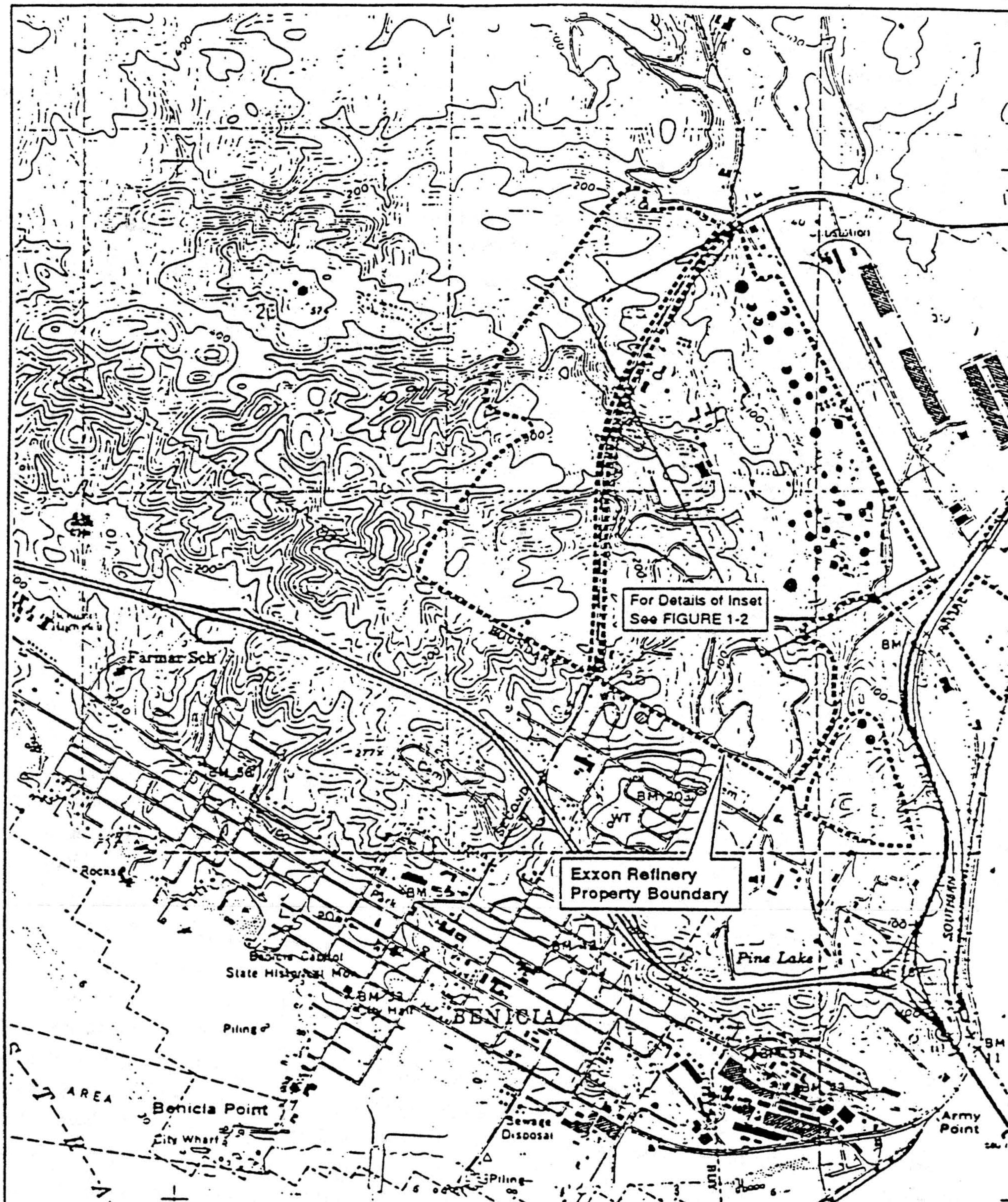
The two components of CARB's program will complement each other because reformulated gasoline has been chosen as the alternative fuel for the low emission vehicle fleet.

The CARB regulations will require that all gasoline sold as a motor vehicle fuel in California meet specified standards for sulfur content, benzene content, aromatic hydrocarbon content, olefin content, Reid Vapor Pressure, oxygen content, 90 percent distillation temperature (T90), and 50 percent distillation temperature (T50).

1.2 Benicia Refinery Background

1.2.1 Location

The Exxon Company, U.S.A. (Exxon), owns and operates the Benicia Refinery located in Benicia, California, approximately 1.5 miles northeast of the Benicia business district on East Second Street (Figure 1-1). Exxon owns approximately 800 acres of land in Benicia and uses 331 of those acres for the refinery.



Source: USGS 7.5 Quadrangle Map; Benicia, CA Quadrangle

0 1/2
Mile

N

PROPERTY BOUNDARY OF THE REFINERY

December 1992

Exxon Company, U.S.A.
Exxon Refinery
Benicia, California

FIGURE 1-1

1.2.2 Gasoline Production

The Refinery currently receives approximately 135,000 barrels per day (BPD) of crude oil and from it produces approximately 110,000 BPD of gasoline, 20,000 BPD of jet fuel, 15,000 BPD of diesel, and smaller amounts of other products. Other products include coke, carbon black oil, sulfur and liquified petroleum gases (LPG).

1.3 Project Summary

1.3.1 Integration of the Clean Fuels Project

The proposed project will be integrated into the existing refinery so that roughly the same amount of products that are produced today can still be produced while meeting the new CARB specifications. The project is not intended to increase the amount of gasoline produced but instead may slightly decrease gasoline production while slightly increasing diesel and jet fuel production.

Most of the new facilities will be located in the southwest corner of the existing process block area and will cover approximately 3 acres within the 46 acres that form the main process block area. Three new hydrocarbon tanks will be placed within the refinery's existing tank farms where over 60 tanks currently exist (See Figure 1-2).

No significant water will be needed to produce steam because hot oil is being used as the heat transfer fluid in the new units. The refinery's Wastewater Treatment plant will be essentially unaffected because the new facilities do not discharge significant amounts of process wastewater. An insignificant amount of additional water will be required as make-up for the existing cooling tower.

