**FINAL REPORT**

# UNIVERSITY OF CALIFORNIA, BERKELEY
# RICHMOND FIELD STATION

# FIELD SAMPLING AND ANALYSIS PLAN
# AND
# TIERED RISK EVALUATION

*Prepared for*
University of California, Berkeley
317 University Hall #1150
Berkeley, California 94720

December 10, 1999

**URS Greiner Woodward Clyde**
500 12th Street, Suite 200
Oakland, California 94607

If you have questions or need further information, please contact Anna Moore (643-9518, e-mail amorel@uclink4.berkeley.edu) or me (643-8676).

Sincerely,

Mark Freiberg (KEH)

Mark Freiberg
Acting Director

Enclosure

(w/o enclosure unless otherwise stated)
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| | |
|---|---|
| ASTM | American Society for Testing Materials |
| bgs | Below Ground Surface |
| Caltrans | California Department of Transportation |
| cm | centimeter |
| $C_{OB}$ | Concentration Measured in Spiked Sample Analysis |
| $C_{sp}$ | Concentration of Spike |
| $C_x$ | Concentration Measured in Unspiked Sample Analysis |
| COPCs | Chemicals of Potential Concern |
| decon | Decontamination |
| DTSC | Department of Toxic Substances Control |
| DQO | Data Quality Objectives |
| EPZ | Ecological Protection Zone |
| ERLs | Effects Range-Low Levels |
| ERMs | Effects Range-Median Levels |
| E-SSTLs | Ecological Site-Specific Target Levels |
| ft | feet |
| FSAP | Field Sampling and Analysis Plan |
| gal | gallon |
| HHPZ | Human Health Protection Zone |
| HH-SSTLs | Human Health Site-Specific Target Levels |
| HSA | Hollow Stem Flight Augers |
| HSP | Health and Safety Plan |
| LCS | Laboratory Control Spike |
| mg/kg | milligrams/kilogram |
| min | minute |
| ml | milliliter |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| MW | Monitoring Well |
| NA | Not Applicable |
| ND | Non Detect |
| NOAA | National Oceanographic and Atmospheric Administration |

| | |
|---|---|
| PCBs | Polychlorinated Biphenyl's |
| PPE | Personal Protective Equipment |
| ppm | Parts Per Million |
| PRGs | Preliminary Remediation Goals |
| PRPs | Potentially Responsible Parties |
| PQLs | Practical Quantitation Limits |
| QA/QC | Quality Assurance/Quality Control |
| RBE | Risk-Based Evaluation |
| RBCA | Risk-Based Collective Action |
| RBSLs | Risk-Based Screening Levels |
| RFS | Richmond Field Station |
| RMZs | Risk Management Zones |
| RPD | Relative Percent Difference |
| RWQCB | Regional Water Quality Control Board |
| SEPZ | Saltwater Ecological Protection Zone |
| SF | San Francisco |
| SOP | Standard Operating Procedure |
| SSTLs | Site-Specific Target Levels |
| SVOCs | Semivolatile Organic Carbons |
| TPH-d | Total Petroleum Hydrocarbon-Diesel |
| UEPZ | Upland Ecological Protection Zone |
| USEPA | United States Environmental Protection Agency |
| QAP | Quality Assurance Plan |
| VOCs | Volatile Organic Carbons |
| WDOE | Washington Department of Ecology |

The Regional Water Quality Control Board (RWQCB) Bay Protection Toxic Cleanup Program has identified Stege Marsh (the Marsh) as one of the highest priority sediment "hot spots" within San Francisco Bay due to contamination with toxic heavy metals, PCBs, and pesticides. Previous investigations have identified several potential sources of contaminants, including historic activities at the University of California Richmond Field Station property (RFS), that have contributed to the sediment contamination that currently resides in the Marsh. Five metals (arsenic, copper, mercury, selenium, and zinc), polychlorinated biphenyls (PCBs), and pesticides have been identified as posing potential risks to human health and the environment.

In response the RWQCB request, the University of California, Berkeley (UC Berkeley) has reviewed the historic and current chemical uses at the RFS to identify activities that may have contributed to the Marsh contaminants. Historic records were reviewed, interviews with RFS employees were conducted, file reviews were performed at the RWQCB, the Department of Toxic Substances Control (DTSC), and the United States Environmental Protection Agency, historical aerial photographs were reviewed, and Sanborn Fire Insurance maps were examined. Based on the information reviewed, other potential off-site sources were identified that may have contributed to the sediment contamination within the Marsh. Subsequently, file reviews were performed for neighboring properties including Stauffer Chemical/Zeneca and Liquid Gold. Other potential sources were also identified including Point Isabel (a lead battery recycling facility), Marina Bay (a former ship repair and manufacturing facility), and upstream properties which may have had past releases into Meeker Creek. Additional research for these properties will be required to determine contribution to existing contaminant levels in the Marsh.

Prior to UC Berkeley purchasing the RFS, California Cap owned and operated a blasting cap manufacturing facility on the property. California Cap's operations were examined to evaluate whether they may have contributed to the Marsh contaminants. Six potential sources were identified at the RFS based on the historical and current Site use; 1) the Forest Products Laboratory, 2) the former California Cap Blasting Cap and Test Pit Area, 3) the former California Cap Company Shell Manufacturing Facility, 4) two former underground storage tanks located at Buildings 118 and 120, 5) the Former Mercury Fulminate Area, and 6) pyrite cinders from Stauffer Chemical that were placed at the RFS as fill material. The potential pathways to from the source areas identified into the Marsh were examined to determine whether potential releases within these areas made their way into the Marsh. Three potential pathways were identified including the two on-Site storm drains, groundwater flow, and overland flow. Based on the location, chemical distribution, and the potential pathways identified, it appears that two of these six sources may have contributed to the chemical contaminants that have been found in the Marsh: 1)the metals in the pyrite cinder fill located on along the eastern storm drain may have migrated into the Marsh, and 2) overland flow containing mercury from the former Mercury Fulminate Plant.

In addition to the on-site sources at the RFS, several potential off-site sources have been identified. Sampling data and historic land use at the Zeneca/ICI Americas/Stauffer Chemical and Liquid Gold properties were reviewed. The Zeneca property has historically been used for heavy industrial activities including chemical and pesticide manufacturing. Based on the distribution of metals and pesticides within the Marsh it appears that there are several activities that have contributed to the Marsh contaminants. Over the years, industrial wastewater was discharged from operations on the Zeneca property into the Marsh through a series of holding ponds and storm drains. As observed in the historic aerial photos, the pond locations and configurations have changed over the years. In 1969, an unlined pond extended to into the Marsh where the current pyrite cinder landfill is currently located. Up until the placement of the pyrite cinder landfill, the Marsh was contiguous between the RFS and Zeneca properties, and the water appeared to flow in a westerly direction.

The pyrite cinder landfill located on the eastern boundary of the RFS is a source of metals that have been detected in the Marsh. The cinder landfill was placed into the Marsh by Stauffer Chemical and is a by-product of the sulfuric acid production. The exact extent of the pyrite cinders is unknown at this time but pyrite cinders have been observed in both what is now identified as the western and eastern portions of the Marsh. Additionally, Liquid Gold, a National Priority Listed (NPL) Site located to the east of Zeneca, may have contributed to the contaminants within Stege Marsh. Elevated metals and PCBs have been found within Liquid Gold soils and within Carlson Creek. Additional investigation will be necessary to determine whether the chemical constituents detected at Liquid Gold, have migrated into Stege Marsh via Carlson Creek.

As required by the RWQCB, and based on the information reviewed, UC Berkeley has prepared a Field Sampling and Analysis Plan (FSAP) to delineate the extent of contamination and to evaluate potential on-Site and off-Site sources. The soil, groundwater, and sediment quality at the Richmond Field Station (RFS) and the neighboring Stege Marsh will be sampled and analyzed for various chemical constituents based on previous data. A tiered risk evaluation will be used to evaluate the results.

The tiered risk assessment framework is presented within Section 3 of the FSAP and will be the basis to evaluate the existing and new data collected for the Marsh. The tiered risk evaluation utilizes a risk management zone concept. The Site is divided into zones based on risks to human health and the environment. A set of Tier 1 screening criteria has been developed for each zone based on the risk to the receptors identified. All existing data has been screened against the appropriate criteria and will be used for the identify chemicals of potential concern in addition to identifying areas that may pose unacceptable risks. These areas will be further targeted for additional investigation or Site specific risk evaluation.

The Regional Water Quality Control Board (RWQCB) Bay Protection Toxic Cleanup Program has identified Stege Marsh (the Marsh) as one of the highest priority sediment "hot spots" within Central San Francisco Bay. Previous investigations have identified several potential sources, including the University of California Richmond Field Station property (RFS), that have contributed to the sediment contamination that currently resides in the Marsh. Five metals (arsenic, copper, mercury, selenium, and zinc), polychlorinated biphenyls (PCBs), and pesticides have been identified as posing potential risks to human health and the environment.

In response to the RWQCB request, the University of California, Berkeley (UC Berkeley) has prepared this Field Sampling and Analysis Plan (FSAP) to evaluate the soil, groundwater, and sediment quality at the Richmond Field Station (RFS) and the neighboring Stege Marsh. Stege Marsh is a small intertidal salt marsh located on the eastern shore of Central San Francisco Bay. The Marsh lies at the southern boundary of the Richmond Field Station, located at 1301 South 46th Street in Richmond, California 94804, and extends west towards Meeker Creek. The eastern portion of the Marsh lies south of Zeneca Inc. (Zeneca) and extends east towards Carlson Creek.

This Field Sampling and Analysis Plan (FSAP) presents a technical approach that will focus on: 1) satisfying the RWQCB requirements; 2) reviewing the RFS Site History to determine whether there are potential sources due to past or current operations that may have contributed to the chemical contaminants detected within Stege Marsh; 3) identifying potential off-site sources that may have contributed to contaminants found within Stege Marsh; 4) delineating the extent of chemicals of potential concern; 5) collecting sufficient data during the field sampling effort to aid in the allocation of responsibility to off-site sources; and 6) obtaining data quality that is adequate for evaluating the potential risks to human health and the environment.

## 2.1 SITE DESCRIPTION

### 2.1.1 Site History

The UC Berkeley Richmond Field Station (RFS) is located at 1301 South 46th Street in Richmond, California (see Figure 1). The RFS, which occupies approximately 150 acres of industrial-zoned land, is bounded by Meade Street and Hoffman Boulevard to the north, Meeker Creek/Regatta Boulevard to the west, South 46th Street to the east, and Stege Marsh, a tidal basin located within Central San Francisco Bay, to the south (see "Property Boundary" in Figure 1). In addition to the upland acreage, the University of California, Berkeley (UC Berkeley) owns submerged land offshore adjacent to Stege Marsh. For this purposes of this investigation, the term "RFS site" refers to the upland portion of the UC Berkeley property (see Figure 1). The term "Stege Marsh" includes the entire marsh area as shown in Figure 1.

Historically, the southeast corner of the RFS property contained the U.S. Briquette Co., which was noted as "not in operation" on a June 1916 Sanborn map (see Appendix D). In addition, the eastern portion of the RFS property was home to the California Cap Company (the Cap Company), a high-explosives blasting cap manufacturing plant. The Cap Company reportedly began purchasing property from the Hercules Powder Company and several other small explosives manufacturers in the area in the early 1900s (Jonas & Associates, 1990). By 1920, the Cap Company was the sole explosives manufacturer on site. According to an article published in the July 1922 edition of *The Detonator,* the Cap Company manufacturing plant consisted of approximately 150 buildings including administration buildings, a shell and metal drawing unit, a wire drawing unit, the blasting cap line unit, an electric blasting cap unit, and fulminate nitrating and recovery units (see Figure 2). All components of the blasting caps were manufactured on site, including explosives, shells, copper containers, tin boxes, paper cartons, and insulated wire. The chief constituent of the explosive used by the Cap Company was a guncotton (nitro cellulose) basecalled "Tonite". Manufacturing of the explosive included the production of Mercury Fulminate ($Hg(CNO)_2$), a whitish-gray solid material derived by treating mercury with strong nitric acid and alcohol. The former Mercury Fulminate facility was located in the southeastern portion of the property. Other former facilities associated with the Cap Company included the shell manufacturing area located in the southern portion of the RFS, the blasting cap manufacturing area centrally located on the RFS, an explosives test pit area in the northeast portion of the RFS, and two explosive storage areas, both located southwest of the former explosives test pit area. The entire Cap Company facility covered approximately 30 acres, with an additional 30 acres of trees surrounding the factory. Prior to its closure, the Cap Company reportedly accepted "cinder fill" from its neighbor, the Stauffer Chemical Company, to use as a pesticide/herbicide around some of its buildings. Although the exact placements of the cinder fill are not known, suspected locations are around the former explosive storage areas (south of Wren Drive), near the former mercury fulminate area, and immediately west of Building 167. The Cap Company operated until 1948.

In 1950, the Cap Company property was purchased by UC Berkeley with the agreement that the Cap Company would remove all hazardous materials from the property. The Cap Company reportedly complied with the purchase agreement, though subsequent site testing and on-site observations revealed potential hazardous material problems on-site. For example, several explosions of unknown magnitudes occurred between 1950 and 1953 when UC Berkeley attempted to clear vegetation at the RFS by using a controlled burn (Jones & Stokes Associates, Inc., 1990). The explosions were thought to be associated with residual chemicals used by the California Cap Company.

In 1951, the University acquired additional undeveloped land to the west and adjacent to the Cap Company property to become what is now known as the RFS. During the 1950s, a number of new buildings were constructed in the northeastern portion of the RFS to accommodate research programs sponsored by the UC Berkeley's College of Engineering. Some of the buildings constructed during this era included administration buildings and a Forest Products Laboratory that was constructed about 1955. The first studies conducted at the Forest Products Laboratory involved the treatment of wood with pentachlorophenol in liquified petroleum gas, mixed with a small percentage of isopropyl ether cosolvent (approximately 4%). After approximately five to six years, the facility converted to a waterborne preservative formulation process, including the use of chromated copper arsenate and ammoniacal copper arsenate. (Jonas & Associates, 1990).

Current research on the facility is derived primarily from the UC Berkeley College of Engineering, and includes the Forest Products Laboratory, the Earthquake Engineering Research Center, the Fire Test Laboratory, the Hydraulics Basin Model Laboratory, the Northern Regional Library Facility, the Soil Mechanics Laboratory, the Structural Research Laboratory, the Sanitary Engineering and Environmental Health Research Laboratory, and various other research-related facilities.

In addition to UC Berkeley's research facilities on-site, the United States Environmental Protection Agency (USEPA) began operating its Region IX Laboratory on the southwest portion of the RFS property in 1993. The USEPA laboratory is still in operation at the RFS.

### 2.1.2 Surrounding Land Use

Several large chemical and industrial sites border the RFS property to the north, west, and east. The California Department of Transportation (Caltrans) equipment storage yard is located to the north, Bio Rad Laboratories and Pacific Gas & Electric are located to the west, and Zeneca Ag Products and the former Liquid Gold Oil Corporation are located to the east. Hoffman Marsh and Point Isabel are also located slightly further to the east, approximately 1.5 miles from the RFS. Richmond Inner Harbor and Stege Marsh border the RFS to the south. Marina Bay, a mixed-use residential and commercial development, lies to the southwest. As of 1997, the Southern Pacific Railroad right-of-way that traverses the southern portion of the RFS was purchased by the East Bay Regional Park District and serves as part of a trail network surrounding the San Francisco Bay.

### 2.1.3 Climate

Meteorological conditions for the City of Richmond are influenced by its proximity to the Central San Francisco Bay Estuary, the Pacific Ocean, and the Oakland-Berkeley Hills. The prevailing winds along the south Richmond shoreline are southeasterly and southwesterly with an average wind speed of six to seven miles per hour. Average annual daily temperatures for the city of Richmond range from 50 degrees Fahrenheit (°F) in the winter, to 67°F in the summer. Average total precipitation for the city of Richmond is 23 inches annually, with November through March contributing roughly 83% of the annual average.

### 2.1.4 Regional Geology/Hydrogeology

The RFS is located at the distal end of an alluvial plain that slopes to the southwest (Jonas & Associates, 1990). The Hayward Fault Zone transects the alluvial plain to the northeast, towards the Berkeley Hills (Jennings & Burnett, 1961). San Pablo Bay lies to the south of RFS.

The RFS is situated on the alluvial plain, which represents relatively recent Quaternary age deposits. The lithology of the alluvial plain consists primarily of consolidated to unconsolidated clays, silts, sands, and gravels, with organic-rich clays and silts bordering San Pablo Bay. The total thickness of all these deposits range from shallow surface deposits, where the alluvium thins against the Berkeley Hills to approximately 300 feet in depth. These deposits are underlain by bedrock of the Mesozoic Franciscan Formation. This Franciscan Formation is a complex assemblage of sepentinite, greenstone, graywacke, chert, shale, sandstone, and schist, and is found on many ridges and mountains of the San Francisco Bay Region.

#### *Local Geology*

Subsurface geology of the upper 100 feet in the area of RFS has been characterized by two boring logs drilled for wells installed on RFS property (Jonas & Associates, 1990; EAL, 1984). Both of these logs indicate that a silty clay layer is present from ground surface to a depth of approximately 6 to 8 feet below ground surface (bgs). Interbeds of poorly sorted gravel, sand, silt, and clay lie beneath this clay layer and extend to approximately 40 feet bgs. Clay to gravelly clay occurs from approximately 40 to 90 feet bgs. Sandy gravel was encountered from approximately 90 feet to the bottom of the borings at approximately 102 feet bgs. These lithologic descriptions are summarized below:

| | |
|---|---|
| • 0 to 8 feet | Silty clay |
| • 8 to 40 feet | Interbeds of poorly sorted gravels, sand, silts and clays |
| • 40 to 90 feet | Clay to sandy gravelly clay |
| • 90 to 102 feet | Sandy gravel |

Four additional borings were drilled to a depth of 60 feet BGS on ICI Americas property, adjacent to the eastern boundary of RFS (ICI Americas, 1988). Previous reports (Jonas & Associates, 1990) indicate that the logs from these borings were not available, but the local subsurface conditions were described as predominantly fine-grained sands, silts, and clays with minor amounts of gravel, found in poorly graded deposits of sand, silts, and clays (Hall, 1988). Discrete lithologies identified in these boreholes did not appear to be laterally or vertically extensive within the upper 60 feet (Jonas & Associates, 1990).

### *Local Hydrogeology*

A discussion of the local hydrogeology was obtained from previous studies conducted by Woodward-Clyde (1993) and Sheperd Miller, Inc., 1999). Woodward-Clyde (1993) identified four major hydrogeologic units in the RFS area. These units, in descending stratigraphic order, include the:

- Artificial Fill
- Quaternary Alluvium
- Bay Sediments
- Yerba Buena Mud (or Older Bay mud).

The Yerba Buena mud is a unit which was deposited in an estuary similar to present day San Francisco Bay. It is a relatively homogeneous, fine-grained unit which typically behaves as an aquitard. The Quaternary Alluvium is a heterogeneous hydrogeologic unit in which several subunits are recognized. Some of these subunits are coarse-grained with relatively high permeability, while others are finer-grained with relatively low permeability. In the RFS vicinity, the bay sediments consist of a fine-to-very-fine-grained sand, peat, and clay. The man-made alluvial fill is heterogeneous, but is suspected to contain pyrite cinders at several locations around the RFS, which are expected to have a relatively high permeability.

Zeneca (Sheperd Miller, Inc., 1999) reports that the bay sediments and quaternary alluvium sequence beneath the Zeneca property contains two aquifer systems, referred to as the water table aquifer and the lower aquifer. Groundwater depth in the water table aquifer was observed at approximately 6 feet BGS in the southeastern portion of the RFS (ECI, 1998). The water table aquifer has been reported as relatively continuous across the Zeneca property and is underlain by a thin silty-clay which serves as an aquitad to the lower aquifer. Measured hydraulic conductivities in the water table aquifer range between $1.4 \times 10^{-5}$ cm/sec and $1.4 \times 10^{-2}$ cm/sec (Sheperd Miller, Inc., 1999). Woodward-Clyde (1993) reports that this aquifer is, on average, 5-feet thick and has an average gradient of 0.004.

The lower aquifer is heterogeneous with clay lenses that cause locally extensive confining conditions, separating the aquifer into two locally separate portions (upper and lower). Measured hydraulic conductiviteis in the lower aquifer range from $1 \times 10^{-8}$ cm/sec and $1.2 \times 10^{-4}$ cm/sec (Sheperd Miller, Inc., 1999). The lower aquifer is, on average, approximately 16-feet thick, with gradients of 0.006 and 0.004 in the upper and lower portions of this aquifer, respectively (Woodward-Clyde, 1993). The generally low hydraulic conductivity and gradients in the lower aquifer indicate that groundwater moves at a relatively slow velocity in the RFS vicinity (Sheperd Miller, Inc., 1999).

Previous information had been used to estimate mass loading to areas down-gradient from the RFS. The estimated groundwater velocities in the water table aquifer, and the upper and lower portions of the lower aquifer, are 0.95 m/yr, 1.4 m/yr, and 0.95 m/yr, respectively (Woodward-Clyde, 1993).

### 2.1.5 Ecological Setting

The RFS consists mainly of developed, upland areas with various ornamental trees, shrubs, and lawn areas surrounding the facility buildings. A row of pine trees (*Pinus sp.*) lines the northern fence-line, and several stands of eucalyptus (*Eucalyptus globulus*), remnants from the California Cap Company, are scattered throughout the property. Pampas grass (*Cortaderia selloana*) is prevalent along the eastern boundary of the property, and persists heavily around the upland perimeter of Stege Marsh toward the southern property boundary. According to past studies conducted within the marsh and an aerial photo review of the RFS, Stege Marsh is the result of the filling in of Central San Francisco Bay beginning in the 1940s. Two breakwaters were constructed in the Bay during this time period, and in 1959 a levee for the railroad right-of-way was constructed (Gutstein, 1989; Woodward-Clyde, 1998). As a result of the railroad embankment, portions of the marsh were isolated, and the only openings between the marsh and the open water were two bridged breaches in the levee to allow outflow from Carlson Creek on the east, and Meeker Creek to the west. These openings subsequently served as embouchements for the tidal basin.

Upon its purchase of the RFS property, UC Berkeley officials officials also had plans to fill in areas of the marsh, and by the early 1960s, an additional two acres of the marsh were filled (Gutstein, 1989). Due to the aforementioned alterations in the vicinity of the marsh, decreased tidal flows have facilitated silt deposition.

Other distinct features of the marsh include a large, elevated area of fill located parallel to the railroad right of way, approximately 100 feet to the north of the east slope of the embankment. It is speculated that the origin of the fill is due to excess spoils from the railroad construction. Also of significance are the remnants of a pier that dates back to 1899 and originally extended from the RFS Site to the shoreline. Although only a severely dilapidated portion of the pier remains today, it was originally reported to have been used for unloading barges in its early years, then later used by the Sanitary Engineering Environmental Health Research Laboratory as an accessway to a baywater pumping station located at its terminus (Gutstein, 1989). In 1976 the RFS demolished the inner marsh portion of the pier and replaced it with a road using fill material that had been deposited against the pier supports over the years. This fill is thought to originate from the cinder landfill area that was located near the pier (Larry Bell, pers. Comm., 1999). In the late 1970s to early 1980s, the RFS was ordered to move the road because it was not consistent with Bay Conservation and Development Commission requirements. At this time, the road was relocated to its present location using the original material.

Vegetation in Stege Marsh is predominately saltgrass (*Distichlis spicata*) and pickleweed (*Salicornia sp.*), with some areas of cordgrass (*Spartina foliosa*) and reed (*Juncus sp.*) interspersed. Gumplant (*Grindelia humilis*) is also sparsely scattered in some higher elevations of the marsh, but is overpowered by invasive species such as broom (*Cytisus sp.*) and pampas grass. Coyote brush (*Bacharis pilularis*), poison oak (*Rhus diversiloba*), as well as annual grasses are also present near the marsh in small amounts.

Potential wildlife for the RFS include red and gray fox (*Vulpes fulva* and *Urocyon cinereoargenteus*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), squirrel, many small mammal species, including the federally endangered salt marsh harvest mouse (*Rheithrodontomys raviventris raviventris*), various amphibian and reptile species, small fish such as goby and sculpin, aquatic invertebrates such as crabs, clams and mussels, and many species of birds (shorebirds, waterfowl, seabirds, raptors, and songbirds), including the endangered California Clapper rail (*Rallus longirostris obsoletus).* Eucalyptus trees at the RFS are also known to be a rest stop for migrating monarch butterflies in autumn, with as many as 5,000 individuals recorded at one time (Gutstein, 1989). A list of special status species from the California Natural Diversity Data Base for Contra Costa and Alameda counties is included as Appendix E (CDFG, 1999).

## 2.2 POTENTIAL OFF-SITE SOURCES

Several neighboring properties are heavily industrialized and may have contributed to the contamination of Stege Marsh. UC Berkeley is taking a comprehensive approach to both delineating the extent of contamination within the marsh as well as identifying potential on-site and off-site sources that may have or still are contributing to the contamination within the Marsh. The following discussions provide site descriptions of off-site properties in the vicinity of the RFS and Stege Marsh and their historical land uses.

### 2.2.1 Zeneca Ag Products/Stauffer Chemical

The Zeneca Ag Products/Stauffer Chemical property is located directly adjacent to and just east of the RFS at 1415 South 47th Street (See Figure 2). The property, which encompasses approximately 75 acres, is bordered to the north and east by Meade Street, to the south by Stege Marsh, and to the west by South 46th Street.

The facility has been in operation for more than 100 years under various ownership. In the late 1800s, the property was reportedly utilized by the Mountain Copper Company, a copper smelting operation (URS Consultants, Inc., 1994). In addition, 1930 Sanborn Maps of the Zeneca property show that a "Copper Leaching Plant" existed near the southwest corner of the property. The leaching plant was located directly adjacent to the bay shoreline that existed during that time period. The plant is not indicated on the SanbornSanborn maps dated 1916 or 1945-1949. A set of Sanborn maps is included as Appendix D.

In 1897, the property was purchased by the Stauffer Chemical Company (Stauffer), which manufactured bulk industrial chemicals including various acid compounds, fertilizers, and pesticides. From the early 1900's to approximately 1919, Stauffer operated a chamber plant which manufactured sulfuric acid. In 1919, the chamber plant was replaced by a contact plant that operated until 1970 (Woodward-Clyde Consultants, 1993). Pyrite cinders were generated from the roasting of pyrite as part of the sulfuric acid manufacturing process. These cinders were subsequently disposed of at a "cinder fill" area located in the southwestern corner of Stauffer's property until 1974.

Pyrite ores are deposits of iron sulfide, which can contain some impurities in the form of heavy metallic sulfides. Metallic analytes characteristic of the cinder fill include iron, copper, zinc, cadmium, arsenic, lead, and aluminum (alum) (The Mark Group, 1991). Boring logs of Stauffer's cinder fill area indicate that the center of the fill area is approximately 19 feet thick with a base elevation of 0.0 feet. Other areas of the southern portion of Stauffer's property (i.e.

near the Ag-Yard Pond) were also found to contain thin surficial layers of cinders attributed to the use of cinders as general fill material (The Mark Group, 1991).

Other uses of Stauffer's property include a superphosphate fertilizer unit (operational from 1906 to 1971), a carbon bisulfide unit (operational from 1906 to 1961), the production of aluminum sulfate (from 1923 to 1984), the production of ferric sulfate (from 1949 to 1972), the production of 2 metal salts: columbium pentachloride and titanium trichloride (until 1969 and 1976 respectively), and the operation of a Devrinol Semi-Works plant (from 1976 to 1987).

In 1985, Stauffer became a subsidiary of Cheesborough Ponds which was taken over by Unilever, an England-based firm. In 1988, Stauffer was sold from Unilever to ICI Americas Inc. In June 1993, Zeneca was spun off from ICI Americas (Woodward Clyde Consultants, 1993).

Agricultural product formulation began on-site in 1960, including the formulation of Eptam, Tillam, Vapam, Ordram, and Devrinol. In 1992, the operations on the property were limited to the manufacture and formulation of Vapam, Ordram, and Devrinol. Vapam is a non-selective liquid soil fumigant effective for the control of weeds, nematodes, and fungi. Devrinol and Ordram are herbicides. Manufacturing and formulation activities were discontinued in early 1997 due to the sale of the product business line. However, Zeneca continues to operate its Western Research Center at 1200 South 47th Street. Both facilities are located within the boundaries of the Stauffer/Zeneca property.

Physical attributes of the Stauffer/Zeneca property include numerous buildings, six sedimentation ponds, and two evaporation ponds. Prior to 1989, wastewater generated by site operations and laboratory operations was released to the sedimentation ponds and then diverted into two evaporation ponds. After passing through the evaporation ponds, wastewater was released into the adjacent saltwater tidal marsh. "Between 1906 and 1974, wastewater was not chemically treated prior to release to the tidal marsh; however, wastewater was treated by a neutralizing system to reduce acidic or basic conditions. During this period, an estimated 100,000 gallons of wastewater was released to the tidal marsh on a daily basis. Since 1974, wastewater has been passed through a carbon adsorption system to remove organic constitiuents prior to release to the settling and evaporation ponds. In 1989, this wastewater discharge system was overhauled and wastewater entering the evaporation ponds is now discharged, via pump and pipe, to the Richmond Publicly Owned Treatment Works." (URS, 1994).

### 2.2.2 Liquid Gold

The Liquid Gold property is located directly west of Hoffman Boulevard in Richmond, California, approximately 0.5 miles east of the RFS (See Figure 2). In total, the property is approximately 18 acres, including 2 acres of filled marshland. This parcel is part of a larger, 40-acre parcel (including the northern portion of Hoffman Marsh) owned by the Southern Pacific Land Corporation since 1904. Although Southern Pacific never used the property for any of its operations, they leased approximately 3 acres to San Pablo Oil, an asphalt manufacturing plant, from 1947 to 1974. San Pablo Oil operated the asphalt plant until 1965 when they subleased the property to the Liquid Gold Oil Corporation. Beginning in 1974, Liquid Gold leased the property directly from Southern Pacific until operations at the facility ceased in 1982.

The Liquid Gold Oil Corporation used the property as an oil storage and transfer facility, where oils, solvents, and tank bottoms were stored on-site and subsequently sold. They are also reported to have operated as an oil recycler, purchasing used oil from generators such as service stations, and selling it for re-refining for use as fuel oil, lubricating oil, and a dust control agent.

As of October 1979, the property consisted of 27 storage tanks of various sizes and several deteriorating buildings remaining from the asphalt manufacturing plant. None of the buildings were used by the Liquid Gold Corporation.

The tanks were arranged in three groups, each group being surrounded by a dirt and gravel berm approximately 2-feet high. An additional berm, approximately 2-feet high, was also present in October 1979, located along the eastern side of the facility approximately 135 feet from the storage tanks. A culvert, approximately 6-feet in diameter and 125-feet long, was located at the southern end of the facility, and was reported to discharge into a bermed area approximately 60 feet by 100 feet at its southern end. The southwestern portion of the facility was leased to a pallet manufacturing and reconditioning company at this time.

After numerous inspections by the Regional Water Quality Control Board, Department of Health Services, and the Department of Fish and Game during the 1970s and early 1980s, the Liquid Gold property was placed on the California State Superfund list in January 1983 and was subsequently included on the EPA National Priority List in September of 1983. In 1983, all storage tanks were removed from the property by IT Corporation. In 1979, the Department of Health Services identified the chemicals of conern for the property as lead, nickel, copper, chromium, zinc, ploychlorinated biphenyls (PCB), and oil. In April of 1980, samples were taken from two locations on the property that contained 28,500 and 29,000 parts per million (ppm) organic phase phenols, and 6,300 and 7,300 ppm aqueous phase phenols. Since that time, the property has been the subject of numerous environmental investigations and remediation efforts. The results of these investigations and sample results are described in Section 4.3.

### 2.2.3 Other Potential Sources

Other potential sources of hazardous materials in the vicinity of the RFS include Bio Rad Laboratories Chemical Division located at 32nd Street and Regatta Boulevard, Hoffman Marsh located to the south of the Liquid Gold property, and Point Isabel located to the southeast. Both the Hoffman Marsh and Point Isabel parcels are currently owned by the East Bay Regional Parks District.

Bio Rad Laboraties is known to use radioactive materials in its research and has had past reports of environmental contamination including the release of an unknown amount of Cobalt-57 in August of 1987, and contamination by chloroform and acrylamide of a creek located on Bio Rad property (Jones & Stokes, 1990).

Hoffman Marsh has been the subject of many environmental investigations due to its close proximity to the Liquid Gold property and its recent acquisition by the Park District. Various metals including copper, mercury, lead, zinc, and arsenic have been detected at levels above ERMs. However, the source of the metal contamination is inconclusive.

The Point Isabel property, which includes Hoffman Channel and Point Isabel Cove (formerly known as Battery Bay), was the subject of a 1984 Cleanup and Abatement Order issued by the Regional Water Quality Control Board due to elevated levels of lead and zinc concentrations. Subsequently, the property underwent remedial activities including excavation and capping of the property and a monitoring program. The source of the elevated metals is thought to be the result of Bay filling activities during the 1940s through the 1960s. During this period, various imported fill materials, including broken concrete, asphalt, various earth materials, and substantial quantities of lead-containing crushed battery casings were deposited on the property.

## 3.1 OVERVIEW OF TIERED RISK-BASED EVALUATION (RBE)

Using a Data Quality Objectives (DQO) approach, URSGWC proposes a three-tiered risk-based framework for the evaluation of the site. The tiered approach, such as the Risk-Based Corrective Action (RBCA) approach published by the American Society for Testing and Materials (ASTM 1995) has been accepted by numerous state agencies, including RWQCB and CAL-EPA. Many state agencies have also developed their own guidance for tiered approaches. The tiered evaluation process includes several steps: site characterization, risk analysis, and evaluating the need for remediation. The advantages of this approach are:

- Several chemicals can be eliminated as Chemicals of Potential Concern (COPCs) early in the tiered evaluation process.
- Each tier represents an increasingly site-specific and complex level of effort in evaluating the site, resulting in fewer chemicals to be evaluated in the quantitative Tier 2 step.
- At the end of each tier, a decision can be made as to whether the site can be recommended for no further action or whether additional effort is necessary.
- Data collection involves only the quantity and quality of data needed to make a decision at each tier, ensuring that data collection is neither inadequate nor excessive but is optimally targeted to decision-making needs.

## 3.2 FATE AND TRANSPORT MECHANISMS

Understanding environmental fate and transport mechanisms for COPCs is critical in selecting an appropriate remedial technology. In order for a COPC to pose a risk to human and/or ecological health, it must occur in an area where exposure to receptors is possible, be bioavailable to the organism and have a complete exposure pathway. In order to determine if COPCs meet these criteria, URSGWC will conduct the following:

- evaluate chemical data trends in relation to depth stratification;
- establish human health and ecological risk management zones based upon the types of receptors that are present within a given area of the site;
- design a conceptual site model demonstrating potential exposure pathways;
- evaluate site-specific data collected for physical characterization as it relates to exposure and bioavailability.

### 3.2.1 Fate and Transport Overview

The fate and transport of the COPCs involves their transformation and reaction in soil and water and their movement due to dispersion and advection. Issues that need to be addressed in regard to fate and transport include:

? What are the historic sources of heavy metals that could have produced the observed concentrations and contamination locations?

? What are the probable pathways from the potential sources to the observed locations of contamination?

? What were the primary transport mechanisms, historically and presently, e.g., surface water or groundwater advection?

? What fate and transport mechanisms will be important in the future, i.e., where will the observed contamination migrate to and at what concentrations will it be at in the future.

It should be noted that the future fate and transport mechanisms of importance may differ from the historic mechanisms of importance. For example, as reported in Section 2.1.4. groundwater velocities in the vicinity of the RFS are about 1 m/year in both the water table and deeper aquifers. Most of the COPCs will travel at a rate many times slower than the velocity of the water due to absorption into the soil. This would indicate that many of the potential sources may not have contributed to the observed contamination if groundwater transport is the primary transport mechanism. On the other hand, surface water transport is very fast. It is possible for the COPCs to be advected from the suspected sources to the observed locations during a single storm event. However, for many of the potential receptors (e.g., benthic organisms in the wetland), groundwater transport may be the primary exposure route. Therefore, groundwater transport may play a greater role than surface water transport for risk assessment purposes, while the reverse may be true for identifying potential historic sources.

The fate and transport mechanism will be analyzed for two conditions. First, historic conditions will be reviewed to determine which sources of COPCs could have contributed to the observed levels and locations of contamination. This analysis will not determine the specific source for each contaminated location, but will identify sources that could have contributed to the contamination and sources that were unlikely to have contributed to the observed contamination.

Secondly, future fate and transport conditions will be analyzed. This analysis will be coordinated with the risk assessment to develop clean-up goals for each contaminated site.

### 3.2.2 Historic Contaminant Transport

Except for Mercury, a review of Figures 10A – 10I show that the highest levels of heavy metal contamination found in investigations to date in Stege Marsh occurs in three places: 1) along the western edge of the pyrite cinders pile located along the RFS and Zeneca property boundary, 2) along the sanitary/storm sewer alignment immediately west of the RFS sewage treatment plant, and 3) along the major slough of Carlson Creek running along the eastern edge of Stege Marsh. These locations may not represent the worst or the only areas of high contamination. Many areas of the RFS property and surrounding properties have not been sampled and additional sampling may indicate other areas of concern.

The existing data indicates that surface water runoff may have historically been an important transport mechanism. This is based on the observation of contamination along sloughs in Stege Marsh and along the storm sewer alignment. The contamination observed along the western edge of the pyrite cinders pile could be due to groundwater discharging at that location or rainwater leaching metals from the pyrite cinders. To determine if surface water runoff could have been the primary transport mechanism from potential sources to observed contaminated sites it is necessary to identify flow paths for surface runoff. This includes overland flow, above ground drainage and underground drainage. This can be accomplished through a visual inspection of the site or if available, analysis of topographic data. To confirm historic surface water transport, the following data should be collected.

1. Topographic map of the RFS with 1 foot contours. This data will be used to identify probable overland flow paths to help determine if rainfall could have washed contamination into the storm sewer system or into Stege Marsh directly. This data will also be used to identify additional sample sites.
2. Storm sewer conditions. This may be determined through visual observations of the storm sewer. The storm sewer (including manholes and drain inlets) will be inspected to identify locations that have failed and significant leakage could have occurred, and for locations where sediment may have collected. If any sediment is observed it should be sampled for contamination.
3. Surface and near surface soil samples for analysis of COPCs. If surface runoff is the main transport mechanism, then the contamination at the source should be near the surface.

The result of this analysis will be a map of the site showing flow paths from each potential source to Central San Francisco Bay. This information will be put on the same map as the contamination.

Groundwater transport is the other mechanism that could have transport the COPCs to the observed contamination sites. Existing data indicates low transport rates, on the order of one meter a year. Existing hydraulic gradients are shallow and flow is towards the west south-west. Hydraulic conductivities in the water table aquifer are around $1\text{x}10^{-5}$ to $1\text{x}10^{-2}$ cm/s and $1\text{x}10^{-8}$ to $1\text{x}10^{-4}$ in the lower aquifer. The water table aquifer is located in the quaternary alluvium material which is described as heterogeneous. We propose to conduct a pump test to obtain a better estimate of the hydraulic conductivity since a pump test averages over a larger area than more passive methods (e.g., slug tests). The test will be conducted for a maximum of 24 hours. Four observation wells will be installed in two lines at right angles to each other, two wells in each line.

General fate mechanisms that could apply to the RFS include vaporization or volatilization (e.g., mercury), adsorption and desorption, degradation and decay (e.g., biological decay), hydrolysis of the organic compounds, and possibly cation exchange in the pyrite cinders. In addition, due to the difference in properties between the pyrite cinders and the native soils important fate mechanisms and/or values will differ around the site and between COPCs.

Because of the uncertainties in estimating the different fate properties, only two fate mechanisms will be analyzed, sorption-desorption and decay. Sorption will be represented by a partition coefficient. Its value will be estimated from soil and water data collected on site. For each soil sample collected below the water table a water sample will be collected at the same location. These data will be used to estimate the partitioning between soil and water and variability of partitioning within the site. These site-specific Kd values will be compared to literature values available from EPA. The calculated Kd values will be used site-wide based on site-specific TOC and pH data.

For the metals, no decay will be assumed. For organic materials, samples will be analyzed for likely daughter products that could be used to indicate that decay is occurring.

### 3.2.3 Existing Contaminant Transport

It is assumed that any surface contamination observed on site will be mitigated so that surface runoff will no longer be a potential transport mechanism. Existing transport mechanisms include groundwater transport and mixing with Bay water in Stege Marsh. Data for the surface water mixing includes tidal flows and bathymetry in the marsh. The tidal prism for Stege Marsh will be estimated from the marsh bathymetry and tidal data.

Data needed to estimate the discharge from the marsh soils to the Bay include tidal elevations in the marsh, piezometric head in the marsh, and partitioning between the soil and water in the marsh soils. Soil and water samples from Stege Marsh will be collected to estimate partition coefficients for constituents in the marsh soils. Tidal data will be obtained from the nearest NOAA tide gage. Piezometers will be installed in each of the aquifers at the upgradient edge of the marsh.

## 3.3 DECISION MATRIX

The decision matrix demonstrated in Figure 6 graphically depicts the tiered risk approach to be taken at the RFS site, as well as the foundation for making risk-based decisions. The matrix identifies specific tasks that will be completed at various steps in the process. Depending on the results of the tasks completed, some of the tasks identified may be deemed unneccessary. The following is a discussion of Tier 1 of the Risk Assessment process.

## 3.4 TIER 1 RISK APPROACH

The Tier 1 risk evaluation is the most conservative and least site-specific level of risk screening. It typically utilizes published benchmark values to screen chemical constituents detected at the site to develop an initial list of COPCs. The Tier 1 screening provides an evaluation of the "reasonable worst-case" scenarios by assuming that exposure doses are maximal or in the upper end of the exposure range. The risk approach will be divided into two classes, human health and ecological risk, and will correspond to their respectively designed risk management zones (RMZs). An overview of the designated protection zones, receptors, exposure scenarios and tiered assessment goals is provided in Table 3-1. Individual source areas (known and currently unknown) may be distributed throughout each protection zone. Each source area or exposure unit will be evaluated independently to determine compliance with the protection goals for that zone. This approach allows a uniform and consistent evaluation of individual source areas by establishing evaluation methods and protection goals that are specific to the receptors and exposure types within each zone.

### 3.4.1 Human Health

The human health protection zones and screening values are based on the types of exposure that may exist for human receptors at the RFS and vicinity.

#### *3.4.1.1 Human Health Protection Zone (HHPZ)*

The preliminary HHPZ for the RFS will be broken down into 3 sub-units: HHPZ-1, HHPZ-2 and HHPZ-3. HHPZ-1 covers the entire upland area of the property and includes the portion of the property where RFS staff may be employed in the offices and laboratories of the property. HHPZ-2 includes the road located near the southeast portion of the property (near Stege Marsh) and the East Bay Regional Park Trail easement that traverses the southern portion of the property where recreational use by bikers, joggers and hikers is known. HHPZ-3 includes the shoreline and offshore portion of the Bay immediately adjacent to the dykes where recreational fishing and shellfishing is known to occur (pers comm., RFS staff).

Screening criteria for the human health zones are discussed below.

#### *3.4.1.2 Human Health Screening Values*

Before risks to human health can be assessed, site (i.e., individual source areas) inorganic data will be compared to background concentrations, where background is defined as ambient concentrations in areas free of site-related chemicals. The purpose of this comparison is based on the understanding that naturally occurring chemicals (metals) cannot be remediated to levels lower than their background concentrations, even if such background exceeds theoretical conservative risk thresholds. For the site, background concentrations will be represented by the Lawrence BerkeleyBerkeley Background Concentrations for metals for upland soils, and the "Ambient Concentrations of Toxic Chemicals in SF Bay," published by RWQCB for the tidal and subtidal areas (1999) (Table 3-2). As recommended by Department of Toxic Substances Control (DTSC), the maximum site concentrations of inorganics will be compared to the ambient concentrations (DTSC 1997). Inorganic chemicals that are lower than or equal to ambient concentrations will be dropped from further human health-based evaluation.

For source areas located in HHPZ-1 and HHPZ-2, inorganic chemicals that exceed ambient levels and all detected organic chemicals will be compared against conservative, human health risk-based screening levels (Tier 1 RBSLs). The human health Tier 1 RBSLs used for both HHPZs for the site will be the United States Environmental Protection Agency (USEPA) Region 9 Industrial Soil PRGs represented in Table 3-2. If all COPCs are below Tier 1 RBSLs, further human health evaluation will be deemed unnecessary for the site. If any chemical exceeds its RBSL, it will be recommended for further evaluation in Tier 2 as described on Figure 6. Because of the transient and short-term nature of recreational exposures, the resultant doses are expected to be much lower than occupational exposures. Therefore, the Industrial Soil PRGs are appropriately conservative for both types of exposures.

If bioaccumulative chemicals are detected in the sediments in HHPZ-3, Tier 1 Risk-Based Screening Levels will be developed for the fish consumption scenario to be protective of anglers who may fish in this area.

#### *3.4.1.3 Human Health Screening Evaluations*

One hundred and thirty six soil samples have been collected from upland areas of the RFS (see Figure 8) and were screened against the criteria outlined above. Of these samples, 19 locations were found to be above Tier 1 RBSL criteria for one or more COPCs (see Table 3-3). These locations are shown on Figures 10-A through 10-I, andwill be the focus of either additional characterization or risk evaluation.

## 3.4.2 Ecological Health

### *3.4.2.1 Ecological Protection Zone (EPZ)*

Similar to the HHPZs described above, the preliminary EPZ for the RFS will be further broken down into 3 sub-units or zones: an Upland Ecological Protection Zone (UEPZ), a Saltwater Ecological Protection Zone-1 (SEPZ-1) and a Saltwater Ecological Protection Zone-2. The UEPZ will consist of upland areas of the RFS where terrestrial ecological receptors may be exposed. The SEPZ-1 will include the subtidal and tidal areas of Stege Marsh where wetland ecological receptors may be exposed. The SEPZ-2 will include the offshore property of the RFS where aquatic ecological receptors may be exposed. Each of the EPZs will be protective of potential ecological receptors within their zone. Tier 1 screening values for each of the EPZs is discussed below.

### *3.4.2.2 Ecological Protection Screening Values*

For the Tier 1 ecological screening, the data will first be organized by the zones outlined above. For each zone, the 90% Upper Confidence Level of the Mean (UCLM) of the sub-unit inorganic concentrations will be compared against the ambient or background metal concentrations. San Francisco Bay ambient concentrations will be used for the SEPZ, while LBNL background concentrations will be used for the UEPZ. For shoreline areas within the UEPZ that may potentially erode into the SEPZ, the SF Bay ambient concentrations will also be considered. Inorganic chemicals that are lower than or equal to ambient concentrations will be dropped from further ecological-based evaluation.

Inorganic chemicals exceeding ambient levels, and all organic chemicals will be compared against conservative, ecologically protective screening benchmarks (Tier 1 benchmarks). The Tier 1 benchmarks to be used for the SEPZ will focus on the protection of the benthic community. The benthic community, by virtue of its relative immobility and intimate contact with sediment is maximally exposed to site-related chemicals. Therefore, benchmarks that are protective of the benthic community are generally agreed to be protective of more mobile or transiently exposed receptors (with the exception of bioaccumulative chemicals). The benchmarks to be considered are the National Oceanographic and Atmospheric Administration (NOAA) Effects Range-Low Levels (ERLs) and Effects Range-Median Levels (ERMs) (NOAA 1997). In the absence of NOAA values, marine sediment screening values developed by Washington Department of Ecology (WDOE 1985), Florida Department of Environmental Protection (1996) and USEPA (1996), using methods similar to NOAA, may be used. The screening values to be used for terrestrial receptors will be drawn from a variety of generally accepted sources, primarily the Oak Ridge National Laboratory benchmarks.

If no screening values are available for ecological receptors who may be exposed to bioaccumulative and biomagnifying COPCs, these chemicals will be carried through to the Tier 2 assessment.

**Saltwater Ecological Protection Zones - 1 and 2**

ERL and ERM levels represent a range of chemical concentrations where toxic effects can be predicted. For concentrations below the ERL, toxicological effects are rarely observed (10% incidence). For concentrations above the ERL but below the ERM, toxicological effects are occasionally observed (10%-50%), and for concentrations above the ERM toxicological effects are frequently observed (>50%). In the absence of regulatory sediment standards, these values in conjunction with biological testing, and consideration of bioaccumulation will be used to identify areas of concern where remedial work is required.

The following factors must be considered when identifying areas of concern: a) chemical concentration, b) observed toxicity in laboratory tests or adverse effects in the field, and c) bioaccumulation/biomagnification. Each of these three factors must be considered independently for each sampling point. Once an area has been identified as a potential area of concern by any one or more of these three factors, then exposure pathway and sediment transport must be examined to determine whether the contaminated sediments will come into contact and impact the aquatic organisms.

**Upland Ecological Protection Zone**

The Tier 1 benchmarks to be used for the UEPZ will be protective of burrowing mammals such as squirrels and fox as these mammals are most likely to come into contact with the surface soils (0 to 3 feet). Therefore, the sampling effort for upland portion of the site to assess the risk to these animals will focus on surficial soils only. As recommended by recent DTSC guidance regarding burrowing depths, the potential for biota at the site to burrow deeper than 3 ft will be evaluated before establishing a lower limit for depth (DTSC 1999).

### 3.4.3 Tier 2 Screening Levels

At the end of the Tier 1 evaluation, source areas with COPCs that exceeded Tier 1 RBSLs will be identified. Areas that contained bioaccumulative chemicals that could not be evaluated in Tier 1 will also be identified. The source areas with exceedances and with bioaccumulative COPCs will be carried forward to the Tier 2 evaluation. As illustrated in Figure 6, the Tier 2 evaluation comprises the development of Tier 2 Site Specific Target Levels (SSTLs).

Tier 2 Screening Values will consider both human health and ecological risks on a more site-specific basis. Site-Specific Target Levels (SSTLs) will be developed by refining Tier 1 RBSLs based on site specific conditions which are protective of the potential exposure scenarios identified for the current and potential land uses of the RFS.

**Tier 2 Screening Levels**

Tier 2 Site-Specific Target Levels (HH-SSTLs) will be developed, on an as-needed basis, for up to four human health exposure scenarios: fish consumption, recreational user, office worker and excavation worker. The cumulative target risk will be 1 x $10^{-6}$ for cancer effects and a Hazard Quotient and cumulative hazard index of 1.0 for non-cancer effects. These target risks represent the intentional conservatism of the Tier 2 evaluation. If all chemicals are below the SSTLs for all scenarios, further human health evaluation will be deemed unnecessary for the site. If any chemical exceeds its SSTL, it will be recommended for further evaluation in Tier 3.

Tier 2 ecological SSTLs will be developed, on an as-needed basis, for ecological receptors that are appropriate to each zone. For the UEPZ, this may include terrestrial birds and mammals. For SEPZ-1, it may include wildlife species that are dependent on wetland conditions, e.g., salt marsh harvest mouse. For SEPZ-2, it may include aquatic life such as bottom-feeding fish or predatory fish.

### 3.4.4 Tier 3 Risk Approach

At the end of Tier 2, areas with where there are exceedances of human health-based or ecological SSTLs or unacceptable cumulative risks will be identified. If remediation to the Tier 2 SSTLs is not feasible in these areas, a more extensive site-specific or Tier 3 evaluation will be performed. The Tier 3 evaluation may incorporate a variety of statistical, analytical or ecological methods to refine exposure and risk estimation assumptions and will thus represent the most site-specific and realistic characterization of risks and remediation goals. Examples of Tier 3 methodologies include probabilistic risk estimation, bioavailability analyses of COPCs and target-organ based evaluations of toxicity.

Since the scope and focus of a Tier 3 evaluation is highly dependent on the Tier 2 findings, it will be developed as a supplement to the current Work Plan, if found to be necessary.

Summary of Previous Site Investigations

At the end of Tier 2, areas with where there are exceedances of human health-based or ecological SSTLs or unacceptable cumulative risks will be identified. If remediation to the Tier 2 SSTLs is not feasible in these areas, a more extensive site-specific or Tier 3 evaluation will be performed. The Tier 3 evaluation may incorporate a variety of statistical, analytical or ecological methods to refine exposure and risk estimation assumptions and will thus represent the most site-specific and realistic characterization of risks and remediation goals. Examples of Tier 3 methodologies include probabilistic risk estimation, bioavailability analyses of COPCs and target-organ based evaluations of toxicity.

Since the scope and focus of a Tier 3 evaluation is highly dependent on the Tier 2 findings, it will be developed as a supplement to the current Work Plan, if found to be necessary.

## 4.1 RICHMOND FIELD STATION (RFS)

### 4.1.1 Soil

One hundred and thirty six soil samples have been collected and analyzed from various locations around the RFS (see Figure 8). The samples were collected from various depths and analyzed for chemical constituents based on historical land use. As a result of the previous investigations, Chemicals of Potential Concern (COPCs) for soils on the RFS property include arsenic, cadmium, copper, mercury, lead and zinc. In addition, 4,4'-DDD and total petroleum hydrocarbons as diesel (TPH-d) have been detected in a limited number of the samples collected.

Many of the COPCs for the RFS occur in isolated areas of the facility. The following is a summary of previous studies conducted for each of the areas of concern.

#### *4.1.1.1 Former Mercury Fulminate Facility*

The former Mercury Fulminate Facility, a circular area in the southeastern portion of the site (See Figure 3), was the subject of an extensive soil sampling effort conducted by Jonas & Associates in 1990. Including duplicate samples, 48 boring and 10 surface samples were collected. Prior to this investigation, limited sampling was conducted by CH2M Hill and the California Department of Health Services. Mercury concentrations detected around the former fulminate facility ranged from 0 to 630 milligrams per kilogram (mg/kg). In addition, arsenic was found at levels between 0.2 and 46.8 mg/kg, cadmium at 0.82 to 437 mg/kg, copper at 22.7 to 451 mg/kg, lead at 4.3 to 1140 mg/kg, and zinc at 53.2 to 2150 mg/kg. Previous soil sampling results are listed in Table 4-1 and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective background and ERM levels and are presented on Figures 10a through 10i.

#### *4.1.1.2 Forest Products Laboratory*

The Forest Products Laboratory currently occupies Buildings 470 and 472, located in the northeastern portion of the site (See Figure 3). Limited metals and phenol testing has been conducted by Jonas & Associates for soils near the facility, however, none of the results were detected above TTLC levels. 4-Methylphenol was detected in sample BF2 at 0.340 mg/kg, but no TTLC level is available for 4-Methylphenol.

Two asphalt composite samples following the drainage pattern of the retort for the Forest Product Laboratory were also analyzed by Jonas & Associates in 1992. These samples were found to contain elevated levels of arsenic (790 and 5100 mg/kg), chromium (460 and 690 mg/kg), copper (1900 and 13,000 mg/kg), and PCP (2.4 and 43 mg/kg). Previous soil sampling results are listed in Table 4-1 and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective background and ERM levels and are presented on Figures 10a through 10i.

#### *4.1.1.3 Former Blasting Cap Manufacturing Area*

Five soil samples were collected and analyzed from the vicinity of the former Blasting Cap manufacturing area located to the east of Owl Way (See Figure 3). The samples, collected from the top 1.5 feet of soil by Jonas and Associates in 1991, were found to contain levels above LBNL background concentrations for the following constituents: mercury (0.41 to 1.75 mg/kg), lead (14.2 to 69.5 mg/kg), and zinc (135 to 392 mg/kg). Previous soil sampling results are listed in Table 4-1 and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective background and ERM levels and are presented on Figures 10a through 10i.

#### *4.1.1.4 Former Shell Manufacturing Area*

The former Shell Manufacturing area is located in the southern portion of the RFS (See Figure 3). Jonas and Associates collected and analyzed 17 soil samples from a depth of 1.3 feet in 1991. In addition, samples were collected from one boring (B15SH) to a depth of 14 feet. The results were found to contain levels above LBNL background concentrations for the following constituents: arsenic (ND(<0.90) to 126 mg/kg), cadmium (ND(<0.76) to 5.1 mg/kg), copper (10.5 to 804 mg/kg), mercury (ND(<0.11) to 97.8 mg/kg), lead (3.2 to 741 mg/kg), and zinc (10.2 to 437 mg/kg). Previous soil sampling results are listed in Table 4-1 and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective background and ERM levels and are presented on Figures 10a through 10i.

#### *4.1.1.5 Former Explosives Storage Area*

Two former explosive storage areas exist at the RFS site, both located south of Wren Drive (See Figure 3). Ten samples were collected and analyzed from the top 1.5 feet of soil by Jonas and Associates in 1991. The results were found to contain levels above LBNL background concentrations for the following constituents: cadmium (0.81 to 4.6 mg/kg), copper (21.2 to 736 mg/kg), mercury (ND(<0.12) to 1.37 mg/kg), and zinc (24.4 to 266 mg/kg). Previous soil sampling results are listed in Table 4-1 and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective background and ERM levels and are presented on Figures 10a through 10i.

#### *4.1.1.6 Former Test Pit Area*

A former explosive test pit area is located in the northeast portion of the RFS site, just north of Wren Drive (See Figure 3). Two samples were collected and analyzed from the top 1.5 feet of soil by Jonas and Associates in 1991. The results were found to contain levels above LBNL background concentrations for the following constituents: arsenic (4.3 and 21.2 mg/kg), cadmium (2.8 and 9.9 mg/kg), copper (899 and 1140 mg/kg), mercury (2.91 and 6.66 mg/kg), lead (46.4 and 49.2 mg/kg), and zinc (142 and 227 mg/kg). Previous soil sampling results are listed in Table 4-1 and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective background and ERM levels and are presented on Figures 10a through 10i.

#### *4.1.1.7 Pyrite Cinders*

As previously mentioned, pyrite cinders from Stauffer Chemical operations were disposed of in a landfill area near the southeastern RFS property boundary, directly adjacent to the former pier. No liners were installed prior to the deposition of cinders, which were placed directly on the native soils and sediments. In addition to the cinder fill area, some waste cinders were reportedly sold to the Mountain Copper Company and shipped off-site, while others were placed directly into the Stege Marsh (URS, 1994).

Pyrite cinders have been observed at the RFS road near Stege Marsh, and may have also been used as a herbicide around some former buildings of the California Cap Company. Aerial photos and visual observations of the RFS property reveal areas of barren soil in the vicinity of the former Explosive Storage area (south of Wren Drive), near the former Mercury Fulminate area, and immediately west of Building 167. Samples collected and analyzed from the vicinity of the Explosive Storage area and Building 167 were discussed in Sections 4.1.1.5. Samples collected and analyzed from the vicinity of the former Mercury Fulminate facility were discussed in Section 4.1.1.1.