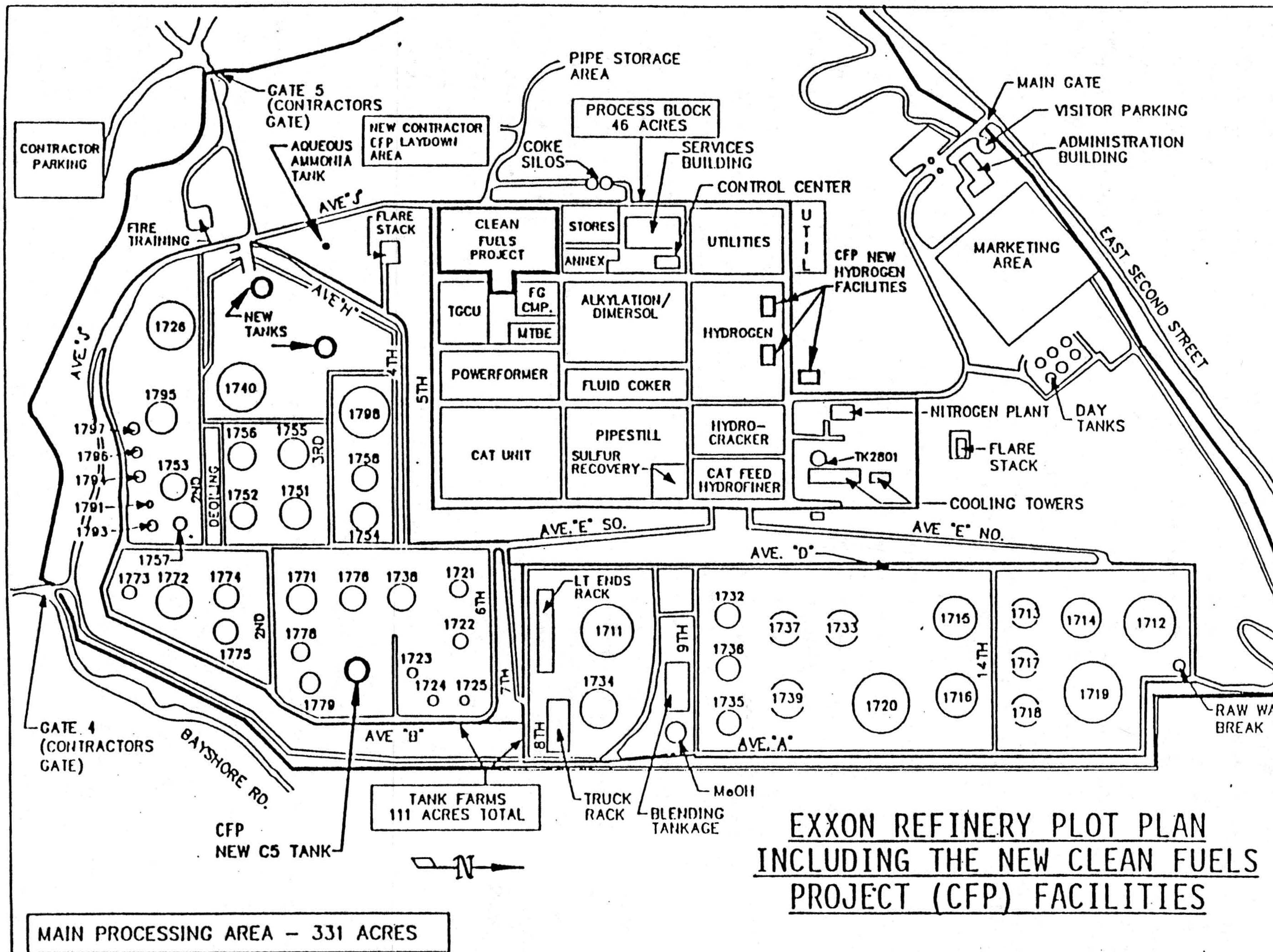
Section 2.4 provides details on the integration of the project into the base refinery.

1.3.2 Facilities

New facilities will be required to enhance the processing capabilities of the refinery in order to meet the new CARB specifications.

The project will include the installation of several new facilities and modifications to several existing facilities. The proposed facilities and modifications are summarized in Table 1-1.

FIGURE 1-2



EXXON REFINERY PLOT PLAN INCLUDING THE NEW CLEAN FUELS PROJECT (CFP) FACILITIES

TABLE 1-1		
New Process Facilities	New Auxiliary Facilities	Modified Facilities
1. Heartcut Tower	1. Aqueous Ammonia Storage for NOx Control	1. Hydrocracker Unit
2. Heartcut Saturation Unit	2. Hot Oil System	2. Hydrogen Furnaces
3. Catalytic Reformer T90 Tower	3. Three hydrocarbon tanks	
4. Catalytic Naphtha T90 Tower	4. Hydrogen Plant expansion	
5. Hydrocracker Distillation Unit		
6. Jet Fuel Saturation Unit		
7. Light Catalytic Naphtha Hydrofiner		
8. Light Virgin Naphtha Splitter		

Figure 1-3 provides an overall refinery flow plan after the implementation of the Clean Fuels Project. Appendix C contains photographs of the refinery with the new facilities overlayed on them as a visual simulation of the project.

1.3.3 Facilities Description

A brief description of the main new facilities follows:

+ Heartcut Tower - To reduce the benzene content of motor gasoline (MOGAS), light hydrocrackate (LHC) and Cat. Reformate (REF8) are fed to the Heartcut Tower, where they are further fractionated, producing a heartcut stream. The heartcut is fed to the Heartcut Saturation Unit.

+ Heartcut Saturation Unit - This unit converts the heartcut stream aromatics into saturated hydrocarbons.