Soil samples collected and analyzed from the vicinity of the Stege Marsh road/cinder landfill (including samples analyzed for the proposed RFS sewer installation and samples S-1, S-2, B3-CIN, and B4-CIN located on Zeneca property) were found to contain levels above LBNL background concentrations for the following constituents: arsenic (ND to 294 mg/kg), cadmium (ND to 340 mg/kg), copper (9.8 to 20,000 mg/kg), mercury (0.16 to 32 mg/kg), lead (ND to 678 mg/kg), selenium (ND to 65.3 mg/kg), and zinc (22 to 7100 mg/kg). Previous soil sampling results are listed in Table 4-1 and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective background and ERM levels and are presented on Figures 10a through 10i.

### 4.1.2 Groundwater/Surface Water

Limited groundwater sampling has been conducted at the RFS to date. Previous results include two samples taken from unknown well locations by the EAL Corporation in 1984, groundwater samples analyzed from a monitoring-well (MW-1) installed by Jonas & Associates in 1990, and two samples, B-2-W and B-7-W, analyzed by ECI in 1998. The two samples collected in 1984 were from approximately 90 feet below ground surface (bgs) and met EPA Safe Drinking Water Act standards for mercury, copper, zinc, iron, and lead (Jonas & Associates, 1990). MW-1, located downgradient from the former mercury fulminate facility and screened from 8 to 13 feet bgs, showed no evidence of mercury contamination (detection limit of 0.001 mg/L) and had total dissolved solids measured at 1,300 mg/L. Samples B-2-W and B-7-W analyzed by ECI were collected along the sewer alignment to the west of the waste water receiving pond, at approximately 6 feet bgs. Elevated zinc levels of 1.6 ppm were measured in groundwater collected from sample B-2-W.

In addition to groundwater samples collected from the RFS, surface water samples from various locations throughout the site were analyzed by Jonas & Associates in 1991. The data indicate that COPCs for surface water at the RFS include arsenic, cadmium, copper, mercury and zinc, with the most elevated concentrations within the marsh detected near the former cinder fill area.

Previous groundwater and surface water sampling results are listed in Table 4-2 and sample locations are shown on Figure 11. The COPC concentrations detected for each location were compared to the USEPA Water Quality Criterion for Saltwater Organisms and are presented on Figures 12a through 12h.

### 4.1.3 Sediment

#### *4.1.3.1 Stege Marsh*

Stege Marsh has been the focus of several past investigations including its recent designation as a high priority "toxic hotspot" by the Bay Protection and Toxic Cleanup Program. Approximately 45 sediment samples have been collected from various locations within the marsh, and COPCs include arsenic (ND(<3.1) to 1660 mg/kg), cadmium (0.14 to 50 mg/kg), copper (20 to 8090 mg/kg), lead (ND to 1240 mg/kg), mercury (0.14) to 166 mg/kg), selenium (ND(<1) to 854 mg/kg), zinc (60 to 6270 mg/kg), and pesticides including alpha-BHC (ND(<0.11) to 292 mg/kg), P,P'-DDD (0.4) to 1800 mg/kg), and P,P'-DDT ( 0.21 to 542 mg/kg). Previous soil and sediment sampling results are listed in Table 4-1 and 4-3, and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective ambient and ERM levels and are presented on Figures 10a through 10i.

## 4.2 ZENECA

### 4.2.1 Soil

Limited soil sampling results are available for the Zeneca property. Four samples collected and analyzed from the vicinity of the cinder fill area are discussed in Section 4.1.1.6. Additional samples collected and analyzed from the Zeneca property include sludge samples from the neutralization pond, surge pond, carbon column pond, agricultural yard pond, and evaporation ponds 1 and 2. These samples were found to contain greater than ambient concentrations for the following constituents: arsenic (7.4 to 208 mg/kg), copper (429 to 10,631 mg/kg), lead (72 to 522 mg/kg), selenium (20 to 67 mg/kg), and zinc (448 to 10,099 mg/kg). Previous soil sampling results are listed in Table 4-3 and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective ambient and ERM levels and are presented on Figures 10a through 10i.

### 4.2.2 Groundwater

Groundwater monitoring has been conducted at the Zeneca site. Data collected and analyzed from the Zeneca monitoring wells were found to contain levels above RWQCB recommended levels for saltwater ecological protection for the following constituents: arsenic (ND(0.001) to 3.91 mg/L), cadmium (ND(0.005) to 0.84 mg/L), copper (ND(0.01) to 11.6 mg/L), lead (ND(0.001) to 0.190 mg/L), and zinc (ND(0.01) to 150 mg/L). No groundwater data was available for mercury, selenium, or pesticides. Previous groundwater and surface water sampling results are listed in Table 4-4 and sample locations are shown on Figure 11. The COPC concentrations detected for each location were compared to the USEPA Water Quality Criterion for Saltwater Organisms and are presented on Figures 12a through 12h.

In addition to the groundwater sampling conducted at the Zeneca site, the surface water pathway was identified as the primary pathway of concern by URS in its 1994 report of the Zeneca property. URS reported that arsenic, cadmium, copper, lead, mercury, zinc, alpha-hexachlorocyclohexane (a-BHC), dichlorodiphenyl dichloroethane (DDD), and 4,4-dichlorodiphenyl trichloroethane (DDT) were among contaminants detected at elevated levels in both on-site waste management sources and adjacent tidal marsh sediments. It was concluded that "the correlation of contaminants detected in on-site waste management sources and sediment samples from the adjacent tidal marsh indicate that contaminants have migrated to surface water bodies from sources at the Stauffer site" (URS, 1994).

### 4.2.3 Sediment

Sediment samples from Stege Marsh were discussed in Section 4.1.3.1. Other sediment samples collected and analyzed from Zeneca property are from within evaporation ponds 1 and 2. These samples, E-13 and E-20, were found to contain levels greater than San Francisco Bay ambient concentrations for the following constituents: arsenic (12.6 to 810 mg/kg), copper (942 to 1930 mg/kg), lead (64.7 to 210 mg/kg), mercury (1.7 to 2.8 mg/kg), selenium (7.2 to 9.3 mg/kg), zinc (490 to 5,490 mg/kg), alpha-BHC (ND to 38 micrograms/kg), and DDT(total) (181 to 269 micrograms/kg). Previous soil and sediment sampling results are listed in Table 4-3, and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective ambient and ERM levels and are presented on Figures 10a through 10i.

### 4.2.4 Other

Other areas of potential concern with respect to Stege Marsh include former sedimentation ponds, evaporation ponds, and wastewater outfalls located on the Zeneca site. As many as ten former sedimentation ponds have existed at the Zeneca site at various times including the alum mud pond, the carbon column pond, the agricultural yard pond (Ag-pond), the neutralization pond, clarification ponds, and two ponds identified by URS in 1994. One former pond was located approximately 125 feet east of the former RFS pier. This pond is outlined in a May 1969 aerial photograph, and is in close proximity to Stege Marsh. It is not clear if this pond was previously identified in the Stauffer investigation. Aerial photos of the RFS and vicinity are presented in Appendix C.

Former sedimentation ponds at the Zeneca site are known to have overflowed during heavy storm events and may have released contaminants directly into the adjacent tidal marsh. The evaporation ponds at the Zeneca site are used to contain and treat wastewater produced by the plant. They are located north of Stege Marsh and contain a combined volume of 630,000 cubic feet. The discharge point from the upper evaporation pond (Evaporation Pond 2) is located in the southeast corner of the pond, and discharges to Stege Marsh near Carlson Creek. Sediment samples were taken near the discharge point by URS in 1992.

Core samples from beneath the evaporation ponds revealed that they were constructed atop layers of sludge and cinders. Sediment samples collected from the sludge demonstrated elevated levels of arsenic, copper, lead, floride and selenium. Further sediment samples collected from the evaporation ponds found elevated levels of arsenic, copper, lead, mercury, zinc and PCBs/organochlorine pesticides (URS, 1994). Previous soil and sediment sampling results are listed in Table 4-3 and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective ambient and ERM levels and are presented on Figures 10a through 10i.

## 4.3 LIQUID GOLD

### 4.3.1 Soil

Liquid Gold has been the focus of several previous soil investigations. Previous samples collected and analyzed from the Liquid Gold property were found to have concentrations greater than LBNL background concentrations for the following constituents: copper (14 to 2,600 mg/kg), lead (5 to 5,200 mg/kg), mercury (ND(<0.05) to 4.8 mg/kg), and zinc (17 to 4,900 mg/kg). Previous sampling results for the Liquid Gold property are given in Table 4-5. Many of the values are shown as average and maximum values detected at various areas of the property. Sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to their respective background and ERM levels and are presented on Figures 10a through 10i.

### 4.3.2 Groundwater

There are numerous groundwater monitoring wells on the Liquid Gold property. Previous samples collected and analyzed from the wells were found to contain levels above RWQCB recommended levels for saltwater ecological protection for the following constituents: copper (ND(<1) to 29 µg/L), and mercury (ND(<0.2) to 0.34 µg/L). No groundwater results were available for arsenic, cadmium, and selenium. Previous groundwater and surface water sampling results are listed in Table 4-6 and sample locations are shown on Figure 8. The COPC concentrations detected for each location were compared to the USEPA Water Quality Criterion for Saltwater Organisms and are presented on Figures 12a through 12h.

### 4.3.3 Sediment

Sediments collected and analyzed from the southwest drainage channel ("Transect 6") of the Liquid Gold property were found to contain levels above San Francisco Bay ambient concentrations for the following constituents: copper (310 to 360 mg/kg), mercury (0.810 to 4.200 mg/kg), lead (240 to 830 mg/kg), and zinc (410 to 940 mg/kg). Sediments from Transect 6 and another transect were excavated to a depth of 1 foot at the channel center in July of 1994. Post-remediation samples from Transect 6 were collected and analyzed in February 1995. The results indicated toxicity to bivalve larvae, however, the toxicity was attributed to naturally occurring ammonia. Sampling and analysis of Transect 6 sediment was conducted again in August 1995 at the request of DTSC. The following report concluded that toxicity associated with the sediments was not a concern and recommended that sediment sampling be discontinued. DTSC reviewed and concurred with the results in November 1995 (ERM, 1998).

## 4.4 TOXICITY TESTING

In a 1998 investigation of Stege Marsh under the BPTCP, the RWQCB conducted a 10-day solid phase bioassay for amphipods (*Eohaustorius estuarius*) and sediment-water interface exposure bioassays for urchin development for two sampling locations within the marsh. The results demonstrated nearly 100 percent mortality and 100 percent abnormal development for their respective species. In addition, benthic community analysis of the two sampling locations revealed a total absence of living benthic organisms.

At the request of the Regional Water Quality Control Board and under contract to Zeneca, Pacific Eco-Risk completed an Ecological Risk Assessment for Stege Marsh in April of 1999. Potential ecological receptors identified in the Pacific Eco-Risk study included aquatic benthic invertebrates, fish, plants, small mammals, and birds. The assessment endpoints identified and used for the assessment included bivalve (*Mytilus sp.*) embryo development for sediment porewater, percent survival of amphipods (*Eohaustorius estuarius)* in a 10-day solid-phase sediment test, topsmelt (*Atherinops affinis*) egg hatchablity/survival at the sediment-water interface, the protection of the existing plant community and its consumers, and protection of individual small mammals and birds using food chain modeling. In addition, pickleweed (*Salicornia sp.*) and bivalve (*Macoma nasuta*) tissues were analyzed to investigate the potential for bioaccumulation. The conclusions reached in the study were that low pH, especially in the northwest corner of the marsh where cinders were deposited, poses the primary ecological risk to plants, aquatic invertebrates, and fish. The acidic condition contributes to increased solubility and bioavailability of metals. Although the pH was considered the source of the toxicity, it should be noted that even when the pH of the samples was buffered, toxicity was still observed. This may indicate that the toxicity may be due to metals or other chemical constituents contained within the samples, and not solely due to the acidic pH conditions. Other potential ecological risks include adverse effects to benthic invertebrates from arsenic and zinc, possible toxicity to fish from Dieldrin and Toxaphene, and some degree of risk to birds from mercury if they were to forage exclusively in the vicinity of sample SM-6.

This section presents the rationale for the selection of chemicals and sampling locations for the FSAP. A three-phased approach will be conducted to focus sampling and evaluation efforts. Phase I consists of identifying chemicals of potential concern (COPC) and collecting samples to determine the presence of COPC in the relevant environmental media within the RFS and Stege Marsh. Phase II will be developed based on the results of Phase I, and may include additional sample collection and field activities as required to complete COPC delineation, hydrogeologic characterization, and human health and ecological evaluations. Due to the anticipated winter sampling schedule, toxicity testing will not be performed until Phase II of the investigation. This was previously discussed with RWQCB staff on October 19, 1999. Phase III will be conducted, as necessary, to further identify and develop information needed to determine areas of concern and remedial design and implementation. The following sections describe the field investigation that is proposed to be conducted during Phase I.

## 5.1 PHASE I FIELD INVESTIGATION OBJECTIVES

The objective of the Phase I field investigation is to collect additional data that will be used to:

Identify potential source areas;

- Delineate areas of contamination for the COPC identified during the risk screening process, as shown on Figures 10(a) through 10(i) and 12(a) through 12(h);
- Link contaminants to source areas identified;
- Identify additional potentially responsible parties (PRPs);
- Develop data to assess potential risks to human health, water quality, and the environment;
- Perform human health and ecological risk assessments; and
- Delineate areas of concern that may require active remediation.

## 5.2 DATA QUALITY OBJECTIVES (DQOs) FOR RISK DECISIONS

Data quality objectives are an integrated set of decision statements which define data quality requirements based on the end use of the data. The USEPA defines DQOs as qualitative and quantitative statements specified to ensure that data of known and appropriate quality are obtained during remedial response activities (USEPA 1994, 1987). The tiered risk screening process for the RFS uses a DQO-based approach to collect and review physical, chemical, and biological data of only the type and quality that is necessary for decision-making at each Phase of the process. Therefore, it is critical that the design for data collection activities be framed to meet these three goals of the DQO process:

(i) Identify decision types: The decision types to be made during the risk evaluation process are the assignment of individual chemicals, exposure pathways or sampling areas RMZs, or the RFS as a whole to 1 of the 3 tiers described earlier.

(ii) Identify data uses and needs: The data that are needed to make these tiered decisions are primarily chemical concentration data, as well as physical and biological toxicity testing data (if necessary), from individual sampling locations within the RMZs of the RFS.

These data are then used to evaluate whether the conditions defining Tiers 1, 2, and 3 are met.

(iii) Design data collection program: The single most important element of the data collection design for the risk-based evaluation approach is to ensure that chemical concentration data are of a quality that is sufficient to make Tier 1, 2, and 3 decisions for each sampling area within the RMZ and the RFS as a whole. The elements defining data quality include adequacy of sample size, sample locations, sampling methods and depths, analytical methods, quality assurance/quality control (QA/QC), and statistical robustness.

### 5.2.1 DQOs for Tier 1 Risk Decisions

The chemical concentration data for each sampling location and depth should meet the following DQOs for Tier 1 screening:

- sample locations should be appropriate for detecting COPCs at the RFS;
- sample size should be adequate for all laboratory analyses to test for all COPC concentrations at the RFS;
- sample size should be adequate for statistical significance testing of COPC concentrations;
- Practical Quantitation Limits (PQLs) for organic and bioaccumulative chemicals should be equal to or lower than acceptable risk levels, as long as analytical methodology and costs permit;
- ambient (background) concentrations for inorganics should be adequately defined;
- elimination of inorganic compounds below ambient (background) concentrations or organic constituents from further consideration should be based on risk-based considerations;
- the human exposure pathways considered should be potentially complete pathways for the RFS as a whole; and
- chemical-specific sediment benchmarks should be available for ecological screening.

### 5.2.2 Methodology

The objective of sample collection is to obtain samples that are representative of the location being sampled. To achieve this, samples will be collected in accordance with the Standard Operating Procedures presented in Appendix B. Samples will be sent to a State certified laboratory, and analyzed for the constituents shown in Table 5-1. Details of the chemical and physical analyses and QA/QC procedures are described in the following Sections. The data obtained will meet the specific DQOs as outlined in this Section.

## 5.3 SITE INSPECTIONS

Prior to beginning the sampling effort, the field team will perform a site walkover to visually identify potential areas of concern. Features that will be noted include areas of discoloration, stressed or lack of vegetation, former areas of disposal (pits, regraded areas, piles, mounds), open storage containers (i.e., drums), locations of sewer lines and storm drainage systems, open pipes from buildings that discharge onto the ground, locations of existing groundwater wells and their design (particularly around Building 167), and surface water drainage patterns (including storm water flowing onto the site and surface water run-off areas and mechanisms for preferential pathflow). These features will be shown on a site map and be considered when determining specific sample locations. The information will be used in conjunction with sample data and is essential for satisfying the objectives of this investigation.

## 5.4 FOREST PRODUCTS LAB

### 5.4.1 Sampling Objectives

Due to past operations and previous sample results, additional characterization of surface and subsurface soils and groundwater is warranted. Surficial and subsurface soil and grab groundwater samples will be collected from soil boring locations in the vicinity of the former facility. The objectives of the sampling are: 1) to define the extend of contamination in the vicinity of the former Forest Products Lab, and 2) to determine whether any on-site contamination has migrated off-site via the groundwater and surface water pathways via the concrete swale or the unpaved drainage area behind Building 472.

### 5.4.2 Sample Location and Analysis

Samples will be collected at the 5 locations shown in Figure 13. Surficial soil samples will be collected at a depth of 0 to 3 inches. Subsurface soil samples will also be collected using a geoprobe from each boring location at depths of 3 feet and 6 feet. The water table is expected to occur at a depth of 6 feet. A total of 15 soil samples will be collected for chemical analysis as shown in Figure 13. Additionally, pH and moisture content will be determined for each soil sample, and TOC, grain-size distribution, and bulk density will determined for 2 of the 15 soil samples. The 5 surficial soil samples will also be analyzed for pentachlorophenol (using EPA Method 8270), which is commonly used for wood preservation. Grab groundwater samples (filtered) will also be collected at the water table using a hydropunch from each of the 5 boring locations. The results of the grab groundwater samples will be used to assess the impact of the Forest Products Lab on groundwater quality.

## 5.5 FORMER TEST PIT AND EXPLOSIVES STORAGE FACILITY

### 5.5.1 Sampling Objectives

Due to past operations and previous sample results, additional characterization of surface and subsurface soils and groundwater is warranted. Surficial and subsurface soil and grab groundwater samples will be collected in the vicinity of the former facility. The objectives of the sampling is: 1) to define the extend of contamination around the test pit and to the south of the Explosives Storage area.

### 5.5.2 Sample Location and Analysis

Samples will be collected at the 5 soil boring locations shown in Figure 13. Surficial soil samples will be collected at a depth of 0 to 3 inches. Subsurface soil samples will also be collected using a geoprobe from each boring location at depths of 3 feet and 6 feet. The water table is expected to occur at a depth of 6 feet. A total of 15 soil samples will be collected for chemical analysis as shown in Figure 13. Analysis of the five surface soil samples will also include explosive compounds since the manufacturing and testing of explosives were conducted by California Cap in this area. Additional sample material from the 3-foot and 6-foot boring intervals will also be collected by the field team and held by the laboratory in case subsequent explosives analyses are necessary. Additionally, pH and moisture content will be determined for each soil sample, and TOC, grain-size distribution, and bulk density will determined for 2 of the 15 soil samples. Grab groundwater samples (filtered) will also be collected at the water table using a hydropunch sampler from each of the 5 boring locations. The results of the grab groundwater samples will be used to assess the impact of these areas on groundwater quality.

## 5.6 PYRITE CINDERS

### 5.6.1 Sampling Objectives

Since the extent of pyrite cinder distribution around the RFS is not known, additional characterization of surface and subsurface soils is warranted. Surficial and subsurface soil and grab groundwater samples will be collected from soil boring locations at locations suspected of cinder disposal. The objectives of the sampling are: 1) to define the horizontal distribution and vertical extend of contaminated pyrite cinders around the RFS, and 2) to determine whether any identified cinder locations are contributing to off-site contamination of Stege Marsh via the groundwater and surface water pathways.

### 5.6.2 Sample Location and Analysis

Samples will be collected at the 5 locations shown in Figure 13. Four of the sample locations are located in the grassy field area to the south of Building 153. This area was selected due to the lack of vegetation and the visual observation of the materials which appear to be pyrite cinders. One additional sample will be collected to the south of the EPA Laboratory, immediately north of Stege Marsh, in fill material. The sample will be evaluated to determine whether the fill material contains pyrite cinders.

Surficial soil samples will be collected at a depth of 0 to 3 inches. Subsurface soil samples will also be collected using a geoprobe from each boring location at depths of 3 feet and 6 feet. The water table is expected to occur at a depth of 6 feet. One additional soil sample (PC-104-B) will also be collected below the water table and analyzed to develop a partitioning coefficient between the solid and soluble phase to be used in the risk evaluation. A total of 16 soil samples will be collected for chemical analysis as shown in Figure 13. Additionally, pH and moisture content will be determined for each soil sample, and TOC, grain-size distribution, and bulk density will determined for 2 of the 16 soil samples. Grab groundwater samples (filtered) will also be collected at the water table using a hydropunch sampler from each of the 5 boring locations. The results of the grab groundwater samples will be used to assess the impact of these areas on groundwater quality.

## 5.7 FORMER SHELL MANUFACTURING FACILITY

### 5.7.1 Sampling Objectives

Due to past operations and previous sample results, additional characterization of surface and subsurface soils and groundwater is warranted. Surficial and subsurface soil and grab groundwater samples will be collected in the vicinity of the former facility. The objectives of the sampling is: 1) to delineate the extend of contamination to the northeast of the former Shell Manufacturing Facility, and 2) to determine whether any on-site contamination has impacted groundwater.

### 5.7.2 Sample Location and Analysis

Samples will be collected at the 2 soil boring locations shown in Figure 13. Surficial soil samples will be collected at a depth of 0 to 3 inches. Subsurface soil samples will also be collected using a geoprobe from each boring location at depths of 3 feet and 6 feet. The water table is expected to occur at a depth of 6 feet. A total of 6 soil samples will be collected for chemical analysis as shown in Figure 13. Additionally, pH and moisture content will be determined for each soil sample, and TOC, grain-size distribution, and bulk density will determined for 2 of the 6 soil samples. Grab groundwater samples (filtered) will also be collected at the water table using a hydropunch sampler from each of the 2 boring locations. The results of the grab groundwater samples will be used to assess the impact of the Shell Manufacturing Facility on groundwater quality.

## 5.8 FORMER MERCURY FULMINATE FACILITY

### 5.8.1 Sampling Objectives

Due to past operations and previous sample results, additional characterization of surface and subsurface soils and groundwater is warranted. Surficial and subsurface soil and grab groundwater samples will be collected in the vicinity of the former facility. The objectives of the sampling is: 1) to define the extend of contamination in the vicinity of the former Mercury Fulminate Facility, and 2) to determine whether any on-site contamination has migrated off-site via the groundwater and surface water pathways.

### 5.8.2 Sample Location and Analysis

Samples will be collected at the 6 soil boring locations shown in Figure 13. Surficial soil samples will be collected at a depth of 0 to 3 inches. Subsurface soil samples will also be collected using a geoprobe from each boring location at depths of 3 feet and 6 feet. The water table is expected to occur at a depth of 6 feet. One additional soil sample (MF-102-B) will also be collected below the water table and analyzed to develop a partitioning coefficient between the solid and soluable phase to be used in the risk evaluation. A total of 19 soil samples will be collected for chemical analysis as shown in Figure 13. Additionally, pH and moisture content will be determined for each soil sample, and TOC, grain-size distribution, and bulk density will determined for 2 of the 19 soil samples. Grab groundwater samples (filtered) will also be collected at the water table using a hydropunch sampler from each of the 6 boring locations. One additional groundwater sample will be collected from the existing monitor well MW-1. This sample will be filtered during sample collection. The results of the groundwater samples will be used to assess the impact of the Mercury Fulminate Facility on groundwater quality.

## 5.9 SEWER LINE, PROPERTY BOUNDARY, AND STORM DRAIN AREAS

### 5.9.1 Sampling Objectives

Due to past operations and previous sample results, additional characterization of surface and subsurface soils and groundwater in these areas is warranted. Surficial and subsurface soil and grab groundwater samples will be collected in the vicinity of each of these areas. The objectives of the sampling is: 1) to delineate the extent of contamination due to pyrite cinders along the sewer line, 2) to determine whether surface water drainage from Zeneca has impacted the eastern portion of the RFS, and 3) to determine whether the western storm drain was a historical source of contamination in Stege Marsh.

### 5.9.2 Sample Location and Analysis

Samples will be collected at a total of 12 soil boring locations shown in Figure 13. Four samples will be collected along the sewer line to determine the northern extent of pyrite cinders, five samples will be collected along the property boundary to determine the surface water impacts to RFS from Zeneca, and three samples will be collected along the western storm drain to evaluate historical releases and discharges.

Surficial soil samples will be collected at a depth of 0 to 3 inches. Subsurface soil samples will also be collected using a geoprobe from each boring location at depths of 3 feet and 6 feet. The water table is expected to occur at a depth of 6 feet. One soil sample (SL-101-B) will also be collected below the water table and analyzed to develop a partitioning coefficient between the solid and soluable phase to be used in the risk evaluation. A total of 37 soil samples will be collected for chemical analysis as shown in Figure 13. Additionally, pH and moisture content will be determined for each soil sample, and TOC, grain-size distribution, and bulk density will determined for 3 of the 37 soil samples. Grab groundwater samples (filtered) will also be collected at the water table using a hydropunch sampler from each of the 12 boring locations.

## 5.10 STEGE MARSH

### 5.10.1 Sampling Objectives

Due to past on-site and off-site operations, previous sample results have indicated that elevated levels of COPCs exist within Stege Marsh. Additional characterization of surface and subsurface sediments and surface water in Stege Marsh is warranted. The objectives of the sampling are: 1) to identify sources entering the Marsh from Meeker and Carlson Creeks; 2) to evaluate the potential COPCs originating from Marina Bay; 3) to evaluate the extent of pyrite cinders within the Marsh; 4) to collect data to perform the risk analysis and to determine the bioavailability of the chemical constituents within the Marsh.

### 5.10.2 Sample Location and Analysis

Samples will be collected at the 22 locations shown on Figure 13. Sediment samples will be collected at a depth of 0 to 3 inches to evaluate the chemicals that are currently bioavailable to organisms in the Marsh. Subsurface sediment samples will also be collected at selected depths to 1) evaluate the bioavailability of deeper dwelling organisms (1 to 2 feet), 2) evaluate historical contamination and vertically characterize the extent of contamination (5 feet), and 3) evaluate the vertical extent of the pyrite cinder pile (greater than 5-foot depth). Whenever possible, samples of sediment will be collected from the depositional areas containing the finer sediment grains. Pore water samples will also be decanted from two of the sediment samples, SM-108-SD and SM-109-SD (both from the 2.5-foot to 3-foot depth interval), and analyzed to develop a partitioning coefficient between the solid and soluable phase to be used in the risk evaluation. Additional sample volume will be required for these pore water samples. Moisture content and pH will be determined for each sediment sample, and TOC, grain-size distribution, and bulk density will determined for 3 of the sediment samples. Additionally, 4 surface water samples and18 sediment samples collected from 6 locations will be analyzed for organotin to determine whether the former shipbuilding activities at Marina Bay have contributed to the Marsh contamination. These samples will be collected in the vicinity of Marina Bay. A detailed description of the sample depths and analyses, along with the rationale for each location, is provided in Table 5-1.

## 5.11 QUALITY ASSURANCE/QUALITY CONTROL PLAN

The purpose of QA/QC procedures is to produce data of known high quality that meet or exceed the requirements of standard analytical methods. It is essential that data collection personnel adhere to strict QA/QC procedures to establish quality. The objectives of the quality assurance program are twofold:

- to provide the mechanism for ongoing control, and
- evaluation of measurement data quality throughout the course of the project and to qualify data precision and accuracy.

Precision and accuracy objectives are presented in Appendix B.

Project-required reporting limits will be low enough to allow comparison of analytical results to Tier 1 risk-based concentrations as outlined in Table 3-2. The laboratory will use techniques to attain the lowest detection limits achievable under the cited analytical methods.

The following data quality indicators will be used to evaluate the data usability and certainty:

- Accuracy
- Precision
- Representativeness
- Completeness
- Comparability

A discussion of each of these data quality indicators is provided below.

### *Accuracy*

Accuracy is a measure of how close a reported value is to the true value and is evaluated using spike analyses. Spike analyses are performed by adding a known quantity of analyte to a sample, analyzing the sample, and comparing the observed result to the known addition. Accuracy is expressed as percent recovery (the difference between known and observed concentrations divided by the known concentration) and is calculated as:

$$\%R = \left( \frac{C_{OB} - C_X}{C_{sp}} \right) x\,100$$

where:

$\%R$ = percent recovery

$C_{sp}$ = concentration of spike

$C_{OB}$ = concentration measured in spiked sample analysis

$C_x$ = concentration measured in unspiked sample analysis

Accuracy is evaluated using matrix spike (MS), laboratory control spikes (LCS), and surrogate spikes. Matrix spikes are spikes of target analytes into environmental samples and are used to evaluate impacts of matrix interference on accuracy. Laboratory control spikes are spikes of target analytes into clean water or sand and are used to evaluate accuracy of laboratory performance. Surrogate spikes are spikes of non-target analytes (compounds that are not likely to be detected in the sample but that behave similarly to the target analytes) into each sample. Surrogate spikes can only be performed for organic analyses and are used to evaluate accuracy on a sample specific basis.

Matrix spikes and LCS will be analyzed with each analytical batch. (A batch is up to 20 samples extracted and analyzed together under a given method protocol. Samples in an analytical batch should be of the same matrix. Reagent lots and handling procedures should be the same for all samples in a batch.) Surrogate spikes will be analyzed with each sample. Matrix spikes, LCS, and surrogate spike percent recoveries will be calculated and compared to the control limits provided in Appendix B. Analyses exhibiting recoveries outside control limits will be considered for re-analysis.

### Precision

Precision refers to the level of agreement among repeated measurements of the same parameter. Precision is expressed as the relative percent difference (RPD) between duplicate measurements, calculated as:

$$RPD = \left( \frac{(C_1 - C_2)}{\left[ \frac{(C_1 + C_2)}{2} \right]} \right) \times 100$$

where:

RPD = relative percent difference

$C_1$ = result from first sample

$C_2$ = result from second sample

Precision is evaluated using duplicate analyses and analyses of duplicate matrix spike samples (MS/MSD). Objectives for precision are provided in Appendix B.

### Representativeness

Representativeness is the degree to which data accurately and precisely represent variations at a sampling point. Representativeness is a qualitative parameter.

To ensure representativeness in the samples being collected for this investigation, standard sampling procedures, as described above, will be strictly adhered to. Any deviations from these procedures will be noted in permanent ink in the field notebook. The field notebooks will be reviewed for deviations as part of evaluation of representativeness.

To ensure representativeness in the analyses being performed, the laboratory will follow standard procedures for collecting the aliquot of sample used for analysis as representative of the whole. Additional laboratory procedures to ensure representativeness include proper log-in, storage, handling, and tracking of samples to minimize possibility of sample contamination, loss, or cross-labeling, and discrete sampling and analysis of immiscible layers, if present in sufficient quantity.

### Completeness

Completeness will be evaluated as the amount of valid, usable data obtained from a measurement system compared to the amount that was expected. The quantitative description of completeness will be evaluated as the percentage of analytical results that are usable (i.e., results that do not require rejection based on review of QA/QC data). The objective for completeness for this investigation is 90 percent for each analytical parameter.

### Comparability

Comparability is a qualitative evaluation of the confidence with which one data set can be compared to another measuring the same parameters. Comparability will be ensured through the use of the standard operating procedures for sampling and field operations as described in this Sampling and Analysis Plan.

### Field Sampling Quality Control

Field quality assurance data are provided by the analysis of rinsate blanks and field duplicate samples. The following field QA/QC sample will be submitted for laboratory analysis:

- Rinsate Blanks - Rinsate blanks will be obtained by the collection of water used to rinse the sampling equipment following decontamination. Rinsate blanks will be collected and analyzed at a frequency of about 10 percent of the number of sediment samples collected.
- Field Duplicate Samples - Blind field duplicate samples will be collected and analyzed at a frequency of about 5 percent of the number of samples collected for each medium.

### Quality Assurance Reporting

Effective management of a field sampling and analytical effort requires timely assessment and review of field and laboratory activities. This will require effective interaction and feedback between the field team members, laboratory, task leaders, and the project manager.

The task leaders will be responsible for keeping the project manager up to date regarding status of their respective tasks and results of the QC activities so that quick and effective solutions can be implemented should any data quality problems arise. At a minimum, this should include frequent weekly or biweekly status reports to provide an effective mechanism for ensuring ongoing evaluation of project efforts.

Data review, validation, and verification will be conducted by the analytical laboratory. Fully validated data reports will be provided for data review and corrective action, if necessary. The laboratory will retain samples for at least one month after results have been received in the event that re-analysis appears warranted.

Upon completion of the FSAP, the data will be evaluated and a written report prepared presenting the findings. There are four main objectives that will the focus of the data evaluation:

- The chemical data will be reviewed to determine whether the extent of contamination has been adequately defined with respect to the appropriate Tier 1 screening levels. If there are areas that have not been adequately characterized, additional step-out sampling (adjacent borings to delineate extent) will be performed to delineate the extent of COPCs.
- The groundwater grab samples from the hydro-punch sampling will be reviewed to determine whether the groundwater has been impacted. If the groundwater is found to contain levels of COPCs at levels that pose an unacceptable risk, then groundwater monitoring wells will be installed within those areas to evaluate the groundwater quality over time.
- The chemical data will be reviewed for concentration trends and spatial analyses to determine whether additional off-Site parties should be pursued. In addition to the FSAP data, file reviews will be performed for Marina Bay and other sources that may have historic releases into Meeker Creek.
- The data will be evaluated utilizing the tiered risk screening procedure outlined within Section 3. Sample locations with COPCs detected above the risk screening levels as outlined in Table 3-2 will be targeted for further risk evaluation including toxicity testing and data collection for Site-specific risk evaluation exposure evaluation. In addition, all bioaccumulative COPCs that are detected above their ambient levels will also be further evaluated to ensure that they do not pose a risk to higher trophic levels such as fish and shore birds.

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# TABLES

## Table 3-1
## Overview of Risk-Based Protection Zones

| Designated Protection Zone | Location | Potential Source Areas | Affected Media | Potential Receptors | Exposure Scenarios | Tier 1 Screening Values | Tier 2 Assessment |
|---|---|---|---|---|---|---|---|
| HHPZ-1 | Upland areas of RFS | Mercury Fulminate Facility, Forest Products Lab, Blasting Cap manufacturing Area, Shell manufacturing Area, Explosive Storage Area, Test Pit Area, Pyrite Cinders disposal area | Soil, Groundwater (Any VOCs known?) | Office and laboratory staff; | Occupational – dust inhalation, dermal contact, incidental ingestion | USEPA Region 9 PRGs | Human health Site-Specific Target Levels (HH- SSTLs) |
|  |  |  |  | Construction/ excavation workers | Dust inhalation, dermal contact, incidental ingestion |  |  |
| HHPZ-2 | Dyke and trails along bayside portion of site | Material dumped in and along dykes and trails | Fill soil | Upland recreational – bikers, joggers, hikers | Dust inhalation, dermal contact, incidental ingestion | USEPA Region 9 PRGs | Human health Site-Specific Target Levels (HH- SSTLs) |
| HHPZ-3 | Bay adjacent to trails (NOT the MARSH) | Material dumped or transported to bayshore | Sediment, seeps | Aquatic recreational - fishing | Fish consumption | Tier 1 RBSLs | Human health Site-Specific Target Levels (HH- SSTLs) |
| UEPZ | Upland areas of RFS, Trails along bayside portion of site | Same as HHPZ-1 and HHPZ-2 | Soil, standing water | Terrestrial receptors | Ingestion, dermal contact, inhalation, food web | Soil Screening Values (Oak Ridge National Labs) | Ecological Site-Specific Target Levels (E-SSTLs) |
| SEPZ – 1 | Marsh between upland parcel and dyke | Stege marsh, Zeneca Stauffer, wastewater outfalls, etc | Sediments, seeps, surface water | Wetland receptors | Ingestion, dermal contact, inhalation, food web | NOAA– ERLs, WDOE Marine Sediment Values, Florida DEP sediment values | Ecological Site-Specific Target Levels (E-SSTLs) |
| SEPZ - 2 | Bay adjacent to trails | Same as HHPZ-3 | Sediments | Aquatic receptors | Ingestion, dermal contact, inhalation, food web | NOAA– ERLs, WDOE Marine Sediment Values, Florida DEP sediment values | Ecological Site-Specific Target Levels (E-SSTLs) |

## Table 3-2
## Tier 1 Risk Based Screening Levels

| Constituent | LBNL Background Concentrations in Soil Colluvium & Fill (mg/kg) | EPA Region 9 PRGs Industrial Soil (mg/kg) | RWQCB-SF Bay Region Ambient Concentrations of Toxic Chemicals in San Francisco Bay (mg/kg) | NOAA ERL Sediment Quality Guidelines (mg/kg) | ERM Sediment Quality Guidelines (mg/kg) | Saltwater Ecological Protection Levels (µg/L) |
|---|---|---|---|---|---|---|
| ***METALS*** | | | | | | |
| Arsenic | 19.1 | 2.7 | 15.3 | 8.2 | 70 | 36 $^{3}$ |
| Cadmium | 2.7 | 810 | 0.33 | 1.2 | 9.6 | 9.3 |
| Chromium | 99.6 | 450 | 112 | 81 | 370 | 50 $^{4}$ |
| Copper | 69.4 | 76,000 | 68.1 | 34 | 270 | 2.4 |
| Lead | 16.1 | 1,000 | 43.2 | 46.7 | 218 | 5.6 $^{5}$ |
| Mercury | 0.4 | 610 | 0.43 | 0.15 | 71 | 0.025 |
| Selenium | 5.6 | 10,000 | 0.64 | NA | NA | 71 |
| Zinc | 106.1 | 100,000 | 158 | 150 | 410 | 58 |
| ***ORGANICS*** | | | | | | |
| ***TPH*** | | | | | | |
| Gasoline | NA | 1,000 $^{1}$ | NA | NA | NA | 3700 $^{6}$ |
| Diesel | NA | 1,000 $^{1}$ | NA | 520 | NA | 314 |
| Motor Oil | NA | 1,000 $^{1}$ | NA | 520 | NA | |
| Toluene | NA | 520 | NA | NA | NA | 5,000 |
| Ethyl Benzene | NA | 230 | NA | NA | NA | 86 |
| Xylene | NA | 210 | NA | NA | NA | 2200 $^{7}$ |
| ***PCBs*** | | | | | | |
| Total | NA | 1 | 0.0148 | 0.0227 | NA | 0.0002 |
| ***Pesticides*** | | | | | | |
| alpha-BHC (HCH) | NA | 0.00059 | NA | NA | NA | NA |
| DDD | NA | 0.017 | .00222 $^{2}$ | 0.027 | NA | 0.00084 $^{8}$ |
| DDT | NA | 0.012 | .00158 $^{2}$ | 0.0461 | NA | 0.00059 |

***NOTES:***

[1] = Level based upon RWQCB guidance for aesthetic and water quality

[2] = No ambient concentrations are available, therefore, ERLs will be used for Tier 1 screening.

[3] = USEPA Marine Chronic Criteria

[4] = Basin Plan Shallow Water Effluent

[5] = CA Water Quality Criteia Limit

[6] = SFIA Tier 1 Ecological Protection Standards

[7] = Phytotox Database (USEPA 1995)

[8] = CA Inland Surface Water Toxics Rule

# Table 3-3
# Richmond Field Station Sample Locations Exceeding the Tier 1 Human Health Risk Based Screening Levels (HH-RBSLs)

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | DATE | As | Cd | Cr | Cu | Hg | Pb | Se | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RFS | B2MF | Soil | 1.5 | Jonas & Ass. | Feb-91 | **33.7** | 437 | 52.4 | 209 | 4.39 | 388 | ND(<8.9) | 2150 |
| RFS | B2MF | Soil | 4 | Jonas & Ass. | Feb-91 | **46.8** | 5.3 | 36.5 | 159 | 2.6 | 697 | ND(<9.9) | 676 |
| RFS | B3MF | Soil | 1.3 | Jonas & Ass. | Feb-91 | 0.2 | 92 | 46.5 | 451 | 11 | **1140** | ND(<0.9) | 1550 |
| RFS | B18 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | 57 | **630** | NA | NA | 640 |
| RFS | B15SH | Soil | 1.5 | Jonas & Ass. | Feb-91 | **126** | 4.2 | 25.9 | 408 | 6.42 | 741 | ND(<8.6) | 366 |
| RFS | B1TP | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | **21.2** | 9.9 | 36.1 | 899 | 6.66 | 49.2 | ND(<0.72) | 227 |
| RFS | B1PR | Soil | 1.3 | Jonas & Ass. | Feb-91 | ***ND(63.4)*** | 1.8 | 36.8 | 108 | 0.94 | 129 | ND(<8.6) | 353 |
| RFS | B-1 | Soil | 4.5-5.0 | ECI | Aug-98 | **62** | ND | ND | 490 | 6.4 | 91 | NA | 580 |
| RFS | B-1 | Soil | 8.5-9.0 | ECI | Aug-98 | **160** | ND | ND | 2600 | 8 | 98 | NA | 1600 |
| RFS | B-2 | Soil | 0.5-1.0 | ECI | Aug-98 | **35** | ND | 15 | 190 | 0.35 | 43 | NA | 210 |
| RFS | B-2 | Soil | 8.0-8.5 | ECI | Aug-98 | **54** | 6 | ND | 870 | 7.3 | 61 | NA | 730 |
| RFS | B-3 | Soil | 8.5-9.0 | ECI | Aug-98 | **110** | 340 | 7.7 | 20000 | 1.3 | 43 | NA | 7900 |
| RFS | B-4 | Soil | 8.0-8.5 | ECI | Aug-98 | **110** | ND | ND | 770 | 8 | 50 | NA | 1000 |
| RFS | B-5 | Soil | 4.0-4.5 | ECI | Aug-98 | **140** | 53 | 15 | 9300 | 10 | 160 | NA | 2300 |
| RFS | B-5 | Soil | 8.0-8.5 | ECI | Aug-98 | **120** | 20 | 5.7 | 17000 | 32 | 80 | NA | 1800 |
| RFS | B-6 | Soil | 8.5-9.0 | ECI | Aug-98 | **160** | 22 | 6.4 | 1100 | 32 | 140 | NA | 7100 |
| RFS | B-7 | Soil | 8.0-8.5 | ECI | Aug-98 | **260** | 27 | ND | 1300 | 9.5 | 72 | NA | 4600 |
| RFS | B-8 | Soil | 4.5-5.0 | ECI | Aug-98 | **160** | ND | 17 | 330 | 2 | 71 | NA | 770 |
| RFS | B-8 | Soil | 8.5-9.0 | ECI | Aug-98 | **210** | ND | ND | 280 | 12 | 84 | NA | 1400 |

# Table 3-4
# Richmond Field Station and Stege Marsh Sample Locations Exceeding the Tier 1 Ecological Risk Based Screening Levels (Eco-RBSLs)

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | DATE | As | Cd | Cr | Cu | Hg | Pb | Se | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RFS | SD1MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 50.6 | 5.9 | 105 | 154 | 3.02 | 123 | ND(<13.7) | 356 |
| RFS | SD2MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 27.2 | 2.8 | 105 | 127 | 2.46 | 95.4 | ND(<13.9) | 343 |
| RFS | SD3MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 190 | 5 | 116 | 145 | 2.44 | 153 | ND(<13.9) | 501 |
| RFS | SD4MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 161 | 9.7 | 32.9 | 262 | 15.7 | 293 | ND(<4.5) | 697 |
| RFS | SD5MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 167 | 11 | 35.8 | 400 | 6.27 | 275 | 4 | 752 |
| RFS | SD6MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 555 | 33.7 | 33.8 | 823 | 10.6 | 814 | 8.7 | 2840 |
| RFS | SD1WSD | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<25.1) | 5.7 | 115 | 152 | 2.34 | 188 | ND(<12.9) | 612 |
| RFS | SD1ESD | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<348) | 31 | 37.6 | 813 | 8 | 172 | ND(<17.9) | 305 |
| RFS | SD1SL | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<2.6) | 4.8 | 95.6 | 178 | 1.84 | 143 | ND(<13.5) | 661 |
| RFS | SD2SL | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<2.7) | 2 | 89.7 | 106 | 2.87 | 108 | ND(<14) | 317 |
| RFS | SD3SL | Sediment | 1 | Jonas & Ass. | Feb-91 | 101 | 10.8 | 138 | 692 | 1.37 | 485 | ND(<14.3) | 1060 |
| RFS | SD1PR | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<24.9) | 5.6 | 83.5 | 85.7 | 2.23 | 122 | ND(<12.8) | 259 |
| RFS | SD1BAY | Sediment | 1 | Jonas & Ass. | Feb-91 | 10.5 | 3.2 | 73.2 | 255 | 1.5 | 58.3 | ND(<12.5) | 283 |
| RFS | SD2BAY | Sediment | 1 | Jonas & Ass. | Feb-91 | 3.2 | 2 | 26.9 | 183 | 0.14 | 10.8 | ND(<0.89) | 134 |
| RFS | RFS-1 | Sediment | 0-2 | Pacific Eco-Risk | Feb-99 | 425 | 2.45 | 83.1 | 425 | 24.2 | 149 | 19.7 | 793 |
| RFS | RFS-1 | Sediment | 2.00-4 | Pacific Eco-Risk | Feb-99 | 895 | 4.6 | 140 | 587 | 22 | 345 | 57 | 1000 |
| RFS | RFS-1 | Sediment | 4-5.75 | Pacific Eco-Risk | Feb-99 | 172 | 1.12 | 54.8 | 145 | 9 | 76.7 | 9 | 304 |
| RFS | RFS-1 | Sediment | SURFACE | Pacific Eco-Risk | Feb-99 | 217 | 16.4 | 50.1 | 1330 | 5.7 | 236 | 19 | 3930 |
| RFS | RFS-2 | Sediment | 0-2 | Pacific Eco-Risk | Feb-99 | 973 | 11.1 | 136 | 1130 | 142 | 801 | 444 | 2000 |
| RFS | RFS-2 | Sediment | 2.0-4 | Pacific Eco-Risk | Feb-99 | 746 | 8.2 | 59.6 | 620 | 53 | 211 | 78 | 1710 |
| RFS | RFS-2 | Sediment | 4.0-6 | Pacific Eco-Risk | Feb-99 | 57 | 1.24 | 50.8 | 109 | 5.2 | 34.1 | 7 | 271 |
| RFS | RFS-3 | Sediment | SURFACE | Pacific Eco-Risk | Feb-99 | 1020 | 2.4 | 12.7 | 193 | 1.3 | 37.2 | 6 | 517 |
| RFS | RFS-3 | Sediment | 0-2 | Pacific Eco-Risk | Feb-99 | 746 | 2.97 | 11.8 | 745 | 27.5 | 289 | 854 | 945 |
| RFS | RFS-3 | Sediment | 2.0-3 | Pacific Eco-Risk | Feb-99 | 1330 | 44.21 | 48.3 | 1640 | 166 | 1240 | 610 | 5000 |
| RFS | RFS-4 | Sediment | 0-2 | Pacific Eco-Risk | Feb-99 | 688 | 19.4 | 9.5 | 4250 | 7.5 | 238 | 249 | 3750 |
| RFS | RFS-4 | Sediment | 2.0-4 | Pacific Eco-Risk | Feb-99 | 319 | 50 | 23.7 | 8090 | 26.6 | 167 | 8 | 5290 |
| RFS | RFS-4 | Sediment | 4.0-5 | Pacific Eco-Risk | Feb-99 | 14 | 0.14 | 57.4 | 30 | 1.5 | 7.61 | ND | 60 |
| RFS | 21401 Stege Marsh#1 | Sediment | NA | BPTCP | Mar-99 | 1140 | NA | NA | 373 | 5.5 | 180 | 35.7 | 2500 |
| RFS | 21402 Stege Marsh#2 | Sediment | NA | BPTCP | Mar-99 | 61.8 | NA | NA | 624 | 1.1 | 72.2 | 7.9 | 434 |
| RFS | 21403 Stege Marsh#3 | Sediment | NA | BPTCP | Mar-99 | 343 | NA | NA | 450 | 2.2 | 102 | 3.8 | 1020 |
| RFS | B1MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 3.5 | 2.2 | 59.6 | 44.4 | ND(<0.12) | 7.5 | ND(<7.9) | 95.9 |
| RFS | B2MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 119 | 9.8 | 85.2 | 112 | 2.32 | 125 | ND(<22.2) | 622 |
| RFS | B3MA | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<33.4) | 3.8 | 102 | 88.6 | 1.97 | 83.7 | ND(<17.2) | 325 |
| RFS | B4MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 186 | 5 | 100 | 514 | 10.5 | 122 | ND(<1.1) | 906 |
| RFS | B5MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 674 | 8.2 | 110 | 494 | 1.74 | 221 | ND(<28.9) | 1470 |
| RFS | B6MA | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<3.1) | 5.3 | 115 | 122 | 2.3 | 99.6 | ND(<16.2) | 446 |
| RFS | B7MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 15.8 | 6.9 | 35.7 | 121 | 0.72 | 72.2 | ND(<6.9) | 930 |
| RFS | B8MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 875 | 7.7 | 209 | 415 | 35.9 | 235 | ND(<1.6) | 517 |
| RFS | B9MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 125 | 8.7 | 39.5 | 519 | 7.09 | 91.3 | ND(<11.1) | 1270 |
| RFS | B10MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 2210 | 12.3 | 185 | 495 | 20.2 | 357 | 11 | 694 |

# Table 3-4
# Richmond Field Station and Stege Marsh Sample Locations Exceeding the Tier 1 Ecological Risk Based Screening Levels (Eco-RBSLs)

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | DATE | As | Cd | Cr | Cu | Hg | Pb | Se | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RFS | B11MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 245 | 7.6 | 143 | 294 | 25.1 | 74.6 | 8.2 | 489 |
| RFS | B-2-W | Groundwater | 6 | ECI | 1998 | 220 | 6.3 | NA | 6.3 | ND | ND | NA | 1600 |
| RFS | B-7-W | Groundwater | 6 | ECI | 1998 | 210 | ND | 19 | ND | ND | ND | NA | 120 |
| RFS | SW1MA | Water | Surface | Jonas & Ass. | Feb-91 | ND(2560) | ND(3.5) | ND(7.0) | 44.5 | ND(0.20) | ND(120) | ND(33.0) | 30.7 |
| RFS | SW2MA | Water | Surface | Jonas & Ass. | Feb-91 | ND(2560) | ND(3.5) | 7.7 | 44.6 | 0.4 | ND(120) | ND(33.0) | 30.6 |
| RFS | SW3MA | Water | Surface | Jonas & Ass. | Feb-91 | ND(2560) | ND(3.5) | ND(7.0) | 50.6 | ND(0.20) | ND(120) | ND(33.0) | 94.3 |
| RFS | SW4MA | Water | Surface | Jonas & Ass. | Feb-91 | ND(2560) | ND(3.5) | ND(7.0) | 92.3 | 0.4 | ND(120) | ND(33.0) | 854 |
| RFS | SW5MA | Water | Surface | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | ND(7.0) | 96.1 | ND(0.20) | ND(120) | ND(33.0) | 877 |
| RFS | SW6MA | Water | Surface | Jonas & Ass. | Feb-91 | 1570 | 53.8 | 132 | 2360 | ND(0.20) | ND(120) | ND(33.0) | 7900 |
| RFS | SW1WSD | Water | Surface | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | ND(7.0) | 36.7 | ND(0.20) | ND(120) | ND(33.0) | 50.1 |
| RFS | SW1SLE | Water | Surface | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | 8.9 | 46.6 | ND(0.20) | ND(120) | ND(3.3) | 116 |
| RFS | SW2SLE | Water | Surface | Jonas & Ass. | Feb-91 | ND(2560) | ND(3.5) | ND(7.0) | 37.7 | ND(0.20) | ND(120) | ND(3.3) | 38.5 |
| RFS | SW1SFL | Water | Surface | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | 7.4 | 42 | ND(0.20) | ND(120) | ND(33.0) | 23.1 |
| RFS | SW2SFL | Water | Surface | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | ND(7.0) | 41 | ND(0.20) | ND(120) | ND(33.0) | 30.8 |
| RFS | SW1BAY | Water | Surface | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | 7.7 | 41.2 | 0.45 | ND(120) | ND(33.0) | 73.2 |
| RFS | SW2BAY | Water | Surface | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | ND(7.0) | 41.9 | 0.2 | ND(120) | ND(33.0) | 11.5 |

# Table 4-1
# Richmond Field Station Summary of Soil and Sediment Sample Results

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | REF. DATE | As mg/kg | Cd mg/kg | Cr mg/kg | Cu mg/kg | Hg mg/kg | Pb mg/kg | Se mg/kg | Zn mg/kg | alpha-BHC (ug/kg) | P,P'-DDD (ug/kg) | P,P'-DDT (ug/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RFS | BF1 | Soil | NA | Jonas & Ass. | Jun-90 | NA | NA | 14 | 49 | NA | NA | NA | NA | NA | NA | NA |
| RFS | BF2 | Soil | NA | Jonas & Ass. | Jun-90 | 16 | NA | 14 | 120 | NA | NA | NA | NA | NA | NA | NA |
| RFS | BF3 | Soil | NA | Jonas & Ass. | Jun-90 | NA | NA | 12 | 32 | NA | NA | NA | NA | NA | NA | NA |
| RFS | B1MF | Soil | 1.3 | Jonas & Ass. | Feb-91 | 9.3 | 0.98 | 32.9 | 102 | 317 | 91.5 | ND(<0.88) | 214 | NA | NA | NA |
| RFS | B2MF | Soil | 1.5 | Jonas & Ass. | Feb-91 | 33.7 | 437 | 52.4 | 209 | 4.39 | 388 | ND(<8.9) | 2150 | NA | NA | NA |
| RFS | B2MF | Soil | 4 | Jonas & Ass. | Feb-91 | 46.8 | 5.3 | 36.5 | 159 | 2.6 | 697 | ND(<9.9) | 676 | NA | NA | NA |
| RFS | B2MF | Soil | 6.5 | Jonas & Ass. | Feb-91 | 3.2 | 1.6 | 51 | 44 | 0.46 | 7.4 | ND(<10) | 68.8 | NA | NA | NA |
| RFS | B2MF | Soil | 9 | Jonas & Ass. | Feb-91 | 1.1 | 2 | 53.7 | 29.2 | ND(<0.12) | 5 | ND(<0.96) | 57.4 | NA | NA | NA |
| RFS | B2MF | Soil | 11.5 | Jonas & Ass. | Feb-91 | 1.3 | 0.82 | 45.8 | 22.7 | 1.63 | 4.3 | ND(<8.9) | 63.9 | NA | NA | NA |
| RFS | B2MF | Soil | 14 | Jonas & Ass. | Feb-91 | 2.3 | 2.5 | 35 | 34.7 | 2.03 | 5.6 | ND(<0.88) | 53.2 | NA | NA | NA |
| RFS | B3MF | Soil | 1.3 | Jonas & Ass. | Feb-91 | 0.2 | 92 | 46.5 | 451 | 11 | 1140 | ND(<0.9) | 1550 | NA | NA | NA |
| RFS | B1 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 3.5 | NA | NA | NA | NA | NA | NA |
| RFS | B2 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 9.6 | NA | NA | NA | NA | NA | NA |
| RFS | B3 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 3.3 | NA | NA | NA | NA | NA | NA |
| RFS | B4 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 4.8 | NA | NA | NA | NA | NA | NA |
| RFS | B5 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 19 | NA | NA | NA | NA | NA | NA |
| RFS | B6 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 22 | NA | NA | NA | NA | NA | NA |
| RFS | B7 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 26 | NA | NA | NA | NA | NA | NA |
| RFS | B8 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 28 | NA | NA | NA | NA | NA | NA |
| RFS | B9 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 61 | NA | NA | NA | NA | NA | NA |
| RFS | B10 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 90 | NA | NA | NA | NA | NA | NA |
| RFS | B11 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 25 | NA | NA | NA | NA | NA | NA |
| RFS | B12 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | 53 | 180 | NA | NA | 65 | NA | NA | NA |
| RFS | B13 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 7.4 | NA | NA | NA | NA | NA | NA |
| RFS | B14 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 8.1 | NA | NA | NA | NA | NA | NA |
| RFS | B15 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 27 | NA | NA | NA | NA | NA | NA |
| RFS | B16 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 28 | NA | NA | NA | NA | NA | NA |
| RFS | B17 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 140 | NA | NA | NA | NA | NA | NA |
| RFS | B18 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | 57 | 630 | NA | NA | 640 | NA | NA | NA |
| RFS | B19 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 27 | NA | NA | NA | NA | NA | NA |
| RFS | B20 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 20 | NA | NA | NA | NA | NA | NA |
| RFS | B21 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 44 | NA | NA | NA | NA | NA | NA |
| RFS | B22 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 11 | NA | NA | NA | NA | NA | NA |
| RFS | B23 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 2.2 | NA | NA | NA | NA | NA | NA |
| RFS | B24 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 41.3 | NA | NA | NA | NA | NA | NA |
| RFS | B25 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 0.46 | NA | NA | NA | NA | NA | NA |
| RFS | B26 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 0.8 | NA | NA | NA | NA | NA | NA |
| RFS | B27 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 1.2 | NA | NA | NA | NA | NA | NA |
| RFS | B28 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 0.29 | NA | NA | NA | NA | NA | NA |
| RFS | B29 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 0.1 | NA | NA | NA | NA | NA | NA |
| RFS | B30 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 4.4 | NA | NA | NA | NA | NA | NA |
| RFS | B31 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 6.7 | NA | NA | NA | NA | NA | NA |

# Table 4-1
# Richmond Field Station Summary of Soil and Sediment Sample Results

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | REF. DATE | As mg/kg | Cd mg/kg | Cr mg/kg | Cu mg/kg | Hg mg/kg | Pb mg/kg | Se mg/kg | Zn mg/kg | alpha-BHC (ug/kg) | P,P'-DDD (ug/kg) | P,P'-DDT (ug/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RFS | B32 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 1.4 | NA | NA | NA | NA | NA | NA |
| RFS | B33 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 0.41 | NA | NA | NA | NA | NA | NA |
| RFS | B34 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 7 | NA | NA | NA | NA | NA | NA |
| RFS | B35 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 3 | NA | NA | NA | NA | NA | NA |
| RFS | B36 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 0.23 | NA | NA | NA | NA | NA | NA |
| RFS | B37 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 0.73 | NA | NA | NA | NA | NA | NA |
| RFS | B38 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | 200 | 2.5 | NA | NA | 170 | NA | NA | NA |
| RFS | B39 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | 160 | 6.7 | NA | NA | 180 | NA | NA | NA |
| RFS | B40 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 2.7 | NA | NA | NA | NA | NA | NA |
| RFS | B41 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 0.34 | NA | NA | NA | NA | NA | NA |
| RFS | B42 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 0.16 | NA | NA | NA | NA | NA | NA |
| RFS | B43 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 1.6 | NA | NA | NA | NA | NA | NA |
| RFS | B44 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 1 | NA | NA | NA | NA | NA | NA |
| RFS | B45 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 6.1 | NA | NA | NA | NA | NA | NA |
| RFS | B46 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 14 | NA | NA | NA | NA | NA | NA |
| RFS | B47 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 4.7 | NA | NA | NA | NA | NA | NA |
| RFS | B48 | Soil | 0-3 | Jonas & Ass. | May-90 | NA | NA | NA | NA | 0.41 | NA | NA | NA | NA | NA | NA |
| RFS | B01SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | ND(<0.9) | 2.3 | 64.1 | 187 | 1.1 | 81.3 | ND(<9) | 125 | NA | NA | NA |
| RFS | B02SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 3.4 | 1.2 | 27.7 | 34 | 3.31 | 37.1 | ND(<3.6) | 40.8 | NA | NA | NA |
| RFS | B03SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 3 | 1.6 | 19.2 | 12.6 | 0.12 | 7.4 | ND(<0.7) | 10.9 | NA | NA | NA |
| RFS | B04SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 2.4 | 0.86 | 16.1 | 10.5 | ND(<0.11) | 6.4 | ND(<0.7) | 10.2 | NA | NA | NA |
| RFS | B05SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 9.7 | 1.4 | 25.1 | 18.1 | ND(<0.11) | 6.3 | ND(<0.74) | 43.8 | NA | NA | NA |
| RFS | B06SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 7.1 | 1.6 | 24.6 | 17 | ND(<0.11) | 5.4 | ND(<0.73) | 42.6 | NA | NA | NA |
| RFS | B07SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 3 | ND(<0.76) | 17.8 | 38.9 | 80.1 | 20.6 | ND(<0.73) | 47.6 | NA | NA | NA |
| RFS | B08SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 6.5 | 1.6 | 20.7 | 181 | 97.8 | 121 | ND(<0.7) | 114 | NA | NA | NA |
| RFS | B09SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 6.3 | 1.9 | 14.8 | 70.5 | 18.8 | 187 | ND(<0.7) | 132 | NA | NA | NA |
| RFS | B10SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 7.4 | 2.2 | 20.9 | 188 | 40.2 | 87.4 | ND(<0.72) | 260 | NA | NA | NA |
| RFS | B11SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | ND(<8.7) | 3 | 28.9 | 291 | 7.74 | 313 | ND(<8.7) | 437 | NA | NA | NA |
| RFS | B12SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 3.2 | ND(<0.77) | 34.2 | 24.3 | 0.57 | 8.9 | ND(<0.72) | 35.7 | NA | NA | NA |
| RFS | B13SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 2.8 | 0.87 | 28 | 24.8 | 0.3 | 9.2 | ND(<0.76) | 43.2 | NA | NA | NA |
| RFS | B14SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 3.2 | 0.87 | 22.5 | 22.5 | 2.48 | 12.9 | ND(<0.71) | 54.7 | NA | NA | NA |
| RFS | B15SH | Soil | 1.5 | Jonas & Ass. | Feb-91 | 126 | 4.2 | 25.9 | 408 | 6.42 | 741 | ND(<8.6) | 366 | NA | NA | NA |
| RFS | B15SH | Soil | 4 | Jonas & Ass. | Feb-91 | 1.9 | 5.1 | 71.2 | 32.3 | 0.3 | 6.5 | ND(<9.3) | 48.4 | NA | NA | NA |
| RFS | B15SH | Soil | 6.5 | Jonas & Ass. | Feb-91 | 2.7 | 2.9 | 58 | 54.3 | 0.26 | 9.7 | ND(<9.2) | 65.7 | NA | NA | NA |
| RFS | B15SH | Soil | 9 | Jonas & Ass. | Feb-91 | ND(<8.8) | 2.5 | 69.8 | 25.3 | 0.11 | 4.2 | ND(<8.8) | 58.7 | NA | NA | NA |
| RFS | B15SH | Soil | 11.5 | Jonas & Ass. | Feb-91 | 3.2 | 1.7 | 63.3 | 62.7 | 0.11 | 4.2 | ND(<9) | 89.3 | NA | NA | NA |
| RFS | B15SH | Soil | 14 | Jonas & Ass. | Feb-91 | 1.7 | 1.9 | 43.3 | 25.5 | 0.25 | 3.2 | ND(<9.5) | 48.5 | NA | NA | NA |
| RFS | B16SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 3.6 | 0.88 | 22.4 | 804 | 1.17 | 9.3 | ND(<0.76) | 71.4 | NA | NA | NA |
| RFS | B18SH | Soil | 1.3 | Jonas & Ass. | Feb-91 | 2.8 | 0.96 | 33.2 | 29.8 | 2.27 | 40.1 | ND(<0.71) | 66.7 | NA | NA | NA |
| RFS | B01BC | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 5.5 | 2.2 | 27.1 | 207 | 0.83 | 19.1 | ND(<0.92) | 135 | NA | NA | NA |
| RFS | B02BC | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 3.5 | 2.5 | 15.8 | 232 | 1.04 | 19.8 | ND(<0.96) | 171 | NA | NA | NA |
| RFS | B03BC | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 1.2 | 2 | 24.3 | 70.8 | 1.75 | 69.5 | ND(<0.91) | 392 | NA | NA | NA |

# Table 4-1
# Richmond Field Station Summary of Soil and Sediment Sample Results

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | REF. DATE | As mg/kg | Cd mg/kg | Cr mg/kg | Cu mg/kg | Hg mg/kg | Pb mg/kg | Se mg/kg | Zn mg/kg | alpha-BHC (ug/kg) | P,P'-DDD (ug/kg) | P,P'-DDT (ug/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RFS | B04BC | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | ND(<0.89) | 2.2 | 18.7 | 149 | 1.06 | 17.1 | ND(<0.89) | 223 | NA | NA | NA |
| RFS | B05BC | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 1.1 | 2.2 | 22.2 | 201 | 0.41 | 14.2 | ND(<0.94) | 267 | NA | NA | NA |
| RFS | B01ES | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 1.3 | 3.3 | 31.7 | 654 | 0.28 | 8.5 | ND(<0.87) | 260 | NA | NA | NA |
| RFS | B03ES | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 0.96 | 1.4 | 28.3 | 736 | ND(<0.12) | 5 | ND(<0.9) | 266 | NA | NA | NA |
| RFS | B05ES | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 2.8 | 1.3 | 24.7 | 44.1 | 0.8 | 10.5 | ND(<0.84) | 177 | NA | NA | NA |
| RFS | B07ES | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 10.2 | 4.6 | 44.4 | 516 | 1.37 | 24.3 | ND(<0.87) | 138 | NA | NA | NA |
| RFS | B09ES | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 3.6 | 3.4 | 56.8 | 77.8 | 0.51 | 18 | ND(<3.5) | 222 | NA | NA | NA |
| RFS | B11ES | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | ND(<8.7) | 0.81 | 42.2 | 21.2 | ND(<0.12) | 6.9 | ND(<8.7) | 24.4 | NA | NA | NA |
| RFS | B13ES | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 2.8 | 1.4 | 30.5 | 29.5 | 0.4 | 12 | ND(<0.85) | 154 | NA | NA | NA |
| RFS | B14ES | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 2.8 | 1.7 | 29.7 | 29.3 | 0.3 | 15.1 | ND(<0.86) | 161 | NA | NA | NA |
| RFS | B15ES | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 2.8 | 1.6 | 27.7 | 22.6 | 0.19 | 17.4 | ND(<0.86) | 270 | NA | NA | NA |
| RFS | B16ES | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 2.4 | 4.1 | 65.1 | 70.7 | 0.84* | 15 | ND(<7.2) | 178 | NA | NA | NA |
| RFS | B1TP | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 21.2 | 9.9 | 36.1 | 899 | 6.66 | 49.2 | ND(<0.72) | 227 | NA | NA | NA |
| RFS | B2TP | Soil | 0.5-1.5 | Jonas & Ass. | Feb-91 | 4.3 | 2.8 | 34 | 1140 | 2.91 | 46.4 | ND(<9.1) | 142 | NA | NA | NA |
| RFS | B1BG | Soil | 1.3 | Jonas & Ass. | Feb-91 | ND(<0.92) | 1.2 | 39.7 | 17.9 | ND(<0.11) | 7.3 | ND(<9.2) | 27.6 | NA | NA | NA |
| RFS | B2BG | Soil | 1.3 | Jonas & Ass. | Feb-91 | ND(<0.95) | 3.1 | 45.1 | 22.4 | ND(<0.12) | 10.7 | ND(<9.2) | 37.1 | NA | NA | NA |
| RFS | B1MA | Soil | 1 | Jonas & Ass. | Feb-91 | 3.5 | 2.2 | 59.6 | 44.4 | ND(<0.12) | 7.5 | ND(<7.9) | 95.9 | NA | NA | NA |
| RFS | B2MA | Soil | 1 | Jonas & Ass. | Feb-91 | 119 | 9.8 | 85.2 | 112 | 2.32 | 125 | ND(<22.2) | 622 | NA | NA | NA |
| RFS | B3MA | Soil | 1 | Jonas & Ass. | Feb-91 | ND(<33.4) | 3.8 | 102 | 88.6 | 1.97 | 83.7 | ND(<17.2) | 325 | NA | NA | NA |
| RFS | B4MA | Soil | 1 | Jonas & Ass. | Feb-91 | 186 | 5 | 100 | 514 | 10.5 | 122 | ND(<1.1) | 906 | NA | NA | NA |
| RFS | B5MA | Soil | 1 | Jonas & Ass. | Feb-91 | 674 | 8.2 | 110 | 494 | 1.74 | 221 | ND(<28.9) | 1470 | NA | NA | NA |
| RFS | B6MA | Soil | 1 | Jonas & Ass. | Feb-91 | ND(<3.1) | 5.3 | 115 | 122 | 2.3 | 99.6 | ND(<16.2) | 446 | NA | NA | NA |
| RFS | B7MA | Soil | 1 | Jonas & Ass. | Feb-91 | 15.8 | 6.9 | 35.7 | 121 | 0.72 | 72.2 | ND(<6.9) | 930 | NA | NA | NA |
| RFS | B8MA | Soil | 1 | Jonas & Ass. | Feb-91 | 875 | 7.7 | 209 | 415 | 35.9 | 235 | ND(<1.6) | 517 | NA | 178 | ND(<82) |
| RFS | B9MA | Soil | 1 | Jonas & Ass. | Feb-91 | 125 | 8.7 | 39.5 | 519 | 7.09 | 91.3 | ND(<11.1) | 1270 | 41.8 | ND(<82) | ND(<82) |
| RFS | B10MA | Soil | 1 | Jonas & Ass. | Feb-91 | 2210 | 12.3 | 185 | 495 | 20.2 | 357 | 11 | 694 | NA | 336 | 129 |
| RFS | B11MA | Soil | 1 | Jonas & Ass. | Feb-91 | 245 | 7.6 | 143 | 294 | 25.1 | 74.6 | 8.2 | 489 | NA | 282 | ND(<82) |
| RFS | B1PR | Soil | 1.3 | Jonas & Ass. | Feb-91 | ND(<63.4) | 1.8 | 36.8 | 108 | 0.94 | 129 | ND(<8.6) | 353 | NA | NA | NA |
| RFS | B-1 | Soil | 0.0-0.5 | ECI | Aug-98 | 15 | ND | 18 | 120 | 4.6 | 27 | NA | 160 | NA | NA | NA |
| RFS | B-1 | Soil | 4.5-5.0 | ECI | Aug-98 | 62 | ND | ND | 490 | 6.4 | 91 | NA | 580 | NA | NA | NA |
| RFS | B-1 | Soil | 8.5-9.0 | ECI | Aug-98 | 160 | ND | ND | 2600 | 8 | 98 | NA | 1600 | NA | NA | NA |
| RFS | B-2 | Soil | 0.5-1.0 | ECI | Aug-98 | 35 | ND | 15 | 190 | 0.35 | 43 | NA | 210 | NA | NA | NA |
| RFS | B-2 | Soil | 4.5-5.0 | ECI | Aug-98 | 6.5 | ND | 36 | 19 | 0.16 | ND | NA | 41 | NA | NA | NA |
| RFS | B-2 | Soil | 8.0-8.5 | ECI | Aug-98 | 54 | 6 | ND | 870 | 7.3 | 61 | NA | 730 | NA | NA | NA |
| RFS | B-3 | Soil | 0.5-1.0 | ECI | Aug-98 | 7.9 | ND | 12 | 65 | 0.64 | 21 | NA | 84 | NA | NA | NA |
| RFS | B-3 | Soil | 4.0-4.5 | ECI | Aug-98 | 14 | ND | 47 | 65 | 0.18 | 12 | NA | 250 | NA | NA | NA |
| RFS | B-3 | Soil | 8.5-9.0 | ECI | Aug-98 | 110 | 340 | 7.7 | 20000 | 1.3 | 43 | NA | 7900 | NA | NA | NA |
| RFS | B-4 | Soil | 0.0-0.5 | ECI | Aug-98 | 17 | ND | 16 | 71 | 0.7 | 15 | NA | 110 | NA | NA | NA |
| RFS | B-4 | Soil | 4.0-4.5 | ECI | Aug-98 | 17 | ND | 26 | 34 | 4.7 | 8.3 | NA | 220 | NA | NA | NA |
| RFS | B-4 | Soil | 8.0-8.5 | ECI | Aug-98 | 110 | ND | ND | 770 | 8 | 50 | NA | 1000 | NA | NA | NA |
| RFS | B-5 | Soil | 0.5-1.0 | ECI | Aug-98 | NA | NA | 11 | 12 | 0.22 | 13 | NA | 37 | NA | NA | NA |
| RFS | B-5 | Soil | 4.0-4.5 | ECI | Aug-98 | 140 | 53 | 15 | 9300 | 10 | 160 | NA | 2300 | NA | NA | NA |

# Table 4-1
# Richmond Field Station Summary of Soil and Sediment Sample Results

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | REF. DATE | As mg/kg | Cd mg/kg | Cr mg/kg | Cu mg/kg | Hg mg/kg | Pb mg/kg | Se mg/kg | Zn mg/kg | alpha-BHC (ug/kg) | P,P'-DDD (ug/kg) | P,P'-DDT (ug/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RFS | B-5 | Soil | 8.0-8.5 | ECI | Aug-98 | 120 | 20 | 5.7 | 17000 | 32 | 80 | NA | 1800 | NA | NA | NA |
| RFS | B-6 | Soil | 0.5-1.0 | ECI | Aug-98 | NA | NA | 7 | 9.8 | 0.59 | 6.9 | NA | 26 | NA | NA | NA |
| RFS | B-6 | Soil | 4.0-4.5 | ECI | Aug-98 | 14 | ND | 43 | 24 | 0.65 | 12 | NA | 87 | NA | NA | NA |
| RFS | B-6 | Soil | 8.5-9.0 | ECI | Aug-98 | 160 | 22 | 6.4 | 1100 | 32 | 140 | NA | 7100 | NA | NA | NA |
| RFS | B-7 | Soil | 0.0-0.5 | ECI | Aug-98 | 8.6 | ND | 18 | 970 | 4 | 18 | NA | 130 | NA | NA | NA |
| RFS | B-7 | Soil | 4.5-5.0 | ECI | Aug-98 | 8.8 | ND | 33 | 16 | 3.2 | ND | NA | 22 | NA | NA | NA |
| RFS | B-7 | Soil | 8.0-8.5 | ECI | Aug-98 | 260 | 27 | ND | 1300 | 9.5 | 72 | NA | 4600 | NA | NA | NA |
| RFS | B-8 | Soil | 0.5-1.0 | ECI | Aug-98 | 16 | ND | 22 | 36 | 6.7 | 16 | NA | 96 | NA | NA | NA |
| RFS | B-8 | Soil | 4.5-5.0 | ECI | Aug-98 | 160 | ND | 17 | 330 | 2 | 71 | NA | 770 | NA | NA | NA |
| RFS | B-8 | Soil | 8.5-9.0 | ECI | Aug-98 | 210 | ND | ND | 280 | 12 | 84 | NA | 1400 | NA | NA | NA |
| RFS | SD1MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 50.6 | 5.9 | 105 | 154 | 3.02 | 123 | ND(<13.7) | 356 | NA | NA | NA |
| RFS | SD2MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 27.2 | 2.8 | 105 | 127 | 2.46 | 95.4 | ND(<13.9) | 343 | NA | NA | NA |
| RFS | SD3MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 190 | 5 | 116 | 145 | 2.44 | 153 | ND(<13.9) | 501 | NA | NA | NA |
| RFS | SD4MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 161 | 9.7 | 32.9 | 262 | 15.7 | 293 | ND(<4.5) | 697 | NA | NA | NA |
| RFS | SD5MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 167 | 11 | 35.8 | 400 | 6.27 | 275 | 4 | 752 | NA | NA | NA |
| RFS | SD6MA | Sediment | 1 | Jonas & Ass. | Feb-91 | 555 | 33.7 | 33.8 | 823 | 10.6 | 814 | 8.7 | 2840 | NA | NA | NA |
| RFS | SD1WSD | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<25.1 | 5.7 | 115 | 152 | 2.34 | 188 | ND(<12.9) | 612 | NA | NA | NA |
| RFS | SD1ESD | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<348) | 31 | 37.6 | 813 | 8 | 172 | ND(<17.9) | 305 | NA | NA | NA |
| RFS | SD1SL | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<2.6) | 4.8 | 95.6 | 178 | 1.84 | 143 | ND(<13.5) | 661 | NA | NA | NA |
| RFS | SD2SL | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<2.7) | 2 | 89.7 | 106 | 2.87 | 108 | ND(<14) | 317 | NA | NA | NA |
| RFS | SD3SL | Sediment | 1 | Jonas & Ass. | Feb-91 | 101 | 10.8 | 138 | 692 | 1.37 | 485 | ND(<14.3) | 1060 | NA | NA | NA |
| RFS | SD1PR | Sediment | 1 | Jonas & Ass. | Feb-91 | ND(<24.9 | 5.6 | 83.5 | 85.7 | 2.23 | 122 | ND(<12.8) | 259 | NA | NA | NA |
| RFS | SD1BAY | Sediment | 1 | Jonas & Ass. | Feb-91 | 10.5 | 3.2 | 73.2 | 255 | 1.5 | 58.3 | ND(<12.5) | 283 | NA | NA | NA |
| RFS | SD2BAY | Sediment | 1 | Jonas & Ass. | Feb-91 | 3.2 | 2 | 26.9 | 183 | 0.14 | 10.8 | ND(<0.89) | 134 | NA | NA | NA |
| RFS | RFS-1 | Sediment | 0-2 | Pacific Eco-Risk | Feb-99 | 425 | 2.45 | 83.1 | 425 | 24.2 | 149 | 19.7 | 793 | NA | NA | NA |
| RFS | RFS-1 | Sediment | 2.00-4 | Pacific Eco-Risk | Feb-99 | 895 | 4.6 | 140 | 587 | 22 | 345 | 57 | 1000 | NA | NA | NA |
| RFS | RFS-1 | Sediment | 4-5.75 | Pacific Eco-Risk | Feb-99 | 172 | 1.12 | 54.8 | 145 | 9 | 76.7 | 9 | 304 | NA | NA | NA |
| RFS | RFS-1 | Sediment | SURFACE | Pacific Eco-Risk | Feb-99 | 217 | 16.4 | 50.1 | 1330 | 5.7 | 236 | 19 | 3930 | NA | NA | NA |
| RFS | RFS-2 | Sediment | 0-2 | Pacific Eco-Risk | Feb-99 | 973 | 11.1 | 136 | 1130 | 142 | 801 | 444 | 2000 | NA | NA | NA |
| RFS | RFS-2 | Sediment | 2.0-4 | Pacific Eco-Risk | Feb-99 | 746 | 8.2 | 59.6 | 620 | 53 | 211 | 78 | 1710 | NA | NA | NA |
| RFS | RFS-2 | Sediment | 4.0-6 | Pacific Eco-Risk | Feb-99 | 57 | 1.24 | 50.8 | 109 | 5.2 | 34.1 | 7 | 271 | NA | NA | NA |
| RFS | RFS-3 | Sediment | SURFACE | Pacific Eco-Risk | Feb-99 | 1020 | 2.4 | 12.7 | 193 | 1.3 | 37.2 | 6 | 517 | NA | NA | NA |
| RFS | RFS-3 | Sediment | 0-2 | Pacific Eco-Risk | Feb-99 | 746 | 2.97 | 11.8 | 745 | 27.5 | 289 | 854 | 945 | NA | NA | NA |
| RFS | RFS-3 | Sediment | 2.0-3 | Pacific Eco-Risk | Feb-99 | 1330 | 44.21 | 48.3 | 1640 | 166 | 1240 | 610 | 5000 | NA | NA | NA |
| RFS | RFS-4 | Sediment | 0-2 | Pacific Eco-Risk | Feb-99 | 688 | 19.4 | 9.5 | 4250 | 7.5 | 238 | 249 | 3750 | NA | NA | NA |
| RFS | RFS-4 | Sediment | 2.0-4 | Pacific Eco-Risk | Feb-99 | 319 | 50 | 23.7 | 8090 | 26.6 | 167 | 8 | 5290 | NA | NA | NA |
| RFS | RFS-4 | Sediment | 4.0-5 | Pacific Eco-Risk | Feb-99 | 14 | 0.14 | 57.4 | 30 | 1.5 | 7.61 | ND | 60 | NA | NA | NA |
| RFS | SED BLANK | Sediment | SURFACE | Pacific Eco-Risk | Feb-99 | 0.07 | 0.05 | 0.06 | ND | ND | 0.83 | ND | ND | NA | NA | NA |
| RFS | 21401 Stege Marsh#1 | Sediment | NA | BPTCP | Mar-99 | 1140 | NA | NA | 373 | 5.5 | 180 | 35.7 | 2500 | 292 |  | 472 |
| RFS | 21402 Stege Marsh#2 | Sediment | NA | BPTCP | Mar-99 | 61.8 | NA | NA | 624 | 1.1 | 72.2 | 7.9 | 434 | 26.1 |  | 304 |
| RFS | 21403 Stege Marsh#3 | Sediment | NA | BPTCP | Mar-99 | 343 | NA | NA | 450 | 2.2 | 102 | 3.8 | 1020 | ND(0.1) |  | 542 |

# Table 4-2

# Richmond Field Station Summary of Surface and Groundwater Sample Results

(micrograms/liter)

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | DATE | As | Cd | Cr | Cu | Hg | Pb | Se | Zn | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RFS | B-2-W | Groundwater | 6 | ECI | 1998 | 220 | 6.3 | 2.4 | ND(<) | ND(<) | ND(<) | NA | 1600 | NA |
| RFS | B-7-W | Groundwater | 6 | ECI | 1998 | 210 | ND(<) | 19 | ND(<) | ND(<) | ND(<) | NA | 120 | NA |
| RFS | MW-1 | Groundwater | 8.0-13 | Jonas & Ass. | Feb-94 | NA | NA | NA | NA | ND(<1) | NA | NA | NA | NA |
| RFS | SW2MA | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(2560) | ND(3.5) | 7.7 | 44.6 | 0.4 | ND(120) | ND(33.0) | 30.6 | NA |
| RFS | SW3MA | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(2560) | ND(3.5) | ND(7.0) | 50.6 | ND(0.20) | ND(120) | ND(33.0) | 94.3 | NA |
| RFS | SW4MA | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(2560) | ND(3.5) | ND(7.0) | 92.3 | 0.4 | ND(120) | ND(33.0) | 854 | NA |
| RFS | SW5MA | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | ND(7.0) | 96.1 | ND(0.20) | ND(120) | ND(33.0) | 877 | NA |
| RFS | SW6MA | Water | SURFACE | Jonas & Ass. | Feb-91 | 1570 | 53.8 | 132 | 2360 | ND(0.20) | ND(120) | ND(33.0) | 7900 | NA |
| RFS | SW1WSD | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | ND(7.0) | 36.7 | ND(0.20) | ND(120) | ND(33.0) | 50.1 | NA |
| RFS | SW1SLE | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | 8.9 | 46.6 | ND(0.20) | ND(120) | ND(3.3) | 116 | NA |
| RFS | SW2SLE | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(2560) | ND(3.5) | ND(7.0) | 37.7 | ND(0.20) | ND(120) | ND(3.3) | 38.5 | NA |
| RFS | SW1SFL | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | 7.4 | 42 | ND(0.20) | ND(120) | ND(33.0) | 23.1 | NA |
| RFS | SW2SFL | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | ND(7.0) | 41 | ND(0.20) | ND(120) | ND(33.0) | 30.8 | NA |
| RFS | SW1BAY | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | 7.7 | 41.2 | 0.45 | ND(120) | ND(33.0) | 73.2 | NA |
| RFS | SW2BAY | Water | SURFACE | Jonas & Ass. | Feb-91 | ND(640) | ND(3.5) | ND(7.0) | 41.9 | 0.2 | ND(120) | ND(33.0) | 11.5 | NA |

# Table 4-3
# Zeneca Summary of Soil and Sediment Sampling Results

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | REF. DATE | As mg/kg | Cd mg/kg | Cr mg/kg | Cu mg/kg | Hg mg/kg | Pb mg/kg | Se mg/kg | Zn mg/kg | alpha-BHC (ug/kg) | P,P'-DDD (ug/kg) | P,P'-DDT (ug/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zeneca | B1-1S | Soil | 1 | Mark Group | Jul-91 | NA | 1.1 | NA | 94 | NA | 15 | ND(<0.4) | 450 | NA | NA | NA |
| Zeneca | B1-2S | Soil | 2 | Mark Group | Jul-91 | NA | 0.2 | NA | 19 | NA | 11 | ND(<0.4) | 130 | NA | NA | NA |
| Zeneca | B1-3S | Soil | 3 | Mark Group | Jul-91 | NA | 0.3 | NA | 19 | NA | 18 | ND(<0.4) | 41 | NA | NA | NA |
| Zeneca | B2-1S | Soil | 1 | Mark Group | Jul-91 | NA | 0.6 | NA | 74 | NA | 120 | ND(<0.4) | 110 | NA | NA | NA |
| Zeneca | B2-2S | Soil | 2 | Mark Group | Jul-91 | NA | 0.2 | NA | 13 | NA | 196 | ND(<0.4) | 37 | NA | NA | NA |
| Zeneca | B3-3S | Soil | 3 | Mark Group | Jul-91 | NA | 1.9 | NA | 15 | NA | 11 | ND(<0.4) | 31 | NA | NA | NA |
| Zeneca | B3-1S | Soil | 1 | Mark Group | Jul-91 | NA | 2 | NA | 110 | NA | 18 | ND(<0.4) | 600 | NA | NA | NA |
| Zeneca | B3-2S | Soil | 2 | Mark Group | Jul-91 | NA | 2.1 | NA | 41 | NA | 20 | ND(<0.4) | 440 | NA | NA | NA |
| Zeneca | B3-3S | Soil | 3 | Mark Group | Jul-91 | NA | 0.3 | NA | 23 | NA | 13 | ND(<0.4) | 95 | NA | NA | NA |
| Zeneca | B4-1S | Soil | 1 | Mark Group | Jul-91 | NA | 1.9 | NA | 710 | NA | 16 | ND(<0.4) | 260 | NA | NA | NA |
| Zeneca | B4-2S | Soil | 2 | Mark Group | Jul-91 | NA | ND(<1) | NA | 40 | NA | 25 | ND(<0.4) | 180 | NA | NA | NA |
| Zeneca | B4-3S | Soil | 3 | Mark Group | Jul-91 | NA | ND(<1) | NA | 20 | NA | 9 | ND(<0.4) | 49 | NA | NA | NA |
| Zeneca | B5-1S | Soil | 1 | Mark Group | Jul-91 | NA | ND(<1) | NA | 240 | NA | 12 | ND(<0.4) | 160 | NA | NA | NA |
| Zeneca | B5-2S | Soil | 2 | Mark Group | Jul-91 | NA | ND(<1) | NA | 380 | NA | 7 | ND(<0.4) | 140 | NA | NA | NA |
| Zeneca | B5-3S | Soil | 3 | Mark Group | Jul-91 | NA | ND(<1) | NA | 320 | NA | 6 | ND(<0.4) | 150 | NA | NA | NA |
| Zeneca | B6-1S | Soil | 1 | Mark Group | Jul-91 | NA | ND(<1) | NA | 280 | NA | 9 | ND(<0.4) | 180 | NA | NA | NA |
| Zeneca | B6-2S | Soil | 2 | Mark Group | Jul-91 | NA | ND(<1) | NA | 160 | NA | ND(<4) | ND(<0.4) | 260 | NA | NA | NA |
| Zeneca | B6-3S | Soil | 3 | Mark Group | Jul-91 | NA | ND(<1) | NA | 450 | NA | ND(<4) | ND(<0.4) | 180 | NA | NA | NA |
| Zeneca | B7-1S | Soil | 1 | Mark Group | Jul-91 | NA | ND(<1) | NA | 73 | NA | 24 | ND(<0.4) | 170 | NA | NA | NA |
| Zeneca | B7-2S | Soil | 2 | Mark Group | Jul-91 | NA | ND(<1) | NA | 4160 | NA | 6 | ND(<0.4) | 1300 | NA | NA | NA |
| Zeneca | B7-3S | Soil | 3 | Mark Group | Jul-91 | NA | 1 | NA | 220 | NA | 6 | ND(<0.4) | 480 | NA | NA | NA |
| Zeneca | B8-1S | Soil | 1 | Mark Group | Jul-91 | NA | 1 | NA | 30 | NA | 7 | ND(<0.4) | 1200 | NA | NA | NA |
| Zeneca | B8-2S | Soil | 2 | Mark Group | Jul-91 | NA | 4 | NA | 84 | NA | 7 | ND(<0.4) | 1100 | NA | NA | NA |
| Zeneca | B8-3S | Soil | 3 | Mark Group | Jul-91 | NA | ND(<1) | NA | 260 | NA | 5 | ND(<0.4) | 400 | NA | NA | NA |
| Zeneca | S-1 | Soil | NA | URS | Jul-94 | 294 | 5.3 | 17.0J | 389 | 7.8 | 338 | 50.5J | 1050J | 91 | 58J | 490 |
| Zeneca | S-2 | Soil | NA | URS | Jul-94 | 145 | 15.5 | 49.6J | 1310 | 30.2 | 678 | 65.3 | 2240J | 150 | 170J | 1800 |
| Zeneca | S-3 | Soil | NA | URS | Jul-94 | 9.0J | ND(<1.1) | 62.1J | 37.9J | 0.13 | 35.5 | ND(<8.6) | 89.5J | ND | 10 | 19 |
| Zeneca | S-4 | Soil | NA | URS | Jul-94 | 5.5J | ND(<1.1) | 68.6J | 27.7J | 0.11 | 10.8J | ND(<8.8) | 66.9J | ND | ND | 1J |
| Zeneca | S-5 | Soil | NA | URS | Jul-94 | 2.2J | ND(<1.2) | 94.7J | 26.2J | ND(<0.12) | 240 | ND(<9.2) | 78.7J | ND | ND | ND |
| Zeneca | S-6 | Soil | NA | URS | Jul-94 | 216 | 4.1 | 15.2J | 319J | 9.9 | 255 | 21.2 | 827J | 77 | 60J | 430 |
| Zeneca | SM1 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 33 | NA | NA | 166 | 1.5 | 93.4 | ND(<1) | 549 | ND(<0.39) | 63 | 18 |
| Zeneca | SM2 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 77 | NA | NA | 187 | 1.2 | 71.3 | ND(<1) | 582 | NA | NA | NA |
| Zeneca | SM3 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 60 | NA | NA | 254 | 1.9 | 102 | 2 | 721 | ND(<3.2) | 1800 | 325 |
| Zeneca | SM4 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 91 | NA | NA | 292 | 2.4 | 106 | 4 | 1030 | NA | NA | NA |
| Zeneca | SM5 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 124 | NA | NA | 309 | 2 | 111 | 3 | 1170 | ND(2.0) | 150 | 30 |
| Zeneca | SM6 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 260 | NA | NA | 483 | 10.9 | 232 | 25 | 1240 | 32 | 350 | 37 |
| Zeneca | SM7 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 62.1 | NA | NA | 131 | 0.6 | 45.4 | 3 | 681 | 17 | 350 | 150 |
| Zeneca | SM8 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 47 | NA | NA | 75 | 0.3 | 15.7 | 4 | 864 | 14 | 130 | 38 |
| Zeneca | SM9 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 38 | NA | NA | 109 | 1 | 64.7 | ND(<1) | 432 | 4.4 | 265 | 67.5 |
| Zeneca | SM10 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 170 | NA | NA | 536 | 2.4 | 152 | 6 | 1260 | 0.54 | 110 | NDR(85) |

# Table 4-3
## Zeneca Summary of Soil and Sediment Sampling Results

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | REF. DATE | As mg/kg | Cd mg/kg | Cr mg/kg | Cu mg/kg | Hg mg/kg | Pb mg/kg | Se mg/kg | Zn mg/kg | alpha-BHC (ug/kg) | P,P'-DDD (ug/kg) | P,P'-DDT (ug/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zeneca | SX1 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 45 | NA | NA | 723 | 0.8 | 35.5 | 8 | 2510 | 8 | 9.7 | 2.1 |
| Zeneca | SX2 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 24 | NA | NA | 20 | ND(<0.2) | 3.4 | ND(<1) | 201 | NA | NA | NA |
| Zeneca | SX3 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 214 | NA | NA | 24 | ND(<0.2) | 6.1 | ND(<1) | 1330 | NA | NA | NA |
| Zeneca | SX4 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 56 | NA | NA | 50 | ND(<0.2) | 9.4 | 3 | 1340 | 7.7 | 15 | 5.4 |
| Zeneca | SX5 | Sediment | NA | Pacific Eco-Risk | Apr-99 | 31 | NA | NA | 84 | ND(<0.2) | 8.3 | 4 | 2070 | NA | NA | NA |
| Zeneca | VC-1 | Sediment | 0-2 | Pacific Eco-Risk | Apr-99 | 771 | 3.45 | 119 | 644 | 5 | 528 | 25 | 1370 | 1.4 | 110 | 8.8 |
| Zeneca | VC-1 | Sediment | 2.0-4 | Pacific Eco-Risk | Apr-99 | 19.5 | 0.49 | 32.7 | 49.8 | 3 | 30 | 3 | 159 | ND(<0.11) | 0.4 | 0.23 |
| Zeneca | VC-1 | Sediment | 2.0-4 DUP | Pacific Eco-Risk | Apr-99 | 17.7 | 0.5 | 33.3 | 44.4 | 3 | 27.3 | 3 | 136 | ND(<0.13) | 0.45 | 0.21 |
| Zeneca | VC-2 | Sediment | 0-2 | Pacific Eco-Risk | Apr-99 | 384 | 1.78 | 68.2 | 486 | 5.7 | 185 | 16 | 916 | ND(<.45) | 72 | 53 |
| Zeneca | VC-2 | Sediment | 2.0-4 | Pacific Eco-Risk | Apr-99 | 11.5 | 0.3 | 36.4 | 63.5 | 1.9 | 35.5 | 4 | 174 | ND(<0.44) | 0.55 | 0.41 |
| Zeneca | VC-3 | Sediment | 0-2 | Pacific Eco-Risk | Apr-99 | 323 | 1.7 | 52.1 | 393 | 12.3 | 146 | 14 | 1010 | 1 | 64 | 6.6 |
| Zeneca | VC-3 | Sediment | 2.0-4 | Pacific Eco-Risk | Apr-99 | 97.9 | 0.99 | 37.8 | 168 | 7.2 | 96.9 | 8 | 517 | 0.46 | 52 | 3.7 |
| Zeneca | VC-4 | Sediment | 0-2 | Pacific Eco-Risk | Apr-99 | 512 | 16.4 | 60.6 | 848 | 46 | 297 | 130 | 4140 | 57 | 1300 | 450 |
| Zeneca | VC-4 | Sediment | 2.0-4 | Pacific Eco-Risk | Apr-99 | 443 | 26.8 | 50.9 | 3890 | 55.4 | 818 | 352 | 6210 | 42 | 750 | 300 |
| Zeneca | VC-4 | Sediment | 2..0-4 DUP | Pacific Eco-Risk | Apr-99 | 473 | 27.5 | 52.7 | 3920 | 52 | 792 | 497 | 6270 | 47 | 860 | 150 |
| Zeneca | VC-5 | Sediment | 0-1.5 | Pacific Eco-Risk | Apr-99 | 426 | 8.1 | 121 | 975 | 12.2 | 317 | 30 | 2560 | ND(<0.59) | 49 | 3.8 |
| Zeneca | VC-5 | Sediment | 1.5-3.5 | Pacific Eco-Risk | Apr-99 | 505 | 9.97 | 123 | 889 | 18.9 | 362 | 43 | 2380 | 53 | 910 | 170 |
| Zeneca | VC-5 | Sediment | 3.5-5.5 | Pacific Eco-Risk | Apr-99 | 44.6 | 0.62 | 39.2 | 115 | 4.5 | 53 | 2 | 257 | 1.7 | 32 | 2.4 |
| Zeneca | VC-6 | Sediment | 0-2 | Pacific Eco-Risk | Apr-99 | 501 | 8.22 | 146 | 1200 | 3.8 | 256 | 12 | 3260 | 2.9 | 27 | 5.3 |
| Zeneca | VC-6 | Sediment | 2.0-3.5 | Pacific Eco-Risk | Apr-99 | 101 | 1.52 | 45.3 | 211 | 3.2 | 69.8 | 10 | 427 | 1 | 79 | 3.3 |
| Zeneca | VC-7 | Sediment | 0-2 | Pacific Eco-Risk | Apr-99 | 236 | 3.67 | 107 | 477 | 9.1 | 266 | 30 | 1260 | 5.9 | 140 | 29 |
| Zeneca | VC-7 | Sediment | 2.0-4 | Pacific Eco-Risk | Apr-99 | 188 | 3.31 | 91.4 | 520 | 11.6 | 188 | 19 | 1060 | 2.1 | 27 | 85 |
| Zeneca | VC-7 | Sediment | 4.0-6 | Pacific Eco-Risk | Apr-99 | 193 | 3.33 | 92.9 | 500 | 11.5 | 182 | 20 | 1160 | 1 | 27 | 15 |
| Zeneca | VC-8 | Sediment | 0-2 | Pacific Eco-Risk | Apr-99 | 167 | 2.58 | 99.9 | 225 | 4.2 | 176 | 20 | 756 | 2.3 | 24 | 2.6 |
| Zeneca | VC-8 | Sediment | 2.0-4 | Pacific Eco-Risk | Apr-99 | 167 | 3.51 | 96.6 | 472 | 11.7 | 171 | 14 | 1410 | ND(<0.28) | 0.87 | ND(<0.66) |
| Zeneca | VC-8 | Sediment | 4.0-6 | Pacific Eco-Risk | Apr-99 | 220 | 3.35 | 82.5 | 388 | 7.6 | 147 | 20 | 1280 | 1.2 | 18 | 3.3 |
| Zeneca | VC-9 | Sediment | 0-2 | Pacific Eco-Risk | Apr-99 | 310 | 5.55 | 116 | 569 | 6.4 | 346 | 27 | 1710 | ND(<4.1) | NDR(50) | 2.9 |
| Zeneca | VC-9 | Sediment | 2.0-4 | Pacific Eco-Risk | Apr-99 | 314 | 3.47 | 85.6 | 527 | 11.5 | 161 | 23 | 1470 | 5.4 | ND(<91) | 110 |
| Zeneca | VC-9 | Sediment | 4.0-6 | Pacific Eco-Risk | Apr-99 | 104 | 1.94 | 91 | 311 | 9.3 | 150 | 11 | 734 | ND(<0.26) | 0.73 | 5.1 |
| Zeneca | VC-10 | Sediment | 0-2 | Pacific Eco-Risk | Apr-99 | 473 | 29 | 34.9 | 5390 | 72.9 | 740 | 95 | 5320 | 20 | 340 | 12 |
| Zeneca | VC-10 | Sediment | 2.0-4 | Pacific Eco-Risk | Apr-99 | 366 | 7.01 | 45 | 908 | 34.7 | 363 | 92 | 1590 | 140 | 1100 | 100 |
| Zeneca | VC-10 | Sediment | 4.0-6 | Pacific Eco-Risk | Apr-99 | 12.9 | 0.43 | 25.9 | 38 | 1.1 | ND | ND | 92 | 0.39 | 2.9 | 0.38 |
| Zeneca | E-1 | Sediment | GRAB | URS | Oct-92 | 496 | NA | NA | 315 | 10.9 | 310 | 60.7 | 957 | 57 | NA | 212 |
| Zeneca | E-2 | Sediment | GRAB | URS | Oct-92 | 749 | NA | NA | 239 | 5.8 | 563 | 124 | 863 | 300 | NA | 521 |
| Zeneca | E-3 | Sediment | GRAB | URS | Oct-92 | 96.3 | NA | NA | 169 | 5.3 | 145 | ND | 2154 | ND | NA | 31 |
| Zeneca | E-4 | Sediment | GRAB | URS | Oct-92 | 20.3 | NA | NA | 88.7 | 0.89 | 74.8 | ND | 231 | ND | NA | 28 |
| Zeneca | E-5 | Sediment | GRAB | URS | Oct-92 | 104 | NA | NA | 649 | 1.9 | 69.2 | ND | 431 | ND | NA | 294 |
| Zeneca | E-6 | Sediment | GRAB | URS | Oct-92 | 20.6 | NA | NA | ND | ND | 10 | ND | 31.6 | 200 | NA | 58 |
| Zeneca | E-7 | Sediment | GRAB | URS | Oct-92 | 146 | NA | NA | 34.4 | 0.88 | 547 | ND | 150 | 5 | NA | 321 |
| Zeneca | E-8 | Sediment | GRAB | URS | Oct-92 | 294 | NA | NA | 600 | 4.5 | 192 | 7.3 | 1250 | ND | NA | 374 |

# Table 4-3
# Zeneca Summary of Soil and Sediment Sampling Results

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | REF. DATE | As mg/kg | Cd mg/kg | Cr mg/kg | Cu mg/kg | Hg mg/kg | Pb mg/kg | Se mg/kg | Zn mg/kg | alpha-BHC (ug/kg) | P,P'-DDD (ug/kg) | P,P'-DDT (ug/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zeneca | E-9 | Sediment | GRAB | URS | Oct-92 | 27.3 | NA | NA | 149 | 1.2 | 116 | ND | 354 | ND | NA | 147 |
| Zeneca | E-10 | Sediment | GRAB | URS | Oct-92 | 1660 | NA | NA | 189 | 1.6 | 78.4 | 5.7 | 348 | 3 | NA | 311 |
| Zeneca | E-11 | Sediment | GRAB | URS | Oct-92 | 177 | NA | NA | 170 | 0.8 | 55.6 | ND | 457 | ND | NA | 98 |
| Zeneca | E-12 | Sediment | GRAB | URS | Oct-92 | 32.1 | NA | NA | 111 | 0.83 | 75.1 | ND | 286 | ND | NA | 72 |
| Zeneca | E-13 | Sediment | GRAB | URS | Oct-92 | 12.6 | NA | NA | 942 | 1.7 | 64.7 | 7.2 | 490 | 38 | NA | 181 |
| Zeneca | E-15 | Sediment | GRAB | URS | Oct-92 | 12.3 | NA | NA | 116 | 3 | 75.1 | ND | 296 | ND | NA | 140 |
| Zeneca | E-16 | Sediment | GRAB | URS | Oct-92 | 60.1 | NA | NA | 816 | 1.6 | 84.1 | 4.5 | 440 | ND | NA | 273 |
| Zeneca | E-17 | Sediment | GRAB | URS | Oct-92 | 65 | NA | NA | 87.2 | 0.88 | 157 | ND | 270 | ND | NA | 13 |
| Zeneca | E-20 | Sediment | GRAB | URS | Oct-92 | 810 | NA | NA | 1930 | 2.8 | 210 | 9.3 | 5490 | ND | NA | 269 |
| Zeneca | E-21 | Sediment | GRAB | URS | Oct-92 | 651 | NA | NA | 104 | 2.3 | 202 | 16.3 | 4820 | ND | NA | 332 |

# Table 4-4
## Groundwater Sampling Results from Previous Studies (micrograms/Liter)

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | DATE | As | Cd | Cr | Cu | Hg | Pb | Se | Zn | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ZENECA | H36 | Groundwater | 12.0-17 | Shepherd Miller | Sep-97 | ND(<50) | ND(<5) | NA | ND(<10) | NA | ND(<50) | NA | ND(<10) | 6.7 |
| ZENECA | H37 | Groundwater | 13-18 | Shepherd Miller | Sep-97 | 160 | ND(<5) | NA | ND(<10) | NA | ND(<50) | NA | ND(<10) | 8 |
| ZENECA | H38 | Groundwater | 12.3-17.3 | Shepherd Miller | Sep-97 | 1500 | 130 | NA | 3200 | NA | ND(<50) | NA | 22000 | 3.7 |
| ZENECA | H40 | Groundwater | 12.0-17 | Shepherd Miller | Sep-97 | 150 | ND(<5) | NA | ND(<10) | NA | ND(<50) | NA | 50 | 6.3 |
| ZENECA | H43 | Groundwater | 10.0-14.5 | Shepherd Miller | Sep-97 | 350 | 12 | NA | 760 | NA | 140 | NA | 2900 | 6.1 |
| ZENECA | H46 | Groundwater | 9.5-14.5 | Shepherd Miller | Sep-97 | 80 | ND(<5) | NA | 1400 | NA | 100 | NA | 10000 | 3.9 |
| ZENECA | H49 | Groundwater | 11.5-14.5 | Shepherd Miller | Sep-97 | 150 | ND(<5) | NA | 10 | NA | ND(<50) | NA | 370 | 6 |
| ZENECA | H50 | Groundwater | 10.5-13.5 | Shepherd Miller | Sep-97 | 160 | ND(<5) | NA | 90 | NA | ND(<50) | NA | 200 | 6.4 |
| ZENECA | H36 | Groundwater | 12.0-17 | Shepherd Miller | Mar-98 | ND(<85) | ND(<5) | NA | ND(<10) | NA | ND(<50) | NA | ND(<100) | 6.8 |
| ZENECA | H37 | Groundwater | 13-18 | Shepherd Miller | Mar-98 | 160 | ND(<5) | NA | ND(<10) | NA | ND(<50) | NA | ND(<100) | 11.3 |
| ZENECA | H38 | Groundwater | 12.3-17.3 | Shepherd Miller | Mar-98 | 1200 | 840 | NA | 7700 | NA | 60 | NA | 150000 | 2.9 |
| ZENECA | H40 | Groundwater | 12.0-17 | Shepherd Miller | Mar-98 | 270 | ND(<5) | NA | 30 | NA | ND(<50) | NA | 170 | 6.3 |
| ZENECA | H43 | Groundwater | 10.0-14.5 | Shepherd Miller | Mar-98 | ND(<85) | ND(<5) | NA | 70 | NA | ND(<50) | NA | 500 | 6.3 |
| ZENECA | H46 | Groundwater | 9.5-14.5 | Shepherd Miller | Mar-98 | 100 | 130 | NA | 970 | NA | 190 | NA | 32000 | 3.7 |
| ZENECA | H49 | Groundwater | 11.5-14.5 | Shepherd Miller | Mar-98 | ND(<85) | ND(<5) | NA | ND(<10) | NA | ND(<50) | NA | 160 | 5.9 |
| ZENECA | H50 | Groundwater | 10.5-13.5 | Shepherd Miller | Mar-98 | ND(<85) | 6 | NA | 30 | NA | ND(<50) | NA | 1500 | 6.1 |
| ZENECA | H36 | Groundwater | 12.0-17 | Shepherd Miller | Jun-98 | ND(<50) | ND(<5) | NA | ND(<10) | NA | ND(<50) | NA | 20 | 6.7 |
| ZENECA | H37 | Groundwater | 13-18 | Shepherd Miller | Jun-98 | 320 | ND(<5) | NA | 40 | NA | ND(<50) | NA | 70 | 11.5 |
| ZENECA | H38 | Groundwater | 12.3-17.3 | Shepherd Miller | Jun-98 | 920 | 720 | NA | 13000 | NA | ND(<50) | NA | 100000 | 3.2 |
| ZENECA | H40 | Groundwater | 12.0-17 | Shepherd Miller | Jun-98 | 240 | ND(<5) | NA | ND(<10) | NA | ND(<50) | NA | 90 | 6.1 |
| ZENECA | H43 | Groundwater | 10.0-14.5 | Shepherd Miller | Jun-98 | ND(<50) | ND(<5) | NA | 30 | NA | ND(<50) | NA | 510 | 5.6 |
| ZENECA | H46 | Groundwater | 9.5-14.5 | Shepherd Miller | Jun-98 | 300 | 210 | NA | 5100 | NA | ND(<50) | NA | 34000 | 3.4 |
| ZENECA | H49 | Groundwater | 11.5-14.5 | Shepherd Miller | Jun-98 | ND(<50) | ND(<5) | NA | ND(<10) | NA | ND(<50) | NA | 290 | 5.9 |
| ZENECA | H50 | Groundwater | 10.5-13.5 | Shepherd Miller | Jun-98 | 90 | ND(<5) | NA | ND(<10) | NA | ND(<50) | NA | 90 | 6.5 |
| ZENECA | HA-6 | Groundwater | Water Table | Woodward Clyde | Jun-93 | ND(<6) | ND(<11) | NA | 43 | NA | 4 | NA | 49 | 7.3 |
| ZENECA | H-24 | Groundwater | Water Table | Woodward Clyde | Jun-93 | ND(<1) | ND(<11) | NA | ND(<33) | NA | ND(<11) | NA | 32 | 6.8 |
| ZENECA | H-32 | Groundwater | Water Table | Woodward Clyde | Jun-93 | 6 | ND(<11) | NA | 68 | NA | 7 | NA | 62 | 7 |
| ZENECA | H-36 | Groundwater | Water Table | Woodward Clyde | Jun-93 | ND(<6) | ND(<11) | NA | ND(<33) | NA | ND(<1) | NA | ND(<22) | 7.1 |
| ZENECA | H-37 | Groundwater | Water Table | Woodward Clyde | Jun-93 | 506 | ND(<11) | NA | ND(<33) | NA | ND(<1) | NA | ND(<22) | 10.9 |
| ZENECA | H-38 | Groundwater | Water Table | Woodward Clyde | Jun-93 | 3910 | 127 | NA | 11600 | NA | 138 | NA | 84600 | 3.7 |
| ZENECA | H-39 | Groundwater | Upper Horizon | Woodward Clyde | Jun-93 | ND(<6) | 12 | NA | ND(<33) | NA | ND(<1) | NA | 43 | 6.2 |
| ZENECA | H-40 | Groundwater | Water Table | Woodward Clyde | Jun-93 | 85 | ND(<11) | NA | 39 | NA | ND(<1) | NA | 93 | 5.8 |
| ZENECA | H-41 | Groundwater | Upper Horizon | Woodward Clyde | Jun-93 | ND(<2) | ND(<11) | NA | ND(<33) | NA | ND(<1) | NA | ND(<22) | 7.1 |
| ZENECA | H-42 | Groundwater | Lower Horizon | Woodward Clyde | Jun-93 | 6 | ND(<11) | NA | ND(<33) | NA | ND(<1) | NA | ND(<22) | 7 |
| ZENECA | H-46 | Groundwater | Water Table | Woodward Clyde | Jun-93 | 53 | 17 | NA | 812 | NA | 13 | NA | 14700 | 3.6 |
| ZENECA | H-47 | Groundwater | Upper Horizon | Woodward Clyde | Jun-93 | 31 | ND(<11) | NA | 139 | NA | 4 | NA | 12300 | 4.5 |
| ZENECA | H-48 | Groundwater | Lower Horizon | Woodward Clyde | Jun-93 | ND(<6) | ND(<11) | NA | ND(<33) | NA | ND(<1) | NA | 52 | 6.8 |
| ZENECA | H-49 | Groundwater | Water Table | Woodward Clyde | Jun-93 | 29 | ND(<11) | NA | 39 | NA | 6 | NA | 142 | 6.2 |
| ZENECA | H-50 | Groundwater | Water Table | Woodward Clyde | Jun-93 | 43 | ND(<11) | NA | 97 | NA | 18 | NA | 226 | 6.2 |
| ZENECA | H-57 | Groundwater | Water Table | Woodward Clyde | Jun-93 | ND(<11) | 37 | NA | 5600 | NA | 1 | NA | 5920 | 5.6 |
| ZENECA | H-58 | Groundwater | Lower Horizon | Woodward Clyde | Jun-93 | ND(<1) | ND(<11) | NA | ND(<33) | NA | ND(<11) | NA | ND(<22) | 7.8 |
| ZENECA | H-59 | Groundwater | Lower Horizon | Woodward Clyde | Jun-93 | ND(<6) | ND(<11) | NA | ND(<33) | NA | 1 | NA | 23 | 7.3 |
| ZENECA | H-60 | Groundwater | Lower Horizon | Woodward Clyde | Jun-93 | ND(<6) | ND(<11) | NA | ND(<33) | NA | ND(<1) | NA | 401 | 6.7 |