+ Cat. Reformer T-90 Tower - To reduce the amount of heavy hydrocarbons in gasoline (referred to as the T-90 cutpoint), the bottoms stream from the Heartcut Tower are further fractionated. The bottoms stream from this fractionation is recycled to the Hydrocracker Unit (HCU) for conversion into products that can eventually be used in gasoline. The overhead stream from the T-90 tower is blended into MOGAS.

+ Light Cat. Naphtha Hydrofiner (LCNHF) - To reduce the olefins and sulfur content of MOGAS, Light Cat. Naphtha (LCN) is hydrotreated in the new LCNHF.

+ Cat. Naphtha T-90 Tower - The fractionator operates similarly to the Cat. Reformer T-90 Tower described above, except that its overhead product is further hydrotreated in the existing Heavy Cat. Naphtha Hydrotreater.

+ Light Virgin Naphtha Splitter - This tower separates pentanes from Light Virgin Naphtha (LVN). The separation and removal of pentanes reduces the RVP of MOGAS which results in lower VOC emissions.

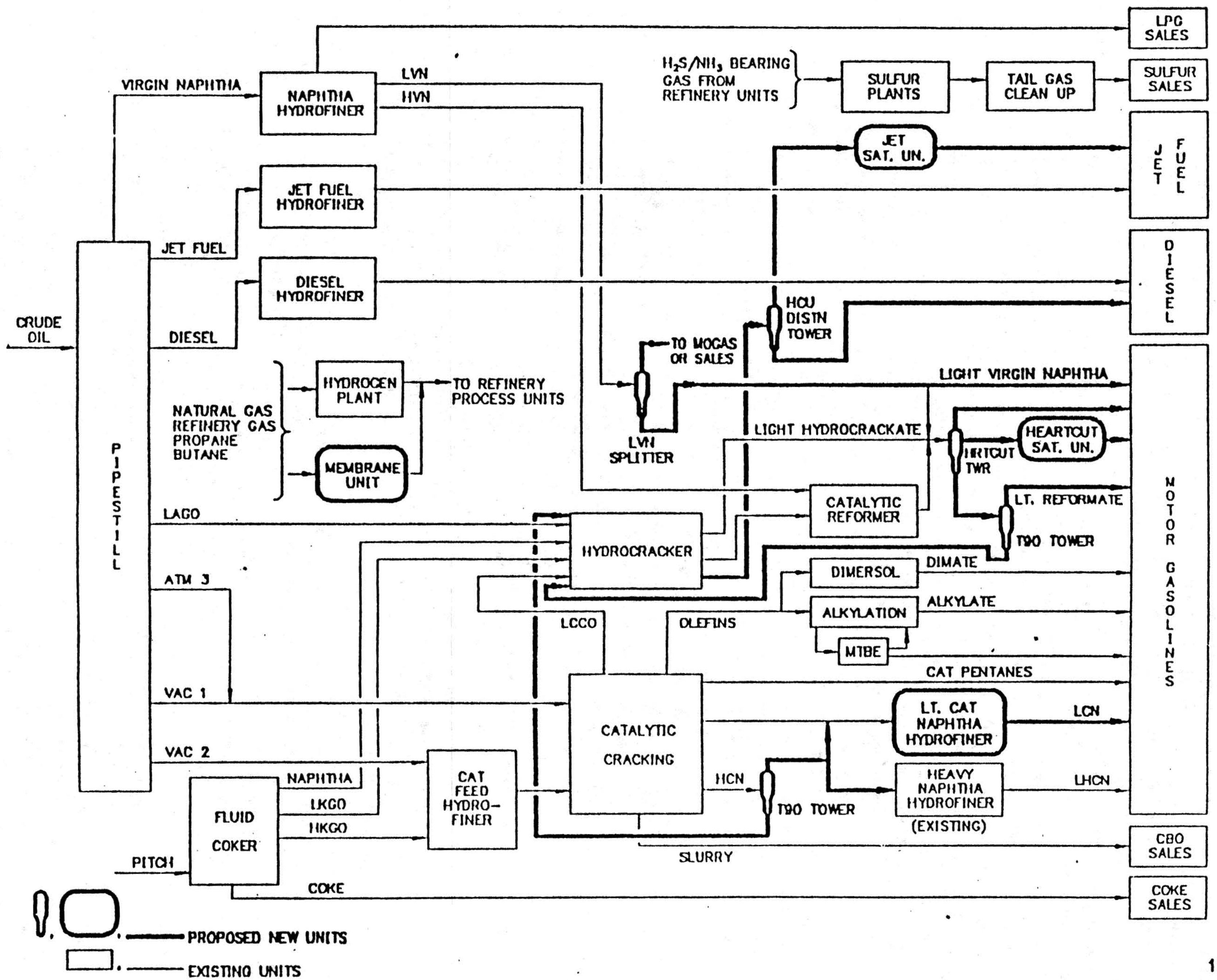
+ Hot Oil System - The additional heat duty required by the new units described above is met by a hot oil system. This consists of two furnaces and a hot oil circulation system.

FIGURE 1

BENICIA REFINERY FLOW PLAN

(1996 CONFIGURATION)

NEW AND EXISTING PROCESS FACILITIES



12/08/92

+ Hydrogen Requirements - The hydrogen requirements of the Heartcut Saturation Unit, the LCNHF, and the HCU are met by the addition of two pre-reformers to the existing hydrogen manufacturing unit. Each pre-reformer consist of a preheat furnace and a reactor.

+ Tankage - The project will require three new hydrocarbon tanks, all of which will be equipped with vapor recovery systems for the control of VOC emissions. One tank will store pentanes and the other two tanks will store a combination of pentanes, heartcut or other heavier streams.

1.3.4 Emission Summary

The estimated emissions from the project's facilities are shown in Table 1-2 below. Also shown are the emission reductions that will be realized in Solano County from the use of reformulated gasoline.[1] Values shown are in tons per year, (TPY).