## Table 4-5
## Liquid Gold Summary of Soil and Sediment Sample Results

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | REF. DATE | As mg/kg | Cd mg/kg | Cr mg/kg | Cu mg/kg | Hg mg/kg | Ni mg/kg | Pb mg/kg | Se mg/kg | Zn mg/kg | Oil/Grease | alpha-BHC (ug/kg) | P,P'-DDD (ug/kg) | P,P'-DDT (ug/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Liquid Gold | Transect 6 | Sediment | SURFACE | Kennedy/Jenks | Feb-95 | NA | NA | NA | 310 | 4.2 | NA | 240 | NA | 940 | NA | NA | NA | NA |
| Liquid Gold | Transect 6 | Sediment | SURFACE | Kennedy/Jenks | Feb-95 | NA | NA | NA | NA | 3.5 | NA | NA | NA | 710 | NA | NA | NA | NA |
| Liquid Gold | Transect 6 | Sediment | SURFACE | Kennedy/Jenks | Feb-95 | NA | NA | NA | NA | 3.1 | NA | NA | NA | 660 | NA | NA | NA | NA |
| Liquid Gold | Transect 6 | Sediment | SURFACE | Kennedy/Jenks | Feb-95 | NA | NA | NA | 360 | 3 | NA | 630 | NA | NA | NA | NA | NA | NA |
| Liquid Gold | Transect 6 | Sediment | SURFACE | Kennedy/Jenks | Feb-95 | NA | NA | NA | NA | 1.5 | NA | 380 | NA | 700 | NA | NA | NA | NA |
| Liquid Gold | Transect 6 | Sediment | SURFACE | Kennedy/Jenks | Feb-95 | NA | NA | NA | NA | 1.3 | NA | NA | NA | 410 | NA | NA | NA | NA |
| Liquid Gold | Transect 6 | Sediment | SURFACE | Kennedy/Jenks | Feb-95 | NA | NA | NA | NA | 0.61 | NA | NA | NA | NA | NA | NA | NA | NA |
| Liquid Gold | 102-A | Soil | 1-1.5 | Kennedy/Jenks/Chilton | Dec-90 | 6.8 | 0.26 | 51 | 130 | 0.74 | NA | 450 | 0.1 | 200 | NA | NA | NA | NA |
| Liquid Gold | 102-B | Soil | 4-4.5 | Kennedy/Jenks/Chilton | Dec-90 | 6 | 0.81 | 16 | 82 | 0.15 | NA | 260 | ND(<0.1) | 140 | NA | NA | NA | NA |
| Liquid Gold | 102-C | Soil | 8.5-9 | Kennedy/Jenks/Chilton | Dec-90 | 7.3 | ND(<0.05) | 21 | 250 | ND(<0.05) | NA | ND(<5) | ND(<0.1) | 100 | NA | NA | NA | NA |
| Liquid Gold | 102-D | Soil | 14-14.5 | Kennedy/Jenks/Chilton | Dec-90 | 7.6 | ND(<0.05) | 19 | 68 | ND(<0.05) | NA | ND(<5) | ND(<0.1) | 62 | NA | NA | NA | NA |
| Liquid Gold | 102-E | Soil | 19-19.5 | Kennedy/Jenks/Chilton | Dec-90 | 7.2 | ND(<0.05) | 33 | 120 | 0.07 | NA | ND(<5) | ND(<0.1) | 50 | NA | NA | NA | NA |
| Liquid Gold | 102-F | Soil | 23.5-24 | Kennedy/Jenks/Chilton | Dec-90 | 12 | ND(<0.05) | 22 | 22 | 0.07 | NA | ND(<5) | ND(<0.1) | 33 | NA | NA | NA | NA |
| Liquid Gold | 102-G | Soil | 28.35-29 | Kennedy/Jenks/Chilton | Dec-90 | 9.5 | ND(<0.05) | 30 | 25 | 0.14 | NA | ND(<5) | ND(<0.1) | 50 | NA | NA | NA | NA |
| Liquid Gold | 116-A | Soil | 2-2.5 | Kennedy/Jenks/Chilton | Dec-90 | 15 | ND(<0.05) | 16 | 26 | 0.11 | NA | 100 | ND(<0.1) | 64 | NA | NA | NA | NA |
| Liquid Gold | 116-B | Soil | 5.5-6 | Kennedy/Jenks/Chilton | Dec-90 | 14 | 0.8 | 28 | 400 | 4.6 | NA | 1600 | ND(<0.1) | 1300 | NA | NA | NA | NA |
| Liquid Gold | 116-C | Soil | 10.5-11 | Kennedy/Jenks/Chilton | Dec-90 | 6.6 | ND(<0.05) | 21 | 400 | 0.13 | NA | 40 | ND(<0.1) | 250 | NA | NA | NA | NA |
| Liquid Gold | 116-D | Soil | 16-16.5 | Kennedy/Jenks/Chilton | Dec-90 | 7.3 | ND(<0.05) | 23 | 90 | ND(<0.05) | NA | ND(<5) | ND(<0.1) | 50 | NA | NA | NA | NA |
| Liquid Gold | 116-E | Soil | 20.5-21 | Kennedy/Jenks/Chilton | Dec-90 | 6.4 | ND(<0.05) | 42 | 14 | 0.1 | NA | ND(<5) | ND(<0.1) | 17 | NA | NA | NA | NA |
| Liquid Gold | 116-F | Soil | 25-25.5 | Kennedy/Jenks/Chilton | Dec-90 | 8.4 | ND(<0.05) | 23 | 66 | 0.07 | NA | 5 | ND(<0.1) | 45 | NA | NA | NA | NA |
| Liquid Gold | 116-G | Soil | 30-30.5 | Kennedy/Jenks/Chilton | Dec-90 | 8.7 | ND(<0.05) | 25 | 50 | 0.07 | NA | ND(<5) | ND(<0.1) | 49 | NA | NA | NA | NA |
| Liquid Gold | 117-A | Soil | 2.5-3 | Kennedy/Jenks/Chilton | Dec-90 | 11 | ND(<0.05) | 21 | 34 | 0.06 | NA | 45 | ND(<0.1) | 57 | NA | NA | NA | NA |
| Liquid Gold | 117-B | Soil | 5.5-6 | Kennedy/Jenks/Chilton | Dec-90 | 5.8 | ND(<0.05) | 16 | 190 | 0.07 | NA | 87 | ND(<0.1) | 220 | NA | NA | NA | NA |
| Liquid Gold | 117-C | Soil | 10-10.5 | Kennedy/Jenks/Chilton | Dec-90 | 8.4 | ND(<0.05) | 24 | 140 | ND(<0.05) | NA | ND(<5) | ND(<0.1) | 91 | NA | NA | NA | NA |
| Liquid Gold | 117-D | Soil | 15.5-16 | Kennedy/Jenks/Chilton | Dec-90 | 10 | ND(<0.05) | 26 | 150 | ND(<0.05) | NA | ND(<5) | 0.39 | 62 | NA | NA | NA | NA |
| Liquid Gold | 117-E | Soil | 20.35-21 | Kennedy/Jenks/Chilton | Dec-90 | 13 | ND(<0.05) | 29 | 120 | ND(<0.05) | NA | 5 | 0.49 | 80 | NA | NA | NA | NA |
| Liquid Gold | 117-F | Soil | 25.5-26 | Kennedy/Jenks/Chilton | Dec-90 | 7.8 | ND(<0.05) | 48 | 31 | 0.09 | NA | 5 | ND(<0.1) | 28 | NA | NA | NA | NA |
| Liquid Gold | 117-G | Soil | 31-31.5 | Kennedy/Jenks/Chilton | Dec-90 | 9.8 | ND(<0.05) | 26 | 66 | 0.06 | NA | ND(<5) | ND(<0.1) | 51 | NA | NA | NA | NA |
| Liquid Gold | 120-A | Soil | 2-2.5 | Kennedy/Jenks/Chilton | Dec-90 | 13 | ND(<0.05) | 25 | 32 | ND(<0.05) | NA | 11 | ND(<0.1) | 47 | NA | NA | NA | NA |
| Liquid Gold | 120-B | Soil | 6-6.5 | Kennedy/Jenks/Chilton | Dec-90 | 16 | ND(<0.05) | 36 | 100 | 2 | NA | 62 | ND(<0.1) | 170 | NA | NA | NA | NA |
| Liquid Gold | 120-C | Soil | 10.5-11 | Kennedy/Jenks/Chilton | Dec-90 | 11 | ND(<0.05) | 25 | 28 | 0.07 | NA | ND(<5) | 0.29 | 41 | NA | NA | NA | NA |
| Liquid Gold | 120-D | Soil | 16-16.5 | Kennedy/Jenks/Chilton | Dec-90 | 8.1 | ND(<0.05) | 22 | 120 | ND(<0.05) | NA | ND(<5) | 0.28 | 61 | NA | NA | NA | NA |
| Liquid Gold | 120-E | Soil | 2035-21 | Kennedy/Jenks/Chilton | Dec-90 | 7.3 | ND(<0.05) | 50 | 27 | 0.08 | NA | ND(<5) | ND(<0.1) | 29 | NA | NA | NA | NA |
| Liquid Gold | 120-F | Soil | 26-26.5 | Kennedy/Jenks/Chilton | Dec-90 | 5.4 | ND(<0.05) | 38 | 40 | ND(<0.05) | NA | ND(<5) | ND(<0.1) | 34 | NA | NA | NA | NA |
| Liquid Gold | 120-G | Soil | 30.5-31 | Kennedy/Jenks/Chilton | Dec-90 | 6.1 | ND(<0.05) | 32 | 17 | 0.076 | NA | ND(<5) | ND(<0.1) | 20 | NA | NA | NA | NA |
| Liquid Gold | 121-A | Soil | 2.5-3 | Kennedy/Jenks/Chilton | Dec-90 | 15 | ND(<0.05) | 20 | 22 | ND(<0.05) | NA | 7.8 | ND(<0.1) | 53 | NA | NA | NA | NA |
| Liquid Gold | 121-B | Soil | 6-6.5 | Kennedy/Jenks/Chilton | Dec-90 | 7.9 | ND(<0.05) | 21 | 220 | ND(<0.05) | NA | ND(<5) | ND(<0.1) | 67 | NA | NA | NA | NA |
| Liquid Gold | 121-C | Soil | 11-11.5 | Kennedy/Jenks/Chilton | Dec-90 | 8.4 | ND(<0.05) | 20 | 41 | ND(<0.05) | NA | ND(<5) | ND(<0.1) | 33 | NA | NA | NA | NA |
| Liquid Gold | 121-D | Soil | 15.5-16 | Kennedy/Jenks/Chilton | Dec-90 | 10 | ND(<0.05) | 22 | 81 | ND(<0.05) | NA | ND(<5) | 0.2 | 47 | NA | NA | NA | NA |
| Liquid Gold | 121-E | Soil | 20.5-21 | Kennedy/Jenks/Chilton | Dec-90 | 5 | ND(<0.05) | 35 | 27 | ND(<0.05) | NA | ND(<5) | ND(<0.1) | 21 | NA | NA | NA | NA |

| | | | | | | | | Avg | Max | Avg | Max | Avg | Max | Avg | Max | Avg | Max | | Avg | Max | Avg | Max | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Liquid Gold | Area 1 | Soil | NA | Kennedy/Jenks/Chilton | Dec-90 | NA | NA | 35 | 80 | 75 | 180 | 0.1 | 0.3 | 47 | 82 | 17 | 46 | NA | 64 | 130 | 487 | 1700 | NA | NA | NA |
| Liquid Gold | Area 2 | Soil | NA | Kennedy/Jenks/Chilton | Dec-90 | NA | NA | 37 | 62 | 272 | 380 | 0.3 | 1.2 | 50 | 71 | 29 | 92 | NA | 196 | 350 | 545 | 2100 | NA | NA | NA |
| Liquid Gold | Area 3 | Soil | NA | Kennedy/Jenks/Chilton | Dec-90 | NA | NA | 42 | 62 | 29 | 40 | 0.1 | 0.1 | 53 | 88 | 19 | 30 | NA | 46 | 63 | 753 | 2100 | NA | NA | NA |
| Liquid Gold | Area 4 | Soil | NA | Kennedy/Jenks/Chilton | Dec-90 | NA | NA | 28 | 51 | 314 | 2600 | 0.2 | 1.3 | 32 | 58 | 29 | 110 | NA | 112 | 340 | 542 | 5400 | NA | NA | NA |
| Liquid Gold | Area 5 | Soil | NA | Kennedy/Jenks/Chilton | Dec-90 | NA | NA | 27 | 65 | 230 | 910 | 0.2 | 1.6 | 30 | 53 | 52 | 350 | NA | 187 | 570 | 2176 | 11000 | NA | NA | NA |
| Liquid Gold | Area 6 | Soil | NA | Kennedy/Jenks/Chilton | Dec-90 | NA | NA | 38 | 150 | 216 | 1100 | 0.2 | 1.4 | 46 | 210 | 642 | 5200 | NA | 367 | 2200 | 223 | 1100 | NA | NA | NA |
| Liquid Gold | Asphalt | Soil | NA | Kennedy/Jenks/Chilton | Dec-90 | NA | NA | 34 | 140 | 156 | 570 | 0.1 | 0.2 | 40 | 190 | 497 | 4200 | NA | 470 | 4900 | 2400 | 27000 | NA | NA | NA |
| Liquid Gold | Concrete | Soil | NA | Kennedy/Jenks/Chilton | Dec-90 | NA | NA | 26 | 34 | 157 | 400 | 0.5 | 1.8 | 26 | 30 | 71 | 120 | NA | 127 | 270 | 1370 | 4300 | NA | NA | NA |
| Liquid Gold | Former Pond | Soil | NA | Kennedy/Jenks/Chilton | Dec-90 | NA | NA | 41 | 230 | 150 | 490 | 0.1 | 0.8 | 53 | 280 | 258 | 3600 | NA | 108 | 390 | 203 | 740 | NA | NA | NA |
| Liquid Gold | SE Drain | Soil | NA | Kennedy/Jenks/Chilton | Dec-90 | NA | NA | 34 | 41 | 129 | 370 | 0.5 | 1.4 | 33 | 34 | 28 | 37 | NA | 143 | 230 | 1920 | 5000 | NA | NA | NA |

# Table 4-6
## Groundwater Sampling Results from Previous Studies
(micrograms/Liter)

| PROPERTY | SAMPLE ID | MATRIX | DEPTH (feet) | REFERENCE | DATE | As | Cd | Cr | Cu | Hg | Pb | Se | Zn | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LIQUID GOLD | MW-01 | Groundwater | D | Kennedy/Jenks | Nov-92 | NA | NA | ND(<1) | 29 | ND(0.2) | ND(<20) | NA | ND(<100) | 6.8 |
| LIQUID GOLD | MW-02 | Groundwater | D | Kennedy/Jenks | Nov-92 | NA | NA | ND(<1) | 8.5 | 0.34 | ND(<100) | NA | ND(<100) | 6.9 |
| LIQUID GOLD | MW-03 | Groundwater | D | Kennedy/Jenks | Nov-92 | NA | NA | ND(<1) | 14 | ND(<2) | ND(<20) | NA | ND(<100) | 6.5 |
| LIQUID GOLD | MW-04 | Groundwater | S | Kennedy/Jenks | Nov-92 | NA | NA | ND(<1) | 5.6 | ND(<2) | 5 | NA | ND(<20) | 7 |
| LIQUID GOLD | MW-05 | Groundwater | S | Kennedy/Jenks | Nov-92 | NA | NA | ND(<2.5) | 16 | ND(<0.2) | ND(<50) | NA | ND(<10) | 6.5 |
| LIQUID GOLD | MW-06 | Groundwater | D | Kennedy/Jenks | Nov-92 | NA | NA | 3 | ND(<6) | ND(<0.2) | ND(<10) | NA | ND(<20) | 6.9 |
| LIQUID GOLD | MW-07R | Groundwater | S | Kennedy/Jenks | Nov-92 | NA | NA | 1.1 | 7.4 | ND(<0.2) | ND(<20) | NA | ND(<20) | 7.2 |
| LIQUID GOLD | MW-08 | Groundwater | S | Kennedy/Jenks | Nov-92 | NA | NA | 7.5 | 13 | ND(<0.2) | ND(<20) | NA | ND(<100) | 7.1 |
| LIQUID GOLD | MW-09 | Groundwater | D | Kennedy/Jenks | Nov-92 | NA | NA | ND(<1) | ND(<1) | ND(<0.2) | ND(<20) | NA | ND(<100) | 7.1 |
| LIQUID GOLD | MW-11 | Groundwater | S | Kennedy/Jenks | Nov-92 | NA | NA | 1.6 | 19 | ND(<0.2) | ND(<5) | NA | ND(<20) | 7 |
| LIQUID GOLD | MW-12R | Groundwater | S | Kennedy/Jenks | Nov-92 | NA | NA | 1.9 | ND(<2) | ND(<0.2) | ND(<50) | NA | ND(<100) | 6.8 |
| LIQUID GOLD | MW-13 | Groundwater | S | Kennedy/Jenks | Nov-92 | NA | NA | 9.7 | 4.5 | 0.2 | ND(<50) | NA | ND(<100) | 6.9 |
| LIQUID GOLD | MW-15R | Groundwater | S | Kennedy/Jenks | Nov-92 | NA | NA | 4 | ND(<6) | ND(<0.2) | ND(<10) | NA | ND(<20) | 6.8 |
| LIQUID GOLD | MW-16 | Groundwater | D | Kennedy/Jenks | Nov-92 | NA | NA | ND(<1) | 6.9 | ND(<0.2) | ND(<10) | NA | ND(<100) | 6.8 |
| LIQUID GOLD | MW-17 | Groundwater | S | Kennedy/Jenks | Nov-92 | NA | NA | 2.7 | 2.1 | ND(<0.2) | ND(<2) | NA | ND(<100) | 6.7 |
| LIQUID GOLD | MW-18R | Groundwater | D | Kennedy/Jenks | Nov-92 | NA | NA | ND(<1) | 20 | ND(<0.2) | ND(<50) | NA | ND(<100) | 6.9 |
| LIQUID GOLD | MW-19 | Groundwater | D | Kennedy/Jenks | Nov-92 | NA | NA | ND(<1) | 8.4 | ND(<2) | ND(<5) | NA | ND(<20) | 7.6 |
| LIQUID GOLD | MW-20 | Groundwater | D | Kennedy/Jenks | Nov-92 | NA | NA | 4.2 | 16 | ND(<0.2) | ND(<5) | NA | ND(<20) | 7.2 |

# TABLE 5-1
## Sample Locations and Analyses

| Sample ID | Matrix | Depth | | | | Location | Analysis | | | | | | Rationale |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *0 to 3"* | *2.5' to 3'* | *5.5' to 6'* | *Other* | | *Metals* EPA Method 6010 | *Mercury* EPA Method 7471 | *Pesticides* Method 8081/ 8082 | *PCB* EPA Method 8141 | *Organotin* EPA Method SW-846 | *Other Analyses (See Notes Below)* | |
| ***Forest Products Lab*** | | | | | | | | | | | | | |
| FP-101-B | Soil | ✓ | ✓ | ✓ | | E of tanks, in SW drainage pathway. | ✓ | ✓ | | | | 1 PCP | To identify any releases from tank operations area to surface water drainage. |
| FP-101-GW | Groundwater | | | | Water Table | At FP-101-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of releases to SW drainage on GW quality. |
| FP-102-B | Soil | ✓ | ✓ | ✓ | | Immediately downgradient of storm drain. | ✓ | ✓ | | | | 1 PCP | To determine whether any contaminants have migrated beyond the storm drain. |
| FP-102-GW | Groundwater | | | | Water Table | At FP-102-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of releases to SW drainage on GW quality. |
| FP-103-B | Soil | ✓ | ✓ | ✓ | | Beneath outlet to the pressure treating tank. | ✓ | ✓ | | | | 1 PCP | To identify any releases from tank operations area. |
| FP-103-GW | Groundwater | | | | Water Table | At FP-103-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of tank releases on GW quality. |
| FP-104-B | Soil | ✓ | ✓ | ✓ | | Beneath valve to copper arsenic storage tank. | ✓ | ✓ | | | | 1 PCP | To identify any releases from tank operations area. |
| FP-104-GW | Groundwater | | | | Water Table | At FP-104-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of tank releases on GW quality. |
| FP-105-B | Soil | ✓ | ✓ | ✓ | | SW of tanks along SW drainage pathway. | ✓ | ✓ | | | | 1 PCP | To identify any releases from tank operations area to surface water drainage. |
| FP-105-GW | Groundwater | | | | Water Table | At FP-105-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of releases to SW drainage on GW quality. |
| ***Test Pit Area*** | | | | | | | | | | | | | |
| TP-101-B | Soil | ✓ | ✓ | ✓ | | W of Test Pit area. | ✓ | ✓ | | | | Explosives | To determine W extent of test pit contamination. Hold deeper samples for possible future explosives analysis. |
| TP-101-GW | Groundwater | | | | Water Table | At TP-101-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of test pit on GW quality. |
| TP-102-B | Soil | ✓ | ✓ | ✓ | | N of Test Pit area. | ✓ | ✓ | | | | Explosives | To determine N extent of test pit contamination. Hold deeper samples for possible future explosives analysis. |
| TP-102-GW | Groundwater | | | | Water Table | At TP-102-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of test pit on GW quality. |
| TP-103-B | Soil | ✓ | ✓ | ✓ | | E of Test Pit area. | ✓ | ✓ | | | | Explosives | To determine E extent of test pit contamination. Hold deeper samples for possible future explosives analysis. |
| TP-103-GW | Groundwater | | | | Water Table | At TP-103-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of test pit on GW quality. |
| ***Explosives Storage Area*** | | | | | | | | | | | | | |
| ES-101-B | Soil | ✓ | ✓ | ✓ | | 100' SW of B7ES sample location. | ✓ | ✓ | | | | Explosives | To determine the extent of contamination detected in B7ES. Hold deeper samples for possible future explosives analysis. |
| ES-101-GW | Groundwater | | | | Water Table | At ES-101-B geoprobe location. | ✓ | ✓ | | | | | To determine the impact of detected metals in soils on GW quality. |
| ES-102-B | Soil | ✓ | ✓ | ✓ | | 100' S of B7ES sample location. | ✓ | ✓ | | | | Explosives | To determine the extent of contamination detected in B7ES. Hold deeper samples for possible future explosives analysis. |
| ES-102-GW | Groundwater | | | | Water Table | At ES-102-B geoprobe location. | ✓ | ✓ | | | | | To determine the impact of detected metals in soils on GW quality. |
| ***Pyrite Cinders Area*** | | | | | | | | | | | | | |
| PC-101-B | Soil | ✓ | ✓ | ✓ | | N portion of open field area. | ✓ | ✓ | | | | Sulfate | To identify any pyrite cinder backfill contamination (particularly Cu, As, Pb) in open field area. |
| PC-101-GW | Groundwater | | | | Water Table | At PC-101-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of pyrite cinder backfill on GW quality. |
| PC-102-B | Soil | ✓ | ✓ | ✓ | | W portion of open field area. | ✓ | ✓ | | | | Sulfate | To identify any pyrite cinder backfill contamination (particularly Cu, As, Pb) in open field area. |
| PC-102-GW | Groundwater | | | | Water Table | At PC-102-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of pyrite cinder backfill on GW quality. |
| PC-103-B | Soil | ✓ | ✓ | ✓ | | E portion of open field area. | ✓ | ✓ | | | | Sulfate | To identify any pyrite cinder backfill contamination (particularly Cu, As, Pb) in open field area. |
| PC-103-GW | Groundwater | | | | Water Table | At PC-103-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of pyrite cinder backfill on GW quality. |
| PC-104-B | Soil | ✓ | ✓ | ✓ | Within 2' below the water table. | S portion of open field area. | ✓ | ✓ | | | | Sulfate | To identify any pyrite cinder backfill contamination (particularly Cu, As, Pb) in open field area. A fourth soil sample from this boring will be collected immediately below the water table for the fate & transport analysis. |
| PC-104-GW | Groundwater | | | | Water Table | At PC-104-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of pyrite cinder backfill on GW quality. |
| PC-105-B | Soil | ✓ | ✓ | ✓ | | In fill area, S of EPA Lab and immediately N of Stege Marsh. | ✓ | ✓ | | | | Sulfate | To identify possible pyrite cinder backfill contamination. |
| PC-105-GW | Groundwater | | | | Water Table | At PC-105-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of possible pyrite cinder backfill on GW quality and to determine GW quality leaving RFS and entering Stege Marsh. |

# TABLE 5-1
## Sample Locations and Analyses

| Sample ID | Matrix | Depth | | | | Location | Analysis | | | | | | Rationale |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *0 to 3"* | *2.5' to 3'* | *5.5' to 6'* | *Other* | | *Metals* | *Mercury* | *Pesticides* | *PCB* | *Organotin* | *Other Analyses (See Notes Below)* | |
| | | | | | | | EPA Method 6010 | EPA Method 7471 | Method 8081/ 8082 | EPA Method 8141 | EPA Method SW-846 | | |
| ***Shell Manufacturing Area*** | | | | | | | | | | | | | |
| SH-101-B | Soil | ✓ | ✓ | ✓ | | Midway between location PC-104-B and former sample location B15SH. | ✓ | ✓ | | | | | To determine the extent of contamination detected in B15SH. |
| SH-101-GW | Groundwater | | | | Water Table | At SH-101-B geoprobe location. | ✓ | ✓ | | | | | To determine the impact of detected metals in soils on GW quality. |
| SH-102-B | Soil | ✓ | ✓ | ✓ | | 100' E of B15SH sample location. | ✓ | ✓ | | | | | To determine the extent of contamination detected in B15SH. |
| SH-102-GW | Groundwater | | | | Water Table | At SH-102-B geoprobe location. | ✓ | ✓ | | | | | To determine the impact of detected metals in soils on GW quality. |
| ***Mercury Fulminate Area*** | | | | | | | | | | | | | |
| MF-101-B | Soil | ✓ | ✓ | ✓ | | Mercury Fulminate Area. | ✓ | ✓ | | | | | To determine the lateral and vertical extent of previously detected contamination around the Mercury Fulminate Plant. |
| MF-101-GW | Groundwater | | | | Water Table | At MF-101-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of SW drainage on GW quality. |
| MF-102-B | Soil | ✓ | ✓ | ✓ | Within 2' below the water table. | Mercury Fulminate Area. | ✓ | ✓ | | | | | To determine the lateral and vertical extent of previously detected contamination around the Mercury Fulminate Plant. A fourth soil sample from this boring will be collected immediately below the water table for the fate & transport analysis. |
| MF-102-GW | Groundwater | | | | Water Table | At MF-102-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of SW drainage on GW quality. |
| MF-103-B | Soil | ✓ | ✓ | ✓ | | Mercury Fulminate Area. | ✓ | ✓ | | | | | To determine the lateral and vertical extent of previously detected contamination around the Mercury Fulminate Plant. |
| MF-103-GW | Groundwater | | | | Water Table | At MF-103-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of SW drainage on GW quality. |
| MF-104-B | Soil | ✓ | ✓ | ✓ | | Mercury Fulminate Area. | ✓ | ✓ | | | | | To determine the lateral and vertical extent of previously detected contamination around the Mercury Fulminate Plant. |
| MF-104-GW | Groundwater | | | | Water Table | At MF-104-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of SW drainage on GW quality. |
| MF-105-B | Soil | ✓ | ✓ | ✓ | | Mercury Fulminate Area. | ✓ | ✓ | | | | | To determine the lateral and vertical extent of previously detected contamination around the Mercury Fulminate Plant. |
| MF-105-GW | Groundwater | | | | Water Table | At MF-105-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of SW drainage on GW quality. |
| MF-106-B | Soil | ✓ | ✓ | ✓ | | Mercury Fulminate Area. | ✓ | ✓ | | | | | To determine the lateral and vertical extent of previously detected contamination around the Mercury Fulminate Plant. |
| MF-106-GW | Groundwater | | | | Water Table | At MF-106-B geoprobe location. | ✓ | ✓ | | | | | To assess impact of SW drainage on GW quality. |
| MW-1-GW | Groundwater | | | | Screened Interval | Existing Monitor Well. | ✓ | ✓ | | | | | A sample will be collected to determine whether the water source has become contaminated. |
| ***Sewer Line*** | | | | | | | | | | | | | |
| SL-101-B | Soil | ✓ | ✓ | ✓ | Within 2' below the water table. | Along sewer line (approx. 300' spacing). | ✓ | ✓ | | ✓ | | | To identify any releases to soils from leaks in sewer line. A fourth soil sample from this boring will be collected immediately below the water table for the fate & transport analysis. |
| SL-101-GW | Groundwater | | | | Water Table | At SL-101-B geoprobe location. | ✓ | ✓ | | ✓ | | | To determine whether leaks in sewer line impacted GW quality. |
| SL-102-B | Soil | ✓ | ✓ | ✓ | | Along sewer line (approx. 300' spacing). | ✓ | ✓ | | ✓ | | | To identify any releases to soils from leaks in sewer line. |
| SL-102-GW | Groundwater | | | | Water Table | At SL-102-B geoprobe location. | ✓ | ✓ | | ✓ | | | To determine whether leaks in sewer line impacted GW quality. |
| SL-103-B | Soil | ✓ | ✓ | ✓ | | Along sewer line (approx. 300' spacing). | ✓ | ✓ | | ✓ | | | To identify any releases to soils from leaks in sewer line. |
| SL-103-GW | Groundwater | | | | Water Table | At SL-103-B geoprobe location. | ✓ | ✓ | | ✓ | | | To determine whether leaks in sewer line impacted GW quality. |
| SL-104-B | Soil | ✓ | ✓ | ✓ | | Along sewer line (approx. 300' spacing). | ✓ | ✓ | | ✓ | | | To identify any releases to soils from leaks in sewer line. |
| SL-104-GW | Groundwater | | | | Water Table | At SL-104-B geoprobe location. | ✓ | ✓ | | ✓ | | | To determine whether leaks in sewer line impacted GW quality. |
| ***Property Boundary*** | | | | | | | | | | | | | |
| PB-101-B | Soil | ✓ | ✓ | ✓ | | On RFS property, at Zeneca property line (approx. 250' spacing). | ✓ | ✓ | ✓ | | | | To determine soil quality along Zeneca property boundary. |
| PB-101-GW | Groundwater | | | | Water Table | At PB-101-B geoprobe location. | ✓ | ✓ | ✓ | | | | To assess GW quality at Zeneca property boundary. |
| PB-102-B | Soil | ✓ | ✓ | ✓ | | On RFS property, at Zeneca property line (approx. 250' spacing). | ✓ | ✓ | ✓ | | | | To determine soil quality along Zeneca property boundary. |
| PB-102-GW | Groundwater | | | | Water Table | At PB-102-B geoprobe location. | ✓ | ✓ | ✓ | | | | To assess GW quality at Zeneca property boundary. |

# TABLE 5-1
## Sample Locations and Analyses

| Sample ID | Matrix | Depth | | | | Location | Analysis | | | | | | Rationale |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *0 to 3"* | *2.5' to 3'* | *5.5' to 6'* | *Other* | | *Metals* EPA Method 6010 | *Mercury* EPA Method 7471 | *Pesticides* Method 8081/ 8082 | *PCB* EPA Method 8141 | *Organotin* EPA Method SW-846 | *Other Analyses (See Notes Below)* | |
| PB-103-B | Soil | ✓ | ✓ | ✓ | | On RFS property, at Zeneca property line (approx. 250' spacing). | ✓ | ✓ | ✓ | | | | To determine soil quality along Zeneca property boundary. |
| PB-103-GW | Groundwater | | | | Water Table | At PB-103-B geoprobe location. | ✓ | ✓ | ✓ | | | | To assess GW quality at Zeneca property boundary. |
| PB-104-B | Soil | ✓ | ✓ | ✓ | | On RFS property, at Zeneca property line (approx. 250' spacing). | ✓ | ✓ | ✓ | | | | To determine soil quality along Zeneca property boundary. |
| PB-104-GW | Groundwater | | | | Water Table | At PB-104-B geoprobe location. | ✓ | ✓ | ✓ | | | | To assess GW quality at Zeneca property boundary. |
| PB-105-B | Soil | ✓ | ✓ | ✓ | | On RFS property, at Zeneca property line (approx. 250' spacing). | ✓ | ✓ | ✓ | | | | To determine soil quality along Zeneca property boundary. |
| PB-105-GW | Groundwater | | | | Water Table | At PB-105-B geoprobe location. | ✓ | ✓ | ✓ | | | | To assess GW quality at Zeneca property boundary. |
| ***Storm Drain*** | | | | | | | | | | | | | |
| SD-101-B | Soil | ✓ | ✓ | ✓ | | Along storm drain (approx. 100' spacing). | ✓ | ✓ | | ✓ | | | To identify any releases to soils from storm drain. |
| SD-101-GW | Groundwater | | | | Water Table | At SD-101-B geoprobe location. | ✓ | ✓ | | ✓ | | | To determine whether constituents in storm water and drain impacted GW quality. |
| SD-102-B | Soil | ✓ | ✓ | ✓ | | Along storm drain (approx. 100' spacing). | ✓ | ✓ | | ✓ | | | To identify any releases to soils from storm drain. |
| SD-102-GW | Groundwater | | | | Water Table | At SD-102-B geoprobe location. | ✓ | ✓ | | ✓ | | | To determine whether constituents in storm water and drain impacted GW quality. |
| SD-103-B | Soil | ✓ | ✓ | ✓ | | Along storm drain (approx. 100' spacing). | ✓ | ✓ | | ✓ | | | To identify any releases to soils from storm drain. |
| SD-103-GW | Groundwater | | | | Water Table | At SD-103-B geoprobe location. | ✓ | ✓ | | ✓ | | | To determine whether constituents in storm water and drain impacted GW quality. |
| ***Stege Marsh*** | | | | | | | | | | | | | |
| SM-101-SD | Sediment | ✓ | | | | Sludge from bottom of PG&E storm drain. | ✓ | ✓ | ✓ | ✓ | | | To identify contaminants from PG&E sources discharging into Stege Marsh. |
| SM-102-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet | Immediately upstream of RFS in Meeker Creek. | ✓ | ✓ | ✓ | ✓ | ✓ | | To determine off-site contributions from Meeker Creek to Stege Marsh. |
| SM-103-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet | Immediately upstream of RFS in Meeker Creek. | ✓ | ✓ | ✓ | ✓ | ✓ | | To determine off-site contributions from Meeker Creek to Stege Marsh. |
| SM-104-SD | Sediment | ✓ | ✓ | ✓ | | See sample location map. | ✓ | ✓ | ✓ | ✓ | ✓ | | To determine the vertical distribution of sediments in Stege Marsh. |
| SM-105-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet | Small slough flowing to the E of Meeker Creek. | ✓ | ✓ | ✓ | ✓ | ✓ | | To evaluate recent water quality and sediment data in small slough from Meeker Creek. |
| SM-106-SD | Sediment | ✓ | ✓ | | | N of walking trail. See sample location map. | ✓ | ✓ | ✓ | ✓ | ✓ | | To evaluate fill material in Marsh that possibly originated from railroad installation. |
| SM-107-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet | Meeker Creek, adjacent to Marina Bay. | ✓ | ✓ | ✓ | ✓ | ✓ | | To evaluate the contribution of Marina Bay to Stege Marsh. |
| SM-108-SD | Sediment | ✓ | ✓ | ✓ | | In discolored area. directly S of E storm drain. | ✓ | ✓ | ✓ | ✓ | | Sulfate | To evaluate discolored area and determine the vertical extent of pyrite cinders. |
| SM-109-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet<br>Below cinders ** | W of pyrite cinder pile. | ✓ | ✓ | ✓ | ✓ | | Sulfate | To evaluate the W extent of pyrite cinders. |
| SM-108-PW | Pore Water | | ✓ | | | Pore water collected from sediment sample SM-108-SD. | ✓ | ✓ | ✓ | ✓ | | | Laboratory will decant pore water from sediment sample SM-108-SD. The data will be used to determine the Kd value for the fate & transport model. |
| SM-109-PW | Pore Water | | ✓ | | | Pore water collected from sediment sample SM-109-SD. | ✓ | ✓ | ✓ | ✓ | | | Laboratory will decant pore water from sediment sample SM-109-SD. The data will be used to determine the Kd value for the fate & transport model. |
| SM-110-SD | Sediment | | | | 0 to 3"<br>5 to 6 feet<br>9 to 10 feet<br>Below cinders ** | On road leading to Marsh. | ✓ | ✓ | ✓ | ✓ | | Sulfate | To evaluate road fill for pyrite cinders and to identify NW extent. |

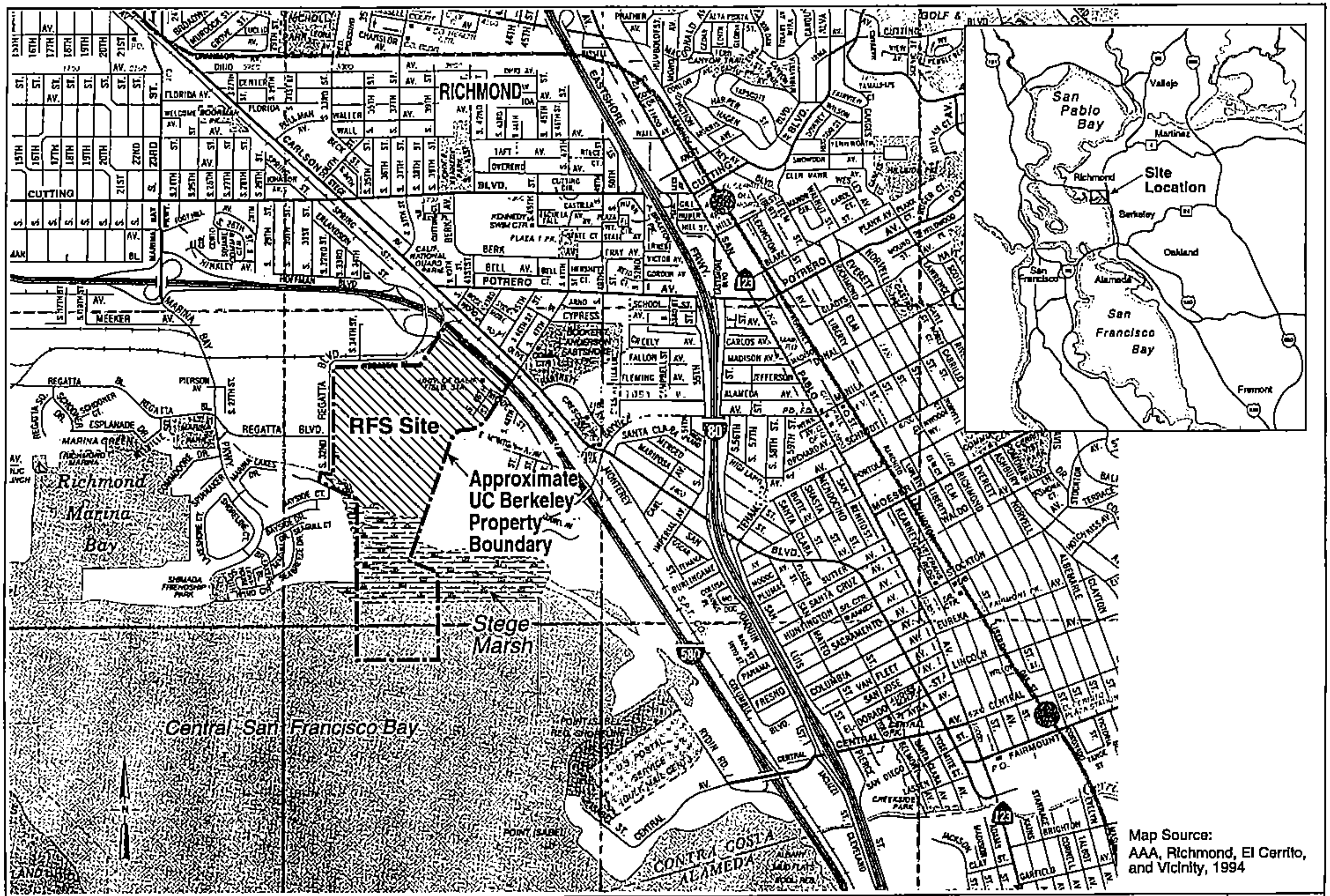
# TABLE 5-1
## Sample Locations and Analyses

| Sample ID | Matrix | Depth<br>*0 to 3"* | Depth<br>*2.5' to 3'* | Depth<br>*5.5' to 6'* | Depth<br>*Other* | Location | Analysis<br>*Metals* EPA Method 6010 | Analysis<br>*Mercury* EPA Method 7471 | Analysis<br>*Pesticides* Method 8081/ 8082 | Analysis<br>*PCB* EPA Method 8141 | Analysis<br>*Organotin* EPA Method SW-846 | Analysis<br>*Other Analyses (See Notes Below)* | Rationale |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SM-111-SD | Sediment | | | | 0 to 3"<br>5 to 6 feet<br>9 to 10 feet<br>Below cinders ** | In pyrite cinder pile. | ✓ | ✓ | ✓ | ✓ | | Sulfate | To evaluate the pyrite cinder pile for metal concentrations and former pond contributions. |
| SM-112-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet<br>Below cinders ** | S of pyrite cinder pile. | ✓ | ✓ | ✓ | ✓ | | Sulfate | To evaluate the SE extent of pyrite cinder pile and to evaluate the former copper leaching plant. |
| SM-113-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet<br>Below cinders ** | SE of pyrite cinder pile. | ✓ | ✓ | ✓ | ✓ | | Sulfate | To evaluate the S extent of pyrite cinders. |
| SM-114-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet | In San Pablo Bay, S of the pyrite cinder pile. | ✓ | ✓ | ✓ | ✓ | | Sulfate | To evaluate the S extent and whether pyrite cinders have migrated into open Bay water. |
| SM-115-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet<br>Below cinders ** | E of pyrite cinder pile. | ✓ | ✓ | ✓ | ✓ | | Sulfate | To evaluate the NE extent of pyrite cinders. |
| SM-116-SD | Sediment | ✓ | ✓ | ✓ | | In discolored area to the E of pyrite cinder pile. | ✓ | ✓ | ✓ | ✓ | | | To evaluate discolored area of Marsh on the E side of the pyrite cinder pile. |
| SM-117-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet | Carlson Creek. | ✓ | ✓ | ✓ | ✓ | | | To evaluate the contributions from Liquid Gold Plant via Carlson Creek. |
| SM-118-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet | Carlson Creek. | ✓ | ✓ | ✓ | ✓ | | | To evaluate the contributions from Liquid Gold Plant via Carlson Creek. |
| SM-119-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet | Along side of old pier. | ✓ | ✓ | ✓ | ✓ | ✓ | Sulfate | Sample collected adjacent to pier to determine risk to fishermens and benthic community. |
| SM-120-SD | Sediment | | | | 0 to 3"<br>1 to 2 feet<br>5 to 6 feet | At end of old pier. | ✓ | ✓ | ✓ | ✓ | ✓ | Sulfate | Sample collected adjacent to pier to determine risk to fishermens and benthic community. |
| SM-121-SD | Sediment | ✓ | ✓ | ✓ | | Along walking track in high-use areas or areas suspected of contamination. | ✓ | ✓ | ✓ | ✓ | | | Sample collected on walking trail to determine risk to recreational users of the trail. |
| SM-122-SD | Sediment | ✓ | ✓ | ✓ | | Along walking track in high-use areas or areas suspected of contamination. | ✓ | ✓ | ✓ | ✓ | | | Sample collected on walking trail to determine risk to recreational users of the trail. |
| SM-102-SW | Surface Water | | | | Grab Sample | At SM-102-SD sample location. | ✓ | ✓ | ✓ | | ✓ | | To identify off-site sources and their impact on Stege Marsh. |
| SM-103-SW | Surface Water | | | | Grab Sample | At SM-103-SD sample location. | ✓ | ✓ | ✓ | | ✓ | | To identify off-site sources and their impact on Stege Marsh. |
| SM-104-SW | Surface Water | | | | Grab Sample | At SM-104-SD sample location. | ✓ | ✓ | | | ✓ | | To identify off-site sources and their impact on Stege Marsh. |
| SM-105-SW | Surface Water | | | | Grab Sample | At SM-105-SD sample location. | ✓ | ✓ | | | ✓ | | To identify off-site sources and their impact on Stege Marsh. |
| SM-107-SW | Surface Water | | | | Grab Sample | At SM-107-SD sample location. | ✓ | ✓ | | | | | To identify off-site sources and their impact on Stege Marsh. |
| SM-108-SW | Surface Water | | | | Grab Sample | At SM-108-SD sample location. | ✓ | ✓ | ✓ | | | | To identify off-site sources and their impact on Stege Marsh. |
| SM-114-SW | Surface Water | | | | Grab Sample | At SM-114-SD sample location. | ✓ | ✓ | | | | | To identify off-site sources and their impact on Stege Marsh. |
| SM-115-SW | Surface Water | | | | Grab Sample | At SM-115-SD sample location. | ✓ | ✓ | ✓ | | | | To identify off-site sources and their impact on Stege Marsh. |
| SM-116-SW | Surface Water | | | | Grab Sample | At SM-116-SD sample location. | ✓ | ✓ | ✓ | | | | To identify off-site sources and their impact on Stege Marsh. |
| SM-117-SW | Surface Water | | | | Grab Sample | At SM-117-SD sample location. | ✓ | ✓ | | | | | To identify off-site sources and their impact on Stege Marsh. |
| SM-118-SW | Surface Water | | | | Grab Sample | At SM-118-SD sample location. | ✓ | ✓ | | | | | To identify off-site sources and their impact on Stege Marsh. |

**Notes:**

** = Obtain a sample 6 inches below pyrite cinders, based on visual observation.
Each soil and sediment sample will be analyzed for pH and moisture content, which is required for the risk assessment.
Selected soil and sediment samples will be analyzed for TOC, grain size distribution, and bulk density, also required for the risk assessment. Refer to Section 5 for sampling details.

# FIGURES



Map Source:
AAA, Richmond, El Cerrito, and Vicinity, 1994

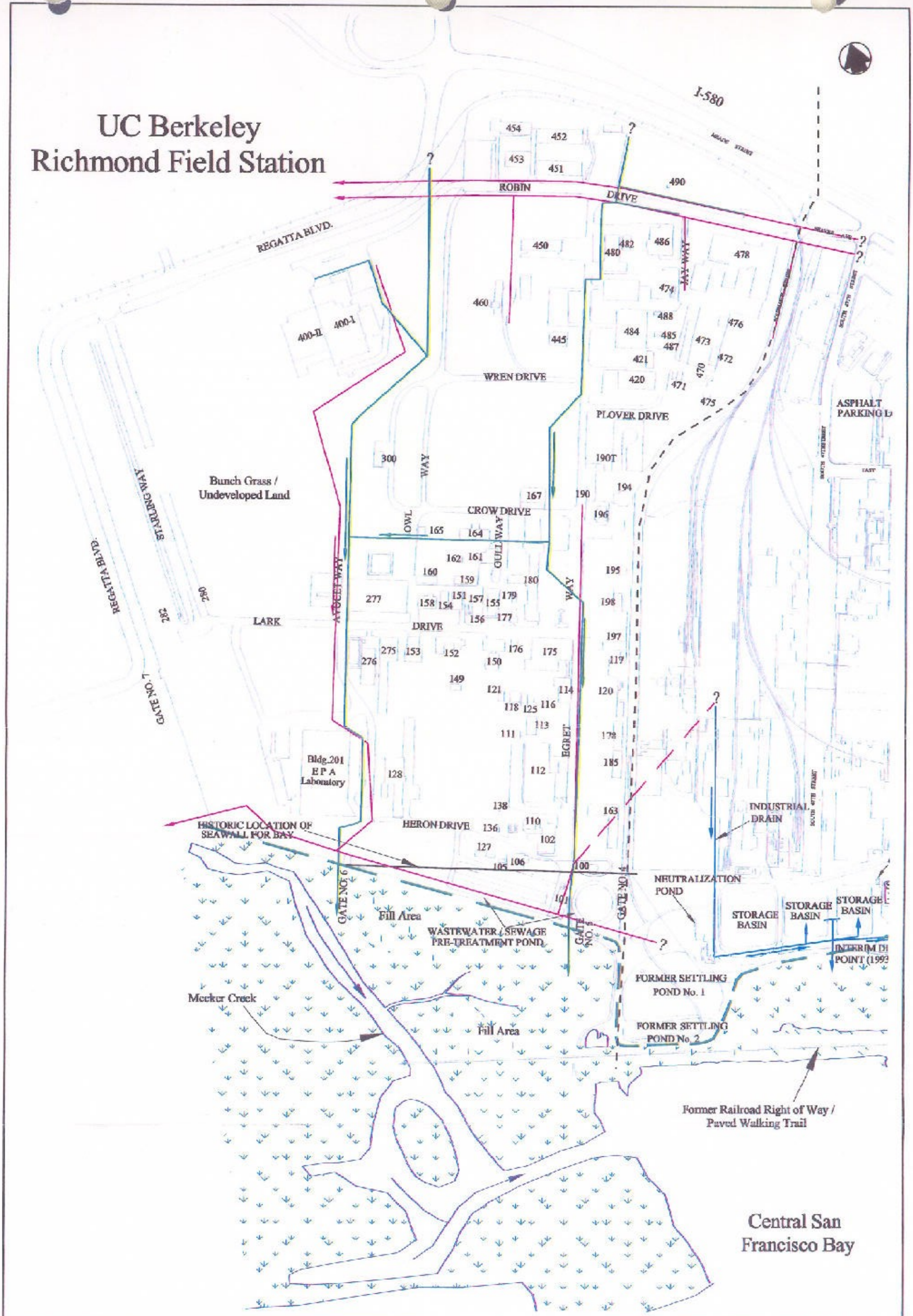
| Project No. 51-09967067.00 | University of California, Berkeley Richmond Field Station | UNIVERSITY OF CALIFORNIA, BERKELEY RICHMOND FIELD STATION SITE LOCATION MAP | Figure 1 |
|---|---|---|---|
| **URS Greiner Woodward Clyde** | | | |

51-09967067.00-00001/120499/gos

Reference: North Bay Aerial Photography, Date 07-15-94

| Project No.<br>51-09967067.00 | University of California, Berkeley<br>Richmond Field Station | STEGE MARSH AND<br>SURROUNDING PROPERTIES | Figure<br>2 |
|---|---|---|---|
| **URS Greiner Woodward Clyde** | | | |

# UC Berkeley
# Richmond Field Station



## LEGEND

- Storm Drain System (Approximate)
- Industrial Drain (Approximate)
- Sanitary Sewer System (Approximate) (dashed line to be verified)
- Approximate Location of former Sea Wall
- Approximate Property Boundary
- Edge of Water
- Surface Water Fow Direction

111 Building Identification Number
Approximate Edge of Marsh
Stege Marsh

NOTES :

1. Marsh Features and Sloughs are Approximate.

Project No.
51-0967067.00

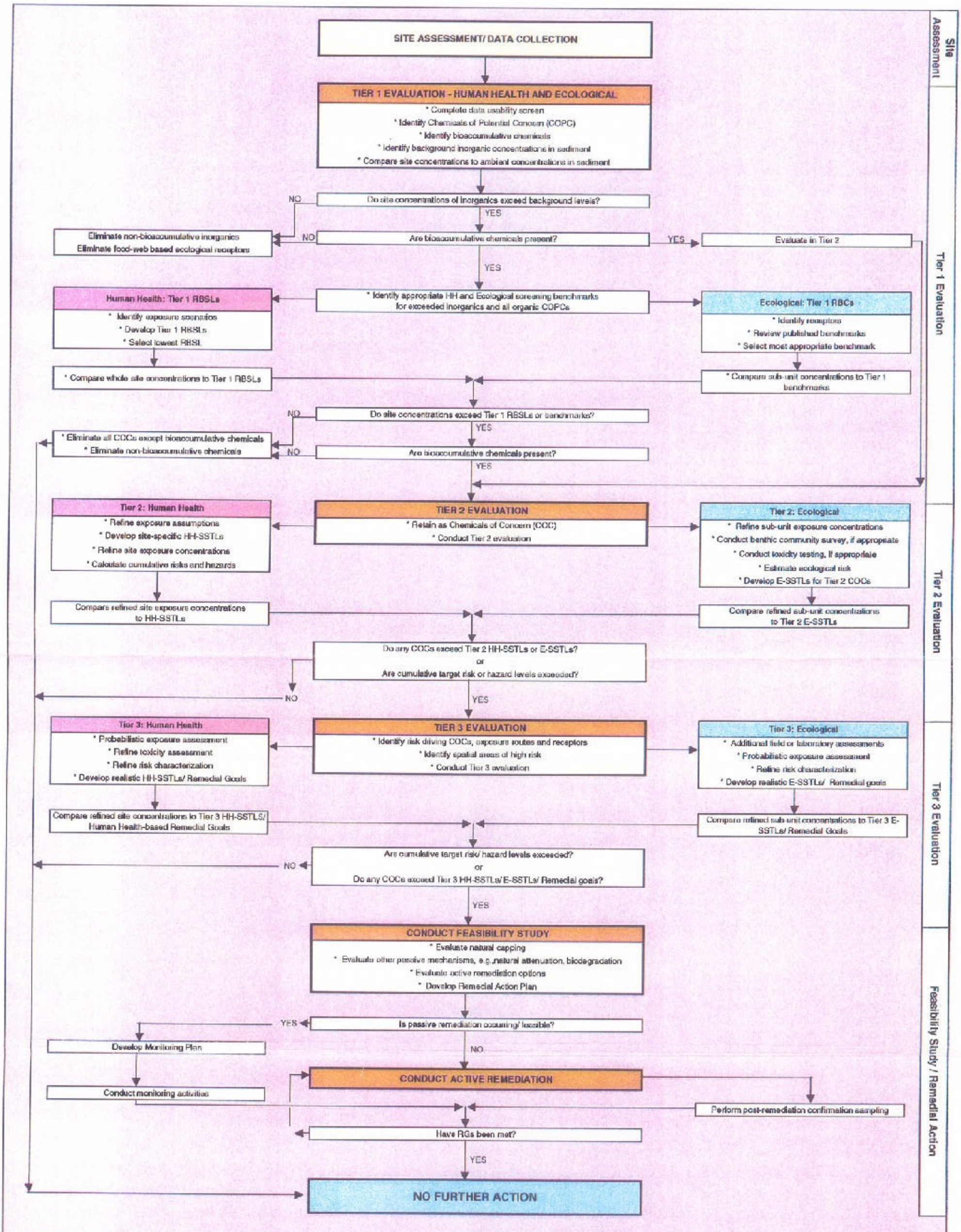
n:/gis/ucb-rfs/rfs-plan.apr

**University of California, Berkeley**
Richmond Field Station

*URS Greiner Woodward Clyde*

Site Layout
Richmond Field Station

| November 1999 | Scale 1" = 300' | Figure 3 |
|---|---|---|



UC Berkeley - RFS

*URS GREINER WOODWARD CLYDE*

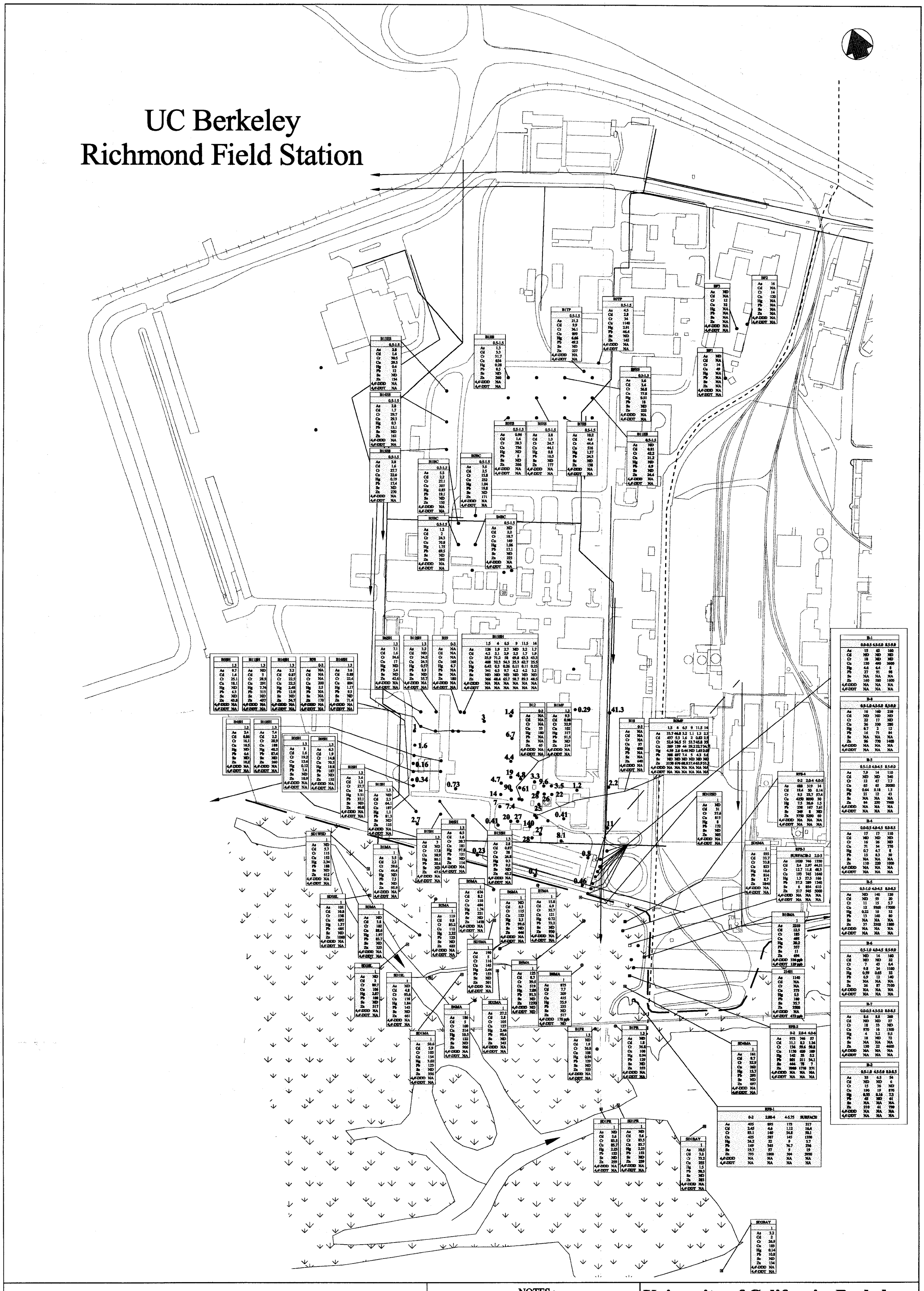
## DECISION FLOWCHART

## FIGURE 6

x:\waste\berk\decisa2

HH-SSTL = Human Health Site Specific Target Level
E-SSTL = Ecological Site Specific Target Level

# UC Berkeley
# Richmond Field Station



LEGEND

- Storm Drain System (Approximate)
- Industrial Drain (Approximate)
- Sanitary Sewer System (Approximate) (dashed line to be verified)
- Approximate Location of former Sea Wall
- 111 Building Identification Number
- Edge of Water
- Surface Water Fow Direction
- Approximate Edge of Marsh
- Stege Marsh
- Approximate Property Boundary

NOTES :

1. Marsh Features and Sloughs are Approximate.
2. All Locations are Approximate
4. Results are in mg/kg.
3. Sampling Locations with results posted in blue are for Mercury at 0-3 feet. Mercury was the only analyte tested at these locations.

Project No.
51-0967067.00

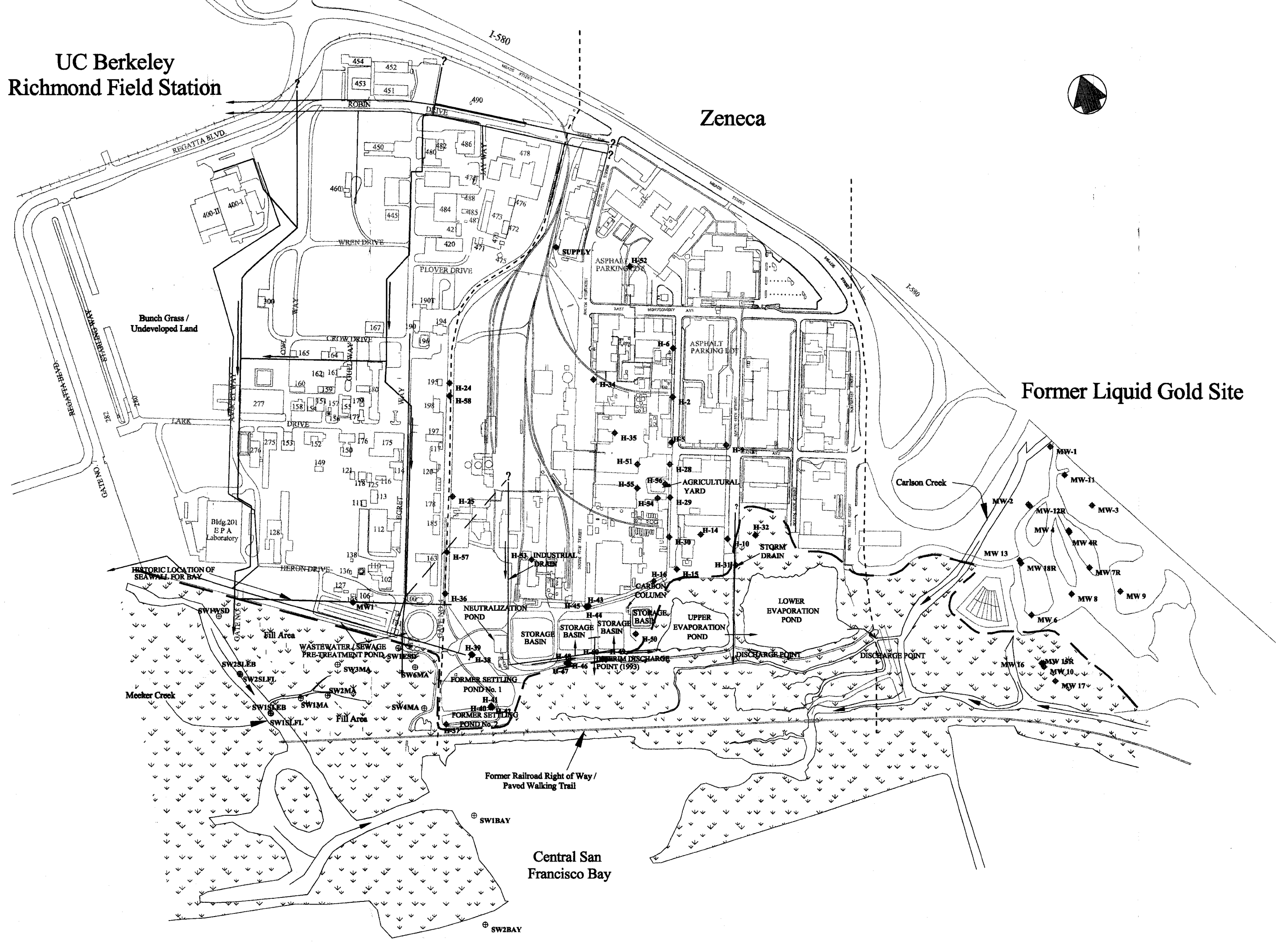
x:/gis/ucb-rfs/rfs-plan.apr

**University of California, Berkeley**
Richmond Field Station

*URS Greiner Woodward Clyde*

Richmond Field Station
Soil and Sediment Sampling Results

November 1999 | Scale 1" = 150' | Figure 9



## LEGEND

- ⊕ Surface Water Sample
- ◆ Groundwater Well
- Storm Drain System (Approximate)
- Industrial Drain (Approximate)
- Sanitary Sewer System (Approximate) (dashed line to be verified)
- Approximate Location of former Sea Wall
- Edge of Water
- Surface Water Fow Direction
- Approximate Edge of Marsh
- Stege Marsh
- Approximate Property Boundary

NOTES :

1. All Locations are Approximate
2. Richmond Field Station Locations are not surveyed.

Project No.
51-0967067.00
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**University of California, Berkeley**
Richmond Field Station

*URS Greiner Woodward Clyde*

Groundwater and Surface Water
Sampling Locations
Stege Marsh Surrounding Properties

November 1999 | Scale 1" = 250' | Figure 11

LEGEND

- Below EPA Saltwater Criteria (36 ppb)
- ● Above EPA Saltwater Criteria (greater than pb)
- • Water Data Not Available

NOTES :

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Richmond Field Station

*URS Greiner Woodward Clyde*

Groundwater and Surface Water Sample Locations Exceeding Tier I Screening Levels
Arsenic

| November 1999 | Scale 1" = 500' | Figure 12-A |
|---|---|---|

LEGEND

- ● Below EPA Saltwater Criteria (58 ppb)
- ● Above EPA Saltwater Criteria (greater than 58 ppb)
- ● Water Data Not Available

NOTES :

No Results above EPA Saltwater Criteria.

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**University of California, Berkeley**
Richmond Field Station

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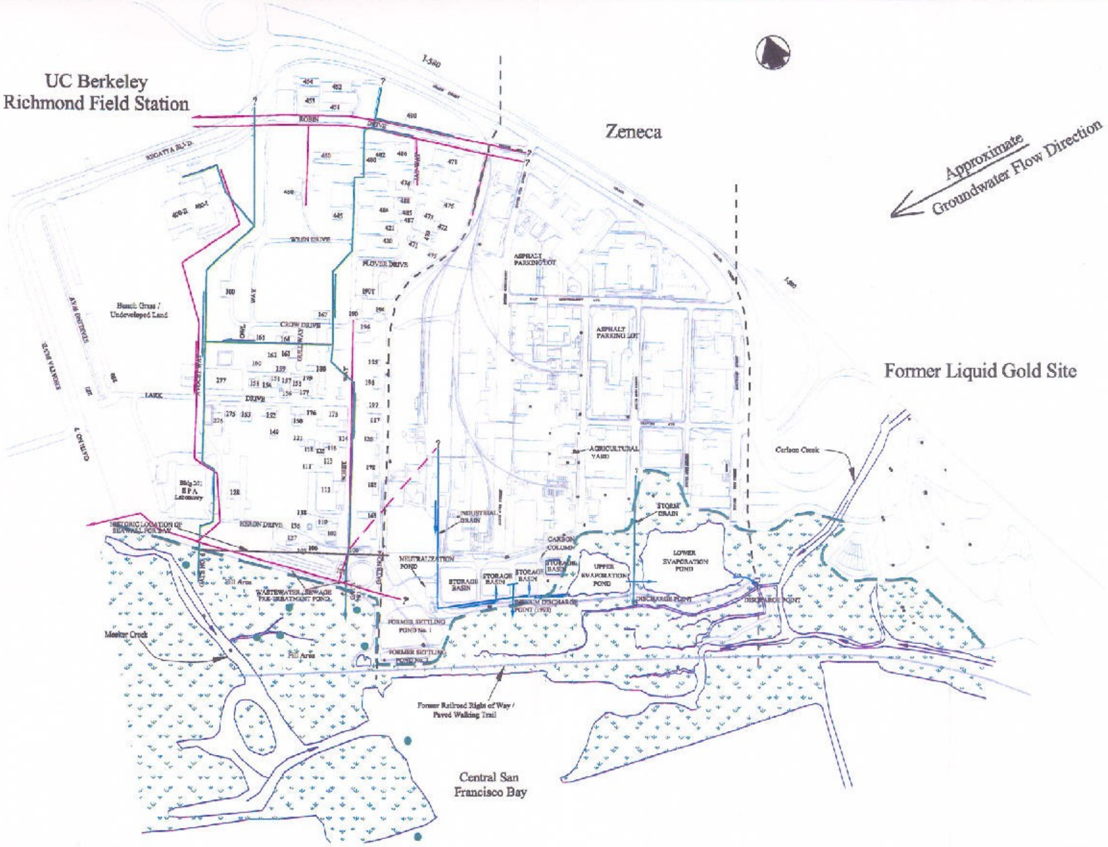
Groundwater and Surface Water Sample
Locations Exceeding Tier I Screening Levels
Zinc

| November 1999 | Scale 1" = 500' | Figure 12-G |
|---|---|---|



LEGEND

- ● Below EPA Saltwater Criteria (71 ppb)
- ● Above EPA Saltwater Criteria (greater than 71 ppb)
- • Water Data Not Available

NOTES :

No Results above EPA Saltwater Criteria

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Richmond Field Station

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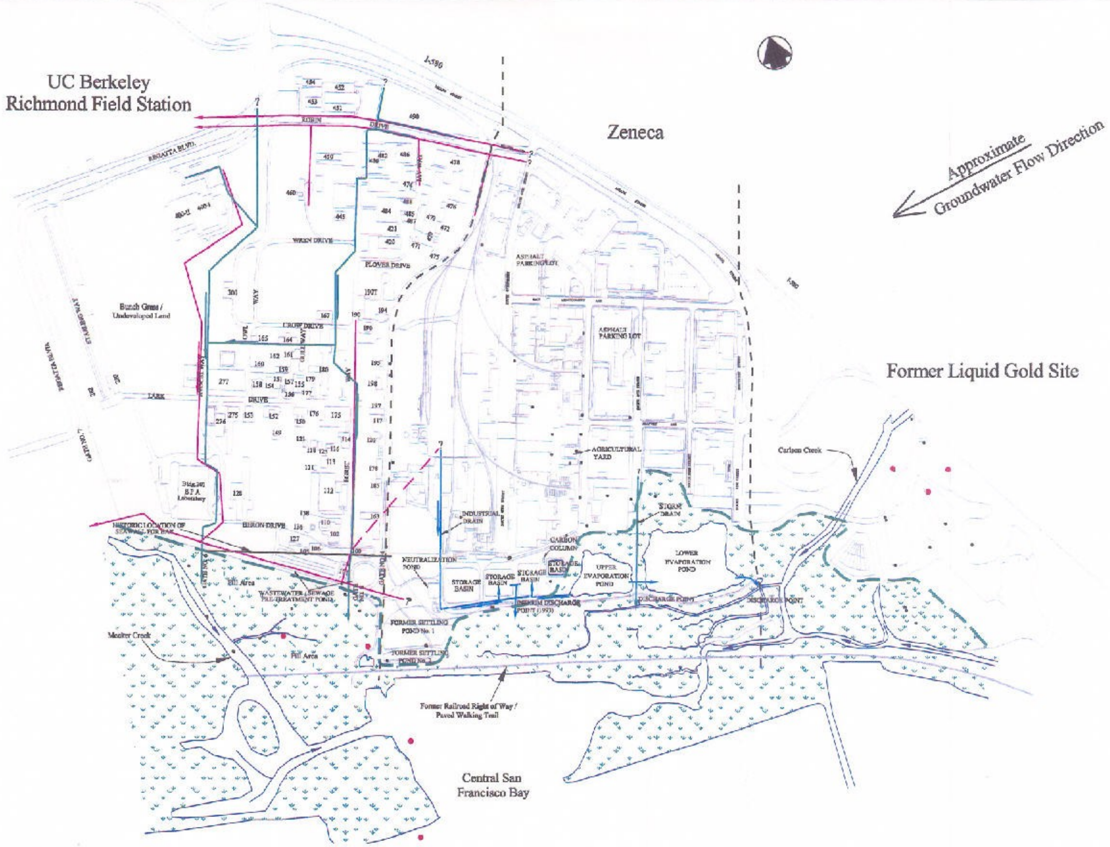
Groundwater and Surface Water Sample
Locations Exceeding Tier I Screening Levels
Selenium

| | | |
|---|---|---|
| November 1999 | Scale 1" = 500' | Figure 12-F |



LEGEND

- ● Below EPA Saltwater Criteria (0.025 ppb)
- ● Above EPA Saltwater Criteria (greater than 0.025 ppb)
- • Water Data Not Available

NOTES :

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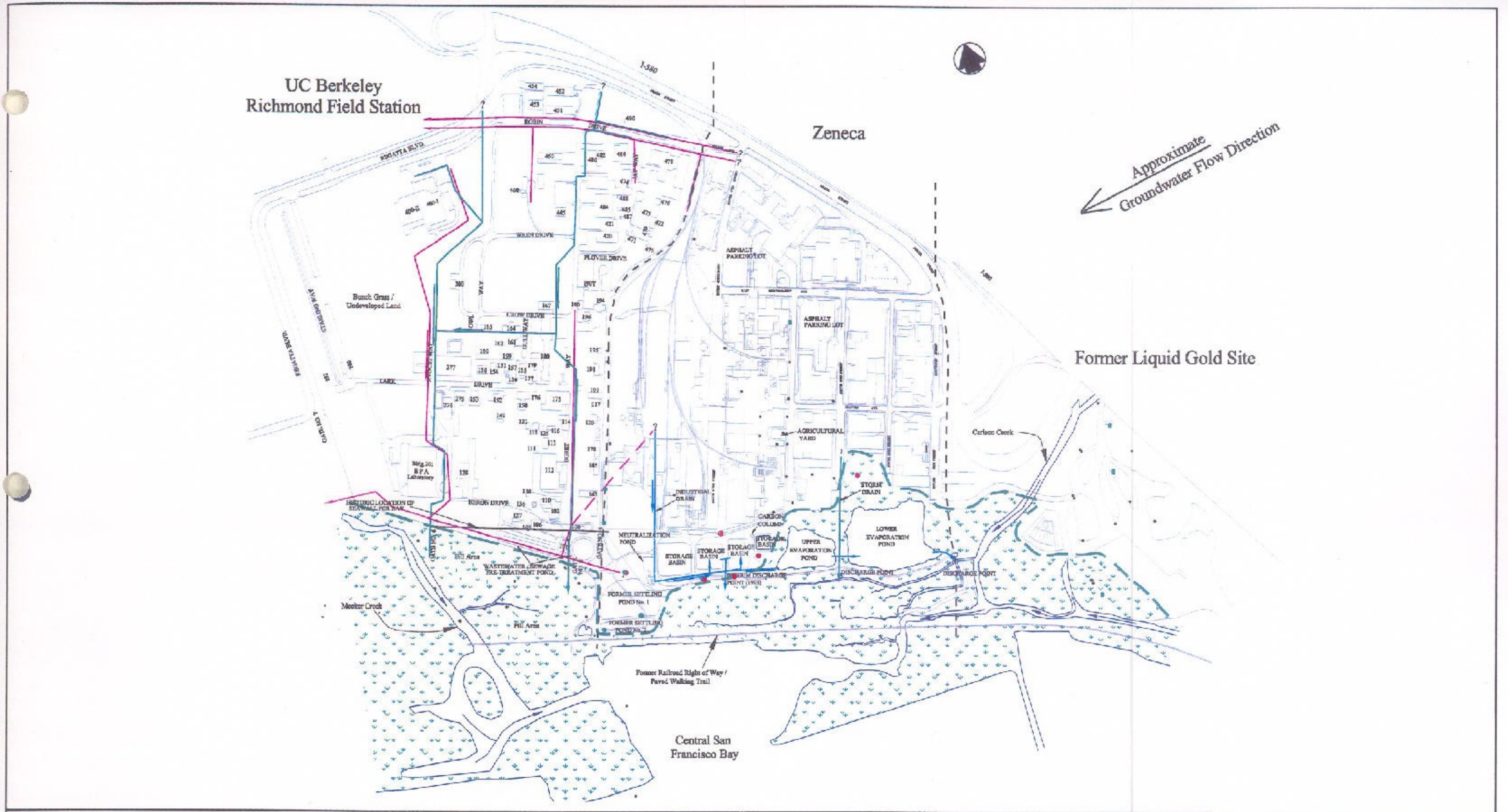
**University of California, Berkeley**
Richmond Field Station

*URS Greiner Woodward Clyde*

Groundwater and Surface Water Sample
Locations Exceeding Tier I Screening Levels
Mercury

| November 1999 | Scale 1" = 500' | Figure 12-E |
|---|---|---|



LEGEND

- Below EPA Saltwater Criteria (5.6 ppb)
- Above EPA Saltwater Criteria (greater than 5.6 ppb)
- Water Data Not Available

NOTES :

Project No.
51-0967067.00

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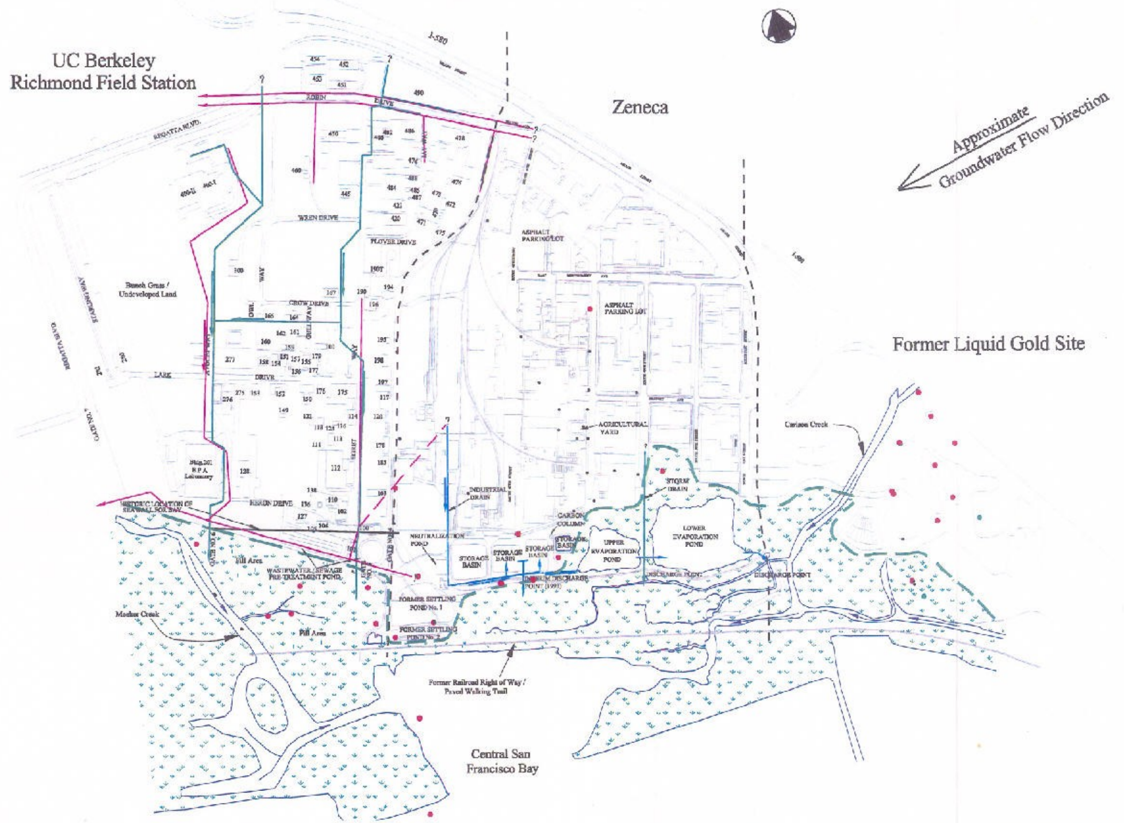
**University of California, Berkeley**
Richmond Field Station

*URS Greiner Woodward Clyde*

Groundwater and Surface Water Sample
Locations Exceeding Tier I Screening Levels
Lead

November 1999 | Scale 1" = 500' | Figure 12-D



LEGEND

● Below EPA Saltwater Criteria (2.4 ppb)

● Above EPA Saltwater Criteria (greater than 2.4 ppb)

● Water Data Not Available

NOTES :

Project No.
51-0967067.00

x:/gis/ucb-rfs/rfs-plan.apr

**University of California, Berkeley**
Richmond Field Station

*URS Greiner Woodward Clyde*

Groundwater and Surface Water Sample
Locations ExceedingTier I Screening Levels
Copper

| November 1999 | Scale 1" = 500' | Figure 12-C |
|---|---|---|

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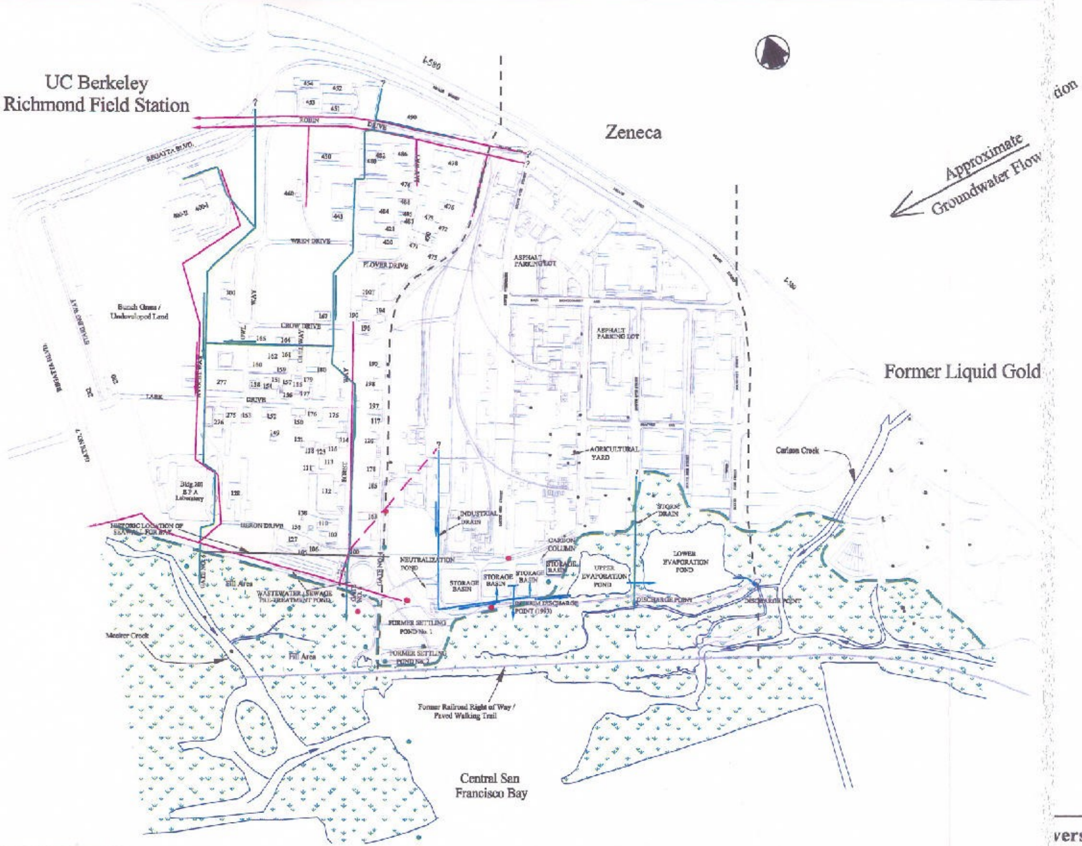

LEGEND

- ● Below EPA Saltwater Criteria (9.3 ppb)
- ● Above EPA Saltwater Criteria (greater than 9.3 ppb)
- ▪ Water Data Not Available

NOTES :

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Richmond Field Station

*IRS Greiner Woodward Clyde*

undwater and Surface Water Sample
ions Exceeding Tier I Screening Levels
Cadmium

| | | |
|---|---|---|
| nber 1999 | Scale 1" = 500' | Figure 12-B |

LEGEND

Screening Criteria

- ● pH less than 6.5
- ● pH between 6.5 and 8.5
- ● pH greater than 8.5
- ■ Water Data Not Available

NOTES :

Project No.
51-0967067.00

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**University of California, Berkeley**
Richmond Field Station

*URS Greiner Woodward Clyde*

Groundwater and Surface Water Sample Locations Exceeding Tier I Screening Levels
pH

| November 1999 | Scale 1" = 500' | Figure 12-H |
|---|---|---|

# APPENDIX A

# Appendix A

# Health and Safety Plan

**REPORT**

# UCB RICHMOND FIELD STATION SAMPLING HEALTH AND SAFETY PLAN

*Prepared for*
University of California
Richmond Field Station
Berkeley, CA 94804

December 6, 1999

**URS Greiner Woodward Clyde**

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# TABLE OF CONTENTS

**Figures**

**Attachments**

The purpose of this procedure is to establish sound and uniform health and safety. This procedure and the attached figures constitute a Site-Specific Site Safety Plan.

## 1.1 SCOPE

The Health and Safety Plan addresses contaminated soil, sediments and groundwater that will be encountered during sampling activities at the UCB Richmond Field Station property. Geoprobe sampling will be conducted at the upland portion of the site in order to collect soil samples. Hyrdropunch sampling will also be conducted in order to collect grab samples of groundwater presumed to be at 10-15 feet. There will also be sampling of surficial water and sediment in the marsh area of the site, with cores down to 10-15 feet. Chemicals of concern at the site includes metals, polyaromatic hydrocarbons, hydrocarbons, and pesticides.

The sampling activities are comprised of obtaining sediment samples from a core sample to a depth of approximately 10 –15 feet. Soil samples will be collected from the surface and down to 15 foot depth. Groundwater samples will be collected, presumably at 10-15 feet. All sampling will occur within the confines of the project investigation area shown on Figures 1 and 2.

## 1.2 RESPONSIBILITIES

### 1.2.1 PROJECT MANAGER (PM)

The PM has the responsibility of implementing this HSP. The PM needs to comply with applicable regulations and ensure that the operations and procedures proceed according to the Health and Safety Manual. The PM has the authority to suspend work when the health and safety of field personnel or the public is threatened. The PM and the HSM also have the authority to remove URSGWC individuals from the site for engaging in activities that jeopardize the health and/or safety of themselves or others.

The Site Safety Officer (SSO) reports directly to the PM and keeps him/her abreast of the daily activities. The PM has overall responsibility for site health and safety. The SSO is responsible for assisting the PM in carrying out the health and safety requirements detailed in this plan.

### 1.2.2 SITE SAFETY OFFICER (SSO)

The SSO will perform the following functions:

- Meet with the HSM prior to monitoring field activities to discuss the requirements of the HSP.
- Provide technical assistance and conduct safety meetings to URSGWC personnel working at the site on the safe and healthful use of chemicals, hazardous substances, and mixtures used at the work site.
- Document and keep copies of initial and subsequent accident and injury reports for review and analysis by the Health and Safety Officer (HSM).

- Complete and return all information sheets to the HSM no later than one week after work activities at the site begin. This includes the Compliance Agreement Signature Sheet, the Acknowledgement Signature Sheet.
- Direct day-to-day health and safety activities in the field. The SSO must be present at the work site whenever URSGWC employees are performing work. The HSM is responsible for advising the PM and SSO on health and safety matters and monitoring compliance.
- Implement the Health and Safety Plan (HSP) and enforce its guidelines.
- Maintain a list of addresses and telephone numbers of emergency assistance units (ambulance service, police, and hospitals), and will inform other members of the URSGWC field team of the existence and location of this list.

### 1.2.3 HEALTH AND SAFETY Manager (HSM)

The Health and Safety Manager (HSM) has responsibility for writing the Health and Safety Plan (HSP) and ensuring that all URSGWC employees designated to work at the site in the exclusion zone, understand its content and application. The HSM ensures that all URSGWC employees designated to work within the exclusion zone have participated in the 40-hour hazardous waste training course and have received medical clearance.

The HSM shall be responsible for the following:

- Advising the SSO and PM on health and safety matters as well as monitoring compliance. The HSM shall serve as a source of information on safety and occupational health for the SSO.
- Recommending methods of minimizing worksite hazards to the degree necessary to create a safe and healthful worksite.
- Investigating work-related injuries or illnesses and recommend corrective action.
- The HSM has the authority to suspend work when the worksite contains hazards that threaten the health and/or safety of URSGWC field personnel or the public. The HSM may also remove URSGWC individuals from the site for engaging in activities that jeopardize themselves or others.

### 1.2.4 RESPONSIBLE INDIVIDUALS

URSGWC Site workers are as follows:

Project Manager: Diane Mims 510.874.3284

Site Safety Officer: Steve Smykowski 510.874.3180

Oakland Health and Safety Manager: Michael de Bettencourt, CSP 510.874.1710

## 1.3 SUBCONTRACTOR NOTIFICATION

Before they arrive at the site, firms contracted by URSGWC to perform on-site work must be informed of the purpose of the sampling operation. An authorized representative of each firm must be provided a copy of this procedure. Subcontractor personnel must acknowledge and sign this HSP on the Compliance Agreement (Attachment A) form provided.

## 2.1 HEALTH AND SAFETY CLEARANCE

All URSGURSGWC employees as well as subcontractor employees assigned to perform field activities covered by this HSP must be currently approved for hazardous waste field work, including:

- Current medical clearance to conduct hazardous waste field work;
- Completion of training as required by Title 29 Code of Federal Regulations (CFR) 1910.120(e), including either:
  - 40 hours of hazardous waste worker basic instruction within the last 12 months, or,
  - 8 hours of hazardous waste worker refresher training within the last 12 months, subsequent to completion of 40 hours of basic hazardous waste worker training.
- Must have been fit tested with an air-purifying respirator.

## 2.2 SITE SAFETY OFFICER

One URSGURSGWC employee shall be designated Site Safety Officer (SSO). The SSO shall be responsible for ensuring that this procedure is followed and must be present at the work site whenever work under URSGWC control is being performed. The SSO has the authority to suspend work when dangerous conditions are encountered and any other time that unsafe or unhealthy conditions develop.

## 2.3 HEALTH AND SAFETY BRIEFING

Before field work begins, all field personnel, including subcontractor employees, must be briefed on their work assignments and the provisions of this procedure, and each person briefed must be given a copy of this document and each must acknowledge receipt and willingness to comply by submitting a signed safety compliance agreement to the URSGWC Project Manager. Individuals refusing to sign the agreement will be prohibited from working at the site.

## 2.4 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Equipment listed below must be available on-site in appropriate sizes for use when needed.

1. Tyvek coveralls must be worn when conducting sampling in contaminated soil or sediment.
2. Safety goggles or glasses. Must be worn when working within 10 feet of operating heavy equipment (e.g., drill rig, backhoe), or anytime power operated equipment is in use.
3. Nitrile gloves must be worn when handling contaminated soil or sediment.
4. Neoprene or butyl rubber safety boots, calf-length. Must be worn when walking on contaminated sediment. Safety shoes must be worn when working within 10 feet of operating heavy equipment.

5. Hard hat. Must be worn when working within 10 feet of operating heavy equipment or performing sampling activities with a winch, davit arm, or A-frame.
6. Personal floatation device (PFD): During boat operations, type III PFDs must be worn at all times while the boat is in operation or away from the shore and the worker is on deck and at the rail.
7. Leather gloves must be worn when handling wire or rope for soil or sediment sampling activities.

The chemicals of primary concern at this site are petroleum hydrocarbons (toluene, ethyl benzene, xylene), gasoline, metals (arsenic, cadmium, copper, lead, mercury, selenium, and vanadium) and pesticides (alpha-BHC (Lindane) and p',p'-DDT). The exposure limits for the primary chemicals of concern are as follows:

| Chemical of Concern | Exposure Limits | | |
|---|---|---|---|
| | **PEL** | **TLV** | **IDLH** |
| Toluene | 50 ppm | 50 ppm | 500 ppm |
| Ethyl benzene | 100 ppm | 100 ppm | 800 ppm |
| Xylene | 100 ppm | 100 ppm | 900 ppm |
| Gasoline | - | 300 ppm | N.D. |
| Arsenic* | 0.01 mg/m$^3$ | 0.01 mg/m$^3$ | 5 mg/m$^3$ |
| Cadmium | 0.005 mg/m$^3$ | 0.002 mg/m$^3$ | 9 mg/m$^3$ |
| Copper | 0.1 mg/m$^3$ | 0.2 mg/m$^3$ | 100 mg/m$^3$ |
| Lead | 0.05 mg/m$^3$ | 0.05 mg/m$^3$ | 100 mg/m$^3$ |
| Mercury | 0.05 mg/m$^3$ | 0.025 mg/m$^3$ | 10 mg/m$^3$ |
| Selenium | .2 mg/m$^3$ | .2 mg/m$^3$ | 1 mg/m$^3$ |
| Zinc | 0.1 mg/m$^3$ | 0.1 mg/m$^3$ | - |
| alpha-BHC (Lindane) | 0.5 mg/m$^3$ | 0.5 mg/m$^3$ | 50 mg/m$^3$ |
| p',p'-DDT | 1 mg/m$^3$ | 1 mg/m$^3$ | 500 mg/m$^3$ |

* Note: Chemicals known to the State of California to cause cancer or reproductive harm.

PELs are permissible exposure limits established by OSHA. The OSHA PEL's are the recognized levels to which the monitoring at the site will adhere to, if applicable. If there are no PEL's listed, then the TLV will be used as a reference number for exposure.

TLVs are exposure guidelines associated with occupational exposures to various compounds for 8-hour work day/40-hour work week situations, as adopted by the American Conference of Governmental Industrial Hygienists (ACGIH, 1996).

IDLHs are the concentrations to which workers can be exposed continuously for a short period of time (30 minutes) without suffering from irritation, chronic or irreversible tissue damage or narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce efficiency provided that the daily TLV is not exceeded.

## 3.1 PETROLEUM HYDROCARBONS

Petroleum hydrocarbons are not expected to be acutely toxic, but can be irritating to the skin. In general, some fuel oils have flash points of 100 degrees Fahrenheit, with auto-ignition temperatures of 494 degrees Fahrenheit. They are considered to be a moderate fire hazard when exposed to heat, flame or oxidizers. Many petroleum products are proven skin carcinogens in animals and could lead to the development of similar lesions in humans if allowed to remain on the skin for an extended period of time. Obviously, prolonged skin contact should be avoided. Major constituents of petroleum hydrocarbons which are considered health hazards are toluene, ethyl benzene, and xylene. These chemicals are discussed below:

**Toluene**: Toluene (toluol, methyl benzene) is used as constituent in the formulation of automotive and aviation fuels. Toluene is a colorless liquid with an aromatic odor. It is flammable by standard tests in air and is not soluble in water. The major response to toluene at high concentrations is depression of the central nervous system. Olfactory fatigue occurs rapidly upon exposure. Eye irritation occurs around 300 to 400 ppm. The lower explosive limit is 1.3 percent and the upper limit is 7.1 percent.

**Ethyl Benzene**: Ethyl benzene is a colorless, flammable liquid with an aromatic odor. This compound is employed as a solvent and as an intermediate in the production of styrene. Ethyl benzene is also found in automotive or aviation gasoline. Significant amounts of ethyl benzene are also found in mixed xylenes which are used as diluents for paint.

Ethyl benzene toxicity is characterized by its irritancy to the skin, and less markedly, to the mucous membranes. Ethyl benzene is the most sever skin irritant of the benzene series. Symptoms resulting from exposure may include irritation of the eyes, headaches, dermatitis, narcosis and coma.

At 1,000 ppm, ethyl benzene causes distinctive eye irritation and tearing, but tolerance develops rapidly; and at 200 ppm, the vapor has a transient irritant effect on human eyes. No systemic effects are expected at levels producing distinctively disagreeable skin and eye irritation.

Ethyl benzene is incompatible with strong oxidizers and can be a dangerous fire hazard. It has a lower explosive limit of 1.0 percent and an upper explosive limit of 6.7 percent. The odor threshold for ethyl benzene in air is 2.3 ppm and in water is 0.029 ppm.

**Xylene**: Xylene is a clear flammable liquid with an aromatic odor. Commercial xylene is a mixture of the isomers; ortho-, meta- and para- xylene. Xylene mixtures may also contain ethyl benzene and toluene. Xylene is a solvent and a constituent of paint, lacquers, varnishes, cleaning fluids and aviation fuels.

Xylene vapors may cause irritation of the eyes, nose and throat. Skin contact may cause dermatitis. When inhaled at high concentrations the initial signs of exposure may include a flushing or reddening of the face and a feeling of increased body heat, owing to the dilation of the superficial blood vessels. In addition, there may be blurred vision, dizziness, tremors, staggering, drowsiness, salivation, cardiac stress, CNS depression, unconsciousness and eventually coma. Extremely high concentrations may cause pulmonary edema, anorexia, nausea, vomiting and abdominal pain. Pulmonary retention of xylene vapors in human subjects amounts to about 64 percent of the inhaled dose, xylene may also be absorbed through the skin and does not appear to be influenced by the application of barrier creams. Xylene is metabolized to methylhippuric acid which is excreted in the urine and can be used as a biologic indicator of exposure.

Xylene is incompatible with strong oxidizers and can be a dangerous fire hazard. It has a lower explosive limit of 1.1 percent and an upper limit of 7 percent. The odor threshold for xylene in air is about 1 ppm. The odor threshold for meta-xylene in air is 1.1 ppm and in water is 0.017 ppm.

**Gasoline:** Gasoline is a clear, aromatic volatile liquid and comprised of a mixture of aliphatic hydrocarbons. It is incompatible with strong oxidizers such as peroxides, nitric acid and perchlorates. It is mildly toxic by inhalation and presents a very dangerous fire and explosion hazard. It has a lower explosive limit of 1.4 percent and an upper limit of 7.6 percent. Pulmonary aspiration can cause severe pneumonitis. It is also an eye irritant.

## 3.2 METALS

These include arsenic, cadmium, copper, lead, mercury, selenium, silver, and zinc. The following paragraphs gives a brief description of the health hazards associated with metals.

**Arsenic:** Arsenic is a silver-gray or white metallic solid. It is used as an alloying agent for heavy metals, and in solders, medicines, and herbicides. Arsenic enters the body via inhalation and dermal contact. Skin contact can cause irritation, burning, itching, thickening and color changes. Eye contact can cause irritation and burns, red, watery eyes. Breathing arsenic can irritate the nose and throat. High or repeated exposure can damage the nerves, with "pins and needles," numbness, and weakness of arms and legs, as well as stomach problems, nose ulcers, hoarseness, or damage to the liver. High exposures can cause poor appetite, nausea, vomiting and muscle cramps. It has been shown to cause skin and lung cancer. **Arsenic is a known carcinogen, may damage developing fetuses, and in some compounds, a teratogen.**

**Cadmium:** Cadmium is a metal with a variety of industrial uses. Exposure to cadmium dust affects the respiratory system, blood, kidneys, and prostate. Symptoms of chronic and acute exposure include shortness of breath, coughing, chest tightness, pain below the sternum, fluid accumulation in the lungs, headaches, chills and muscle aches, nausea, diarrhea, loss r impairment of the sense of smell, emphysema, and anemia. Cadmium is considered a carcinogen and is known to the State of California to cause cancer or reproductive harm.

**Copper:** Copper is a reddish, malleable solid commonly used in electric wiring, plumbing, roofing, and alloys. The eyes, skin, and respiratory system are target organs of copper. Symptoms of exposure may include irritation of the eyes, nose and respiratory tract and a metallic taste. Exposure to copper at this site is expected to be limited to inhalation of dust particles containing copper. However, the probability of exposure to low due to the low concentration of copper on site.

**Lead:** The primary route of entry for metals, including lead is through inhalation and ingestion via dermal contact. Hand auger sampling could create some dust containing metals. Most metals are relatively nontoxic if ingested and mildly toxic by inhalation and skin contact. Some metals such as lead and mercury can cause central and peripheral nervous system disorders and damage. Long-term exposure to lead has been shown to cause brain damage to children and adults; however, children are more sensitive to the effects of lead.

Lead has been shown to cause damage to the central and peripheral nervous system. Lead exposure in dust and paint has been linked to brain and nervous system disorders in children. Long-term exposure to lead can damage brain cells and nerve cells if ingested or inhaled. Acute toxic symptoms include ataxia, repeated vomiting, headache, stupor, hallucinations, tremors, convulsions, and coma. Lead is a Class B2 carcinogen and is listed as a possible teratogen by the State of California and ACGIH.

**Mercury:** Mercury is a silvery, extremely heavy liquid, soluble in sulfuric acid, nitric acid and lipids. Insoluble in water, alcohol, ether and hydrochloric acid. Most inorganic and organic compounds are highly toxic by skin absorption and inhalation off fume or vapor. Spillage may be a toxic hazard due to droplet proliferation. Clean-up requires special care. Mercury compounds cause dysfunction of the central nervous system, and kidneys and are irritants of the eyes, mucous membranes, and skin. Symptoms of poisoning include numbness and tingling of the lips, hands, and feet, concentric constriction of the visual fields; impairment of hearing and emotional disturbances.

**Selenium:** Elemental selenium and selenium compounds as dusts, vapors, and fumes are irritants of the eyes, mucous membranes and skin. Chronic exposure may cause central nervous system effects, gastrointestinal disturbances and loss of hair and fingernails. Selenium is an amorphous, red powder becoming black on standing and crystalline on heating. Exposure hazard is inhalation.

**Zinc**: Zinc is a shining white metal with bluish-gray luster, soluble in acids and alkalines, insoluble in water. Inhalation of zinc oxide fume causes an influenza-like illness termed metal fume fever. Effects include dryness and irritation of the throat, a sweet or metallic taste, constriction in the chest and a dry cough. Several hours following exposure, the subject develops chills, malaise, fatigue, frontal headache, lower back pain, muscle cramps and occasionally blurred vision, nausea, and vomiting. The symptoms usually last up to 24 hours and occur after exposure to freshly formed fumes. The dust of zinc oxide is considered a nuisance dust that has little adverse effect on the lung and does not produce significant organic disease when exposures are kept under reasonable control. Nickel is a silver-white metal; salts are crystals. Metallic nickel and certain nickel compounds cause sensitization dermatitis. Nickel sensitivity, once acquired, is apparently not lost; recovery usually occurs within 7 days of cessation of exposure but may take several weeks. Nickel dust is flammable and toxic and considered a carcinogen by OSHA. Exposure hazard is inhalation, skin contact.

## 3.3 PESTICIDES

These include alpha-BHC or Lindane and p',p'-DDT. The following paragraphs gives a brief description of the health hazards associated with these compounds.

**Alpha-BHC (Lindane):** It is a white to yellow crystalline powder with a slight musty odor. It is corrosive to metals. It is a poison by ingestion. The target organs it affects are the eyes, skin, respiratory system, central nervous system, blood, liver and kidneys.

**p',p'-DDT:** DDT was one of the most widely used chemicals for the control of insect pests on agricultural crops and for control of insects which carry such diseases as malaria and typhus. DDT does not occur naturally in the environment. The presence of DDT in the environment is generally as a result of contamination due to its past production and used and its subsequent movement from sites of application to land, water, and air. DDT can no longer be used in the U.S. , but is still used in several other areas of the world. It is a colorless crystals or off-white powder with a slight, aromatic odor. It is incompatible with strong oxidizers and alkalis. It is a human poison by ingestion and an experimental poison by skin contact.

## 3.4 ROUTES OF EXPOSURE

The effects of exposure depend not only on the chemical, its concentration, route of entry, and duration of exposure, but also on personal factors, such as an individual's smoking habits, alcohol consumption, medication use, nutrition, age, and sex. There are four major routes of exposure: inhalation, direct contact, ingestion, and injection.

### 3.4.1 Inhalation

Chemicals can enter the respiratory tract through inhalation or breathing. To protect against this hazard, air monitoring will be conducted and if vapor or dust concentrations exceed applicable standards, appropriate protective equipment such as respirators will be employed. Engineering controls including dust suppression or ventilation will also be used as appropriate to reduce exposure to acceptable levels. Chemicals can also enter the respiratory tract through punctured eardrums. Where this is a hazard, individuals with punctured eardrums will be medically evaluated to determine if such a condition would place them at unacceptable risk and preclude their working at the task in question.

### 3.4.2 Direct Contact

Some chemicals can cause injury as a result of direct contact with skin or eyes. Protective techniques such as wearing protective equipment, avoiding use of contact lenses in contaminated atmospheres (since they may trap chemicals against the eye surface), keeping hands away from the face, and minimizing contact with liquid and solid chemicals will be used to protect against the risk of direct skin and eye contact.

### 3.4.3 Ingestion

Deliberate ingestion of chemicals is unlikely, however, personal habits such as chewing gum or tobacco, drinking, eating, smoking cigarettes, and applying cosmetics onsite may provide a route of entry for chemicals. Eating, drinking and/or smoking will not be allowed in the contaminated zone.

### 3.4.4 Injection

The last primary route of chemical exposure is injection, whereby chemicals are introduced into the body through puncture wounds (for example, by stepping or tripping and falling onto a sharp, contaminated object). To protect against this potential hazard, workers will be instructed to wear safety shoes, avoid physical hazards, and take common-sense precautions.

## 3.5 MARINE SAFETY AND BOAT OPERATIONS

This section of the HSP establishes guidelines for the safe conduct of personnel working in the marine environment and personnel operating watercraft during sediment sampling.

Maritime work has the same risks associated with land-side activities and adds the dimensions of drowning, hypothermia, and the energy of wave action. It is an inherently dangerous environment that must be treated with respect. In this project, subcontractors who specialize in the operation of watercraft will be contracted to use the Vibracore to obtain sediment samples, if adequate access to the area can be provided.

### 3.5.1 GENERAL MARINE SAFETY

In general, the two additional hazards that maritime work involves are drowning and hypothermia. All other hazards are generally similar to our land-side activities, and the personal protective equipment requirements are identical (hardhat, safety glasses, hearing protection, steel-toe shoes, etc).

The risk of drowning is mitigated by wearing a personal floatation device. Company employees are required to wear a type III PFD anytime they are aboard a small craft and are outside of an enclosed cabin. The PFD must be readily accessible for personnel inside a cabin. If employees are working aboard a larger vessel (>26 feet in length), a PFD must be readily accessible, but need not be worn unless engaged in activities on an open deck or at the rail.

The risk of hypothermia is mitigated by wearing appropriate insulated floating outerwear when cold weather or cold water is a threat. The wearing of these PFDs is required when the air temperature and the water temperature combined are less than 100 degrees F (38 degrees C), ***and*** when the small craft is less than 26 feet in length. When the working platform is larger than 26 feet, the wearing of a mustang suite is at the discretion of the site supervisor and site workers.

### 3.5.2 OPERATING LIMITATIONS

URSGWC personnel may perform work form a boat under the following conditions:

- The boat used for the work must be appropriate to the type of work and suitable for safe carriage of the workers necessary for the task.
- The work site must be located in a protected area like a bay, sound, lake, or body of water that is protected from open-sea weather conditions.
- The work site must be within sight of land, and in no case more than 5 miles from shore.
- All operations will be completed in daylight hours under reasonable weather conditions with good visibility.
- The operator of the boat must have sufficient experience and knowledge to be competent in the operation of the boat at the work site location.
- The boat and personnel must be properly equipped as specified below.

## 3.6 PROTECTIVE MEASURES FOR SAMPLING

Prior to conducting sampling, an understanding of activities to be performed and procedures in which to perform them must be communicated between all personnel on-site.

During sampling, personnel must be aware of slippery or hot surfaces, electrically energized sources and when handling heavy parts and equipment.

Proper care should be taken to avoid vehicle contamination during transport of samples to the analytical chemistry laboratory. If the samples are to be transported in an ice chest or similar container, the container should not be taken to the sampling areas. If the container must be taken to sampling areas, the outside must be thoroughly washed before the container is placed in the transport vehicle. If there is any possibility that the sample bottles, bags, or wrapping are contaminated, the analytical laboratory should be notified.

Non-disposable equipment used on-site must either be decontaminated on-site or placed in secure containers and decontaminated off-site. Disposable equipment, including respirator cartridges, must be placed in heavy plastic bags and disposed of off-site in an approved manner.

New gloves should be used at the beginning of each work day and for each sample obtained. Respirator face pieces are not necessary for this site, but if used, should be washed, dried, inspected for missing parts, and stored in clean plastic bags at the end of the work day.

Dust control should be used to minimize airborne dust levels. Should visible dust levels not be possible to control, work must stop or respirators using HEPA cartridges must be donned.

The following air monitoring activities and action levels will apply to the soil sampling events. A photo-ionizing detector (PID) shall be used to monitor sampling locations for airborne contaminants and potential airborne vapors. If PID readings of twenty (20) ppm above background near the sampling locations are sustained for 10 minutes, the breathing zone of the person working closest to the source shall be monitored. If meter readings of five (5) ppm above background are detected in the operating breathing zone, the area should be evacuated.

| Instrument Reading | Action |
|---|---|
| Excavation 50 ppm | Monitor operator breathing zone |
| Breathing zone 20 ppm | Leave sampling area |

The PID shall be calibrated to iso-hexane. Because the PID responds to various chemicals differently, a relative response percentage has been established to indicate the percent at which a particular chemical is being detected.

## 4.1 PERSONNEL DECONTAMINATION

Soil and sediment must be washed from hands and face. Workers must wash their hands before eating, drinking, or smoking. Good personal hygiene is necessary to avoid ingestion of contaminated sediment.

## 4.2 EQUIPMENT DECONTAMINATION

Contaminated gloves, hard hats, boots and goggles should be thoroughly cleaned with detergent and water or disposed of as appropriate. All equipment subjected to contamination should be rinsed with water. If boots do not become clean after washing with detergent and water, wash them with a strong solution of trisodium phosphate and hot water. Respirators should be cleaned as above, and then cleaned in accordance with proper maintenance protocols.

Sampling equipment should be steam or high pressure washer cleaned. The steam cleaner is a convenient source of hot water for personnel and protective equipment cleaning.

Eating and drinking is prohibited during sampling activities. All workers must wash hands and remove external PPE before eating, drinking, or smoking.

Work shall be suspended when:

- Unsafe weather conditions for working on or near the water exist
- Unusual odors are detected in the sediment.
- Symptoms of possible exposure occur in any individual while on the job (symptoms include eye, throat, or skin irritation; nausea, dizziness, light-headedness, blurred vision, muscular uncoordination, and vomiting).

Upon suspending work, the SSO will direct the field personnel under URSGWC control to move to a safe place. The SSO shall then inform the Project Manager and HSM of the reasons why work was suspended and wait for instructions.

In the event of an injury accident or when exposure results in illness or other bodily harm, the injured person or another informed person should notify the SSO.

If the injury is moderate or severe, the SSO should call 9-1-1, and ask for emergency assistance. The caller should describe the injury or illness and answer all questions asked by the person answering the telephone. The person should not hang up until the other person hangs up.

If the injury or illness appears minor, the affected person may be driven to the nearest emergency hospital. The emergency ward of the hospital should be contacted before or while the affected person is en route and informed that the person will be arriving. The hospital should be informed of the nature of the illness or injury. The name, address, and telephone number of and the directions to the nearest emergency hospital are:

Doctors Medical Center
200 Vale Road
Richmond, CA 94806
(510) 970-5000

**Directions: See Figure 7-1.**

S. 46th St. to Seaver Ave. Right on Seaver Ave., left on S. 47th, left on Meade St. Right on Erlandson St. to S. 31st St., right on Cutting Blvd., left onto Carlson Blvd. to 23rd St. Right onto McBryde Ave., left on 29th St. which becomes Vale Road.

### *Emergency Phone Numbers:*

| | |
|---|---|
| Ambulance: | 911 |
| Fire Department: | 911 |
| Police Department: | 911 |

## 7.1 EMERGENCY RESPONSE PROCEDURES

The Project Manager, with assistance from the SSO, has responsibility and authority for coordinating all emergency response activities until proper authorities arrive and assume control. The Project Manager will also coordinate emergency response activities with local emergency response personnel.

### *Emergency Medical Treatment*

If an employee working in a contaminated area is physically injured, Red Cross first aid procedures will be followed. The SSO shall be trained in CPR and First Aid. However, other field personnel may also be certified and available to assist in emergency treatment. Depending on the severity of the injury, emergency medical response may be sought. If the employee can be moved, he/she will be taken to the edge of the work area (on a stretcher, if needed) where contaminated clothing will be removed (if possible) and emergency first aid administered, and then he/she will be transported to the hospital. Directions to the hospital are shown in Figure 7-1.

### *Emergency Medical Procedures*

For severe injuries, illnesses, or overexposure:

- Remove the injured or exposed person(s) from immediate danger.
- If possible, at least partial decontamination should be completed. Wash, rinse, and/or cut off protective clothing and equipment and redress the victim in clean coveralls.
- If decontamination cannot be done, wrap the victim in blankets or plastic sheeting to reduce contamination of other personnel.
- Render emergency first aid and call an ambulance for transport to the local hospital immediately. The chemical hazard information included in Section 4.0 should be sent with the victim to the hospital.
- Evacuate other personnel on site to a safe place until the SSO determines that it is safe to resume work.
- Report the accident to the PM and HSO immediately and complete an incident report.

For minor injuries or illnesses:

- Complete a full decontamination.
- Administer first aid. Minor injuries may be treated on site, but all injuries will be examined by trained medical personnel. Victims of serious bites or stings will be taken to a medical center.
- Notify the PM and HSO immediately.

### *First Aid - Chemical Injury*

If the injury to the worker is chemical in nature (e.g., overexposure), the following first aid procedures are to be instituted as soon as possible:

| | |
|---|---|
| Eye Exposure | If contaminated solid or liquid gets into the eyes, wash eyes immediately with sterile saline solution, lifting the lower and upper lids occasionally. Continue eye wash for 15 minutes. Cover the eye with a dry pad and obtain medical attention immediately. (Contact lenses are not permitted in the exclusion zone.) |
| Skin Exposure | If contaminated solid or liquid gets on the skin, promptly wash contaminated skin for 15 minutes using soap or mild detergent and water. If solids or liquid penetrate the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medical attention immediately if symptoms warrant. |

### *First Aid - Physical Injury*

| | |
|---|---|
| Animal Bites | Thoroughly wash the wound with soap and water. Flush the area with running water and apply a sterile dressing. Immobilize affected part until the victim has been attended by a physician. See that the animal is kept |

| | |
|---|---|
| | alive and in quarantine. Obtain name and address of the owner of the animal. |
| Burns (minor) | Do not apply vaseline or grease of any kind. Apply cold water applications until pain subsides. Cover with a wet sterile gauze dressing. Do not break blisters or remove tissue. Seek medical attention. |
| Burns (severe) | Do not remove adhered particles of clothing. Do not apply ice or immerse in cold water. Do not apply ointment, grease or vaseline. Cover burns with thick sterile dressings. Keep burned feet or legs elevated. Seek medical attention immediately. |
| Cuts | Apply pressure with sterile gauze dressing, and elevate the area until bleeding stops. Apply a bandage and seek medical attention. |
| Eyes | Keep the victim from rubbing the eye. Flush the eye (foreign objects) with water. If flushing fails to remove the object, apply a dry, protective dressing and consult a physician. |
| Fainting | Keep the victim lying down with feet elevated. Loosen tight clothing. If victim vomits, roll him onto his side or turn his head to the side. If necessary wipe out his mouth. Maintain an open airway. Bathe his face gently with cool water. Unless recovery is prompt, seek medical attention. |
| Fracture | Deformity of an injured part usually means a fracture. If fracture is suspected, splint the part as it lies. Do not attempt to move the injured part of the person. Seek medical attention immediately. |
| Snake Bites | Submerge the bite area in ice water or cover the bite area with ice. Keep the bite area as low as possible. Transport the victim immediately to a medical facility. |
| Insect Bites | Remove "stinger" if present. Keep affected part down below the level of the heart. Apply ice bag. For minor bites and stings apply soothing lotions, such as calamine. |
| Puncture Wounds | If puncture wound is deeper than skin surface, seek medical attention. Serious infection can arise unless proper treatment is received. |
| Sprains | Elevate injured part and apply ice bag or cold packs. Do not soak in hot water. If pain and swelling persist, seek medical attention. |
| Unconsciousness | Do not attempt to give any fluid or solid by mouth. Keep victim flat, maintain an open airway. If victim is not breathing, provide artificial |

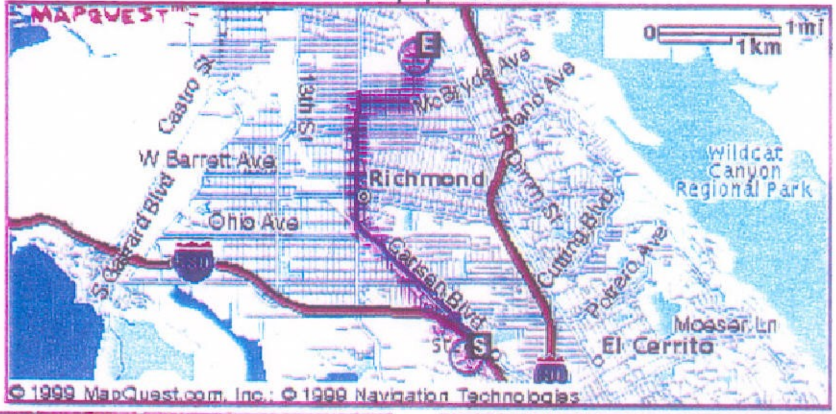
Form HS-102 must be completed and delivered to the HSM for each accident or incident involving URSGURSGWC personnel. The form is available from the HSM.

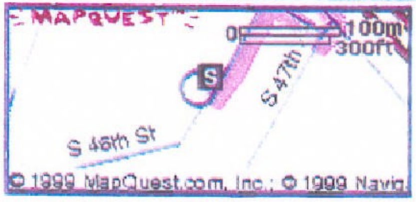
# Doctors Medical Center
2000 Vale Road
Richmond, CA 94806

Figure 7-1
Map From Site to Hospital

MAPQUEST

www.mapquest.com





**Start**
1301 South 46th St
Richmond, CA

**Destination**
2000 Vale Rd
Richmond, CA

## Door to Door Directions

| | |
|---|---|
| **From:** | 1301 South 46th St<br>Richmond CA |
| **To:** | 2000 Vale Rd<br>Richmond CA |

| Direction | Distance |
|---|---|
| **1:** Start out going Northeast on S 46TH ST towards SEAVER AVE by turning left. | 0.1 miles<br>(0.1 km) |
| **2:** Turn RIGHT onto SEAVER AVE. | 0.0 miles<br>(0.1 km) |
| **3:** Turn LEFT onto S 47TH ST. | 0.0 miles<br>(0.0 km) |
| **4:** Turn LEFT onto MEADE ST. | 0.3 miles<br>(0.5 km) |
| **5:** Turn RIGHT onto ERLANDSON ST. | 0.5 miles<br>(0.8 km) |
| **6:** Turn SLIGHT RIGHT onto S 31ST ST. | 0.1 miles<br>(0.1 km) |
| **7:** Turn RIGHT onto CUTTING BLVD. | 0.1 miles<br>(0.1 km) |
| **8:** Turn SHARP LEFT onto CARLSON BLVD. | 0.7 miles<br>(1.1 km) |
| **9:** Stay straight to go onto 23RD ST. | 1.0 miles<br>(1.6 km) |
| **10:** Turn RIGHT onto MCBRYDE AVE. | 0.5 miles<br>(0.8 km) |
| **11:** Turn LEFT onto 29TH ST. | 0.4 miles<br>(0.6 km) |
| **12:** 29TH ST becomes VALE RD. | 0.0 miles |

| | |
|---|---|
| | (0.0 km) |
| **Total Distance:** | 3.7 miles (6.0 km) |
| **Estimated Time:** | 11 minutes |

Calculate New Directions

"These directions are informational only. No representation is made or warranty given as to their content, road conditions or route usability or expeditiousness. User assumes all risk of use. MapQuest and its suppliers assume no responsibility for any loss or delay resulting from such use."

URSGWC Project Name: UCB Richmond Field Station

URSGWC Project Number: 5109967067.00

Project Manager: Diane Mims

Site Safety Officer: Steve Smykowski

Health and Safety Manager: Michael de Bettencourt

Date of Issue: 10 December, 1999

**APPROVALS**

Pearl Peller for 12/10/99.

Michael de Bettencourt, CSP
Health and Safety Manager, Oakland

Date

12/10/99

Mark Litzinger
Regional Health and Safety

Date

Diane K. Mims 12-10-99

Diane Mims
Project Manager

Date

# Attachment A
# Compliance Agreement

# URS Griener Woodward Clyde
# Health and Safety Compliance Agreement

I have reviewed a copy of the health and safety plan and I have received a safety briefing for the UCB Richmond Field Station Soil and Sediment Sampling in Richmond, California. I have read the plan, understand it, and agree to comply with the requirements therein. I understand that I may be prohibited from continuing work on the project for failing to comply.

| Printed Name | Signature | Date |
|---|---|---|
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# Attachment B
# Injury/Incident Reporting (Hs Sop 102)

# INJURY/INCIDENT REPORTING
## Health and Safety Operating Procedure 101

## PURPOSE

This health and safety operating procedure (HSOP) provides guidance in the timely preparation of injury/incident reports. Prompt reporting is critical for effective accident investigation and implementation of prompt corrective action. Timely reporting also helps compliance with regulatory requirements and helps reduce company liability.

## SCOPE

This HSOP applies to all URS Greiner Woodward Clyde (URSGWC) employees.

## EMPLOYEE CERTIFICATION/TRAINING REQUIREMENTS

All employees will receive a briefing on the requirements of this HSOP.

## RESPONSIBILITIES

*Any employee* who suffers a work-related injury or illness, is involved in an accident, or who observes a reportable incident shall immediately notify his or her supervisor or company health and safety representative. The employee will, if asked by his or her manager or health and safety representative, complete a health and safety injury/incident report (attached).

If the employee is unable to complete the injury/incident report, it may be completed by the *line supervisor, project manager, or health and safety representative*.

## DEFINITIONS

*Reportable Incident.* A reportable health and safety incident is any of the following:

- An injury to any URSGWC worker or subcontractor even if the injury does not require medical attention
- An injury to a member of the public occurring on a URSGWC work site or possibly resulting from a URSGWC or subcontractor activity or involving URSGWC or subcontractor property, equipment, or resource
- Illness resulting from suspected chemical exposure
- Fire, explosion, or flash

- Vehicle accidents occurring on site, while traveling to and from client locations, or with any company-owned or leased vehicle
- Property damage resulting from any URSGWC or subcontractor activity
- Structural collapse or potential structural hazards
- Equipment failure, damage, or improper operation
- Personal protection equipment (PPE) failure, malfunction, damage, or improper use
- Unexpected release or imminent release of a hazardous material
- Unexpected chemical exposures to workers or the public
- Infractions or violations of health and safety rules or plans
- A complaint from the public regarding any URSGWC activity

*Major Incident.* A major incident is one that involves a fatality, hospitalization of a URSGWC or subcontractor employee, or any illness or injury to a member of the public that is related to any URSGWC activity.

## PROCEDURES

### Reportable Incidents

The following actions are to be taken within the specified time frame following all reportable incidents (see definition above).

**Employees**

- If necessary, suspend operations and secure and/or evacuate the area.
- Notify your supervisor, project manager (if applicable), human resources representative, and local health and safety representative within 24 hours of occurrence.
- Record information pertaining to the incident (e.g., time, date, location, name and company of person(s) involved, description of event, and actions taken).
- If directed by management, complete injury/incident report (attached)

- Assist with incident investigation (as directed by management).
- Implement corrective actions as directed by management.
- *Do not* discuss the incident with members of the news media or legal representatives (except URSGWC legal counsel or your personal legal advisor) unless directed to do so by URSGWC management.
- *Do not* make statements pertaining to guilt, fault, or liability.

**Line/Project Management**

- Review circumstances of the incident with applicable employee(s).
- Verify that representatives of the health and safety and human resources departments have been notified of the incident.
- Verify that an injury/incident report is completed. (Note: If the employee is unable to complete the report, another company employee, line manager, project manager, or local health and safety representative may complete the report.)
- Review and verify that necessary corrective actions are identified and implemented.
- When appropriate, discuss with department or project staff the circumstances surrounding the incident and corrective actions taken.
- If necessary, notify client of incident and corrective actions.