TABLE 1-2

Criteria Air Pollutants	Project Emissions	Automobile Emission Reductions in Solano County
Volatile Organic Compound (VOC)	25 TPY	(546) TPY
Carbon Monoxide (CO)	70 TPY	(2728) TPY
Sulfur Dioxide (SOx)	38 TPY	(126) TPY
Nitrogen Oxides (NOx)	(61) TPY	(210) TPY
Particulate Matter (PM)	0 TPY	N/A

The reduction of emissions in the City of Benicia from the use of reformulated gasoline is shown in Table 1-3 below[2].

TABLE 1-3

Criteria Pollutants	Project Emissions	Automobile Emission Reduction Within Benicia	Net Emissions Within the City of Benicia
VOC	25 TPY	(32) TPY	(7) TPY
CO	70 TPY	(316) TPY	(244) TPY
SOx	38 TPY	(8) TPY	30 TPY
NOx	(61) TPY	(12) TPY	(73) TPY
PM	0 TPY	N/A	0 TPY

Emissions increases from individual project sources will be minimized through the use of the best available control technology (BACT). In addition to automobile emission reductions, the project's emissions will be fully offset according to the Bay Area Air Quality Management District's regulations. These offsets will reduce criteria air pollutants in the Bay Area as shown in Table 1-4.

TABLE 1-4		
POLLUTANT	PROJECT EMISSIONS	OFFSETS TO BE PROVIDED
VOC	25	(37)
CO	70	NA
SOx	38	(46)
NOx	(61)	(28)
PM	0	0

Further information regarding offsets and BACT is supplied in Appendix D and Appendix E respectively.

1.3.5 Health Risk Assessment

The project has been analyzed for projected health risk. The projection shows a risk below the level deemed significant by the BAAQMD of ten in one million.

A separate benefit of the project, not accounted for in the Health Risk Assessment, will be a 40% reduction in health risks associated with the inhalation of vehicle emissions.

The Health Risk Assessment performed for the project was done according to EPA, CARB, and BAAQMD guidelines. Section 5 provides a summary of the assessment and Appendix F contains the entire assessment.

1.3.6 Other Permits Required

The permits required for this project are as follows:

- Bay Area Quality Management District Authority to Construct/Permit to Operate
- City of Benicia Use Permit
- Demolition Permit for Site Clearance
- City of Benicia Grading Permit

1. Volume 1, Proposed Regulations for CA Phase 2 Reformulated Gasoline Staff Report, State of California Air Resources Board, October 4, 1991 and;

   Travel and Related Factors in California Annual Summary 1991, State of California Business, Transportation, and Housing Agency.

2. Information dervied from record of telephone conversation, April 27, 1992, Sam Hammonds, Exxon Project Manager with Dan Shiada, City of Benicia Staff Member.

PART II: INITIAL STUDY CHECKLIST

Potential Significant Impact	Yes	Maybe	N

_. Earth. Will the proposal result in:

a. Unstable earth conditions or in changes in geologic substructures?	___	x	___

Unstable soil conditions have been identified on portions of th refinery site. The location of the proposed new facilities should b evaluated to determine if there would be any impact in this regard.

b. Disruptions, displacements, compaction or overcovering of the soil?	___	X	___

The project site has been previously graded and partially compacted Grading and foundation work required for project implementation i likely to disrupt and displace a small amount of soil. This should b documented in the EIR.

c. Change in topography or ground surface relief features?	___	X	___

The project site has been previously graded and partially compacted an is level. As such, there are no outstanding topographic or groun surface relief features on the site which will be disturbed as a resul of project implementation. Construction of the Clean Fuels Projec related equipment may result in changes in the topography of the sit by providing proper surface drainage in order to prevent ponding o surface water.

d. The destruction, covering and modification of any unique geologic or physical features?	___	___	X

The project site does not contain any unique geologic or physica features. See responses to Items 1 (a) - (c) above.

e. Any increase in wind or water erosion of soils, either on or off the site?	___	X	___

Soil erosion is likely to be limited to the construction period of the project. Specifically, increases in the volume and rate of water runoff from the project may increase offsite soil erosion during the construction period of the project.

f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet, or lake?	___	___	X

Development of the project site will not create erosion, deposition, or changes in siltation that would alter the channel or the bay. The refinery site is located at an elevation of 95 feet above mean sea level and at a distance of one- and one-half miles from Suisun Bay.

g. Exposure of people or property to geologic hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards? ___ _x_ _

The project site is located in an area of seismic activity. T greatest earthquake hazard to the site would be from seismic events either the Green Valley-Concord or Hayward faults. A major earthqua (Richter 7 to 8+) could occur on one of the many nearby active faul during the life of the project. The project should be evaluated determine that the design standards are appropriate for the magnitu of an earthquake that might be anticipated. The refinery site is n subject to landslides or mudslides.

2. **Air.** Will the proposal result in:

a. Substantial air emissions or deterioration of ambient air quality? ___ _x_ _

A detailed air quality analysis should be performed to determine t specific impacts related to the operation of the Clean Fuels project

Air pollutants will be emitted by construction equipment and fugiti dust will be generated during grading and site preparation. The emissions should be evaluated to determine their significance.

b. The creation of objectionable odors? ___ _X_ _

The project should be evaluated to determine if any unusual emissio or odors would be produced during construction or upon completion a operation of the proposed Clean Fuels Project.

c. Alteration of air movement, moisture, or temperature, or any change in climate, either locally or regionally? ___ ___ _

Due to the scale of the project, changes in local or regional clima conditions are not expected as a result of the project.

3. **Water.** Will the proposal result in:

a. Changes in current, or the course or direction of water movements, in either marine or fresh waters? ___ ___ .