**Local Health And Safety Representative**

- Assist with incident evaluation.
- With management, identify cause(s) of incident and identify corrective actions needed to avoid recurrence.
- Review injury/incident report for completeness and accuracy.
- Forward a copy of the injury/incident report to the regional health and safety manager and, when appropriate, to a representative of the human resources department.

- Verify that corrective actions are implemented.
- When necessary, notify the Occupational Safety and Health Administration (OSHA) or applicable regulatory agency of the incident (see Major Incidents section, below).

**Local Human Resources Representative**

- Report work-related injuries and illness to worker compensation carrier.
- Identify injuries and illnesses that are OSHA recordable. (Note: All work-related illnesses are OSHA recordable.)
- Track and record lost time and/or work restriction days.
- Maintain OSHA 200 log.

## Major Incidents

A formal investigation will be conducted for all major incidents. In addition to the procedures identified above, the following actions shall be taken for major accidents.

**Employees**

- Stop work; secure and/or evacuate the area.
- Without placing yourself in danger, assist injured personnel and/or implement spill control procedures.
- If necessary, summon emergency assistance.
- *Immediately notify* management and the local health and safety representative.

**Line/Project Management**

- Verify that local health and safety representative has been notified.
- Notify client or client's representative.
- Assist with formal incident investigation.

**Operations Manager**

- Notify upper management and corporate legal counsel.
- If necessary, serve as company spokesperson.

- Participate in formal incident investigation.
- Verify that corrective actions are implemented.

**Local Health And Safety Representative**

- Record pertinent data as they becomes available.
- Notify regional health and safety manager.
- If necessary, notify OSHA or applicable regulatory agency. (Note: OSHA, or the applicable state authority, *must be notified* within 8 hours of all work-related fatalities or accidents resulting in the hospitalization of three or more workers.)
- When requested, assist with formal incident investigation.

**Regional Health And Safety Manager**

- Notify corporate health and safety director.
- Verify that upper management and corporate legal counsel have been informed of the incident.
- Verify that OSHA or applicable regulatory agency has been notified.
- Serve as lead for the incident investigation team.
- Submit incident investigation report to upper management.

**Human Resources Department**

- If necessary, notify immediate family of incident.
- If necessary, coordinate benefits with insurance carrier.

# INJURY/INCIDENT REPORT

**ADMINISTRATION INFORMATION:**

Project Name: ____________________

Project Number: ____________________

Date/Time of Incident: ____________________

Location: ____________________

____________________

**For Injuries/Illnesses:**

Name of Injured Employee:

____________________

Age: _____ Sex: ____ SSN: __________

Nature of Injury: ____________________

See a Doctor? ☐ Yes ☐ No

**TYPE OF INCIDENT (Check all applicable items)**

☐ Illness

☐ Unexpected Exposure

☐ Health and Safety Infraction

☐ Fire, Explosion, Flash

☐ Property Damage

☐ Other (describe) ____________________

☐ Injury

☐ Vehicular Accident

**DESCRIPTION OF INCIDENT** (Describe what happened and possible cause. Identify individuals involved, witnesses, and their affiliations. Attach additional sheets, drawings, or photographs as needed.)

____________________

____________________

____________________

____________________

____________________

Description of Corrective Action: ____________________

____________________

____________________

____________________

**REPORTED BY:** Print Name: ____________________ Signature: ____________________

Date: ____________________

Reporter must deliver this report to the operating unit health and safety representative within 24 hours of the reported incident for medical treatment cases and within 5 days for other incidents.

**REVIEWED BY:** ____________________ ______________

Supervisor Date

____________________ ______________

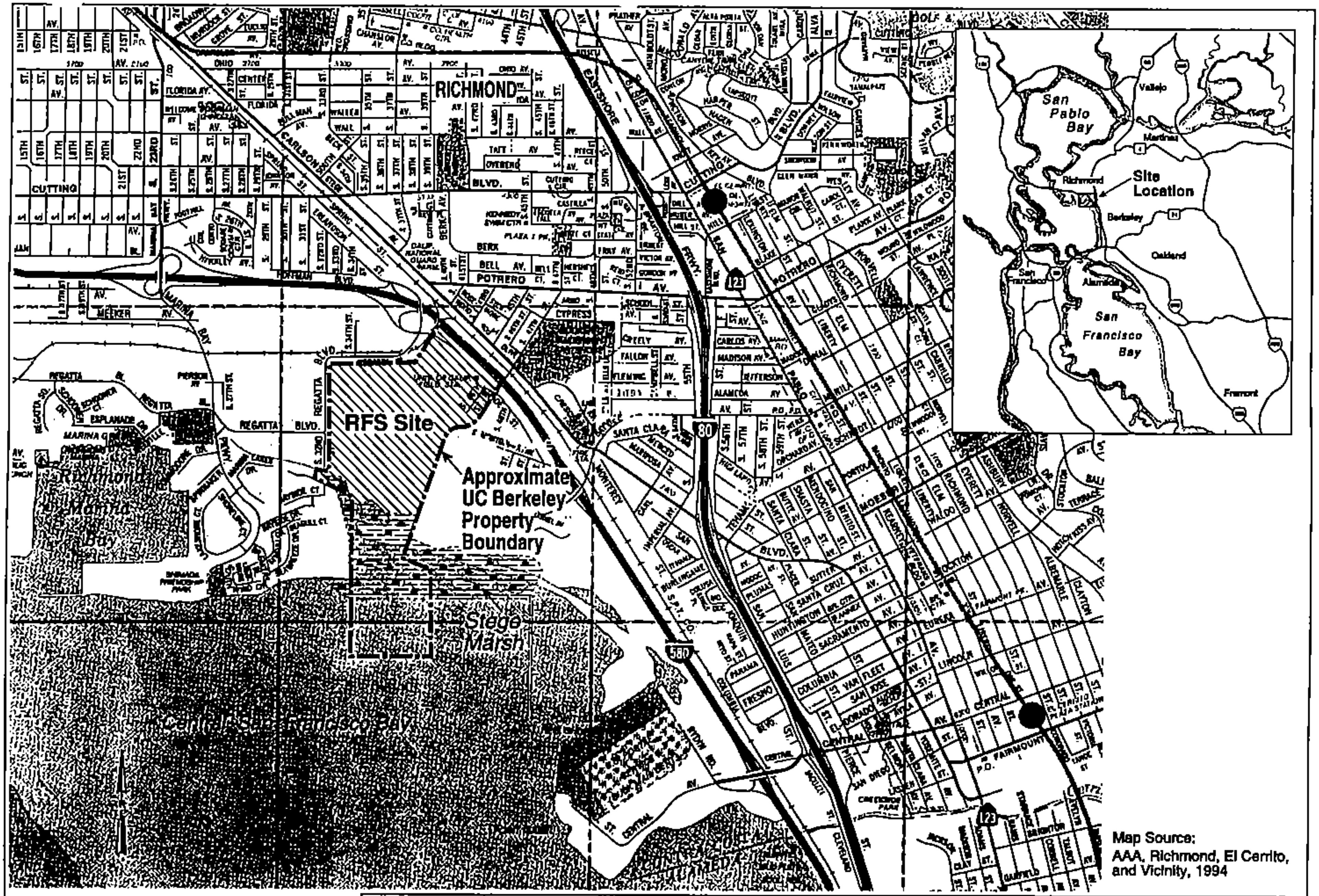
Health and Safety Representative Date

Distribution by HSO:

- Regional Health and Safety Manager
- Corporate Health and Safety Director
- Project Manager
- Human Resources Office (injury/illness cases only)

OSHA Recordable?

☐ Yes ☐ No



Map Source:
AAA, Richmond, El Cerrito, and Vicinity, 1994

Project No.
51-09967067.00

University of California, Berkeley
Richmond Field Station

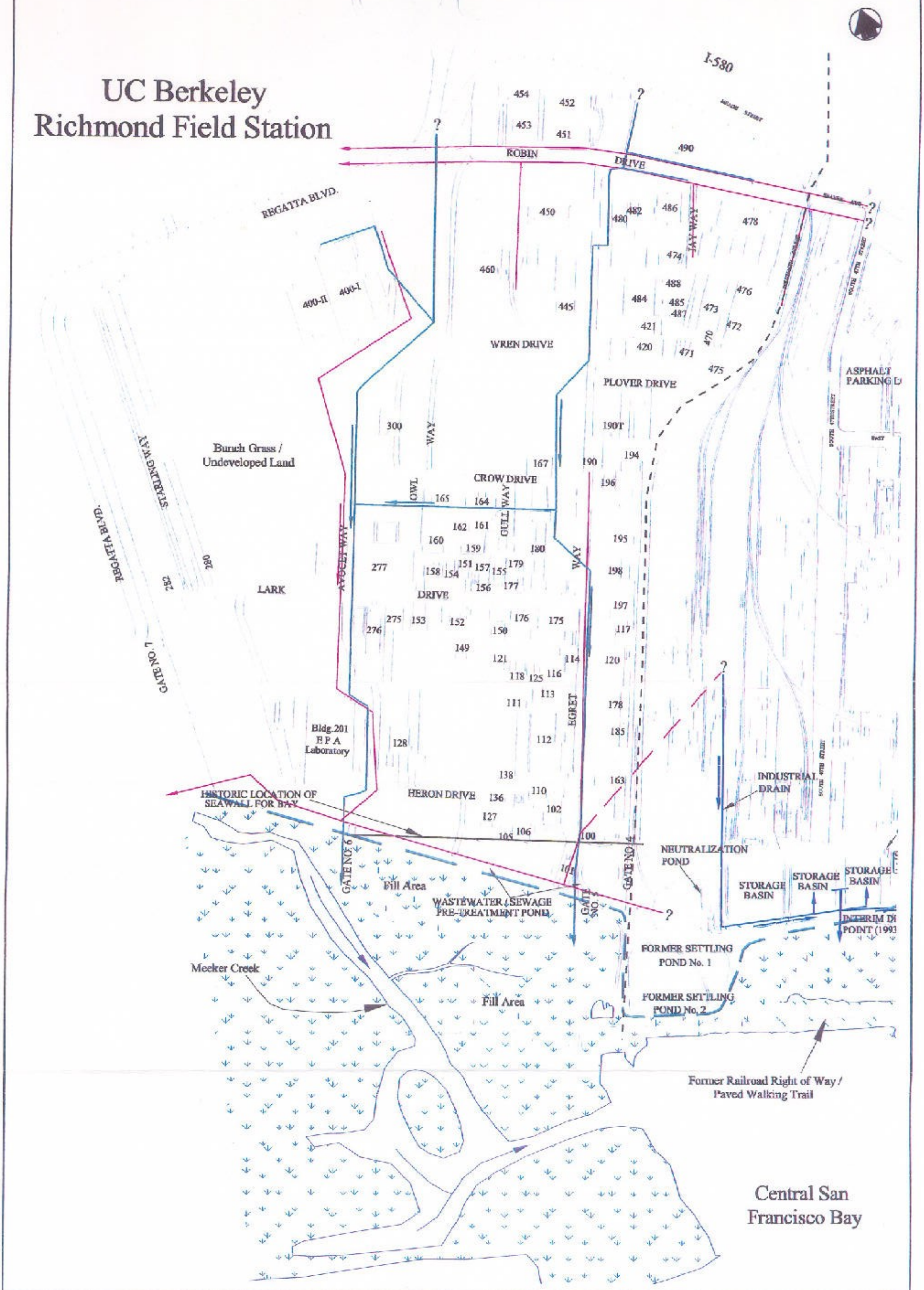
**URS Greiner Woodward Clyde**

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
SITE LOCATION MAP

Figure
1

51-09967067.00-00001/120499/gos

# UC Berkeley
# Richmond Field Station



**LEGEND**

- Storm Drain System (Approximate)
- Industrial Drain (Approximate)
- Sanitary Sewer System (Approximate) (dashed line to be verified)
- Approximate Location of former Sea Wall
- Approximate Property Boundary
- Edge of Water
- Surface Water Fow Direction
- 111 Building Identification Number
- Approximate Edge of Marsh
- Stege Marsh

NOTES :

1. Marsh Features and Sloughs are Approximate.

Project No.
51-0967067.00

x:/gis/ucb-rfs/rfs-plan.apr

**University of California, Berkeley**
**Richmond Field Station**

*URS Greiner Woodward Clyde*

Site Layout
Richmond Field Station

| November 1999 | Scale 1" = 300' | Figure 3 |
|---|---|---|

# APPENDIX B

# Appendix B

## Standard Operating Procedure (SOPs)

# STANDARD OPERATING PROCEDURE

## GROUNDWATER & SURFACE WATER SAMPLING

URS Corporation

Oakland, CA

University of California

Richmond Field Station

Disclaimer: This Standard Operating Procedure has been prepared for the sole use of URS Corporation and may not be specifically applicable to the activities of other organizations.

# TABLE OF CONTENTS

Section | Page

LIST OF FIGURES

## 1.0

## PURPOSE AND SCOPE

This document defines the standard procedure for collecting groundwater and surface water samples. This Standard Operating Procedure (SOP) serves as a supplement to the Field Sampling & Analysis Plan (FSAP) and Quality Assurance Plan (QAP). This procedure gives descriptions of equipment, field procedures, and Quality Assurance/Quality Control (QA/QC) procedures necessary to collect groundwater and surface water samples. The sample locations and frequency of collection are specified in the FSAP.

This SOP is intended to be used together with the FSAP, QAP, and several other SOPs. Health and safety procedures and equipment that will be required during the investigation are detailed in the Health and Safety Plan (HSP).

# 2.0

# GROUNDWATER SAMPLING PROCEDURES

## 2.1 EQUIPMENT LIST

The following equipment will be used during well purging and sampling activities:

- Well keys
- Water level indicator (oil/water probe if appropriate)
- Assorted tools (knife, screwdriver, etc.)
- PTFE (Teflon™ ) or stainless steel bailer (bottom filling for sampling and/or purging)
- Teflon, stainless steel submersible pump or centrifugal pump
- Nylon rope or twine
- PVC pump discharge hose
- Thermometer, pH meter (with automatic temperature compensation) and conductivity meter or meter containing a combination of these three
- Plastic squeeze bottle filled with deionized water
- Polyethylene or glass container (for field parameter measurements)
- Paper towels or Kimwipes
- Calculator
- Field notebook
- Waterproof and permanent marker
- 55-gallon drum or holding tank for storing purged water (if necessary)
- Plastic sheeting (for placing around well)

- Appropriate health and safety equipment as specified in the Health and Safety Plan (HSP)
- Well completion information sheet
- Appropriate decontamination equipment as specified in the decontamination SOP
- Generator or other power source
- Sample jars and labels. Sample bottles with preservatives added will be obtained from the analytical laboratory. Several extra sample bottles will be obtained in case of breakage or other problems.
- Water sample collection form
- Well completion information sheet

## 2.2 SAMPLING PROCEDURES

This section gives the step-by-step procedures for collecting groundwater samples in the field. Observations made during sample collection will be recorded in the field notebook and field data sheet.

### 2.2.1 Equipment Decontamination

Before any purging or sampling begins, all well probes, bailers, and other purging or sampling equipment will be decontaminated following the procedures specified in the Decontamination SOP.

### 2.2.2 Instrument Calibration

Before going into the field, the sampler shall verify that field instruments are operating properly. The pH and conductivity meters require daily calibration prior to use. Calibration times and readings will be recorded in a notebook to be kept by the field sampler. Calibration of the instruments will be conducted in accordance with the manufacturers specifications.

### 2.2.3 Well Purging

The purpose of well purging is to remove stagnant water from the well so that a sample of water representative of the aquifer (or portion of aquifer) can be obtained while minimizing disturbance of the aquifer. Before a sample is taken, the well will be purged until a minimum of five well volumes have been removed and field parameters have stabilized or until the well is pumped or bailed dry. All wells shall be purged on the same day that samples are taken.

Before well purging begins, the following procedures will be performed at each well:

- The condition of the outer well casing, concrete well pad and protective posts (if present), and any unusual conditions of the area around the well will be noted in the field logbook.
- Clean plastic sheeting will be placed around the well.
- The well will be opened.
- The condition of the inner well cap and casing will be noted.
- The depth of static water level will be measured (to nearest 0.01 foot) and recorded from a permanent easily identified measuring point on the well casing (e.g., notch on north side, top of PVC well casing), the time of measurement will be indicated.
- The total well depth will be measured and recorded from the same permanently identified point on the well casing.
- The volume of water in the well casing will be calculated in gallons based on feet of water and casing diameter. (See Section 2.3.2 for calculation of volumes.)
- From the above calculation, the five well casing volumes to be removed will be calculated.
- An initial sample will be obtained from the bailer or purge pump for field measurements of temperature, conductivity, and pH, and for observation of water quality. This sample will not be retained after these initial measurements are recorded. A dedicated pump lift pipe or tubing will be used if wells are purged with a pump. Dedicated line will be used if wells are purged with a bailer.

- Five volumes of water in the well casing will be evacuated with a bailer or pump. Temperature, conductivity, and pH measurements will be taken after evacuation of each well volume to determine whether the water chemistry has stabilized. This information will be recorded on the Groundwater Sampling Forms (Figure 1).
- When evacuating a well using a pump, the pump intake should be placed:
  - at the bottom of the screened interval, for low recovery wells (wells that can be pumped dry).
  - at the top of the water column, for high recovery wells (little drawdown with pumping).
- If the well is bailed or pumped dry during evacuation, it will be assumed that all stagnant water has been removed and the well is ready to be sampled. If recovery is very slow, samples may be obtained as soon as sufficient water is available in the well.

### 2.2.4 Sample Collection

Samples for chemical analysis will be collected within eight hours after purging is completed. For slow recovering wells, the sample shall be collected immediately after a sufficient volume is available. The samples shall be taken from the depth specified in the FSAP. The following sampling procedure is to be used at each well:

- Decontaminated sampling equipment will be assembled. If bailers are not dedicated new nylon rope will be used for each well for each sampling event.
- Identification labels for sample bottles will be filled out for each well.
- Don a new pair of disposable gloves.
- The bailer will be lowered slowly and <u>gently</u> into contact with the water in the well. If additional volume of water is required to fill all the sample containers, the bailer will be lowered to the same depth in the well each time.
- The bailer will be retrieved smoothly and the water will be slowly drained into the sample containers.

- The individual sample bottles should be filled in the order given below:
    - Volatile organic compounds (VOCs)
    - Semivolatiles organic compounds (SVOCs)
    - Dioxins/Furans
    - Pesticides/PCBs
    - Petroleum Hydrocarbons
    - Herbicides
    - Metals
    - Field test parameters (pH, specific conductance and temperature)

  VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles in the vial which indicate air space. If air bubbles are observed in the sample vial, discard the sample vial and repeat the procedure until no air bubbles appear.
- Time of sampling will be recorded.
- The well cap will be replaced and locked.
- Field documentation will be completed, including the chain-of-custody (see Description of Sampling Points and Sample Identification, Handling and Documentation SOP).

### 2.2.5 Field Quality Assurance/Quality Control Procedures and Samples

The well sampling order will be dependent on expected levels of contamination in each well, if known, and will be determined prior to sampling. Sampling will progress from the least contaminated well to the most contaminated.

Field QA/QC samples are designed to help identify potential sources of sample contamination and evaluate potential error introduced by sample collection and handling. The frequency of collection and types of QA/QC samples required are indicted in the QAP. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

## 2.3 SAMPLE IDENTIFICATION, HANDLING AND DOCUMENTATION

Samples will be identified, handled, and recorded as described in this SOP and the Description of Sampling Points and Sample Identification, Handling and Documentation SOP.

### 2.3.1 Groundwater Sampling Form

A sampling form for groundwater samples (Figure 1) will be completed at each sampling location. The data sheet will be completely filled in. If items on the sheet do not apply to a specific location, the item will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Weather conditions
- Location and well number
- Condition of the well
- Decontamination information
- Initial static water level and total well depth
- Calculations (e.g., calculation of purged volume)
- Analyses that will be performed by the laboratory
- Well number
- Date and time of sampling
- Person performing sampling
- Volume of water purged before sampling
- Conductivity, temperature, and pH during evacuation (note number of well volumes)

- Number of samples taken
- Sample identification number
- Preservation of samples
- Record of any QC samples from site
- Any irregularities or problems that may have a bearing on sampling quality

### 2.3.2 Well Volume Calculations

The following equation shall be used to calculate the volume of water to be removed during well

$$Vol.\ of\ casing\ water\ (gal) = 12\ \frac{inches}{ft} x water\ col.\ (ft.) x \pi x (well\ radius)^2 x 0.0043\ \frac{gal}{inches^3}$$

$$Vol.\ of\ annulus\ water\ (gal) = 12\ \frac{inches}{ft} x water\ col.\ (ft.) x \pi x$$

$$[(bore. radius)^2 (well\ radius)^2] x 0.0043\ \frac{gal}{inches^3} x 0.3$$

$$where\ 0.3 = assumed\ porosity\ of\ filter\ pack$$

evacuation:

Multiply the volume of one well casing volume by five (5) to obtain the minimum volume of water to be evacuated.

# SOP NO. 7

# FIGURES

## GROUNDWATER SAMPLING FORM

**CLIENT** ______________________ **DATE** ______________________

**LOCATION** ______________________ **SAMPLING TEAM** ______________________

**PROJECT NO.** ______________________ **WEATHER** ______________________

| Well ID | Well Depth (feet) | Time/Depth to Water (feet) Before Purge | After Purge | Before Sample | Casing Diameter (inches) | Volume to be Removed (gal.) | Pumping Rate (gal./min.) | Pumping Time (min.) | Actual Volume Removed (gal.) | pH | Temperature (°F) | Conductivity (umbos/cm) | FID/PID Reading | Analytical Parameters | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

2 in. = 0.16 gal/ft
4 in. = 0.65 gal/ft
8 in. = 2.61 gal/ft
12 in. = 5.87 gal/ft
3 in. = 0.37 gal/ft
6 in. = 1.47 gal/ft
10 in. = 4.09 gal/ft

FIGURE 1

GROUNDWATER SAMPLING FORM

# STANDARD OPERATING PROCEDURE

URS Corporation

Oakland, CA

University of California

Richmond Field Station

**<u>Disclaimer:</u>** **This Standard Operating Procedure has been prepared for the sole use of URS Corporation and may not be specifically applicable to the activities of other organizations.**

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LIST OF FIGURES

# 1.0

# PURPOSE AND SCOPE

The purpose of this document is to define the standard procedure for collecting soil samples at different depths in the subsurface. This Standard Operating Procedure (SOP) serves as a supplement to the Field Sampling & Analysis Plan (FSAP) and Quality Assurance Plan (QAP). These procedures give descriptions of equipment, field procedures, and QA/QC procedures necessary to collect soil samples. The sample locations and frequency of collection are specified in the QAP. These procedures are intended to be used together with the FSAP and several other SOPs.

## 2.0

## PROCEDURES

Samples of soil and unconsolidated materials will be collected using a drill rig assisted 2-inch O.D. stainless steel split-spoon sampler.

### 2.1 EQUIPMENT LIST

The following list of equipment may be needed to collect soil samples:

- Measuring tape - 100 feet
- Ruler marked in 1/10 feet divisions
- Field books/field sheets
- Stainless steel knife
- Sample bottles provided by the laboratory
- Sample bottle labels
- Label tape (clear)
- Paper towels
- Camera and film
- Waterproof and permanent marking pens
- Plastic sheeting
- Plastic bags
- Appropriate health and safety equipment, as specified in the Health and Safety Plan (HSP)
- Appropriate decontamination supplies as specified in the decontamination SOP

- Aluminum foil
- Surveyor's stakes or surveyor's flags
- Orange spray paint
- Drill rig with appropriate drilling tools
- Stainless steel 2-inch O.D. or stainless steel 3-inch O.D. split spoon sampler

## 2.2 DECONTAMINATION

Before drilling or sampling begins, the drilling and sampling equipment will be decontaminated according to the Protocols listed in the decontamination SOP. Drilling equipment will be decontaminated, before the equipment is brought on site, between boring locations, and before the equipment leaves the site; sampling equipment will be decontaminated between sample locations.

## 2.3 ANALYTICAL SOIL SAMPLING PROCEDURES

### 2.3.1 Soil Sampling Using a Drill Rig with Split Spoon Samples

Near surface and subsurface soil samples will be collected from drill rig assisted split spoon samplers. Analytical soil sampling using a drill rig with split spoon samples will begin by auger drilling a boring, using machine driven hollow stem flight augers (HSA) with a 4-1/4 inch minimum inside diameter to accommodate a 2-inch or 3-inch outside diameter split-spoon sampler. Auger borings will be performed in accordance with ASTM D1452. A HSA finger plug installed in the bit or similar device may be used to prevent soil material from coming into the interior of the hollow stem augers.

The coupling head for the split-spoon sampler will be provided with a ball check valve and will have open vents. Where necessary for sample recovery, the sampler may also be equipped with a spring-type sample retainer or an equivalent retainer.

Soil samples will be collected at the locations and depths specified in the FSAP or to refusal in consolidated material, whichever occurs first. The procedure for collecting soil samples from a drill rig with split spoon samplers is described below:

- Record the boring location on a site map and in the field log book.
- Decontaminate the drilling and sampling equipment according to the decontamination SOP.
- Advance the augers on the drill rig to the top of the desired depth at which a sample is to be collected.
- Drive samples will be obtained in general accordance with ASTM Designation D 1586.
- The standard split spoon sampler, attached to the end of the drill rod, will be lowered to the bottom of the boring.
- The standard 140-pound hammer assembly will then be attached to the top of the drill rod.
- The depth to the bottom of the sampler will be recorded, and reference marks at 6-inch increments will be placed on the drill rod.
- The test consists of driving the sampler with the standard 140-pound hammer dropped 30 inches. The height of fall will be checked periodically during driving.
- Drive the sampler through four 6-inch increments (or 100 blows, whichever occurs first), with the sum of the middle two increments being the Standard Penetration Count, Blow Count or N-value, and the first 6-inch increment being considered as seating.
- Open the split-spoon sampler and remove a portion of the sample for headspace analysis. Headspace analysis will be performed on all split spoon samples according to the SOP
- Determine and identify the use of the recovered sample to include soil classification and stratigraphic logging and chemical or geotechnical analysis, if appropriate.

- If chemical analysis of the sample is required, immediately collect VOA samples first by filling the VOA container with a representative portion of the soil from the sampler. Place the remainder of the sample on plastic sheeting, tinfoil, or in a suitable decontaminated container. Mix thoroughly by hand while wearing clean latex gloves or the appropriate decontaminated utensil. Place the sample into the required number of sample jars. Place jars for laboratory analysis in a cooler. If sample recoveries are poor, it may be necessary to composite samples before placing them in jars. In this case, the procedure will be the same, except that two split spoon samples will be mixed together. The field logbook should clearly state that the samples have been composited, which samples were composited, and why the compositing was done. The required analyses including quality assurance samples are stated in the QAP.
- Complete the lithologic description of the recovered sample according to the Unified Soil Classification System or appropriate classification system.
- Label, store, transport and document the samples (depending on the use of the sample) according to the appropriate SOP.

### 2.3.2 Compositing Analytical Soil Samples

If a representative sample is desired over the depth of a shallow hole or if several shallow samples are to be taken to represent an area, composite the samples as follows:

- As each sample is collected, place the soil on plastic sheeting, tinfoil or in a suitable decontaminated container.
- After all samples from each hole or area are collected thoroughly mix the samples by hand using clean latex gloves or appropriate decontaminated utensil.
- Divide the sample in half. Continue dividing each split sample in half repeatedly until the resultant splits are of the appropriate size to fit into the appropriate sample containers as specified in the QAP.

## 2.4 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Quality assurance/quality control (QA/QC) samples are designed to help identify potential sources of sample contamination. The frequency of collection and types of QA/QC samples required are indicted in the QAP. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

## 2.5 BORING COMPLETION AND ABANDONMENT

Drill rig advanced borings, after they are advanced to their predetermined depth, will either be abandoned or completed as wells, as specified in the QAP. The Well Installation and Development SOP will be followed if a drill rig advanced boring is to be completed as a monitoring well. If a boring is to be abandoned, the following steps will be performed:

- Upon completion of each, all equipment, such as augers, samplers, casing, tremie pipe, shovels, and other tools, will be scraped clean as they are withdrawn from the hole. After preliminary cleaning in the field, all equipment, including the drill rig, will be transported to the primary decontamination area and thoroughly cleaned following the Decontamination SOP.
- Leave the boring location stake in the ground adjacent to the borehole and place a board over the hole until it has been grouted.
- All drill cuttings will be placed in containers and staged at the designated location (disposition sampling is beyond the scope of this investigation).
- All borings will be grouted. Grout will be introduced into the open boring through a tremie pipe placed 1 foot above the bottom of the hole and filled to the surface. The tremie pipe will be inserted through the hollow-stem augers prior to removing the augers. If the boring terminates above the groundwater level and at depths not greater than 10 feet, grout may be placed from the surface into the augers or open borehole without the tremie.
- The grout mix will be 1 sack (94 pounds) of Portland cement, 4.7 pounds of powdered bentonite, and a maximum of 8 gallons of water. The grout mixture will be prepared in an above-ground rigid container by first thoroughly mixing the

bentonite with water and then mixing in the cement. The grout will be mixed until it is free of excessive cement/bentonite clumps.

- Check the boring for grout settlement 24 hours after initial grouting and add grout if settlement has occurred. Continue to check for settlement and add grout until no more settlement occurs during a 24-hour period.
- Abandonment details will be noted on the boring log, including grout quantities and tremie method used.

## 2.6 SAMPLE DOCUMENTATION, IDENTIFICATION AND HANDLING

Each field activity must be properly documented to facilitate a timely and accurate reconstruction of events in the field. Samples will be identified, handled and recorded as described in this SOP and the Description of Sampling Points and Sample Identification, handling and Documentation SOP. The analytical parameters and preservation of analytical samples are specified in the QAP.

### 2.6.1 Boring Logs

Boring logs will be completed for each boring by qualified personnel (geologist, geological engineer, or geotechnical engineer). The boring log forms (first page and subsequent pages) are shown in Figures 1 and 2.

Boring logs will include the following information:

- Project name and number
- Boring location information
- Drilling company name
- Drilling equipment and method
- Date drilling started and completed

- Completion depth
- Person logging the hole
- Description of lithologies by depth including soil or rock type, grain size, sorting, texture, thickness of lithologic zones, moisture content, color and Unified Soil Classification System or appropriate classification system.
- Blow counts (if appropriate)
- Samples collected, intervals, types, collection time and sample recovery
- Origin of the lithologies (fill, loess, glacial till, glacial outwash, alluvium or colluvium, etc.) if it can be determined
- Reference elevations for all depth measurements
- Project and site name
- Other remarks or observations
- Type of auger and size
- Drillers name
- Type of drill rig
- Water level during drilling (if appropriate)

# STANDARD OPERATING PROCEDURE

## GROUNDWATER SAMPLING BY DIRECT PUSH TECHNOLOGY PROCEDURES

URS Corporation

Oakland, CA

University of California

Richmond Field Station

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## TABLE OF CONTENTS

## 1.0

## SUMMARY

The purpose of this document is to define the Standard Operating Procedure (SOP) for collecting groundwater samples by the direct push sampling method. These procedures give descriptions of equipment and field procedures required to use direct push technology to collect groundwater samples. These step-by-step procedures are designed to ensure repeatable groundwater sample collection methods.

This type of technology enables the in-situ collection of groundwater samples (soil or soil gas samples may also be obtained using this technology) using a truck mounted hydraulic lever to push a stainless steel rod equipped with a sampling device to the desired depth and retrieve a sample. One such technology is patented as the Geoprobe. Typically this method enables the collection of samples up to 20 feet below the ground surface. In some cases, subcontractors providing the direct push method of sampling will also provided and a mobile lab and laboratory technicians equipped with a gas chromatograph for the analysis of samples in the field.

## 2.0

## EQUIPMENT

The following equipment is required to collect groundwater samples using a direct push technology:

- Subcontractor with direct push technology (e.g., Geoprobe) [including mobile laboratory].
- Cement corer for the removal of any pavement in the vicinity of sample locations.
- Field Log book and writing instruments.
- Appropriate laboratory containers and preservatives.
- Self-adhesive labels.
- Cement for grouting (Portland cement, Type II to V).
- Appropriate decontamination equipment.
- Appropriate health and safety equipment and PPE as specified in the health and safety plans.

## 3.0

## PROCEDURES

The following procedures describe direct push groundwater sample collection:

1. Clear area of all utilities.
2. Mark location to be sampled.
3. Inspect, clean, and put on appropriate PPE.
4. Decontaminate all equipment and place on clean plastic sheeting until needed.
5. Instruct subcontractor to set up truck mounted equipment at sample location.
6. Remove any pavement and gravel bed using a cement coring device.
7. Inform subcontractor of the depth of sample collection.
8. Subcontractor will advance the sample probe and extract a sample from the required depth using a decontaminated sample collection device. The sample probe will be attached to the bottom of a stainless steel rod. The rod will be pushed below ground surface with a hydraulic lever attached to the truck. The predetermined depth will be reached by connecting rods together. When the depth is reached a handle will be connected to the rods and turned to open the sampling device. Wait a few minutes to allow the sample chamber to fill. Extract the sampling device.
9. Label laboratory bottles and document sample collection.
10. Transfer the sample to a laboratory sample container and place in cooler for shipment to the laboratory, or the subcontractor will analyze the sample in their mobile lab.

The sampling device may have a disposable liner or collection port (Teflon or glass). Note that the amount of groundwater recovered in this manner may only be on the order of 80 ml (2 VOA vials) or less. This method of sampling is similar to that of hydropunch. If a larger amount of water is needed, a Hydropunch-2 (Hydrocarbon Mode/Free-Product Mode) sampling device may be used along with a drill rig to recover groundwater samples. Some direct push sampling devices may not be designed to collect samples at depths greater than 20 feet below ground surface.

### Boring Completion and Abandonment

After the boring has been advanced to its predetermined depth, it will be abandoned.

## 4.0

## DOCUMENTATION

Each field activity must be properly documented to facilitate a timely and accurate reconstruction of events in the field. Samples will be identified, handled and recorded.

The field log will contain the following information:

- Date/Time
- Weather
- Field Personnel
- Subcontractors Onsite
- Sample Location
- Depth of sample
- Time of sampling
- Elapsed time allowed for collection of sample
- Analytical Parameters
- Description of soil and groundwater

Note to the reader: All entries in the field log book must be printed in black ink and legible.

# STANDARD OPERATING PROCEDURE

# DECONTAMINATION

URS Corporation

Oakland, CA

University of California

Richmond Field Station

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# TABLE OF CONTENTS

# 1.0

# PURPOSE AND SCOPE

This document defines the standard procedure for decontamination (decon) of personnel and equipment engaged in the Field Investigative activities for Special Study No. 1. This Standard Operating Procedure (SOP) serves as a supplement to the Field Sampling & Analysis Plan (FSAP), Quality Assurance Plan (QAP), and the Health and Safety Plan (HSP). This procedure is intended to be used together with the FSAP, QAP, HSP and other SOPs.

The overall objective of multimedia sampling programs is to obtain samples which accurately characterize the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminant materials can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g. by bailing or pumping of ground water with equipment previously contaminated at another sampling site). Trace quantities of these contaminant materials can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., bailers, pumps, tubing, soil and sediment sampling equipment) and field support equipment (e.g., drill rigs, vehicles) is therefore required prior to use to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

# 2.0

# PROCEDURE

Equipment which enters an environmental investigation area (exclusion zone) must be thoroughly decontaminated prior to entering the area. Upon leaving the exclusion zone, all personnel and equipment must be thoroughly decontaminated. This will decrease the potential for the transfer of contamination and reduce adverse health effects. This procedure describes the decontamination of personnel, drilling and sampling equipment, tools, and monitor well construction materials during Field Investigation activities unless modified by the HSP.

## 2.1 EQUIPMENT LIST

The following is a list of equipment that may be needed to perform decontamination:

- Plastic sheeting
- Brushes
- Wash tubs
- Buckets
- Scrapers, flat blade
- Hot water - high-pressure sprayer
- Disposal drums (55-gallon with secure lids)
- Sponges or paper towels
- Alconox/Liquinox detergent (or equivalent)
- Potable tap water
- Laboratory-grade deionized water
- Pesticide grade methanol

- 10% (V/V) ultrapure $HNO_3$
- Garden-type water sprayers

## 2.0

## PROCEDURE

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- Sponges or paper towels
- Alconox/Liquinox detergent (or equivalent)
- Potable tap water

- Laboratory-grade deionized water
- Pesticide grade methanol
- 10% (V/V) ultrapure $HNO_3$
- Garden-type water sprayers

## 2.2 PERSONNEL DECONTAMINATION

A temporary personnel decontamination line will be set up around each exclusion zone. If contamination is not encountered, a dry decontamination station may be established which consists of discarding of disposable personal protective equipment (PPE).

If real-time monitoring instruments indicates that contamination has been encountered, (i.e. action levels are exceeded requiring an upgrade from initial PPE levels), or if the initial PPE is Level B or C, a complete personnel decontamination station will be established.

The temporary decontamination line should provide space to wash and rinse boots, gloves, and all sampling or measuring equipment and a container to dispose of used disposable items such as gloves, tape or tyvek (if used).

The decontamination procedure for field personnel in Level B or C PPE shall include (also see HSP):

1. Glove and boot wash in an Alconox solution
2. Glove and boot rinse
3. Duct tape removal
4. Outer glove removal
5. Coverall (TYVEK) removal
6. Respirator or SCBA removal
7. Inner glove removal

## 2.3 SAMPLING EQUIPMENT DECONTAMINATION

The following steps will be used to decontaminate sampling equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure as required by the HSP.
- Gross contamination on equipment will be scraped off at the sampling site.
- Equipment that will not be damaged by water will be placed in a wash tub containing Alconox or low-sudsing detergent along with tap water and scrubbed with a bristle brush or similar utensil.
- Equipment will be rinsed with tap water in a second wash tub followed by a deionized water rinse.
- Sampling equipment used to collect samples for VOC analysis will then be rinsed with pesticide grade methanol, followed by a deionized water rinse.
- Sampling equipment used to collect samples for metals analysis will then be rinsed with $HNO_3$, followed by a deionized water rinse.
- When practical the equipment will be allowed to air dry.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and rinsed with deionized water. Care will be taken to prevent any equipment damage.
- Rinse and detergent water will be replaced with new solutions between borings or sample locations.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent cross contamination. If the equipment is to be transported, it will be covered or wrapped in aluminum foil, plastic sheeting, or heavy-duty trash bags to minimize potential airborne contamination.

## 2.4 DRILLING AND HEAVY EQUIPMENT DECONTAMINATION

Drilling rigs will be decontaminated at the decontamination station. The following steps may be used to decontaminate drilling and heavy equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure as required by the HSP.
- Remove as much soil and debris as possible from augers and tools at the borehole or sampling location.
- Equipment that will not be damaged by water, such as drill rigs, augers, drill bits, and shovels, will be sprayed with a hot water, high-pressure washer. Care will be taken to adequately clean the insides of the hollow-stem augers.
- After cleaning, place augers and tools on plastic sheeting on the steam cleaned bed of the support truck or the steam-cleaned auger rack on the drill rig.

## 2.5 WASTE HANDLING

All waste generated during decontamination activities will be collected and handled according to the procedures outlined in the QAP and the SOP for waste handling.

## 2.6 DOCUMENTATION

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination should include the following:

- Decontamination personnel
- Date and start and end times

- Decontamination observations
- Weather conditions

## 3.0

## QUALITY ASSURANCE REQUIREMENTS

### 3.1 FIELD QUALITY ASSURANCE REQUIREMENTS

The following guidelines will be followed in the fields at all times to ensure sample integrity and to prevent any cross contamination of samples.

- A clean pair of disposable latex gloves will be worn each time a different location is sampled and shall be changed each time the gloves come into contact with a material that has not been properly decontaminated.
- Sample collection activities will proceed from the least contaminated area to the most contaminated area when this information is available.

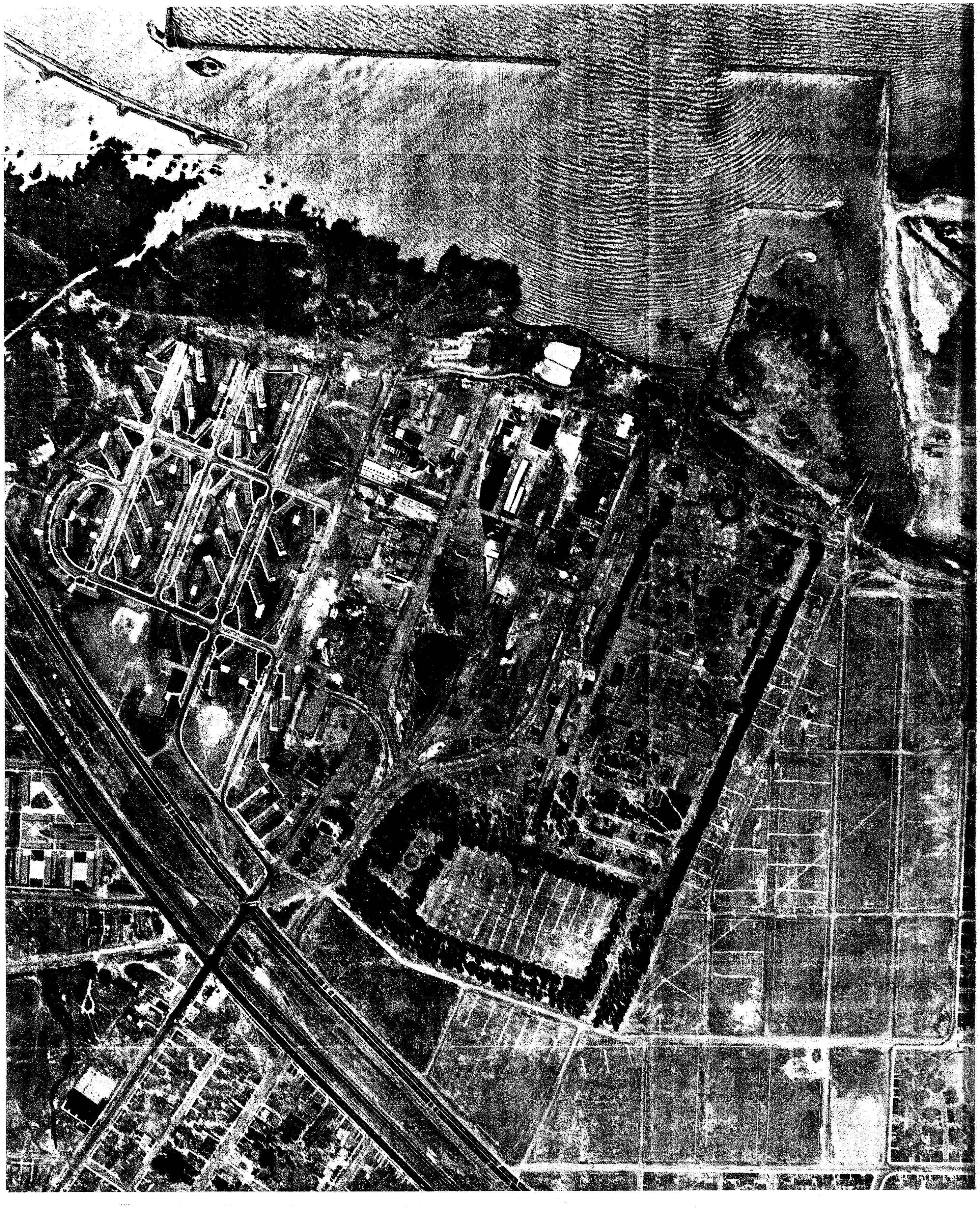
### 3.2 QUALITY ASSURANCE SAMPLE REQUIREMENTS

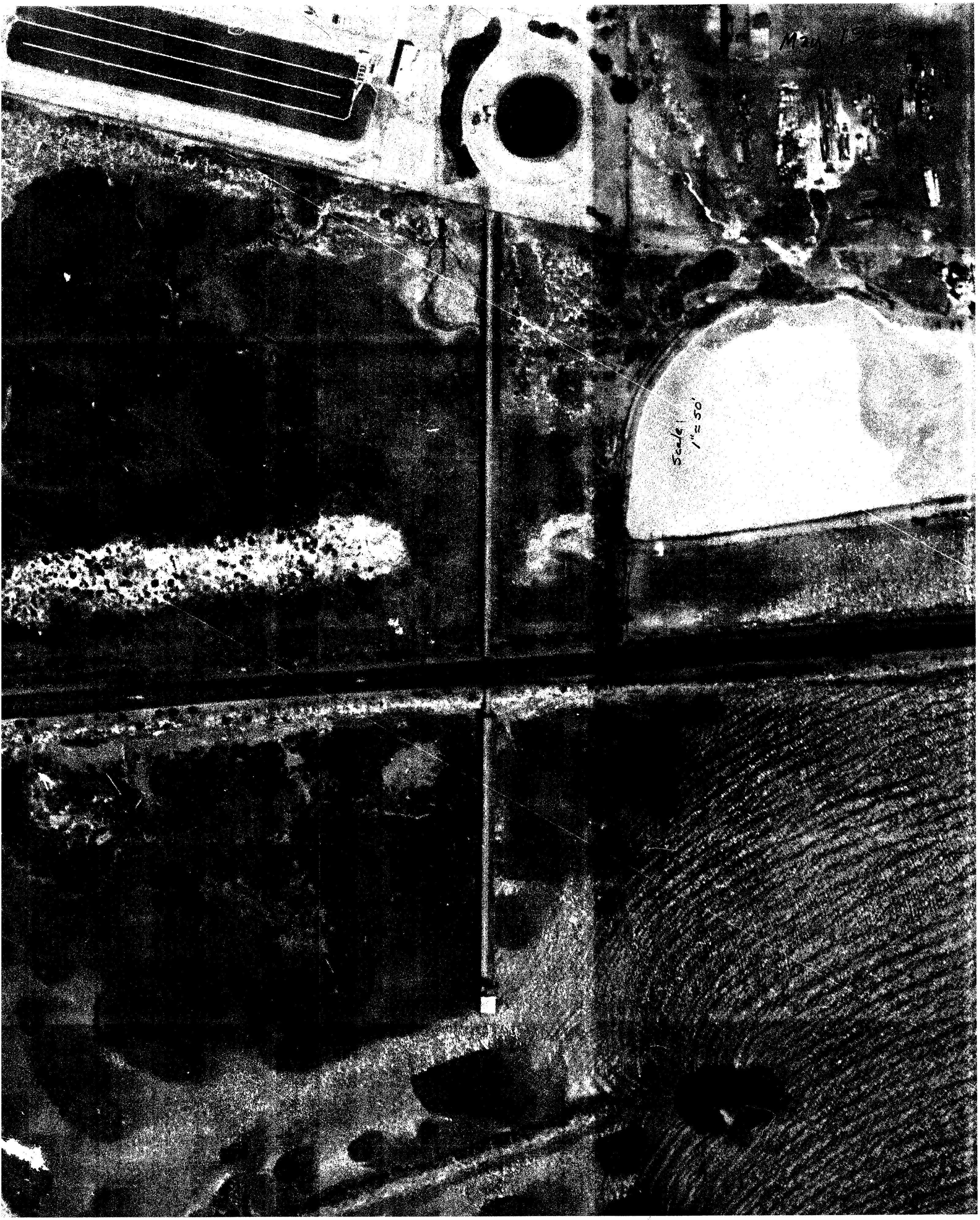
Equipment rinsate samples will be taken of the decontaminated sampling equipment to verify the effectiveness of the decontamination procedures. The sampling procedure will include rinsing deionized water through or over a decontaminated sampling tool (such as a split spoon sampler or Teflon bailer) and collecting the rinsate water into the sample bottles, which will be sent to the laboratory for analysis. The rinsate procedure, including the sample number, will be recorded in the field notebook. The frequency of rinsate sample collection and the laboratory analysis required are described in the QAP. The handling and documentation procedures of the rinsate sample are described in the Description of Sampling Points and Sample Identification, Handling and Documentation SOP.

# APPENDIX C

# Appendix C

## Historical Aerial Photographs of the RFS and Vicinity





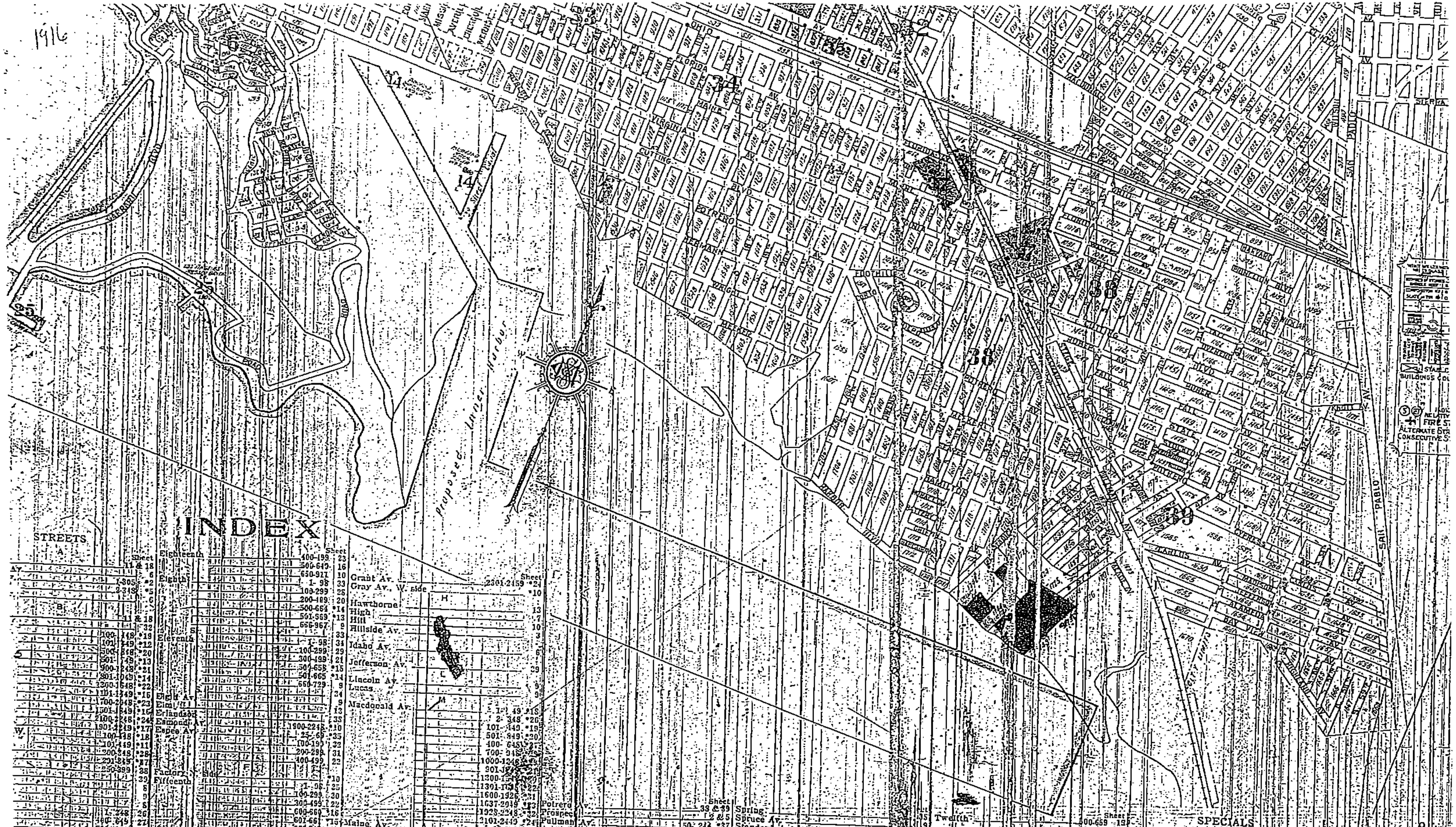
May 1969
Scale 1" = 50'