There are no freshwater features on or near the site that would affected by project development. As such, no changes will occur in t currents, or the course or direction of water movements.

b. Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff? ___ _x_ ___

Site development will result in an increase in runoff. This will be caused by the placement of impervious surfaces, including equipment foundations and paving. Such increases could be significant and should be evaluated.

c. Alterations to the course or flow of flood waters? ___ ___ _X_

The project site is not within a flood zone as exhibited by the FEMA Flood Boundary Map dated 8/3/89. Therefore there would be no alteration to the course or flow of flood waters upon project implementation.

d. Changes in the amount of surface water in any water body? ___ ___ _X_

As described in Item 3(b) above, there will be a slight increase in runoff as a result of the project. Increased runoff from the project will be directed into the existing drainage system. The project site is one- and one-half miles away from the Suisun Bay and is therefore not expected to change the amount of surface water in any water body.

e. Discharge into surface waters, or in any alteration of surface water quality, including, but not limited to, temperature, dissolved oxygen or turbidity? ___ _X_ ___

The project may result in an increase of pollutant discharge from the refinery's wastewater treatment plant to Suisun Bay.

f. Alteration of the direction or rate of flow of ground waters? ___ ___ _X_

The ground water beneath the new process facilities site is more than thirty feet below the ground surface. The project will not affect the direction or rate of flow of ground water since site disturbance will be minimal.

g. Change in the quantity or quality of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations? ___ _X_ ___

The ground water beneath the new process facilities site is more than thirty feet below the ground surface. There would be minimal site disturbance, and therefore construction activity would not affect the quantity of ground water. The Regional Water Quality Control Board has required Exxon to monitor groundwater quality on the refinery site. The project should be evaluated in relation to current monitoring results to determine any potential impacts on the future quality of groundwater.

h. Substantial reduction in the amount of water otherwise available for public water supplies? ___ X

The project itself would require a limited amount of additional wate which falls within the refinery water allocation by the City of Benici However, the potential water usage should be evaluated in relation the potential future water supply restrictions to determine a potential impact on the amount of water otherwise available for publ water supplies.

i. Exposure of people or property to water related hazards such as flooding or tidal waves? ___ ___

The project site is not within a flood zone as exhibited by the FE Flood Boundary Map dated 8/3/89. Therefore, development of the proje would not expose people or property to water-related hazards such flooding or tidal waves.

4. **Plant Life.** Will the proposal result in:

a. Change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, and aquatic plants)? ___ ___

The site has been previously graded and is nearly devoid of vegetatio On-site vegetation consists of introduced species for landscaping arou the border of the refinery property including ice plant. There are trees or other vegetation in the areas where the Clean Fuels faciliti would be constructed on the refinery site. The elevation and topograp of the project site precludes the site from having wetla characteristics which provide habitat for species of concern.

b. Reduction of the numbers of any unique, rare or endangered species of plants? ___ ___

As noted under item 4(a) the project site has been previously grade The site is nearly devoid of vegetation due to the relatively compact or paved nature of the ground surfaces and the development surroundi the sites within the refinery where the new facilities would constructed. There are no rare or endangered species of plants on t property, therefore the proposed project would not affect this resourc

c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species? ___ ___

The project would be constructed in the middle of an existing refine site. No landscaping would be provided.

d. Reduction in acreage of any agricultural crop? ___ ___ X

The project site is a refinery, and thus there would be no reduction in acreage of any agricultural crop upon project implementation.

5. **Animal Life.** Will the proposal result in:

a. Change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms or insects)? ___ ___ X

The site is in an urban industrial setting. Currently, animal life on the site is limited to that which is typical to the surrounding disturbed environment, including ground squirrels, deer and other fauna that live in disturbed areas. Since the site has been graded and is nearly devoid of vegetation, it is expected that even these small animals do not exist in great numbers on the site. The limited animal life on the refinery site would not be affected by project implementation.

b. Reduction of the numbers of any unique rare or endangered species of animals? ___ ___ X

There are no known unique, rare or endangered species of animals on the project site. Therefore, there would not be a reduction of the numbers of any unique, rare or endangered species of animal upon project implementation.

c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals? ___ ___ X

The project would not introduce new landscaping which could provide habitat for birds or animals. No animal migration corridors currently exist on the site, and therefore the project would have no effect on this resource.

d. Deterioration to existing fish or wildlife habitat? ___ ___ X

The site is already highly degraded from prior grading and the fact that it is developed with industrial use as a refinery. There is no existing fish or wildlife habitat on the site that would be affected by the project.

6. **Noise.** Will the proposal result in:

a. Increases in existing noise levels? ___ X ___

The project should be evaluated to determine the potential noise impact resulting from construction activities and from project operation.

Potential Significant Impact — Yes — Maybe

b. Exposure of people to severe noise levels? ___ X ___

The project should be evaluated to determine the potential noise impac from construction activities and project operation on residents a sensitive receptors in the vicinity of the refinery.

7. **Light and Glare.** Will the proposal produce new light and glare? ___ X ___

The proposed project will introduce new lighting to the refinery in the ar where new facilities are constructed. This lighting should be evaluated determine the potential for a significant impact.

8. **Land Use.** Will the proposal result in a substantial alteration to the present or planned land use of the area? ___ X ___

The proposal should be evaluated in the context of the present and plann land use of the area.

9. **Natural Resources.** Will the proposal result in:

a. Increases in the rate of use of any natural resources? ___ X ___

The project would require construction materials and energy to be used both the construction and operation of the facility. These should evaluated.

10. **Risk of Upset.** Will the proposal involve:

a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions? ___ X ___

The project should be evaluated to determine the risk of explosion release of hazardous substances in the event of an accident or upse conditions.

b. Possible interference with an emergency response plan or an emergency evacuation plan? ___ X ___

The proposed project should be evaluated in the context of the Ris Management Preparedness Plan which outlines the procedures at th refinery for dealing with emergencies.

Potential Significant Impact	Yes	Maybe	N
11. **Population.** Will the proposal alter the location, distribution, density, or growth rate of the human population of an area?		X	

The project should be evaluated with respect to the number of employee required, both for construction and operation of the project, and potenti employee related population impacts.

12. **Housing.** Will the proposal affect existing housing, or create a demand for additional housing?		X	

The impact of future employees on the jobs/housing balance in Benicia shoul be documented.

13. **Transportation/Circulation.** Will the proposal result in:

a. Generation of substantial additional vehicular movement?	X		

Project construction-related traffic could significantly impact traffi operations at the P.M. peak period during the construction period. Th potential impact of both construction-related traffic and project related traffic should be documented.

b. Effects on existing parking facilities, or demand for new parking?	X		

Parking for both construction workers and the future employees neede to operate the new process facilities would be provided within th refinery site. The location, size and configuration of these facilitie should be evaluated in relation to the anticipated demand.

c. Substantial impact upon existing transportation systems?	X		

Project construction-related traffic could significantly impact traffi operations at the P.M. peak period during the construction period. Th potential impact of both construction-related traffic and project related traffic should be documented.

d. Alterations to present patterns of circulation or movement of people and/or goods?		X	

The potential for project related traffic to affect the existin circulation system should be evaluated.

e. Alterations to waterborne, rail or air traffic?		X	

There could be a shift in transportation mode of materials supplied t the refinery. This issue must be evaluated.

f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians? ___ X

If the proposed rail crossing protection at the Bayshore Road/Par intersection is not implemented, additional traffic generated durir project construction could incrementally increase the potential for rai crossing accidents. This potential impact should be evaluated.

14. **Public Service.** Will the proposal have an effect upon, or result in a need for, new or altered governmental services in any of the following areas:

a. Fire protection? ___ X ___

The proposed project should be evaluated to determine the potentia impact on fire protection.

b. Police protection? ___ X ___

The proposed project should be evaluated to determine the potentia impact on police protection.

c. Schools? ___ X ___

The proposed project should be evaluated to determine the potentia impact on schools.

d. Parks or other recreational facilities? ___ ___ X

e. Maintenance of public facilities, including roads? ___ X ___

Construction traffic related to the importation of materials coul affect the maintenance of roads in the vicinity of the refinery.

f. Other governmental services? ___ ___ ___

The project is not anticipated to generate a substantial increase in th need for any other governmental services.

15. **Energy.** Will the proposal result in:

a. Use of substantial amounts of fuel or energy? ___ X ___

The project should be evaluated to determine the potential use of fue or energy.

Item	Yes	Maybe	No
b. Substantial increase in demand upon existing sources of energy, or require the development of new sources of energy?		X	

The project should be evaluated to determine the demand upon existing sources of energy.

Item	Yes	Maybe	No
15. **Utilities.** Will the proposal result in a need for new systems, or substantial alterations of existing utilities including water, sewer, storm water, electricity or natural gas?		X	

The project should be evaluated to determine the impact on existing utilities.

16. **Human Health.** Will the proposal result in:

Item	Yes	Maybe	No
a. Creation of any health hazard or potential health hazard (excluding mental health)?		X	

The project should be evaluated to determine potential health risk impacts from the proposed project.

Item	Yes	Maybe	No
b Exposure of people to potential health hazards?		X	

The project should be evaluated to determine potential health risk impacts from the proposed project.

Item	Yes	Maybe	No
7. **Aesthetics.** Will the proposal result in the obstruction of any scenic vista or view open to the public, or will the proposal result in the creation of any aesthetically offensive site open to public view?		X	

The project should be evaluated to determine the potential impact related to aesthetics.

Item	Yes	Maybe	No
8. **Recreation.** Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?			X

The project would not have an impact on the quality or quantity of existing recreational opportunities.

19. **Cultural Resources.**

a. Will the proposal result in the alteration of or the destruction of a prehistoric or historic archaeological site? ___ ___

Based on the archeological inventory and the recent history of t development on the site, it would not be expected that cultural historical resources would be discovered on the site. Therefore, t project would not result in the alteration, or destruction of, prehistoric or historic archaeological site,

b. Physical or aesthetic effects to a prehistoric or historic building, structure, or object? ___ ___

There are no historic buildings on the project site, therefore t project would have no impact on such resources.

c. Does the proposal have the potential to cause a physical change which would affect unique ethnic cultural values? ___ ___

Based on the archeological inventory and the recent history of t development on the site, it would not be expected that cultural historical resources would be discovered on the site. Therefore, t project would not cause a physical change which would affect uniq ethnic cultural values.

d. Will the proposal restrict existing religious or sacred uses within the potential impact area? ___ ___

The subject site is not used for religious or sacred purposes.

.0. **Mandatory Findings of Significance.**

a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory? ___ ___

The preliminary evaluation of the project determined that the proje would not have the potential to substantially reduce the habitat of fish or wildlife species, cause a fish or wildlife population to dr below sustaining levels, threaten to eliminate a plant or anim community, reduce the number or restrict the range of a rare endangered plant or animal, or to eliminate important examples of the major periods of California history or prehistory.

b. Does the project have the potential to achieve short-term to the disadvantage of long-term environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time, while long-term impacts will endure well into the future.) ___ X ___

The proposed project is designed to comply with specific regulations to achieve a long-term improvement in air quality. However, the project should be evaluated to determine that operation of the project would not significantly impact the local environment.

c. Does the project have impacts which are individually limited, but cumulative considerable? (a project may impact two or more separate resources where the impact on each resource is relatively small, but where the total effect of those impacts on the environment is significant) ___ X ___

Detailed cumulative impacts analyses should be prepared for air quality, risk of upset and health risks to determine that these impacts would not be cumulatively considerable when combined with other Exxon projects and other projects in the area, including other clean fuels projects. The remaining topic areas should be evaluated to determine whether there is any potential for cumulative impacts.

d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly? ___ X ___

The project could have environmental effects that would cause substantial adverse impacts on human beings including those related to unstable earth conditions, air quality, odors, groundwater, noise, risk of upset, population and housing, transportation/circulation, public services and utilities, human health, and aesthetics. The project should be evaluated to determine the significance of these potential impacts.

PART III: DETERMINATION

On the basis of this initial evaluation:

I find that the proposed project COULD NOT have a significant effect on t environment, and a NEGATIVE DECLARATION will be prepared [

I find that although the proposed project could have a significant effect on t environment, there will not be a significant effect in this case because t mitigation measures described on the attached sheet have been added to t project. A NEGATIVE DECLARATION WILL BE PREPARED. [

I find the proposed project MAY have a significant effect on the environment, a an ENVIRONMENTAL IMPACT REPORT is required. [

February 10, 1993
Date

Joan Lamphier
Signature

Joan Lamphier
Name

Project Manager
Title

For: CITY OF BENICIA
PLANNING DEPARTMEN

ENVIRONMENTAL CHECKLIST - APPLICANT

PLEASE COMPLETE ALL APPLICABLE ITEMS. TYPE OR PRINT IN DARK INK.