# APPENDIX D

# Appendix D

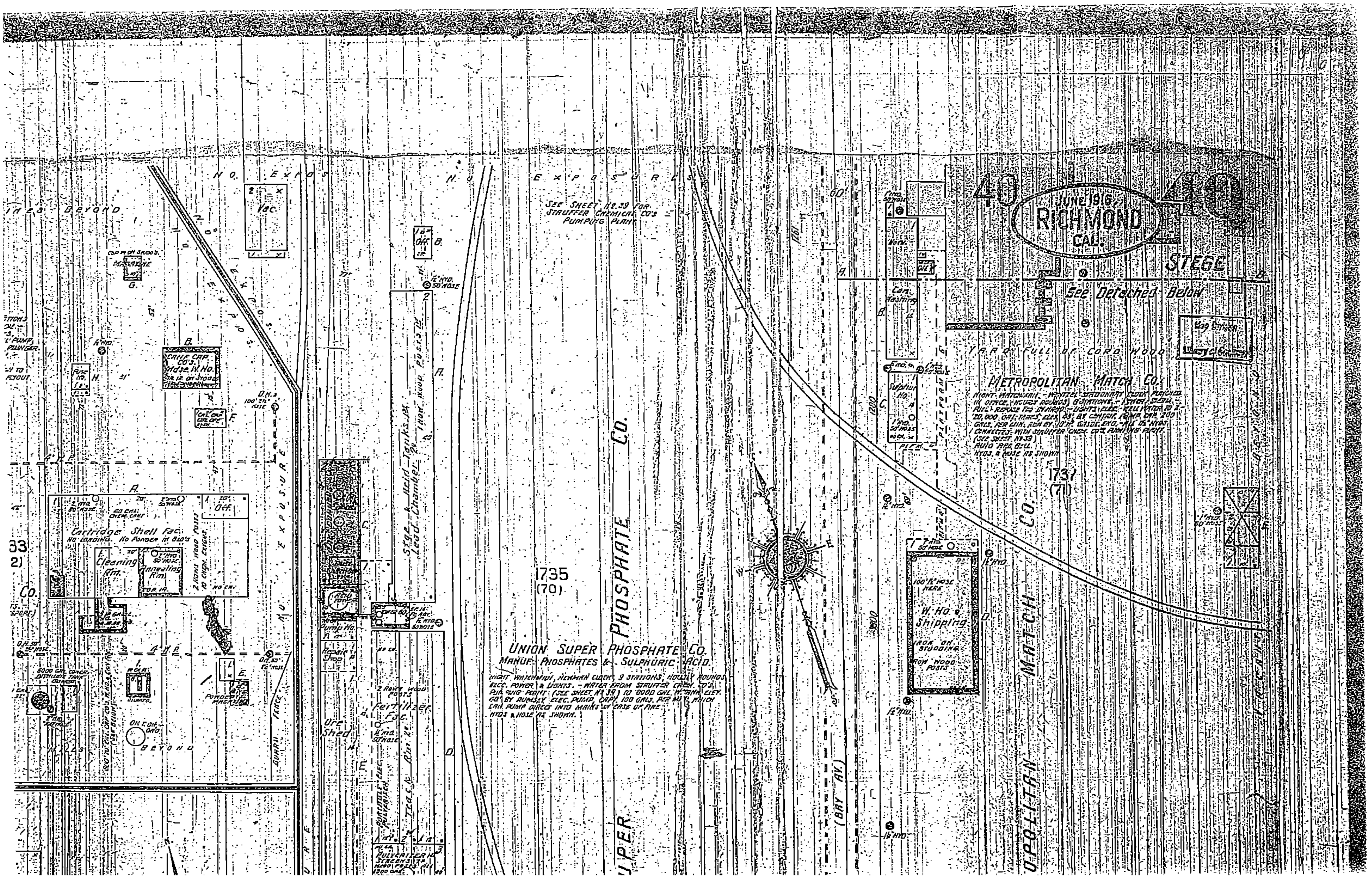
## Sanborn Maps

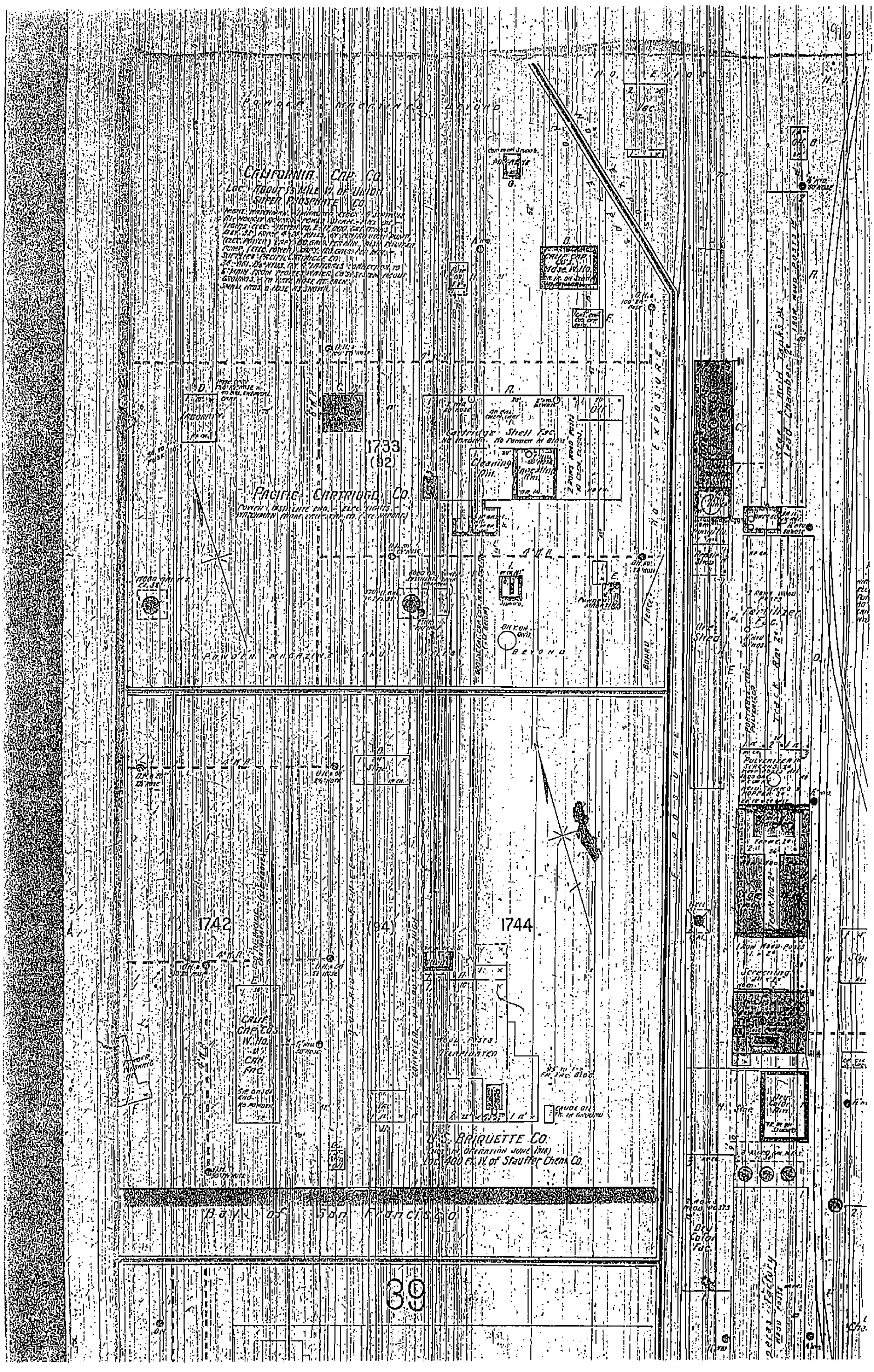
1916

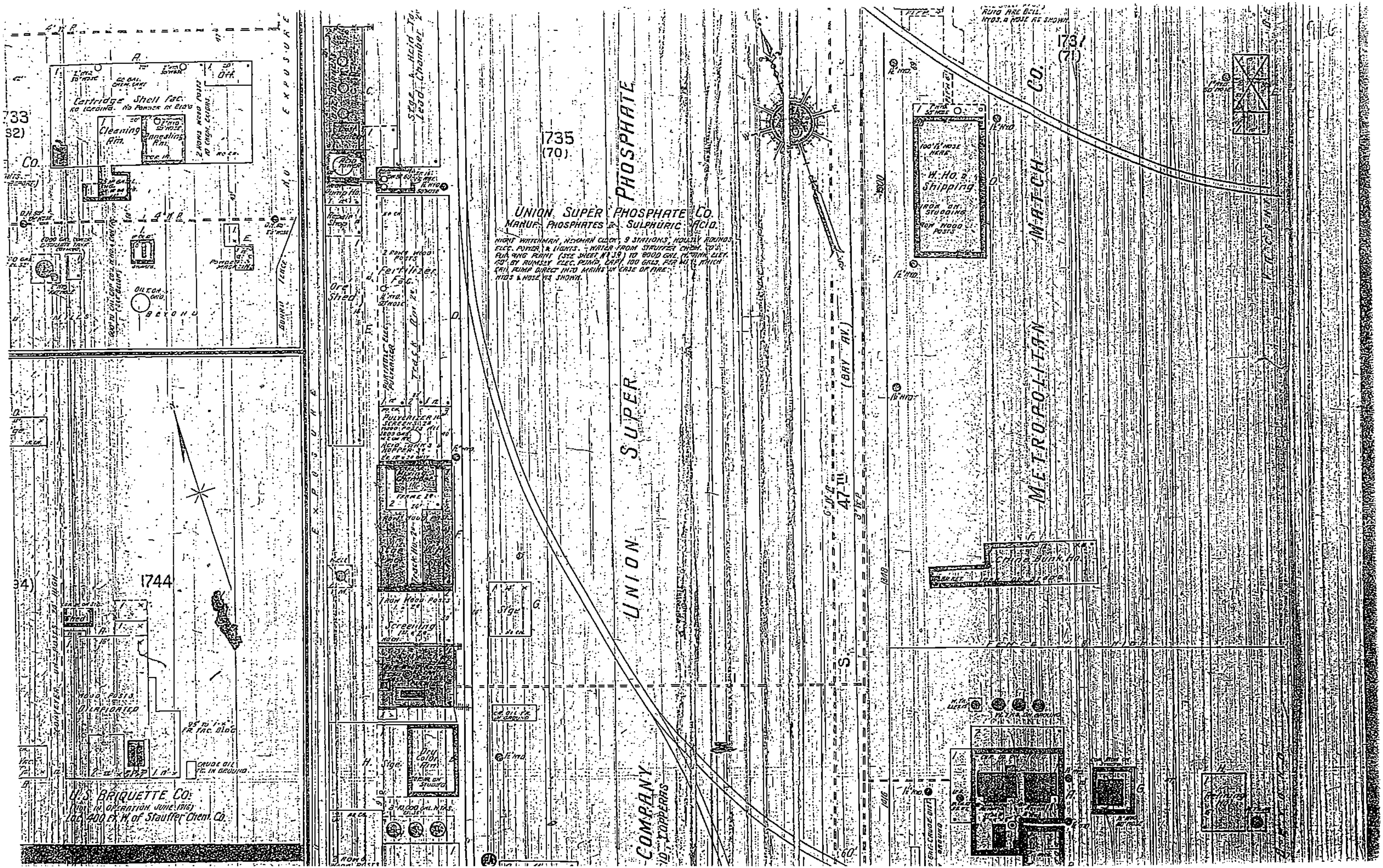


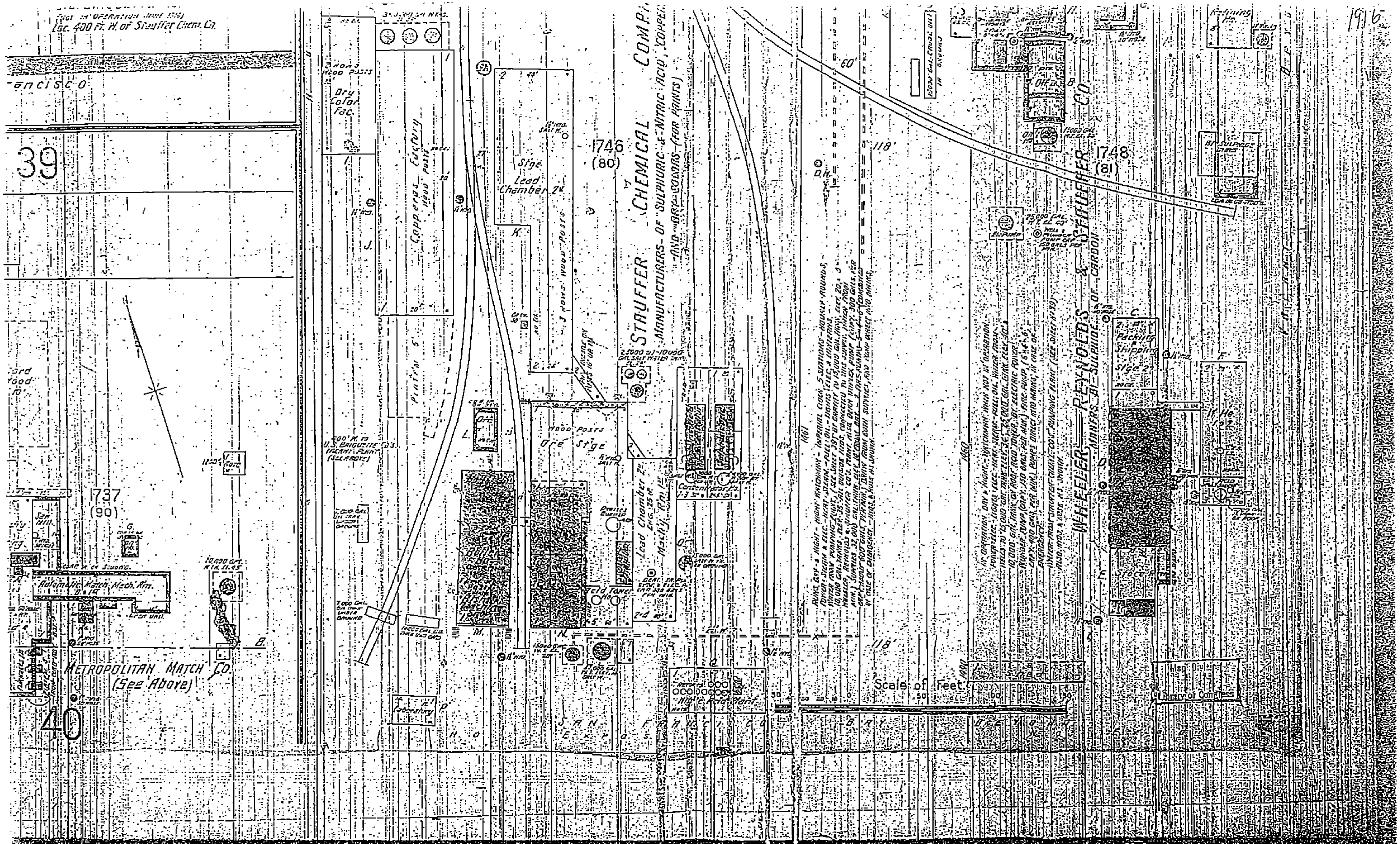
14
14
25
34
36
38
39
Proposed Inner Harbor
OHIO
FLORIDA
VIRGINIA
CUTTING
POTRERO
FOOTHILL AV.
SAN PABLO

# INDEX

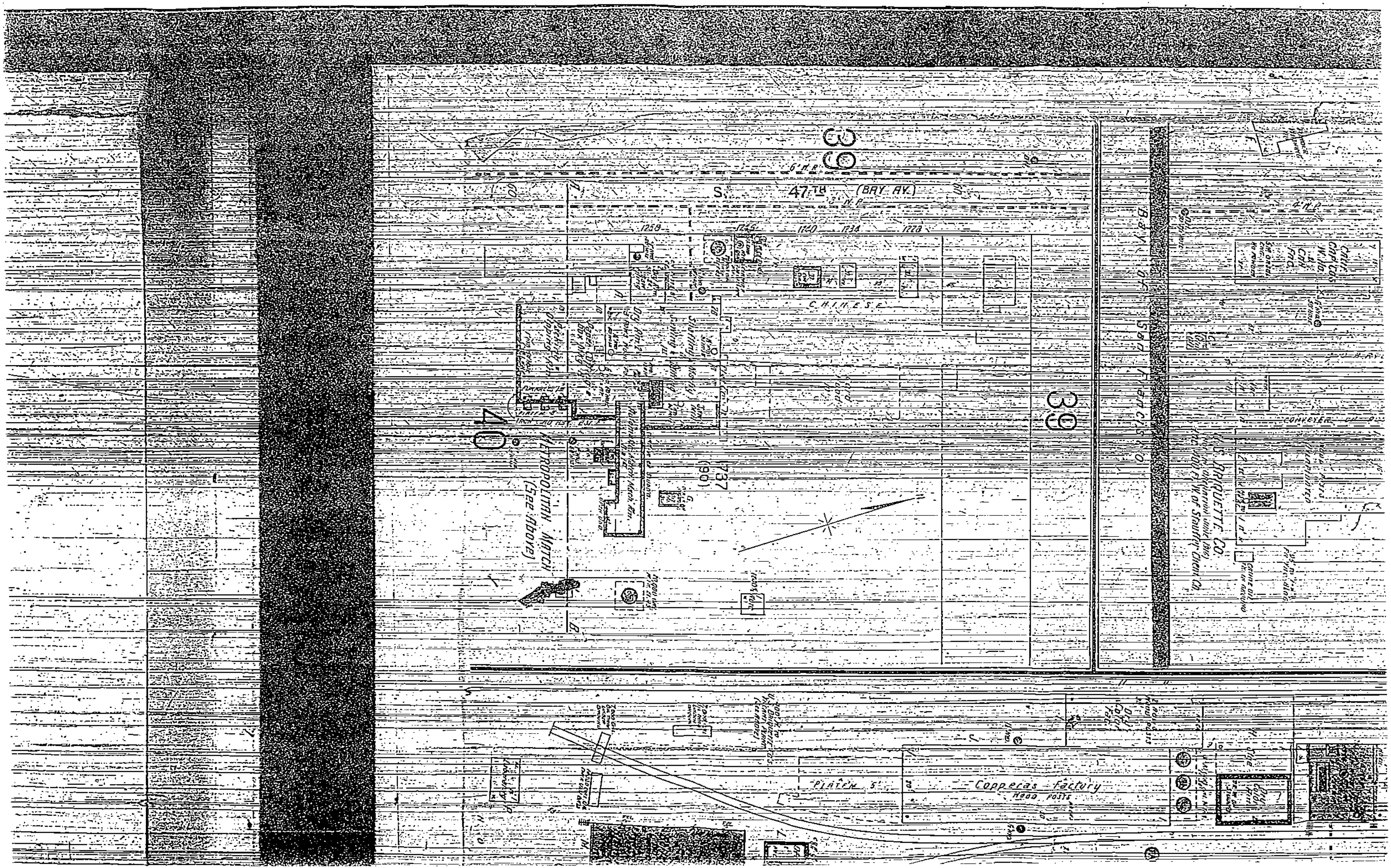

40
JUNE 1916
RICHMOND
CAL.
40
STEGE
See Detached Below
SEE SHEET No.39 FOR STAUFFER CHEMICAL CO'S PUMPING PLANT
NO EXPOSURES
UNION SUPER PHOSPHATE CO.
MANUF. PHOSPHATES & SULPHURIC ACID.
NIGHT WATCHMAN, NEWMAN CLOCK, 9 STATIONS, HOURLY ROUNDS
ELEC. POWER & LIGHTS. - WATER FROM STAUFFER CHEM. CO'S PUMPING PLANT (SEE SHEET No 39) TO 8000 GAL. W. TANK ELEV. 60' BY RUMSEY ELEC. PUMP. CAPY. 100 GALS. PER MIN. WHICH CAN PUMP DIRECT INTO MAINS IN CASE OF FIRE.
HYDS & HOSE AS SHOWN.
1735
(70)
UNION SUPER PHOSPHATE CO.
Stge. & Acid Tanks 1st. Lead Chamber 2d.
Fertilizer Fac.
Ore Shed
Pump Ho.
Track Rm.
YARD FULL OF CORD WOOD
METROPOLITAN MATCH CO.
NIGHT WATCHMAN - WENTZEL STATIONARY CLOCK PLACED IN OFFICE - HOURLY ROUNDS, 8 STATIONS - 1 STEAM SIGNAL. FUEL - REFUSE FED BY HAND - LIGHTS: ELEC. - ELEVATOR TO 2 - 20,000 GAL. TANKS, ELEV. 43' AS CONTROL. PUMP CAP. 200 GALS. PER MIN. RUN BY 10 H.P. GASOL. ENG. - ALL 6" HYDS. CONNECTED WITH STAUFFER CHEM. CO'S PUMPING PLANT. (SEE SHEET No 39)
AUTO FIRE BELL.
HYDS. & HOSE AS SHOWN
1737
(71)
METROPOLITAN MATCH CO.
Can Washing
Sulphur Ho.
W. Ho. & Shipping
100 Ft. HOSE HERE
PLATFORM
(BAY AV.)
Cartridge Shell Fac.
NO LOADING. NO POWDER IN BLDG.
Cleaning Rm.
Annealing Rm.
Off.
Vac.
Magazine
CALIF. CAP CO'S Mdse. W. Ho.
Powder Magazine
NO EXPOSURE
BURRH FENCE
BEYOND
Co.
1733
(72)
6000 GAL. CONC. DISTILLED TANK

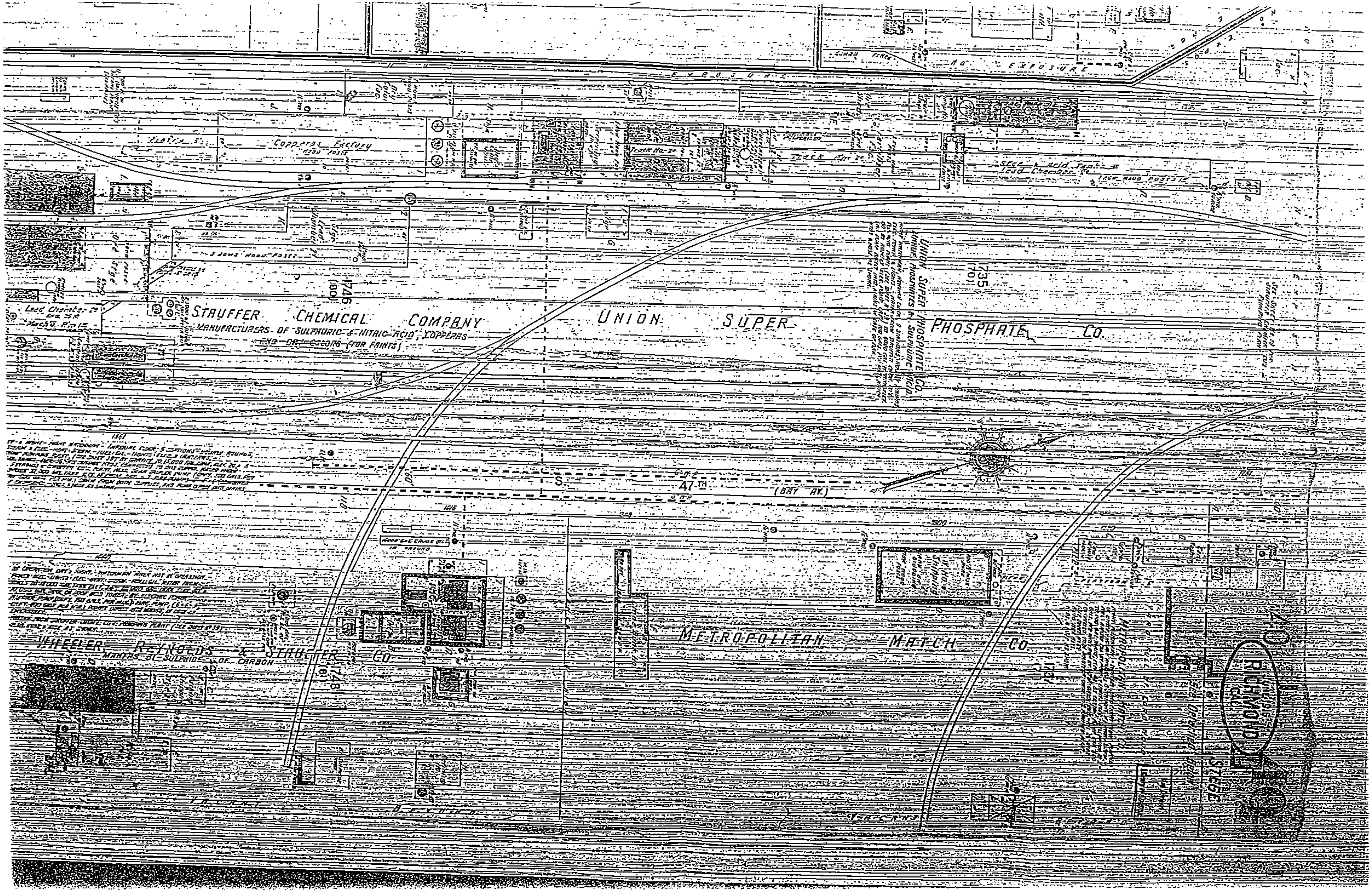

Powder Magazines Beyond
California Cap Co.
Loc. About ½ Mile W. of Union Super Phosphate Co.
Pacific Cartridge Co.
1733
(92)
Cartridge Shell Fac.
Cleaning Rm.
Annealing Rm.
No Exposure
Exposure
Powder Magazine
Beyond
Bdard Fence
1742
(94)
1744
Calif. Cap Co's W. Ho. & Cap Fac.
U.S. Briquette Co.
(Not in Operation June 1916)
Loc. 400 Ft. W. of Stauffer Chem. Co.
Crude Oil Tk. in Ground
Bay of San Francisco
Stge. & Acid Tanks
Lead Chamber
Fertilizer Fac.
Track No. 2
Screening
Dry Color Rm.
Dry Color Fac.
Color Factory
Repair Shop
39


Cartridge Shell Fac.
No Loading. No Powder in Bldg.
Off.
Cleaning Rm.
Annealing Rm.
Powder Mag.
Oil Tk. Grd.
Beyond
Guard Fence
Exposure
733
Co.
1744
Shed
Wood Posts Dilapidated
Crude Oil Tk. in Ground
Conveyor
U.S. BRIQUETTE CO.
(Not in Operation June 1916)
Loc. 400 Ft. W. of Stauffer Chem. Co.
Acid Tanks
Lead Chamber
Pump Ho.
Repair Shop
Ore Shed
Fertilizer Fac.
Pulverizer
Screening
Dry Color Rm.
Sige.
1735
(70)
UNION SUPER PHOSPHATE CO.
MANUF. PHOSPHATES & SULPHURIC ACID.
NIGHT WATCHMAN, NEWMAN CLOCK, 9 STATIONS, HOURLY ROUNDS.
ELEC. POWER & LIGHTS. - WATER FROM STAUFFER CHEM. CO'S.
PUMPING PLANT (SEE SHEET No. 39) TO 8000 GAL. W. TANK ELEV. 50' BY RUMSEY ELEC. PUMP, CAP. 100 GALS. PER MIN. WHICH CAN PUMP DIRECT INTO MAINS IN CASE OF FIRE.
HYDS & HOSE AS SHOWN.
UNION SUPER PHOSPHATE COMPANY
COPPERAS
47th
(BAY AV.)
S.
1737
(71)
METROPOLITAN MATCH CO.
W. Ho. & Shipping
Fence
60



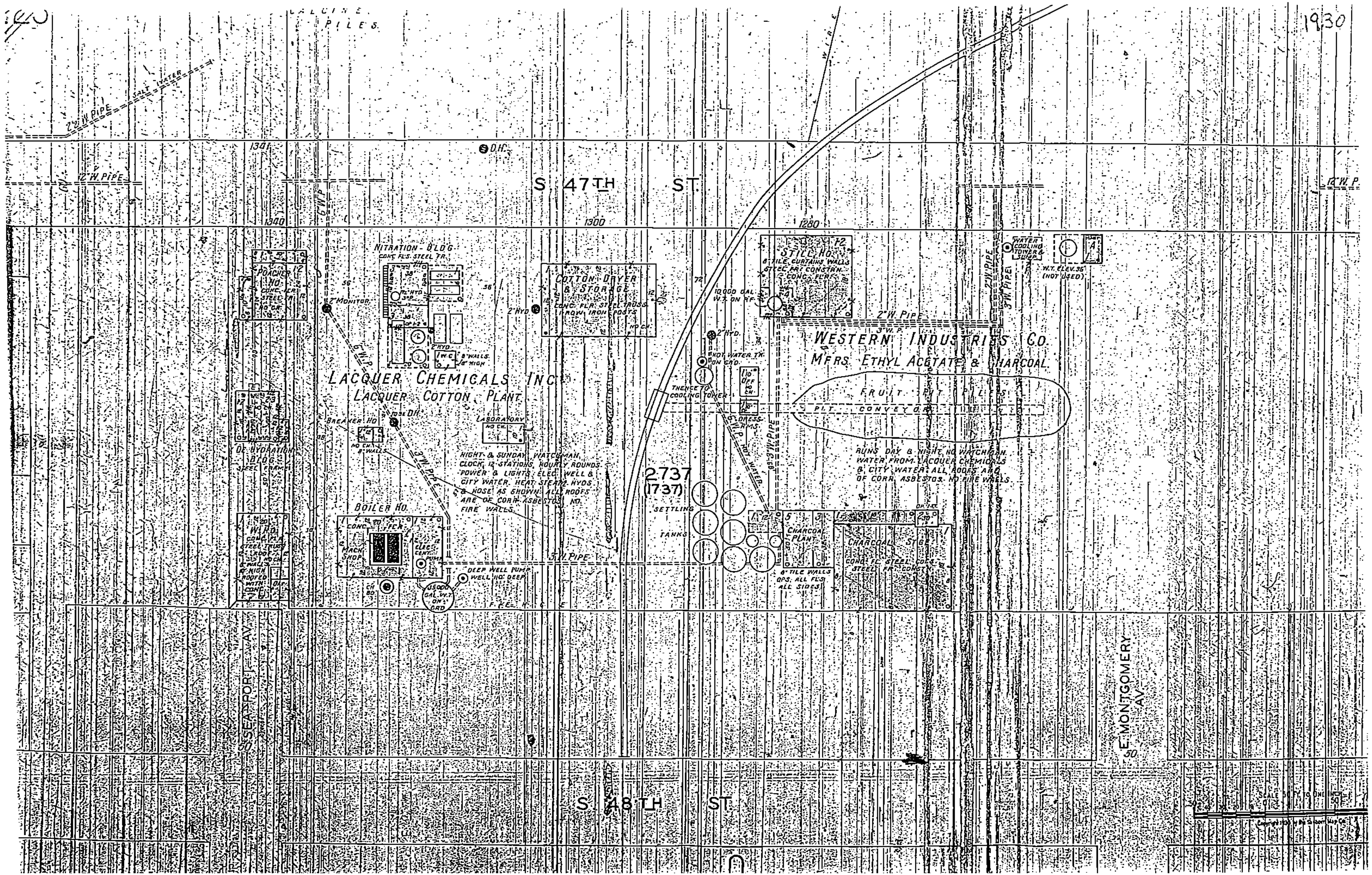
1916
Not in operation June 1916
Loc. 400 Ft. N. of Stauffer Chem. Co.
ancisco
39
40
1737
(90)
Automatic Match Mach. Rm.
METROPOLITAN MATCH CO.
(See Above)
B.
Dry Color Fac.
Copperas Factory
Wood Posts
J.
Platf'm
500' N. to U.S. Briquette Co's (Cement Plant) (See Above)
Laboratory
P.
L.
M.
Stge
Lead Chamber 2nd
K.
3 Rows Wood Posts
Wood Posts
Ore Stge
Lead Chamber 2nd
Glover Tower
Acid Tower
Concentrator Ho.
O.
N.
1746
(80)
STAUFFER CHEMICAL COMPANY
MANUFACTURERS OF SULPHURIC & NITRIC ACID, COPPERAS AND DRY COLORS (FOR PAINTS)
D.H.
60'
118'
118'
Off.
1748
(81)
WHEELER — REYNOLDS & STAUFFER CO.
MANFRS. OF BI-SULPHIDE OF CARBON
Bi Sulphide Stge
Packing Shipping Stge 2nd
C
D
E
F
Scale of Feet
Library of Congress
SAN FRANCISCO BAY


39
S.
47TH
(BAY AV.)
1258
1246
1240
1238
1228
CHINESE
39
40
METROPOLITAN MATCH
(See Above)
737
(90)
Bay of San Francisco
CONVEYER
PLATF'M 5'
Copperas Factory

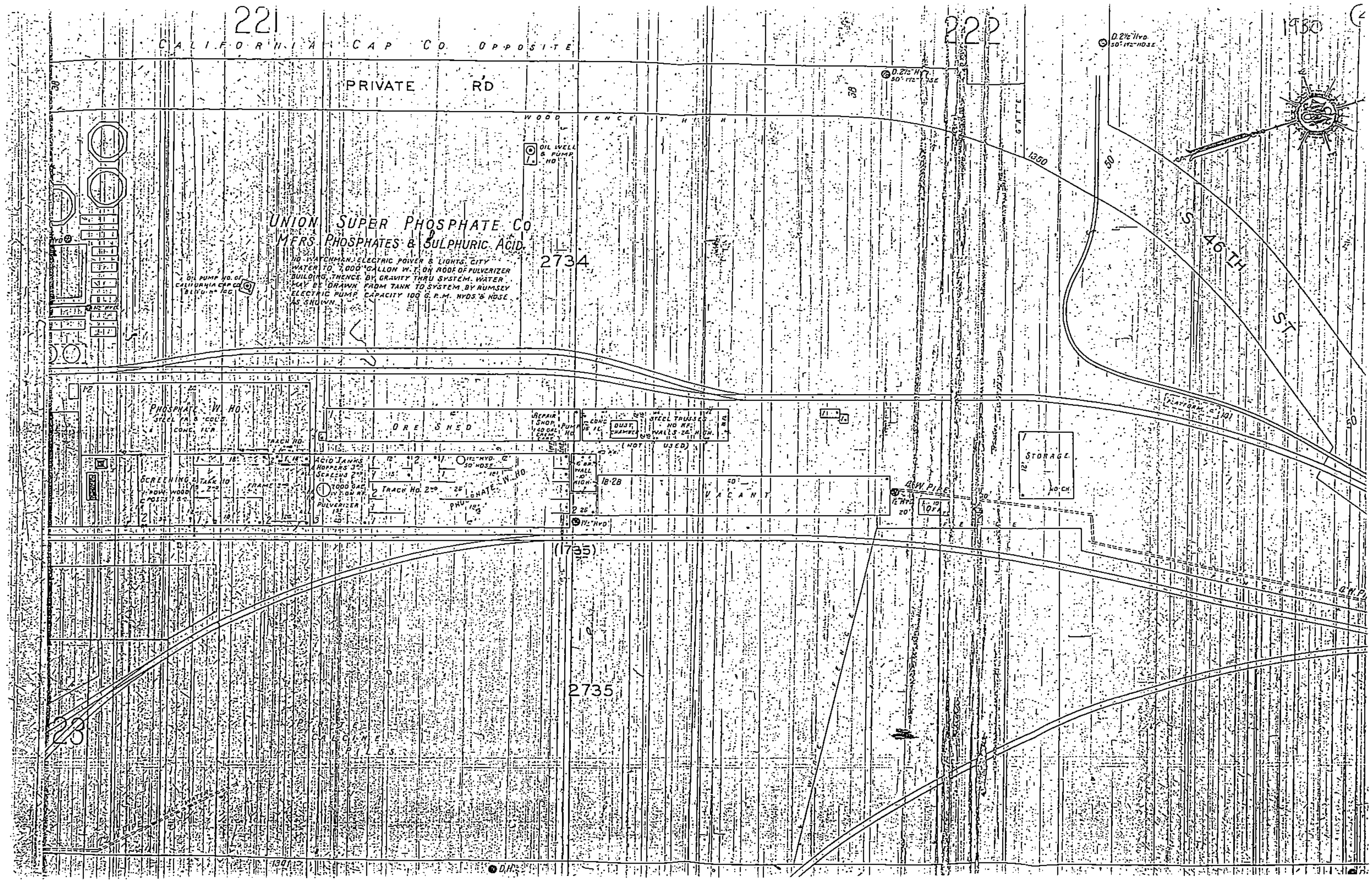

EXPOSURE
NO EXPOSURE
Copperas Factory
Lead Chamber
Steel & acid tanks Lead Chamber
STAUFFER CHEMICAL COMPANY
MANUFACTURERS OF SULPHURIC & NITRIC ACID, COPPERAS AND DRY COLORS (FOR PAINTS)
1746 (100)
UNION SUPER PHOSPHATE CO.
UNION SUPER PHOSPHATE CO.
MANUF. PHOSPHATES & SULPHURIC ACID
1735 (101)
S.
47TH
(BAY AV.)
1116
WHEELER REYNOLDS & STAUFFER CO
MANFRS OF SULPHIDE OF CARBON
1748 (61)
METROPOLITAN MATCH CO.
METROPOLITAN MATCH CO.
1737
40
RICHMOND CAL.

140

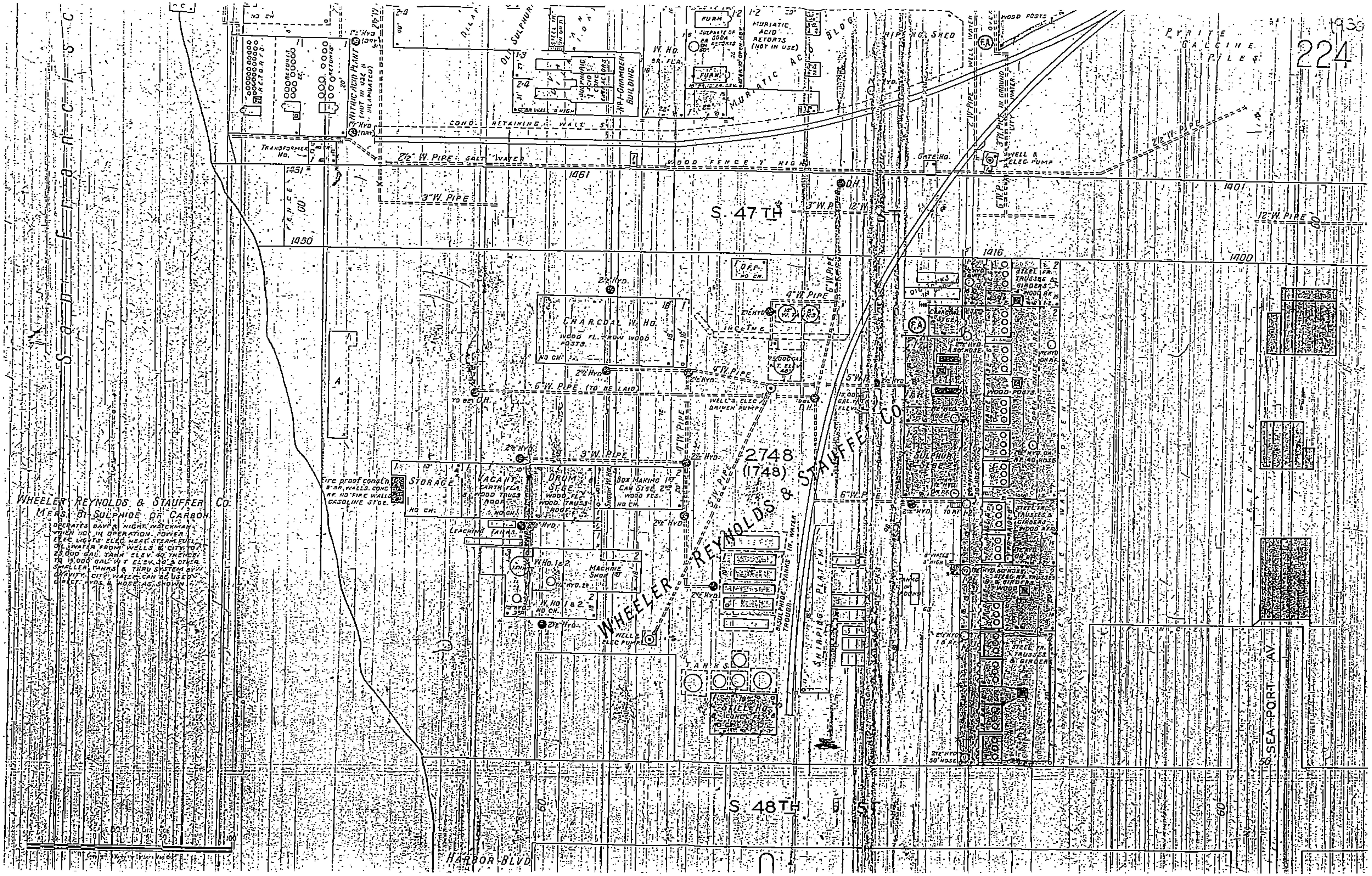
1930

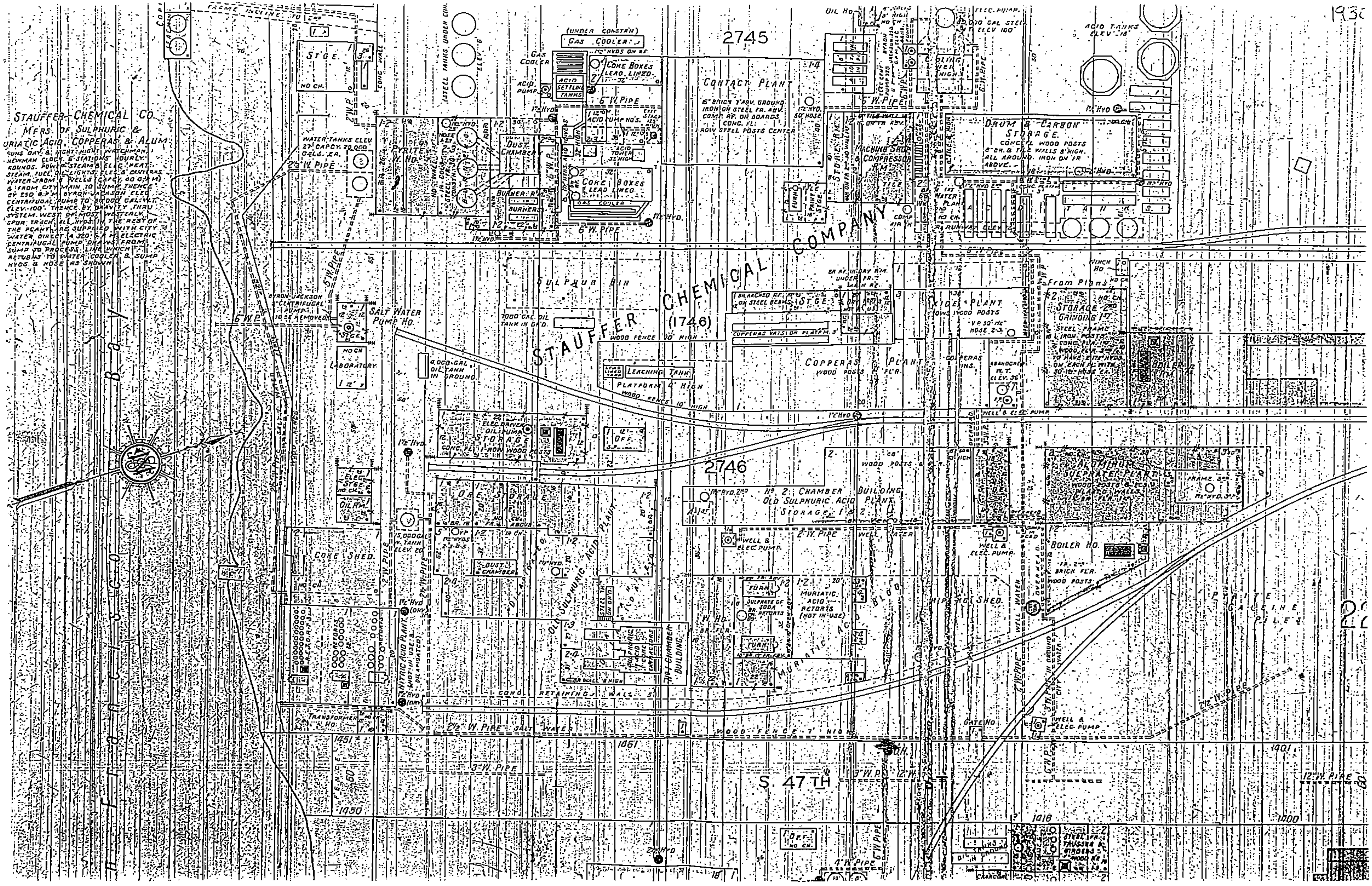


CALCINE PILES
2" W. PIPE
SALT WATER
1341
D.H.
12" W. PIPE
S. 47TH ST.
12" W. P.
1340
1300
1280
6 W.P.
NITRATION - BLD'G
CONC. FLS. STEEL FR.
POACHER HO.
CONC. FLR.
STEEL FR.
NO CH.
2" MONITOR
56
2" HYD
COTTON DRYER & STORAGE
CONC. FLR. STEEL TRUSS
I ROW IRON POSTS
NO CH.
I.W.C.
8' WALLS 10' HIGH
LACQUER CHEMICALS INC.
LACQUER COTTON PLANT
DE HYDRATION BLDG
STEEL FRAME
BREAKER HO.
NO CH.
8' WALLS
HOSE D.H.
3" W. PIPE
LABORATORY
NO CH.
NIGHT & SUNDAY WATCHMAN.
CLOCK, 12 STATIONS, HOURLY ROUNDS.
POWER & LIGHTS: ELEC. WELL & CITY WATER. HEAT: STEAM. HYDS & HOSE AS SHOWN. ALL ROOFS ARE OF CORR. ASBESTOS. NO FIRE WALLS.
BOILER HO.
CONC. FLR.
MACH. SHOP
ELEC. CENT. PUMP
W. HO.
CONC. FLR.
STEEL TRUSS
ROOF
NO CH.
8' WALLS 10' HIGH
ROOFED WITH CONC.
DEEP WELL PUMP
WELL 110' DEEP
15000 GAL. W.T. ON GRD.
CH. 80'
3" W. PIPE
FENCE
72
10,000 GAL. W.T. ON RF.
STILL HO.
8" TILE CURTAINS WALLS
STEEL FR. CONSTR'N.
CONC. FLRS.
2" HYD.
HOT WATER TK. ON GRD.
THENCE TO COOLING TOWER
OFF. NO CH.
DRESS. RMS.
6 W.P.
HOT WATER
3" W. PIPE
2" W. PIPE
3" W. P.
WESTERN INDUSTRIES CO.
MFRS. ETHYL ACETATE & CHARCOAL.
FRUIT PIT PILES
PIT CONVEYOR
2" W. PIPE
3" W. PIPE
WATER COOLING TOWER & SUMP
W.T. ELEV. 35' (NOT USED)
RUNS DAY & NIGHT. NO WATCHMAN. WATER FROM LACQUER CHEMICALS & CITY WATER. ALL ROOFS ARE OF CORR. ASBESTOS. NO FIRE WALLS.
2737
(1737)
SETTLING TANKS
CHARCOAL PLANT
8" TILE WALLS
OPS. ALL FLS. ALL SIDES
CHARCOAL STGE.
CONC. FL. STEEL COLS.
STEEL FR. CONSTN.
SEAPORT AV.
50
S. 48TH ST.
E. MONTGOMERY AV.
50
SCALE


221
222
1950
CALIFORNIA CAP CO. OPPOSITE
PRIVATE RD
WOOD FENCE 7' HIGH
D. 2½" HYD. 50' 1½" HOSE
OIL WELL & PUMP HO.
UNION SUPER PHOSPHATE CO.
MFRS. PHOSPHATES & SULPHURIC ACID.
NO WATCHMAN. ELECTRIC POWER & LIGHTS. CITY WATER TO 7,000 GALLON W.T. ON ROOF OF PULVERIZER BUILDING, THENCE BY GRAVITY THRU SYSTEM. WATER MAY BE DRAWN FROM TANK TO SYSTEM BY RUMSEY ELECTRIC PUMP CAPACITY 100 G.P.M. HYDS & HOSE AS SHOWN.
OIL PUMP HO. OF CALIFORNIA CAP CO.
2734
1350
S. 46TH ST.
50'
PHOSPHATE W. HO.
STEEL TRUSSES CONC. FLR.
ORE SHED
REPAIR SHOP
PUMP HO.
DUST CHAMBER
STEEL TRUSSES NO RF. WALLS 24' HIGH
(NOT USED)
PLATFORM
STORAGE
ACID TANKS
HOPPERS
SCREENING
TANK
FRAME
7000 GAL. W.T. ON RF.
PULVERIZER
TRACK HO.
PHOSPHATE W. HO.
1½" HYD. 50' HOSE
VACANT
4" W. PIPE
OFF.
1½" HYD.
(1735)
2735
23
PYRITE CINDER PILES
1301
D.H.

1936

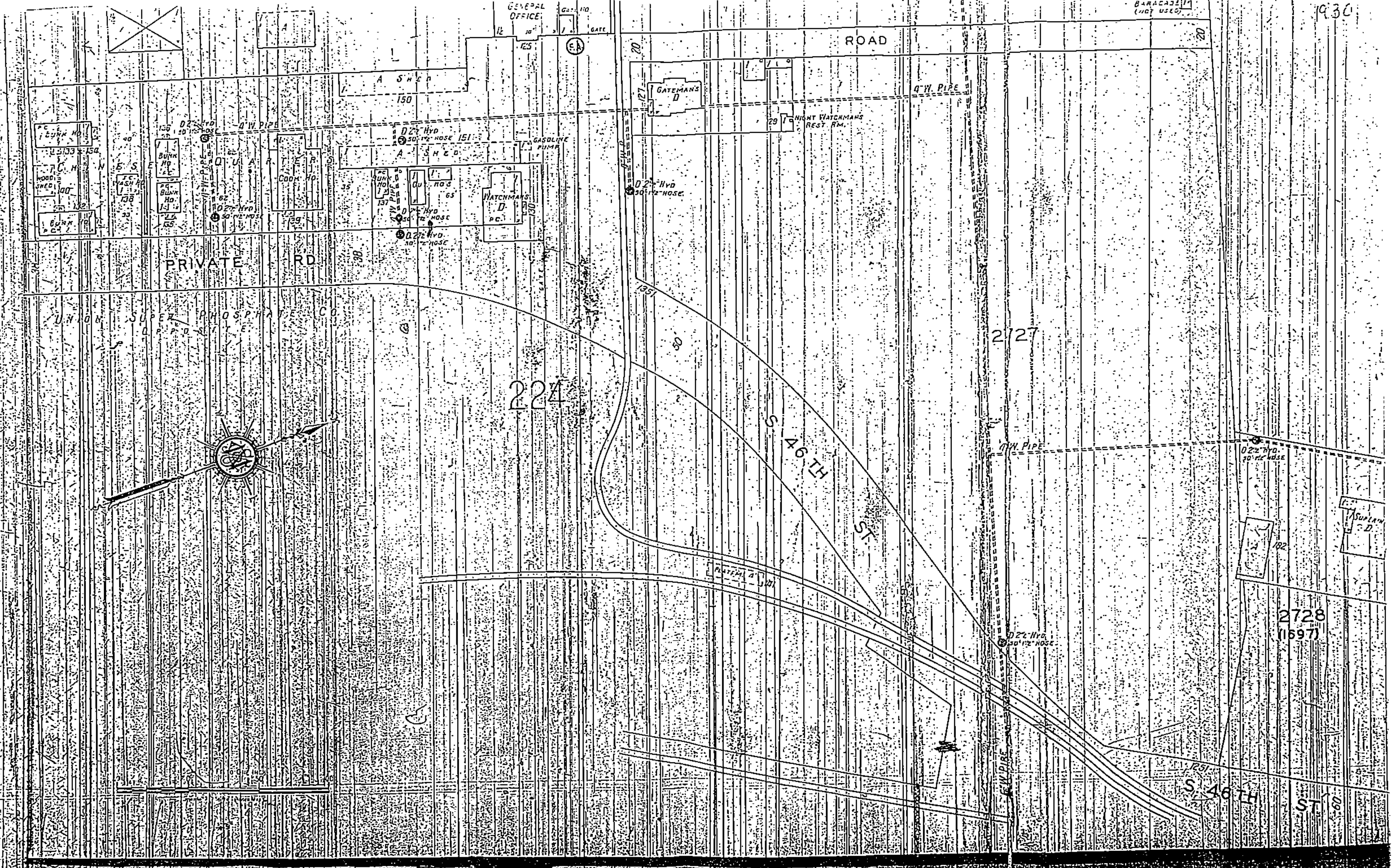

San Francisco
PYRITE CALCINE PILES
NITRIC ACID PLANT (NOT IN USE & DILAPIDATED)
RETORTS
NO CH
1½" HYD (DRY)
TRANSFORMER HO.
2½" W. PIPE SALT WATER
CONC. RETAINING WALL 5'
OLD SULPHURIC ACID
STEEL TK.
No 1 CHAMBER BUILDING
SULPHURIC ACID CONCENTRATORS
W. HO.
FURN.
SULPHATE OF SODA RETORTS
MURIATIC ACID RETORTS (NOT IN USE)
MURIATIC ACID BLDG
SHIPPING SHED
WELL WATER
F.A.
WOOD POSTS
3" W. PIPE IN GROUND CITY WATER
WELL & ELEC. PUMP
GATE HO.
WOOD FENCE 7' HIGH
1451
1461
1401
1450
1400
1416
FENCE
3" W. PIPE
S. 47TH ST.
12" W. PIPE
OFF.
CHARCOAL W. HO.
WOOD FL. & ROW WOOD POSTS.
INCLINE
25,000 GAL. T. ELEV. 40'
4" W. PIPE
6" W. PIPE (TO BE LAID)
TO BE O.H.
O.H.
WELL & ELEC DRIVEN PUMP
15,000 GAL. T. ELEV. 40'
2½" HYD.
2748 (1748)
WHEELER REYNOLDS & STAUFFER CO.
Fire proof constn. 8" BR. WALLS. CONC. RF. NO FIRE WALLS GASOLINE STGE.
STORAGE NO CH.
VACANT EARTH FLS. WOOD TRUSS ROOF NO CH.
DRUM STGE. WOOD FLS. WOOD TRUSS ROOF
SHOOK W. HO.
BOX MAKING 1ST CAN STGE. 2ND WOOD FLS. NO CH.
LEACHING TANKS
W. HO. 1 & 2
MACHINE SHOP 1ST
W. HO. 1 & 2 NO CH.
WELL & ELEC PUMP
TANKS
STILL HO. CONC. FL.
DISULPHIDE TANKS IN WATER
SHIPPING PLATFM
6" W. P.
CHARCOAL STGE.
SULPHUR STGE.
STEEL FR. TRUSSES & GIRDERS WOOD RF.
WOOD POSTS
1½" HYD. ON RF. 40' HOSE
2½" HYD. 50' HOSE
OPEN
WALL
FENCE
SEA PORT AV.
S. 48TH ST.
HARBOR BLVD.
WHEELER REYNOLDS & STAUFFER CO.
MFRS. BI-SULPHIDE OF CARBON
OPERATES DAY & NIGHT. WATCHMAN WHEN NOT IN OPERATION. POWER ELEC. LIGHTS ELEC. HEAT STEAM FUEL OIL. WATER FROM WELLS & CITY TO 25,000 GAL. TANK ELEV. 40 THENCE TO 15,000 GAL. W. T. ELEV. 40' & OTHER SMALLER TANKS & THRU SYSTEM BY GRAVITY. CITY WATER CAN BE USED DIRECT. HYDS. & HOSE AS SHOWN.
60
50


193
STAUFFER CHEMICAL CO.
MFRS. OF SULPHURIC & MURIATIC ACID, COPPERAS & ALUM
RUNS DAY & NIGHT. NIGHT WATCHMAN, NEWMAN CLOCK, 6 STATIONS HOURLY ROUNDS. POWER STEAM & ELEC. HEAT STEAM. FUEL OIL. LIGHTS ELEC. & LANTERNS. WATER FROM 6 WELLS (CAPCY. 40 G.P.M.) & FROM CITY MAIN TO SUMP, THENCE BY 250 G.P.M. BYRON-JACKSON ELEC. CENTRIFUGAL PUMP TO 50,000 GAL. W.T. ELEV. 100'. THENCE BY GRAVITY THRU SYSTEM. WEST OF MOST WESTERLY SPUR TRACK, ALL HYDS. IN THE REST OF THE PLANT ARE SUPPLIED WITH CITY WATER DIRECT. A 320 G.P.M. ELECTRIC CENTRIFUGAL PUMP DRAWS FROM SUMP TO PROCESS LINE WHICH RETURNS TO WATER COOLER & SUMP. HYDS. & HOSE AS SHOWN.
San Francisco Bay
STAUFFER CHEMICAL COMPANY
(1746)
2745
2746
S. 47TH
1061
1401
1400
1416
1451
1450
CONTACT PLANT
GAS COOLER
(UNDER CONSTR'N)
COKE BOXES LEAD LINED
ACID SETTLING TANKS
PYRITE W. HO.
DUST CHAMBER
BURNERS
STGE.
MACHINE SHOP & COMPRESSOR RM.
DRUM & CARBON STORAGE
ACID TANKS ELEV. 18'
15,000 GAL STEEL T. ELEV. 100'
WATER TANKS ELEV. 27' CAPCY. 20,000 GALS. EA.
SULPHUR BIN
SALT WATER PUMP HO.
LABORATORY
7000 GAL. OIL TANK IN GR'D.
4000 GAL. OIL TANK IN GROUND
LEACHING TANK
PLATFORM 4' HIGH
WOOD FENCE 10' HIGH
COPPERAS VATS ON PLATF'M.
COPPERAS PLANT
OXIDE PLANT
STORAGE 2ND GRINDING 1ST
BOILER R.
ELEC. DRIVEN OIL PUMP
STORAGE
OFF.
ELEC. STGE.
OIL RM.
ORE STORAGE
NO. 2 CHAMBER BUILDING OLD SULPHURIC ACID PLANT STORAGE 1 & 2
ALUMINUM SULPHATE PLANT
WELL & ELEC. PUMP
BOILER HO.
COKE SHED
DUST CHAMBER
OLD SULPHURIC ACID PLANT
NO. 1 CHAMBER BUILDING
MURIATIC ACID RETORTS (NOT IN USE)
SULPHATE OF SODA RETORTS
MURIATIC ACID BLDG.
W. HO.
PIPE SHED
NITRIC ACID PLANT
TRANSFORMER HO.
15,000 GAL. W. TANK ELEV. 20'
CONC. RETAINING WALLS
WOOD FENCE 7' HIGH
SALT WATER
GATE HO.
PYRITE CALCINE PILES
2½" W. PIPE
6" W. PIPE
5" W. PIPE
3" W. PIPE
12" W. PIPE
1½" HYD.
2½" HYD.
OFF.
TANKS
STEEL FR. TRUSSES & GIRDERS

1930

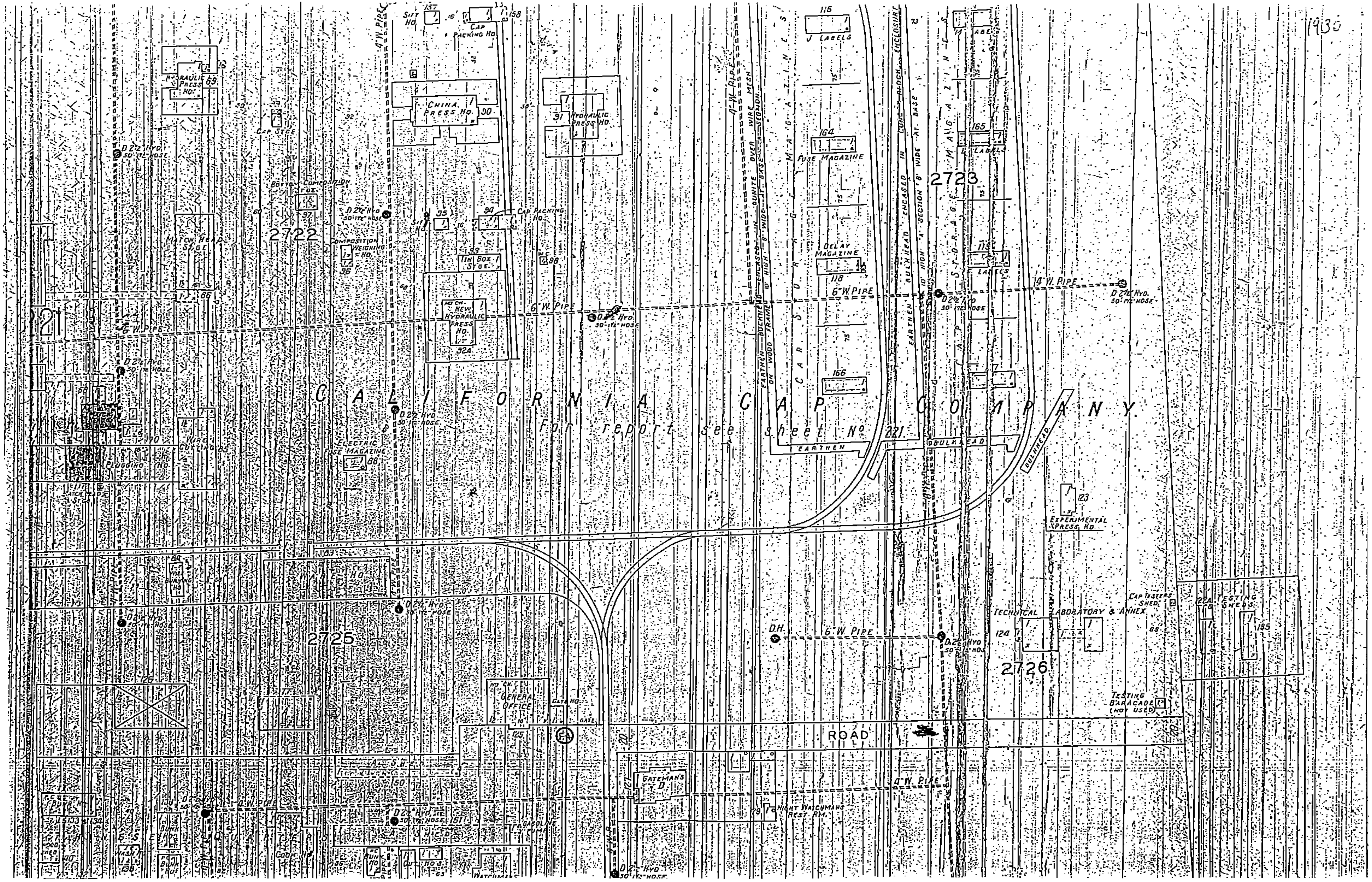

(40)
221
CALIFORNIA CAP CO. OPPOSITE
D.2½" HYD. 50' 1½" HOSE
PRIVATE RD
38
BRICK WALL 8' HIGH
LABORATORY
LEACHING TANKS
FRAME INCLINE
STGE.
NO CH.
(STEEL TANKS UNDER CONSTN)
WELL & ELEC. PUMP
2" W. PIPE WELL WATER
CEMENT STGE.
OIL HO.
2745
(UNDER CONSTN.)
GAS COOLER
COKE BOXES LEAD LINED
ACID PUMP
ACID SETTLING TANKS
6" W. PIPE
CONTACT PLANT
ACID TANKS
DRUM & CARBON STORAGE
STAUFFER CHEMICAL CO.
MFRS. OF SULPHURIC & MURIATIC ACID, COPPERAS & ALUM
RUNS DAY & NIGHT. NIGHT WATCHMAN NEWMAN CLOCK - 6 STATIONS HOURLY ROUNDS: POWER STEAM & ELEC. HEAT STEAM FUEL OIL LIGHTS ELEC. & LANTERNS WATER FROM 4 WELLS (CAPCY. 90 G.P.M.) & FROM CITY MAIN TO SUMP. THENCE BY 250 G.P.M. BYRON JACKSON ELEC. CENTRIFUGAL PUMP TO 50,000 GAL. W.T. ELEV. 100'. THENCE BY GRAVITY THRU SYSTEM WEST OF MOST WESTERLY SPUR TRACK. ALL HYDS. IN THE REST OF THE PLANT ARE SUPPLIED WITH CITY WATER DIRECT. A 320 G.P.M. ELECTRIC CENTRIFUGAL PUMP DRAWS FROM SUMP TO PROCESS LINE WHICH RETURNS TO WATER COOLER & SUMP HYDS. & HOSE AS SHOWN
WATER TANKS ELEV. 27' CAPCY. 20,000 GALS. EA.
2½" W. PIPE
PYRITES W. HO.
DUST CHAMBER
BURNER R'M.
COKE BOXES LEAD LINED
COOLER
ACID TOWER
STORAGE
MACHINE SHOP & COMPRESSOR R'M.
STAUFFER CHEMICAL COMPANY
(1746)
SULPHUR BIN
BYRON JACKSON CENTRIFUGAL PUMP
SALT WATER PUMP HO.
7000 GAL. OIL TANK IN GRD.
WOOD FENCE 10' HIGH
BRANCHED RF. ON STEEL BEAMS STGE.
COPPERAS VATS ON PLATFM.
COPPERAS PLANT
LEACHING TANK
PLATFORM 4' HIGH
LABORATORY
1,000 GAL. OIL TANK IN GROUND
WINCH HO.
From Plant
STORAGE & GRINDING
OIL STORAGE
OFF.
2746
ELEC. STGE.
OIL R'M.
ORE STORAGE
No. 2 CHAMBER BUILDING
OLD SULPHURIC ACID PLANT
STORAGE
COKE SHED
15,000 GAL. TANK ELEV. 20
DUST CHAMBER
SULPHURIC ACID PLANT
WELL & ELEC. PUMP
MURIATIC ACID RETORTS (NOT IN USE)
SULPHATE OF SODA RETORTS
BOILER HO.
BRICK FLR. WOOD POSTS
SHIPPING SHED
S. F. BAY