For Dept. use:
Application no. ____

1. Project name: Benicia Refinery Clean Fuels Project

2. Type of application: Use Permit

3. Project sponsor's name: Exxon Company, U.S.A. Phone (707) 745-7780

   Mailing address: 3400 East Second Street, Benicia, CA 94510

4. Other permits/approvals required for project (state, federal, regional, etc.)

   Bay Area Air Quality Management District Authority to Construct

Indicate which of the following items are applicable to the project, or to effects created by the project. Discuss below all items checked "yes" or "maybe". Attach additional sheets if necessary.

Please see attached Appendix C of the application for the Benicia Refinery Clean Fuels Project

	Yes	Maybe	No
a) Change in existing features of any bay, tidelands, beaches, lakes or hills, or substantial alteration of ground cover.			X
b) Change in scenic views or vistas from existing residential areas or public lands or roads.			X
c) Change in pattern, scale, or character of general area of project.			X
d) Creation of significant amounts of solid waste or litter.		X	
e) Change in dust, ash, smoke, fumes, or odors in vicinity.			X
f) Change in bay, lake, stream, or groundwater quality or quantity, or alteration of existing drainage patterns.			X
g) Change in existing noise or vibration levels in the vicinity.			X
h) Site on filled land or slope of 10 percent or more.	X		
i) Use or disposal of potentially hazardous materials (toxic substances, flammables, explosives, etc.).	X		
j) Substantial change in demand for municipal services (police, fire, water, etc.).			X
k) Substantial increase in fossil fuel consumption (oil, natural gas, etc.).		X	
l) Relationship to a larger project or series of projects.			X
m) Construction in a floodplain.			X

DISCUSSION OF ITEMS CHECKED "YES" OR "MAYBE". (Attach second sheet if necessary.)

Please see Appendix C of the Permit Application.

APPLICATION FOR PLANNING ACTION

TYPE OF APPLICATION (Check applicable items)

- [ ] General Plan amendment
- [X] Use permit ______
- [ ] Transfer of Density
- [ ] Rezoning or prezoning
- [ ] Variance
- [ ] Game Center
- [ ] Zoning text amendment
- [ ] Design review ______
- [ ] Amendment to existing permit
- [ ] Planned development
- [ ] Revision to approved project
- Other ______

PLEASE COMPLETE ALL APPLICABLE ITEMS. TYPE OR PRINT IN DARK INK.

1. Project name Benicia Refinery Clean Fuels Project
2. Project address or location 3400 East Second Street, Benicia, CA 94510
3. Assessor's parcel no. 80-110-03 Property size ______
4. Property owner's name Exxon Company, U.S.A. Phone S. J. Hammonds 745-7780

   Mailing address 3400 East Second Street, Benicia, CA 94510
5. Applicant's name Exxon Company, U.S.A. Phone 745-7780

   Mailing address 3400 East Second Street, Benicia, CA 94510
6. Architect/designer Exxon Company, U.S.A. Phone ______

   Mailing address ______
7. Current zoning General Industrial General Plan designation ______
8. Project description (type of development, need for variance, specific General Plan or zone change proposed, use being proposed, etc., as applicable to the type of application(s) being filed. Attach second sheet if necessary.

   Install facilities to produce cleaner burning, reformulated fuels as specified by the California Air Resources Board and as required by the 1990 Amendments to the Federal Clean Air Act and the California Clean Air Act.

NOTE: Additional information is required as part of each application submittal. Separate instruction sheets containing all submittal requirements are available from the Planning Department.

S J Hammonds
Property owner's signature Date 1/6/93

S J Hammonds
Applicant's signature Date 1/6/93

DEPARTMENT USE ONLY

Application no. ______ Fee ______ Receipt no. ______ Rec'd. by ______

Date filed ______ Date accepted ______ Accepted by ______

Commission hearing date ______ Action/date ______ Res. no. ______

Council hearing date ______ Action/date ______ Res. no. ______

Environmental determination: ______ Exempt ______ Negative declaration ______ Environmental Impact Report

PROJECT SUMMARY SHEET

PLEASE COMPLETE ALL APPLICABLE ITEMS. TYPE OR PRINT ALL INFORMATION IN DARK INK.

1. Project name: Benicia Refinery Clean Fuels Project

2. Present use of project site: Industrial

3. Surrounding land uses on adjacent properties:

   North: Industrial

   West: Industrial

   South: Industrial

   East: Industrial

4. Existing vegetation and land forms (number, type, and size of existing trees, ground cover, slope, etc.):

   Gravel and dirt are typical for the new process unit site and the new tank sites. Ground cover does exist in the area proposed for the new equipment laydown area. All areas are flat except for the proposed equipment laydown area.

5. Project area in square feet: Process units and tank areas: 199,000 sq. ft.
   Equipment laydown and storage area: 260,000 sq. ft.

6. Number/type of existing structures (indicate if structures will be removed as part of the project):

   The new process block area will occupy an existing equipment laydown and storage area. No structures currently exist at any of the new project areas.

7. Power lines, water lines or other utility lines located on or adjacent to the property:

8. Project description:

   a) Size of new structure(s) in square feet: See Appendix C

   b) Maximum height of new structures: 200 ft - see Appendix C

   c) Number of stories: N/A

   d) Number of parking spaces proposed: Regular None Compact None

   e) Building coverage as a % of total lot size: N/A

   f) Hours of operation: 24 hours/day

   g) Number of employees: See Appendix C

   h) Total number of square feet by type of use (for example, office, retail, storage, restaurant, etc.)

   See plot plan which is included in the Application - Section 2

PROJECT SUMMARY SHEET

8. Project description continued:

i) For residential projects: Total number of living units: N/A

h) Number of living units by type of unit:

Single family detached: ______

Duplex: ______

Apartment: ______

Condominium/townhouse: ______

If apartments/condominiums, number units by type:

Studio: ______

One bedroom: ______

Two bedroom: ______

Three + bedroom: ______

9. Estimated construction period:

Begin: December 1993

End: January 1996

10. Number, size and type of trees to be removed: None

11. Any other information considered pertinent to the project application:

S. J. Hammonds
Print applicant's name

[signature]
Applicant's signature

Date 1/6/93

DEPARTMENT USE ONLY

Application number(s): ______

Environmental determination:

Exempt: ______

Negative declaration: ______

EIR: ______

Date: ______ By: ______

APPENDIX B
COMMENTS RECEIVED ON THE NOTICE OF PREPARATION

This appendix is a copy of all comments received on the Notice of Preparation.

CITY OF VALLEJO

DEVELOPMENT SERVICES DEPARTMENT

City of Benicia
2 1993

May 26, 1993

Joan Lamphier
City of Benicia, Planning Department
250 East L Street
Benicia, CA 94510

re: Exxon Benicia Refinery Clean Fuels Project

Thank you for providing the City of Vallejo with the opportunity to comment on the proposed Exxon refinery project.

Our main concern is any potential local air quality impacts from the increased emissions generated by the clean fuels project. This area of concern is properly noted in the Initial Study for the project. While the project will assist in improving regional air quality the EIR should also be focused on the local impacts of the project. Subsequent analysis should include localized peak impacts based on 'worse case scenario' weather patterns (probably typical smog alert weather, calm conditions with an inversion layer) occurring on any one day and series of days. This type of peak analysis will help to identify any potential health hazards created by the project. Of course, the average longer term air quality impacts should also be analyzed for the same reason.

Other potential environmental concerns include unstable earth conditions, odors, groundwater contamination, and risk of upset as noted in the Initial Study.

The City of Vallejo looks forward to participating in the continuing review of the project and the Environmental Impact Report. Thank you for your consideration.

Sincerely,

Patrick J. Bryk

Patrick J. Bryk
Associate Planner

555 SANTA CLARA STREET • P.O. BOX 3068 • VALLEJO • CALIFORNIA • 94590 • (707) 648-4326 • FAX (707) 552-0163

PM Sig[illegible]

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

June 24, 1993

Ms. Joan Lamphier
City of Benicia Planning Department
250 East L Street
Benicia, CA 94510

Dear Ms. Lamphier:

The Bay Area Air Quality Management District (District) has reviewed the Notice of Preparation for the Exxon Benicia Refinery Clean Fuels Project. We recommend that the Draft EIR include an air quality impact analysis and, if air quality problems are indicated, a commitment to appropriate mitigation measures. Analysis should take into account impacts of the project itself and, where relevant, cumulative impacts of all predictable development in the vicinity of the project.

Recommended methods for conducting the air quality analysis, and for choosing among potential mitigation measures, are contained in the District's publication, Air Quality and Urban Development Guidelines for Assessing Impacts of Projects and Plans (Guidelines). At a minimum, the analysis should include the following elements:

Setting

- Provide a baseline emission inventory for criteria air pollutants, odorous compounds, and toxic air contaminants from existing operations at the facility.
- Discuss local and regional climatology and topography affecting atmospheric pollution potential.
- Provide a discussion of the regulatory history for criteria, toxic and odorous emissions at the regional, state and federal levels. Discuss the federal and state legislative mandate for the production of reformulated fuels and the anticipated air quality benefits.
- Present facility and the regional trends in air quality for criteria, toxic and odorous compounds.
- Identify sensitive receptors in the vicinity of the proposed project.

Impacts

- Estimate emissions of criteria, toxic and odorous air contaminants from stationary sources resulting from implementation of the proposed project and assess the significance of the impacts. Identify those emissions associated with the reformulated fuels requirements and emissions from proposed projects to upgrade the facilities.

939 ELLIS STREET • SAN FRANCISCO, CALIFORNIA 94109 • (415) 771-6000 • FAX (415) 928-8560

RECYCLED PAPER

Emission estimates should be consistent with the District's preliminary permit evaluations. The District should be contacted during the preparation of the DEIR to confirm that the proposed project emissions are consistent with those contained in the District's permit evaluation.

- Estimate emissions and assess the significance of the impacts of ozone precursors (nitrogen oxides and reactive hydrocarbons) and fine particulate matter (PM_{10}) from project-generated traffic for both the construction and operational phases of the proposed project.

- Calculate worst-case carbon monoxide (CO) concentrations at the most congested and/or heavily traveled intersections affected by project-generated traffic. Assess the significance of the impacts during the construction and operational phases of the proposed project.

- Calculate construction-related particulate emissions from such operations as demolition and grading. Indicate whether demolition activities would involve the removal of asbestos. If asbestos removal is required, address the regulatory requirements and health risks associated with this removal.

- Analyze cumulative criteria and toxic air quality impacts. The cumulative analysis should address local and regional impacts for projected stationary and project-generated mobile sources of air pollution.

- Estimate air contaminant emission reduction benefits, as well as negative impacts, if any, to the Bay Area Air Basin due to the use of reformulated fuels from this refinery. In addition, compare changes in basin-wide mobile source emissions with changes in emissions from the project itself.

<u>Mitigation</u>

- Identify appropriate mitigation measures and alternatives, evaluate their effectiveness in reducing impacts, and indicate who is responsible for implementing each mitigation measure. For impacts due to project-generated traffic, trip reduction measures, such as programs to encourage ridesharing, transit use, and bicycling, should be considered as well as roadway improvements.

- The District requests that the mitigation monitoring or reporting program be developed and circulated concurrently with the Draft EIR. This will allow the District advance knowledge of the proposed program and allow time to resolve potential problems.

If you have any questions, please contact Joseph Steinberger, Planner, at (415) 749-5018.

Sincerely,

Milton Feldstein
Air Pollution Control Officer

MF:JES:jsw