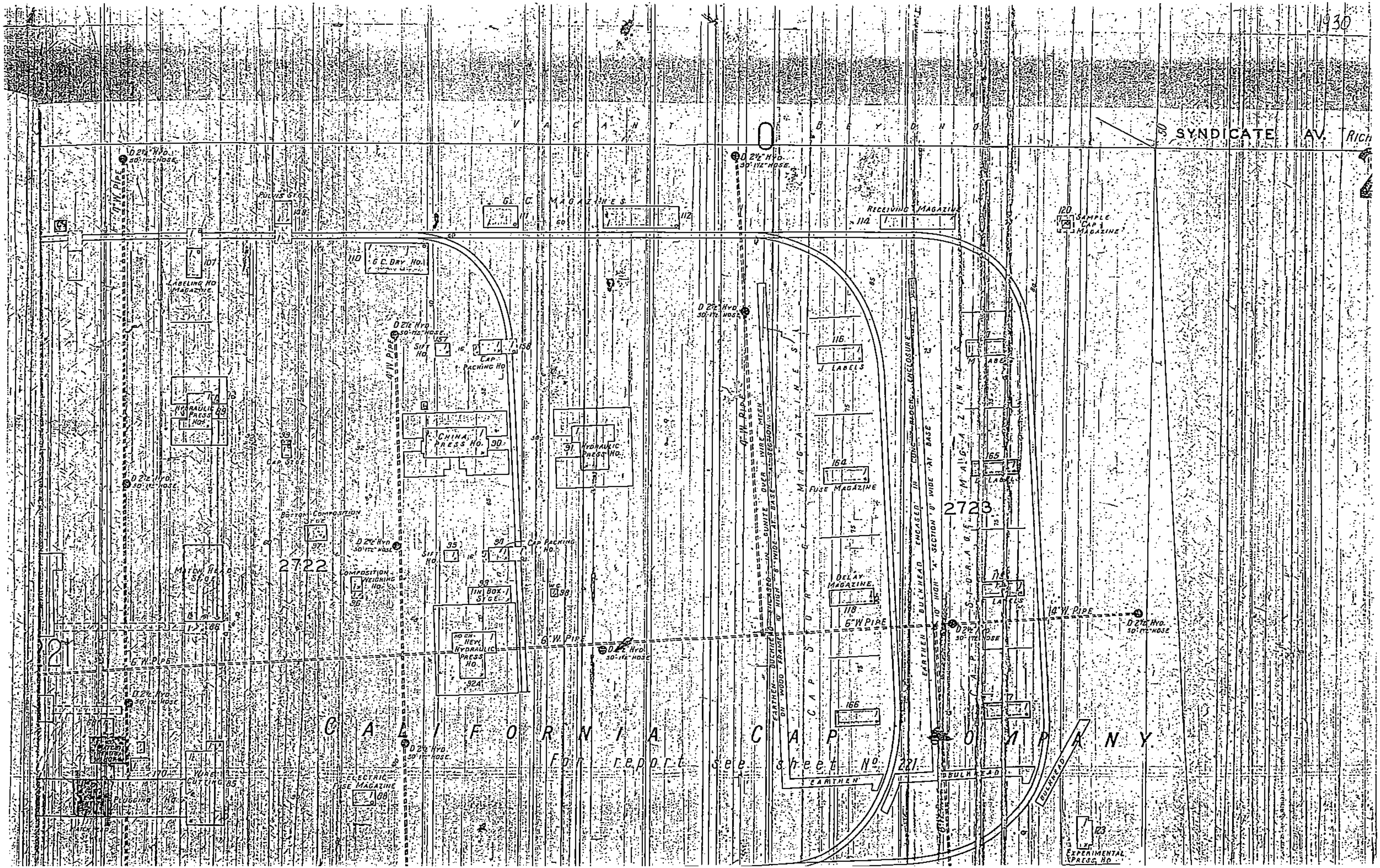
930

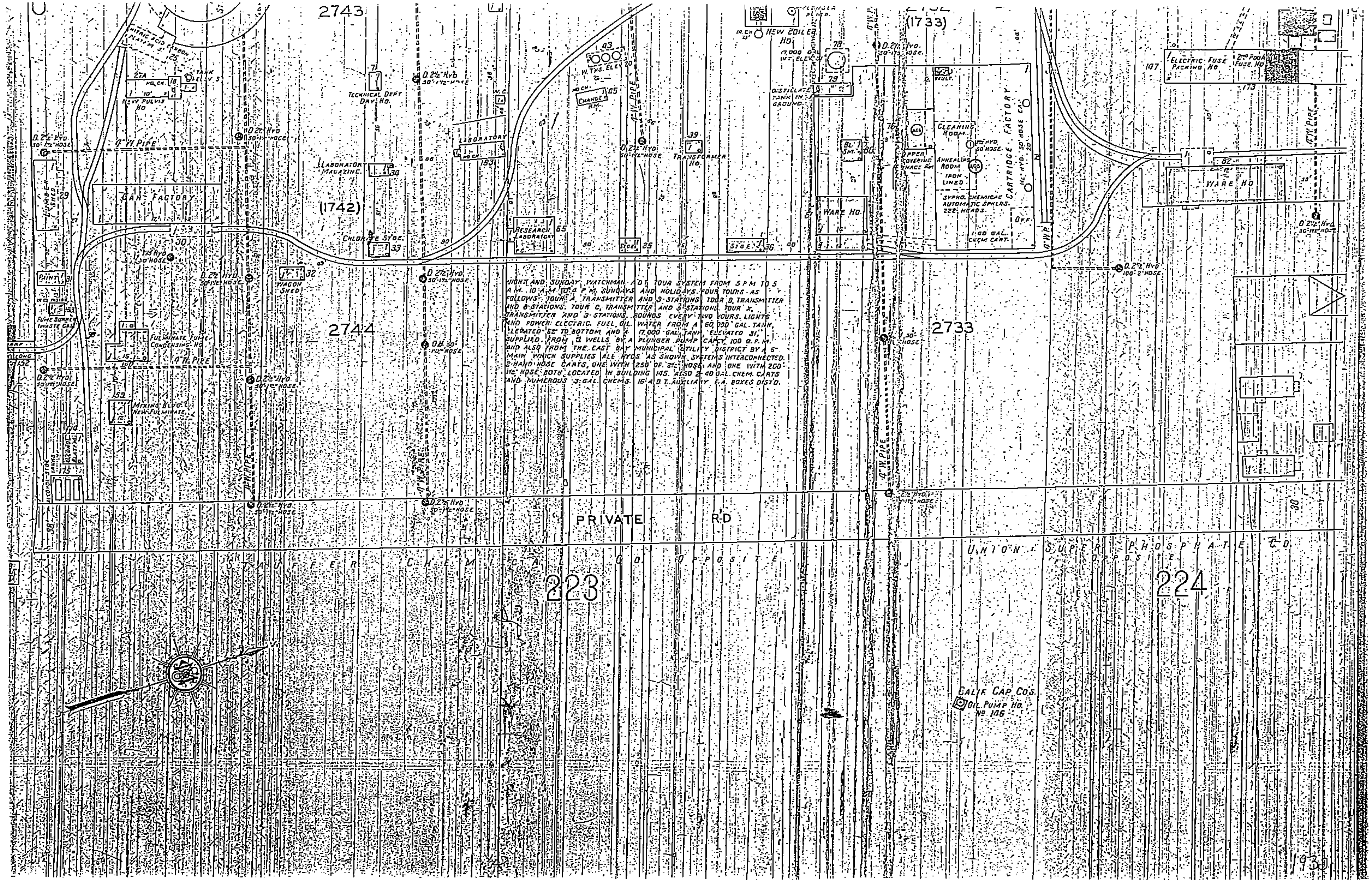


GENERAL OFFICE
GATE HO.
GATE
TESTING BARACADE (NOT USED)
ROAD
20
A SHED
150
4" W. PIPE
GATEMAN'S D
NIGHT WATCHMANS REST RM.
BUNK HO.
CHINESE QUARTERS
COOK HO.
WASH HO.
WOOD SHED
A SHED
151
GASOLINE PUMP
D 2½" HYD. 50' 1½" HOSE
WATCHMAN'S D
PRIVATE RD
UNION SUPER PHOSPHATE CO. OPPOSITE
224
2727
S. 46TH ST.
1351
50
PLATFORM
4" W. PIPE
SUPT'S D.
2728
(1597)
1251
S. 46TH ST.
80

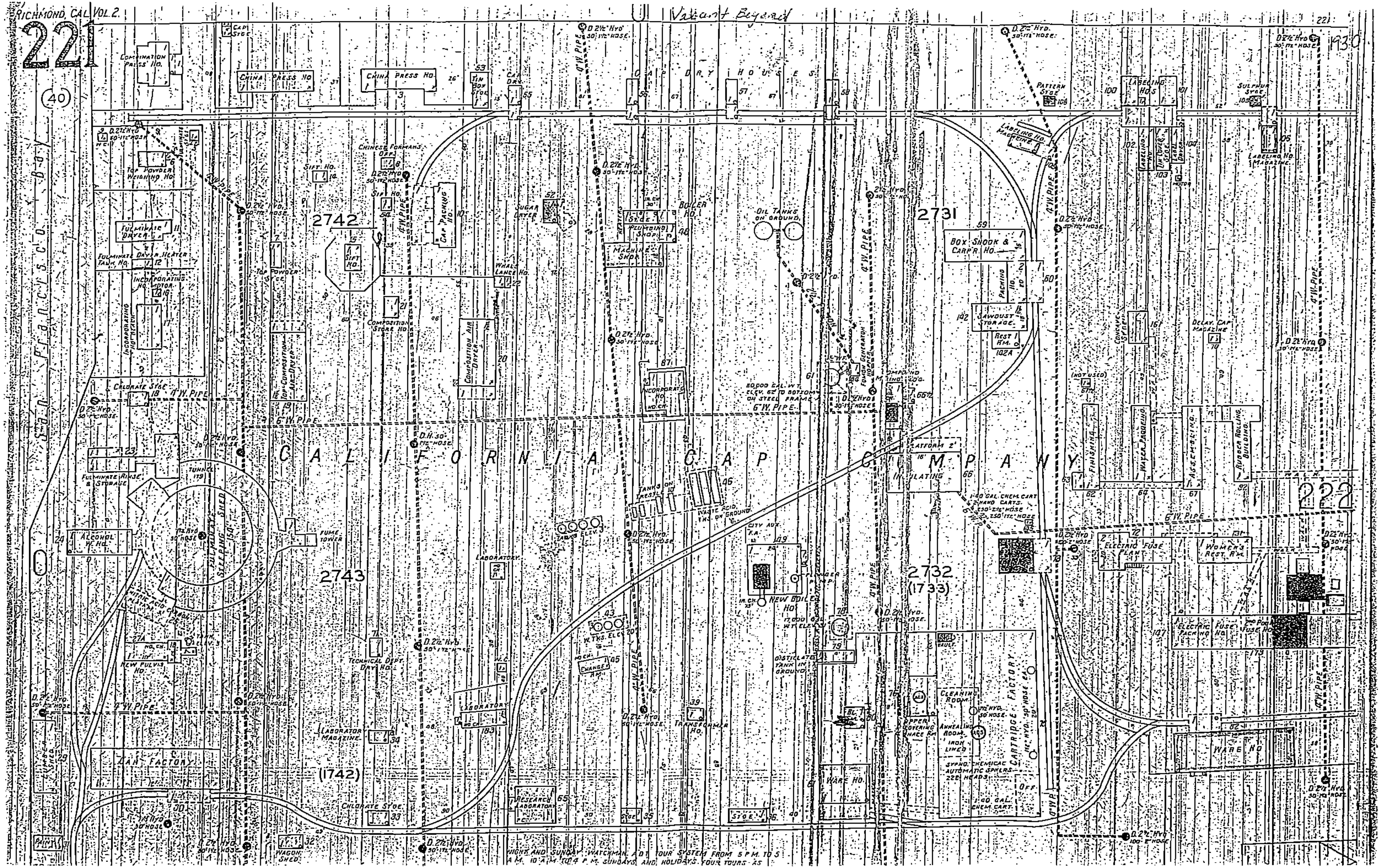
1930

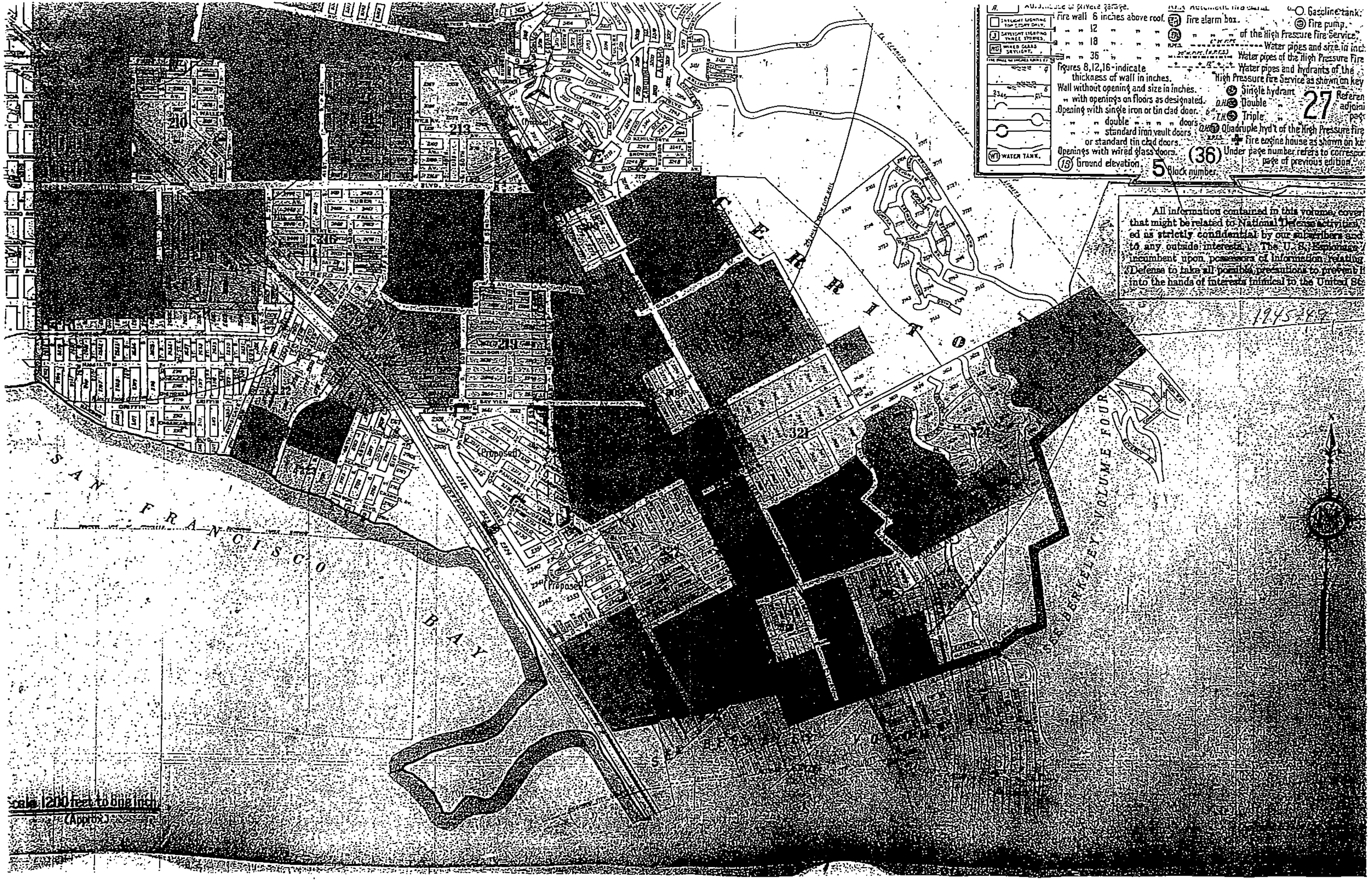

CALIFORNIA CAP COMPANY
For report see sheet No 221
2722
2723
2725
2726
221
Hydraulic Press Ho. 89
China Press Ho. 90
91 Hydraulic Press Ho.
Cap Packing Ho.
Sift Ho.
Cap Stge.
Button Composition
Match Head Stge.
Composition Weighing Ho. 96
Tin Box Stge. 93
New Hydraulic Press Ho. 92A
Electric Fuse Magazine 88
Wire Cutting 85
Plugging Ho.
Match Stge.
Fuse Magazine 164
Delay Magazine 118
166
115 Labels
Labels 165
Labels
Magazines
Cap Storage Magazines
Earthen bulkhead encased in wire mesh over gunite 10' high 6' wide 1' at base. Section on wood frame
Earthen bulkhead encased in concrete block 10' high 'A' section 8' wide at base
Earthen
Bulkhead
123 Experimental Press Ho.
Technical Laboratory & Annex 124
Cap Testers Shed
Testing Sheds 185
Testing Baracade (not used)
General Office 125
Gate Ho.
Gate
Gatemans D.
Night Watchmans Rest Rm.
Road
Gasoline
Cook
Bunk Ho.
Shed
A.S.
Watchman
D.H.
6" W. Pipe
4" W. Pipe
D 2½" Hyd. 50' 1½" Hose

1930
VACANT BEYOND
SYNDICATE AV.
Rich
50
D 2½" Hyd. 50'-1½" Hose
4" W. Pipe
Pulvis Stge 109
G. C. Magazines
111
112
Receiving Magazine
114
120 Sample Cap Magazine
107 Labeling Ho. Magazine
110 G. C. Dry Ho.
Sift Ho. 157
Cap Packing Ho. 158
116 J. Labels
Hydraulic Press Ho. 89
Cap Stge 99
China Press Ho. 90
91 Hydraulic Press Ho.
164 Fuse Magazine
165 Labels
2723
Button Composition Stge 97
2722
Match Head Stge
Composition Weighing Ho. 96
Sift Ho. 95
94 Cap Packing Ho.
93 Tin Box Stge
98
No. Ch. New Hydraulic Press Ho. 92A
Delay Magazine 118
Labels
6" W. Pipe
14" W. Pipe
121
Earthen bulkhead oh wood frame encased in Gunite 10' high 6' wide at base over wire mesh
Earthen bulkhead encased in conc. block enclosure 10' high "A" section 8' wide at base
Cap Storage Magazines
Cap Storage Magazines
166
170
Wire Cutting 85
Plugging Ho.
Electric Fuse Magazine 108
Earthen
Bulkhead
Bulkhead
123 Experimental Press Ho.
CALIFORNIA CAP COMPANY
For report see sheet No. 221



NIGHT AND SUNDAY WATCHMAN A.D.T. TOUR SYSTEM FROM 5 P.M. TO 5 A.M. 10 A.M. TO 4 P.M. SUNDAYS AND HOLIDAYS. FOUR TOURS AS FOLLOWS: TOUR A, TRANSMITTER AND 3-STATIONS. TOUR B, TRANSMITTER AND 8 STATIONS. TOUR C, TRANSMITTER AND 5 STATIONS. TOUR X, TRANSMITTER AND 3-STATIONS. ROUNDS EVERY TWO HOURS. LIGHTS AND POWER ELECTRIC. FUEL OIL. WATER FROM A 60,000 GAL. TANK, ELEVATED 62' TO BOTTOM AND A 17,000 GAL. TANK, ELEVATED 31', SUPPLIED FROM 3 WELLS BY A PLUNGER PUMP CAP'CY. 100 G.P.M. AND ALSO FROM THE EAST BAY MUNICIPAL UTILITY DISTRICT BY A 6" MAIN WHICH SUPPLIES ALL HYDS. AS SHOWN. SYSTEMS INTERCONNECTED. 2-HAND HOSE CARTS, ONE WITH 250' OF 2½" HOSE AND ONE WITH 200' 1½" HOSE BOTH LOCATED IN BUILDING 145. ALSO 2-40 GAL. CHEM. CARTS AND NUMEROUS 3 GAL. CHEMS. 16 A.D.T. AUXILIARY F.A. BOXES DIST'D.


(40)
San Francisco Bay
Vacant Beyond
1930
221
222
CALIFORNIA CAP COMPANY
2742
2743
(1742)
2731
2732
(1733)
Combination Press Ho.
China Press Ho.
China Press Ho.
Tin Box Stge.
Cap Dry
Cap Dry Houses
Pattern Stge.
Labeling Ho's
Sulphur Stge.
Labeling Ho. Magazine
Labeling Ho. Magazine
Top Powder Weighing Ho.
Fulminate Dryer
Fulminate Dryer Heater Tank Ho.
Incorporating Ho.
Chinese Formans Off.
Sift Ho.
Sift Ho.
Cap Packing Ho.
Sugar Dryer
Boiler Ho.
Plumbing Shop
Machine Shop
Oil Tanks on Ground
Box Shook & Carp'r Ho.
Packing
Sawdust Storage
Rest Rm.
Whale Lance Ho.
Top Powder
Composition Store Ho.
Top Composition Air Dryer
Composition Air Dryer
Incorporating Ho.
Fulmon Generator
Compounding Ho.
50,000 Gal. W.T. Elev. 62' to Bottom on Steel Frame
Finishing
Wafer Packing
Assembling
Rubber Rolling Building
Delay Cap Magazine
Conveyor
Chlorate Stge.
4" W. Pipe
6" W. Pipe
Fulminate Rinse & Storage
Tunnel
Fulminate Sleeping Shed
Fume Tower
Alcohol W. Ho.
Tanks on Trestle
Waste Acid Tks. on Ground
Platform 2'
Insulating
1-40 Gal. Chem. Cart
2 Hand Carts
Electric Fuse Plant
Women's Rest Rm.
Laboratory
City Aux. F.A.
New Boiler Ho.
Tanks Elev.
Nitric Acid Plant
New Pulvig Ho.
Technical Dept. Dry Ho.
W. Tks. Elev.
Change Rm.
17,000 Gal. W.T. Elev.
Distillate Tank in Ground
Electric Fuse Packing Ho.
Fuse Ho.
Cleaning Room
Annealing Room Iron Lined
Cartridge Factory
Sypho Chemical Automatic Sprklrs. 222 Heads
1-60 Gal. Chem. Cart
Copper Covering
Transformer Ho.
Laboratory
Laboratory Magazine
Cap Factory
Lumber Shed
Ware Ho.
Ware Ho.
Research Laboratory
Chlorate Stge.
Stge.
Stge.
Wagon Shed
Paint
D. 2½" Hyd. 50' 1½" Hose
NIGHT AND SUNDAY WATCHMAN. A.D.T. TOUR SYSTEM FROM 5 P.M. TO 5 A.M. 10 A.M. TO 4 P.M. SUNDAYS AND HOLIDAYS. FOUR TOURS AS



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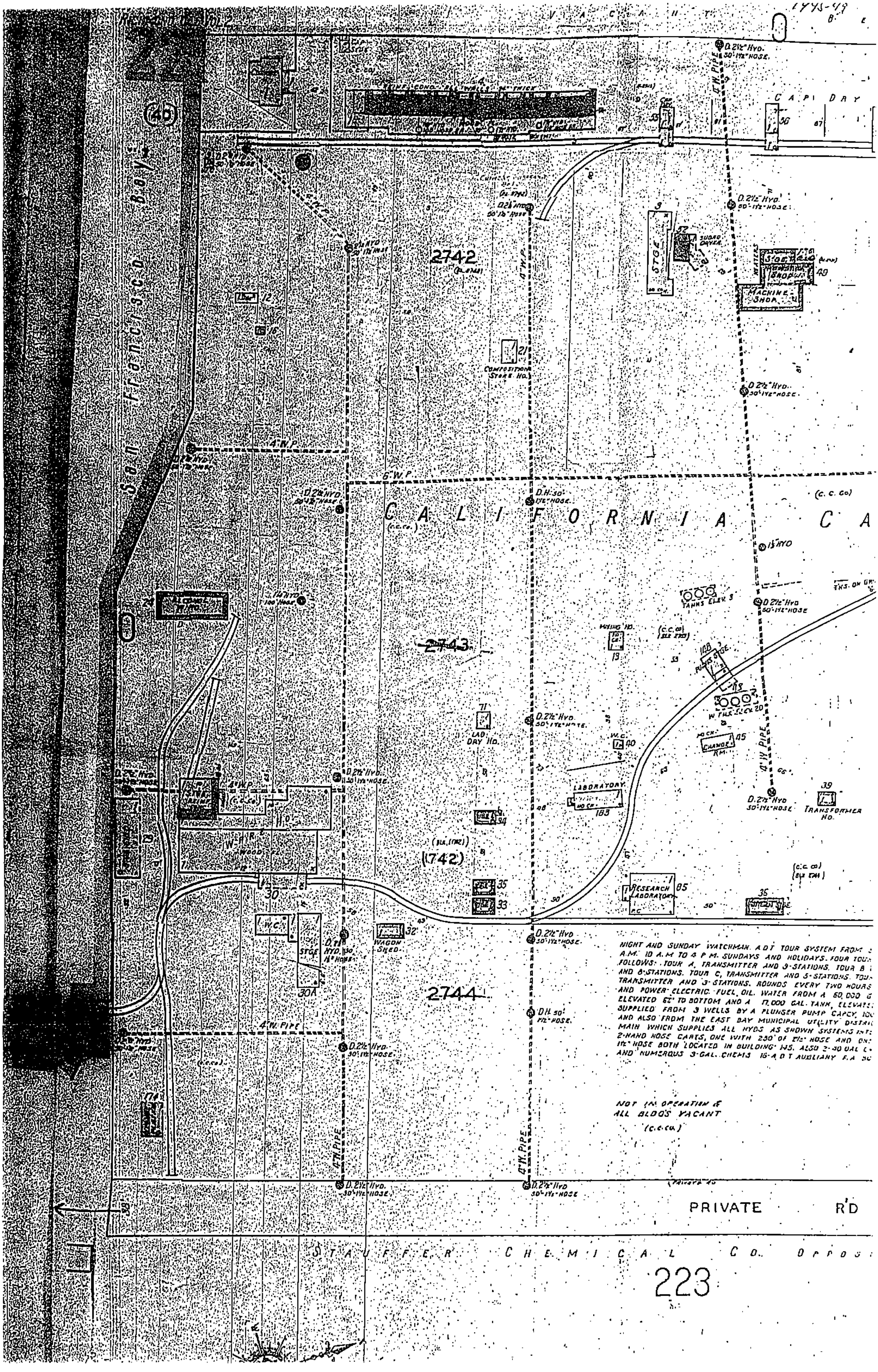
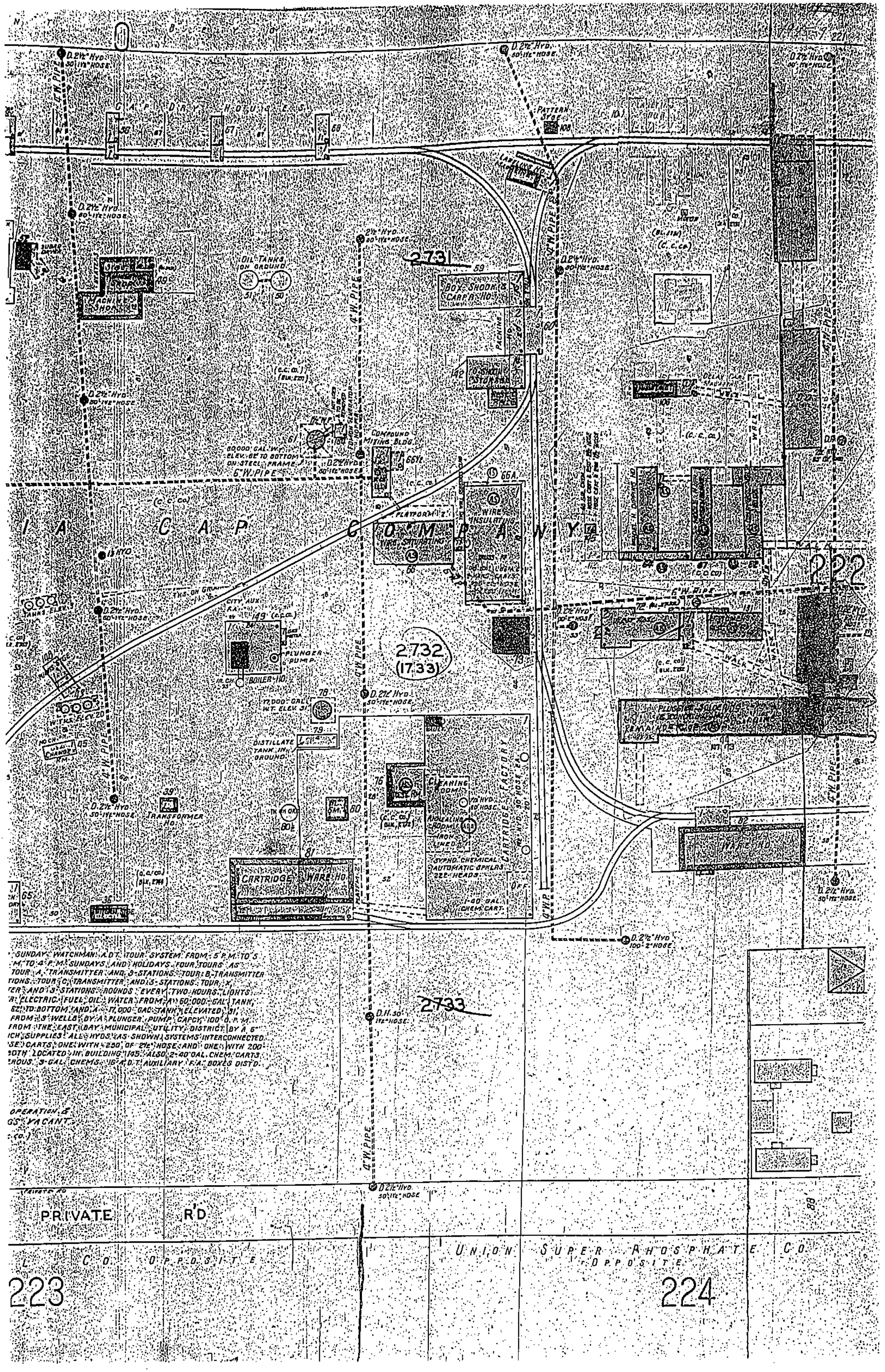
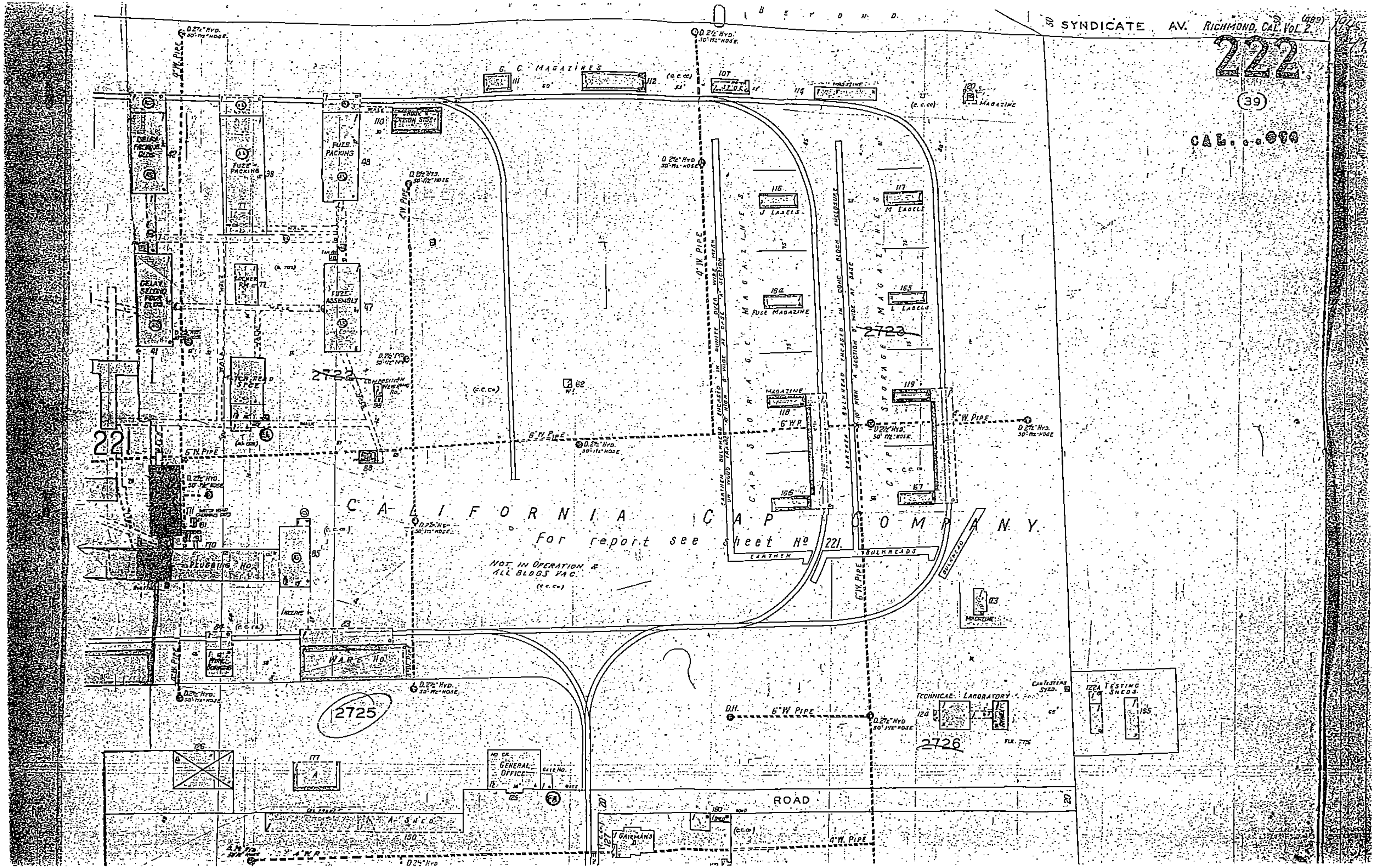
incumbent upon possessors of information relating
Defense to take all possible precautions to prevent i
into the hands of interests inimical to the United St

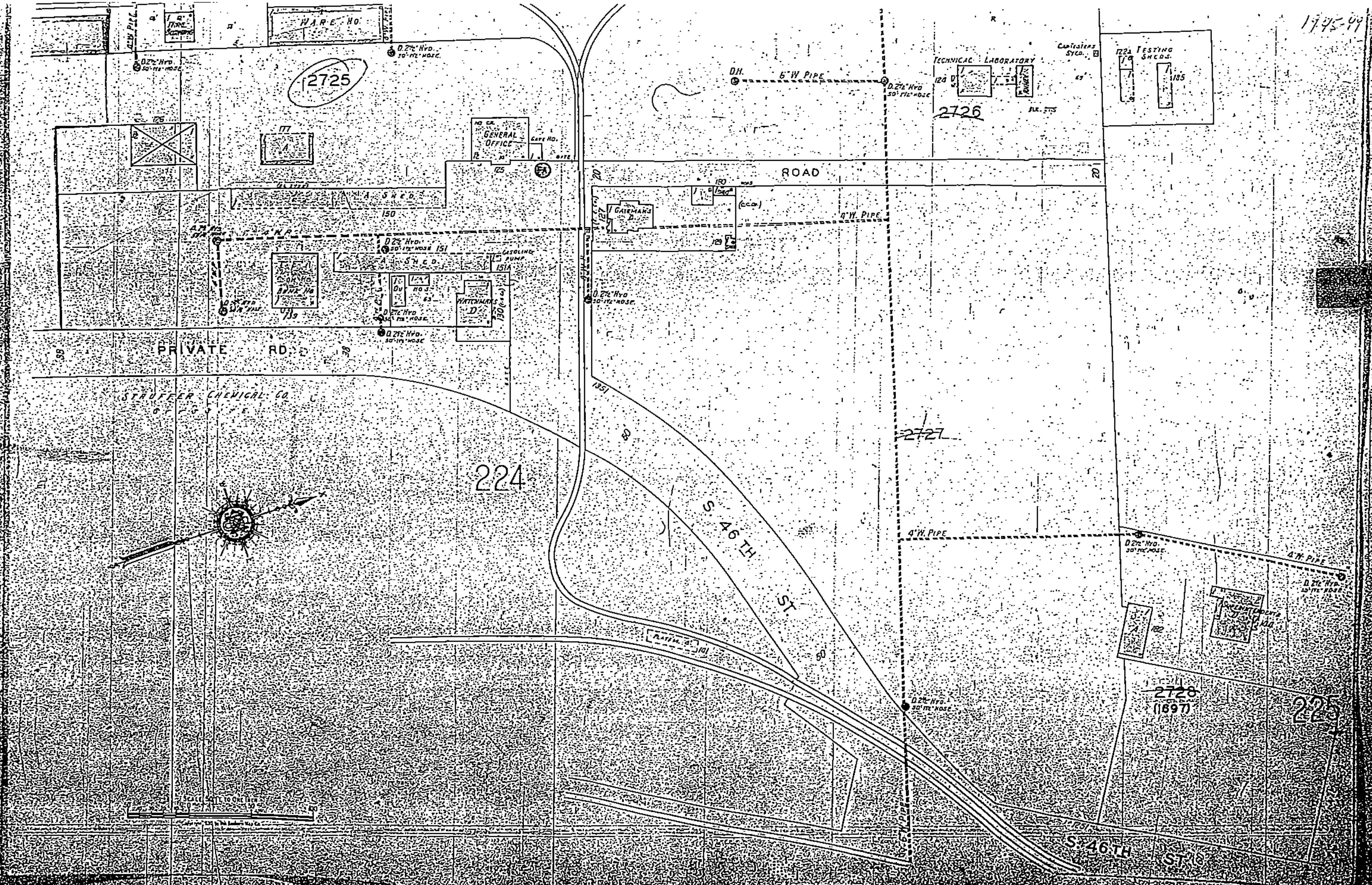
1945-49


1945-49
VACANT
CAPI DRY
San Francisco Bay
(40)
22
D.2½" HYD. 50'-1½" HOSE.
4" W. PIPE
4" W.P.
6" W.P.
2742
2743
2744
(742)
CALIFORNIA CA
(C. C. CO)
STGE
SUGAR DRYER
52
3
MACHINE-SHOP.
40
WATERS
21
COMPOSITION STORE HO.
12
16
1½" HYD.
TANKS ELEV. 3
WEIG HO.
13
108
PUMPS STGE.
W. TKS. ELEV. 20
CHANGE RM.
85
W.C.
40
LAB. DAY HO.
71
94
LABORATORY
183
35
33
TRANSFORMER HO.
39
RESEARCH LABORATORY
85
35
32
WAGON SHED.
W.C.
STGE
D.H. 50' 1½" HOSE.
30A
30
W-H-R WOOD
2-D
NIGHT AND SUNDAY WATCHMAN. A D T TOUR SYSTEM FROM
A.M. 10 A.M. TO 4 P.M. SUNDAYS AND HOLIDAYS. FOUR TOU
FOLLOWS: TOUR A, TRANSMITTER AND 9-STATIONS. TOUR B
AND 8-STATIONS. TOUR C, TRANSMITTER AND 5-STATIONS. TOU
TRANSMITTER AND 3-STATIONS. ROUNDS EVERY TWO HOURS
AND POWER-ELECTRIC. FUEL, OIL. WATER FROM A 60,000 G
ELEVATED 62' TO BOTTOM AND A 17,000 GAL. TANK, ELEVAT
SUPPLIED FROM 3 WELLS BY A PLUNGER PUMP CAPCY. 100
AND ALSO FROM THE EAST BAY MUNICIPAL UTILITY DISTRI
MAIN WHICH SUPPLIES ALL HYDS AS SHOWN SYSTEMS INT
2-HAND HOSE CARTS, ONE WITH 250' OF 2½" HOSE AND ON
1½" HOSE BOTH LOCATED IN BUILDING 145. ALSO 2-40 GAL C
AND NUMEROUS 3-GAL. CHEMS 16-A D T AUXILIARY F.A. 30
NOT IN OPERATION & ALL BLDG'S VACANT
(C.C.CO.)
PRIVATE R'D
STAUFFER CHEMICAL CO. OPPOS
223

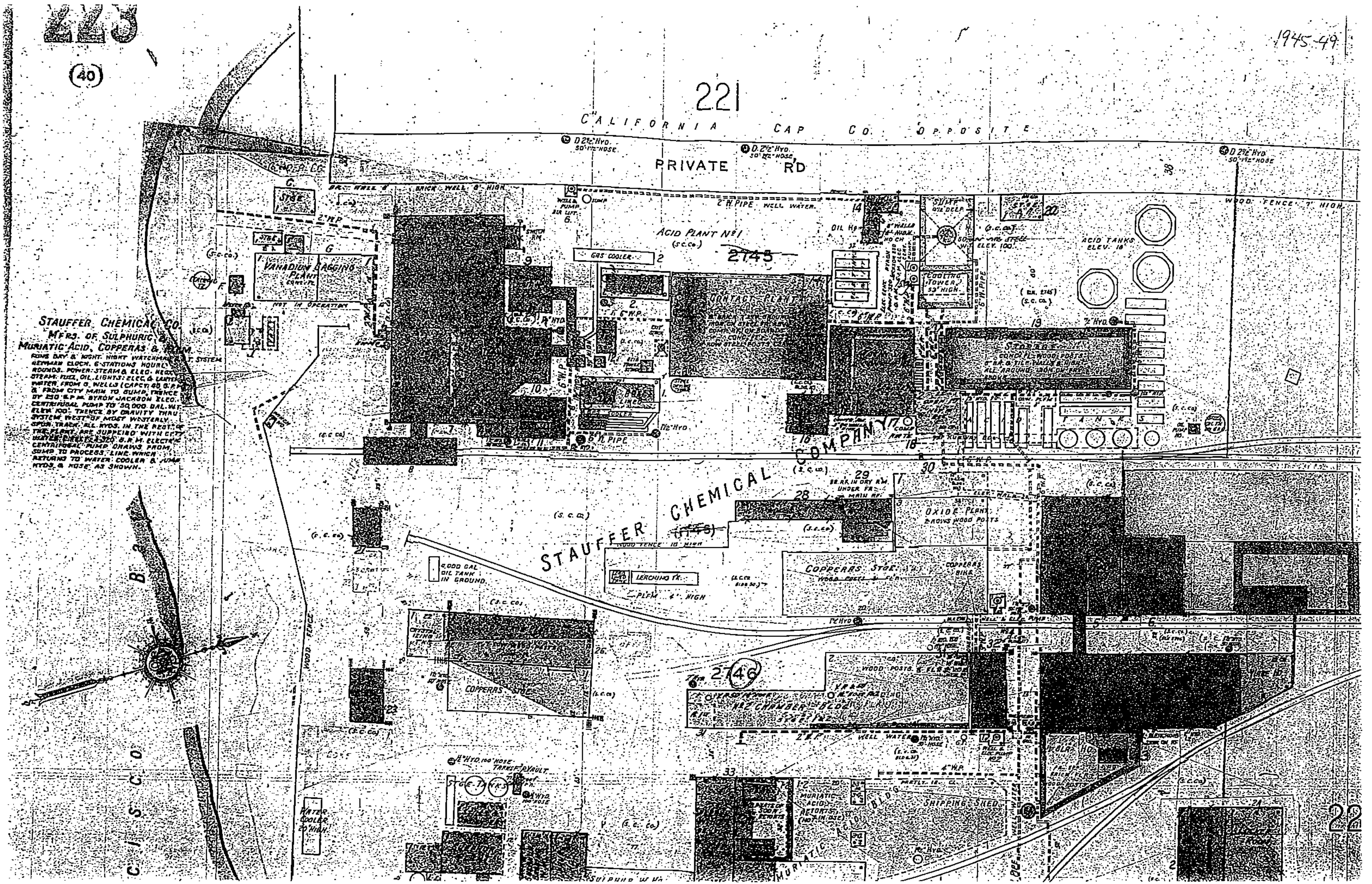

221
222
223
224
2731
2732
(17.33)
2733
C A P   C O M P A N Y
GAP DRY HOUSES
PATTERN STGE.
108
BOX SHOOK & CARP.'S HO.
69
PACKING
O. SHOOK STORAGE
142
OIL TANKS ON GROUND
51
50
MACHINE SHOP
COMPOUND MIXING BLDG.
66½
80000 GAL. W.T. ELEV. 82' TO BOTTOM ON STEEL FRAME
6" W. PIPE
4" W. PIPE
D. 2½" HYD. 50'-1½" HOSE
D. 2½" HYD. 100'-2" HOSE
D.H. 50' 1½" HOSE
(C. C. CO.)
PLATFORM
WIRE INSULATING
66A
WRE. SATURATING
66
149
CITY AUX.
PLUNGER PUMP
BOILER-110
TKS. ON GR.
TANKS ELEV.
78
17,000 GAL. WT. ELEV. 31'
DISTILLATE TANK IN GROUND
79
80
80½
81
39
TRANSFORMER HO.
CARTRIDGE WARE HO.
36
65
CLEANING ROOM
ANNEALING ROOM
IRON LINED
76
CARTRIDGE FACTORY
SYPHO. CHEMICAL AUTOMATIC SPKLRS. 222-HEADS
1-40 GAL. CHEM. CART.
73
PLUSHER SOLDERING
WARE HO.
82
WALK
(C. C. CO.)
SUNDAY, WATCHMAN, A.D.T. TOUR SYSTEM: FROM 5 P.M. TO 5
M. TO 4 P.M. SUNDAYS AND HOLIDAYS FOUR TOURS AS
TOUR A, TRANSMITTER AND 9 STATIONS: TOUR B, TRANSMITTER
TIONS: TOUR C, TRANSMITTER AND 5 STATIONS: TOUR X,
TER AND 3 STATIONS: ROUNDS EVERY TWO HOURS. LIGHTS
R: ELECTRIC. FUEL: OIL. WATER: FROM A 60,000 GAL. TANK,
82' TO BOTTOM AND A 17,000 GAL. TANK ELEVATED 31',
FROM 3 WELLS BY A PLUNGER PUMP, CAPCY. 100 G.P.M.
FROM THE EAST BAY MUNICIPAL UTILITY DISTRICT BY A 6"
ICH SUPPLIES ALL HYDS. AS SHOWN. SYSTEMS INTERCONNECTED.
SE CARTS: ONE WITH 250' OF 2½" HOSE AND ONE WITH 200'
BOTH LOCATED IN BUILDING 145. ALSO 2-40 GAL. CHEM. CARTS
EROUS 3-GAL. CHEMS. 16 A.D.T. AUXILIARY F.A. BOXES DISTD.
OPERATION &
GS VACANT
CO.)
PRIVATE RD
L CO. OPPOSITE
UNION SUPER PHOSPHATE CO.
OPPOSITE


BEYOND
SYNDICATE AV.
50
(489)
(39)
CAL. . . 010
G. C. MAGAZINES
111
112
107
114
MAGAZINE
120
MAGAZINE
(C. C. CO.)
110
DELAY FACING BLDG.
42
FUZE PACKING
38
FUZE PACKING
48
FUZE ASSEMBLY
47
DELAY SECOND FACE BLDG.
41
LOCKER RM.
MATCH HEAD STGE.
COMPOSITION WEIGHING RO.
98
88
2722
D. 2½" HYD. 50' 1½" HOSE
4" W. PIPE
6" W. PIPE
62
W.T.
116
J LABELS
117
M LABELS
164
FUSE MAGAZINE
165
L LABELS
2723
CAP STORAGE MAGAZINES
EARTHEN BULKHEAD ENCASED IN GUNITE OVER WIRE MESH 8' WIDE AT BASE 'A' SECTION
BULKHEAD ENCASED IN CONC. BLOCK ENCLOSURE 10' HIGH A SECTION 8' WIDE AT BASE
MAGAZINE
118
6" W.P.
119
166
167
EARTHEN
BULKHEADS
BULKHEAD
221
CALIFORNIA CAP COMPANY
For report see sheet No 221.
NOT IN OPERATION & ALL BLDGS VAC.
(C. C. CO.)
170
PLUGGING HO.
85
INCLINE
84
83
WARE HO.
2725
126
177
A
GENERAL OFFICE
125
GATE HO.
GATE
A SHED
150
ROAD
20
180
GATEMAN'S
127
103
MAGAZINE
D.H.
TECHNICAL LABORATORY
124
2726
CAP TESTERS SHED
122A
TESTING SHEDS
155

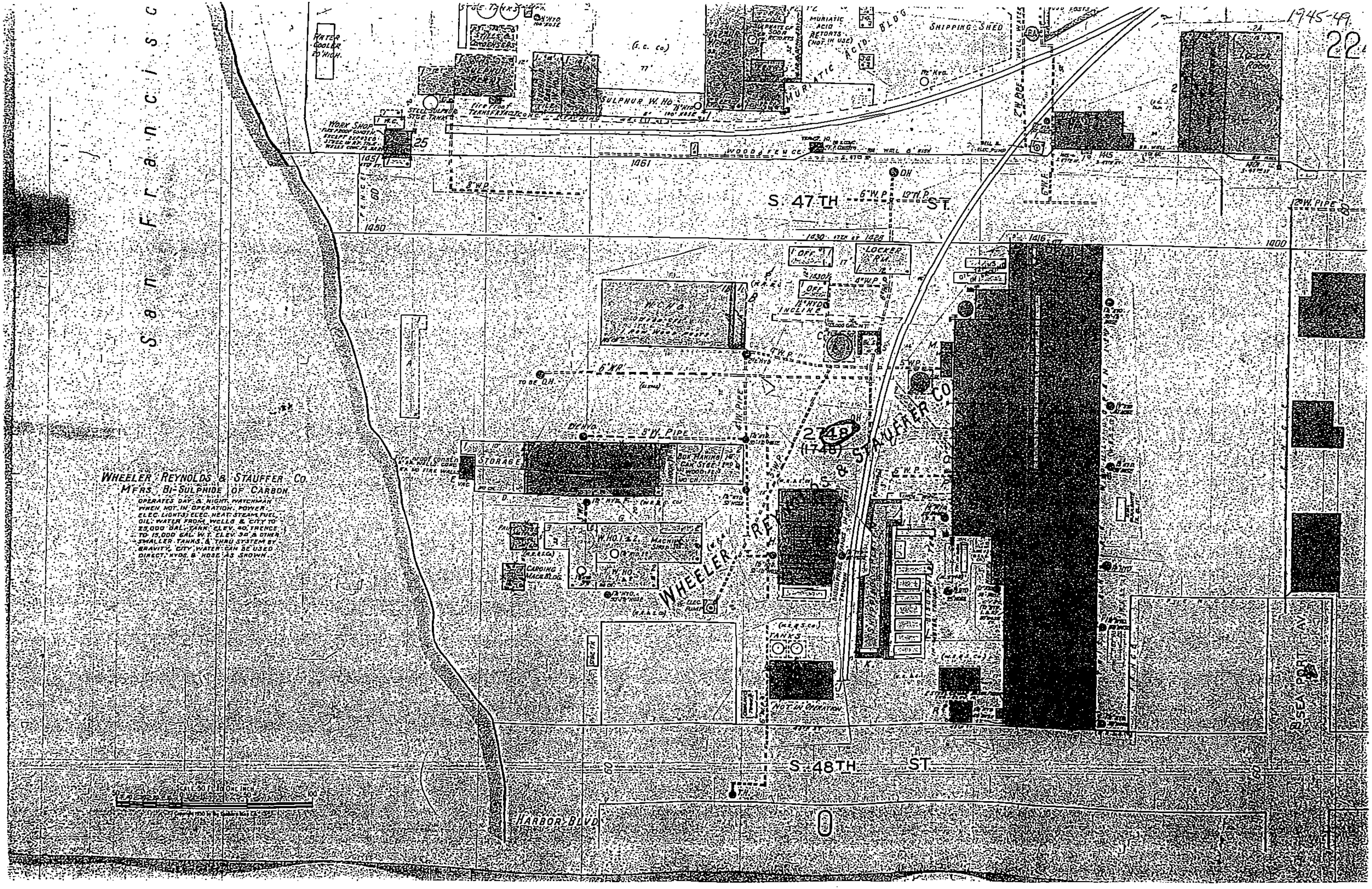
1945-49


WARE HO.
TIRE STORAGE
4" W. PIPE
D. 2½" HYD. 50' 1½" HOSE
2725
126
177
A
GENERAL OFFICE
GATE HO.
GATE
125
F.A.
A. SHED
150
4" W.P.
D. 2½" HYD. 50' 1½" HOSE 151
A. SHED
GASOLINE PUMP
151A
COOK HO. BUNK HO.
139
HO. 63
WATCHMANS D.
130
PRIVATE RD.
38
STAUFFER CHEMICAL CO.
224
20
ROAD
20
GATEMANS D.
127
180
189
(C.C.D.)
4" W. PIPE
D.H.
6" W. PIPE
TECHNICAL LABORATORY
128
2726
CARPENTERS SHOP
122A
TESTING SHEDS
185
1351
80
S. 46TH ST.
2727
4" W. PIPE
PLATFM. 3'
101
80
A
182
2728
(1897)
225
S. 46TH ST.

1945-49

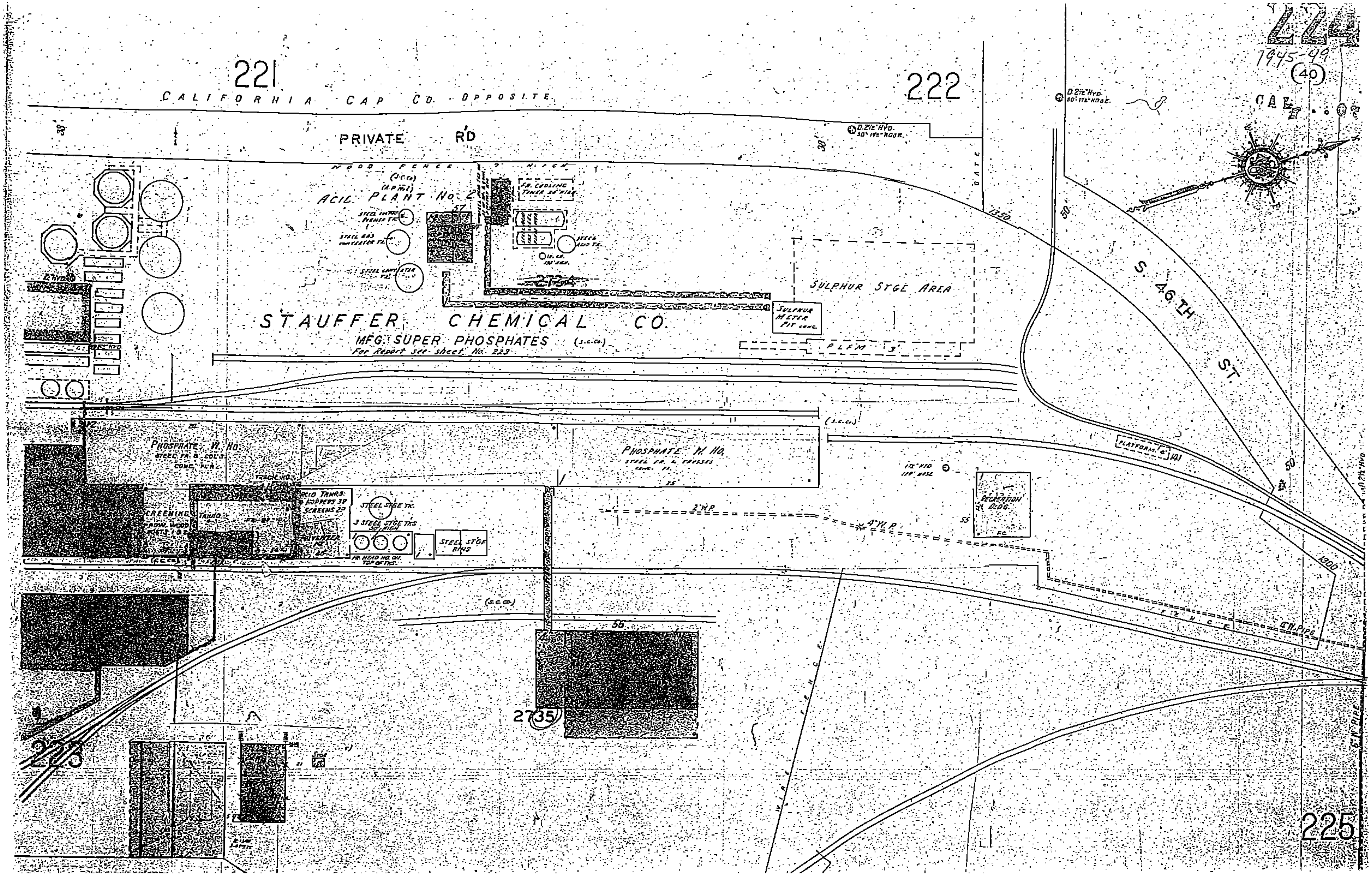

223
(40)
221
CALIFORNIA CAP CO. OPPOSITE
PRIVATE RD
ACID PLANT Nº1
(S.C.CO.)
~~2745~~
GAS COOLER
CONTACT PLANT
COOLING TOWER 53' HIGH
ACID TANKS ELEV. 18'
STORAGE
TANKS
VANADIUM BAGGING PLANT
NOT IN OPERATION
STAUFFER CHEMICAL CO.
MFRS. OF SULPHURIC & MURIATIC ACID, COPPERAS & ALUM.
RUNS DAY & NIGHT. NIGHT WATCHMAN, SYSTEM GERMAN CLOCK, 6 STATIONS HOURLY ROUNDS. POWER: STEAM & ELEC. HEAT: STEAM. FUEL, OIL. LIGHTS: ELEC. & LANTERNS. WATER FROM 6 WELLS (CAPCY. 40 G.P.M.) & FROM CITY MAIN TO SUMP, THENCE BY 250 G.P.M. BYRON JACKSON ELEC. CENTRIFUGAL PUMP TO 50,000 GAL. WT. ELEV. 100'. THENCE BY GRAVITY THRU SYSTEM WEST OF MOST WESTERLY SPUR TRACK. ALL HYDS. IN THE REST OF THE PLANT ARE SUPPLIED WITH CITY WATER. A 320 G.P.M. ELECTRIC CENTRIFUGAL PUMP DRAWS FROM SUMP TO PROCESS LINE WHICH RETURNS TO WATER COOLER & SUMP HYDS. & HOSE AS SHOWN.
STAUFFER CHEMICAL COMPANY
(2746)
2746
OXIDE PLANT
COPPERAS STGE.
LEACHING TK.
COPPERAS STGE.
6,000 GAL. OIL TANK IN GROUND.
WOOD FENCE
WATER COOLER 20' HIGH
H2 CHAMBER FLOOR
MURIATIC ACID RETORTS (NOT IN USE)
MURIATIC ACID BLDG.
SHIPPING SHED
SULPHUR W.H.
SAN FRANCISCO BAY
22

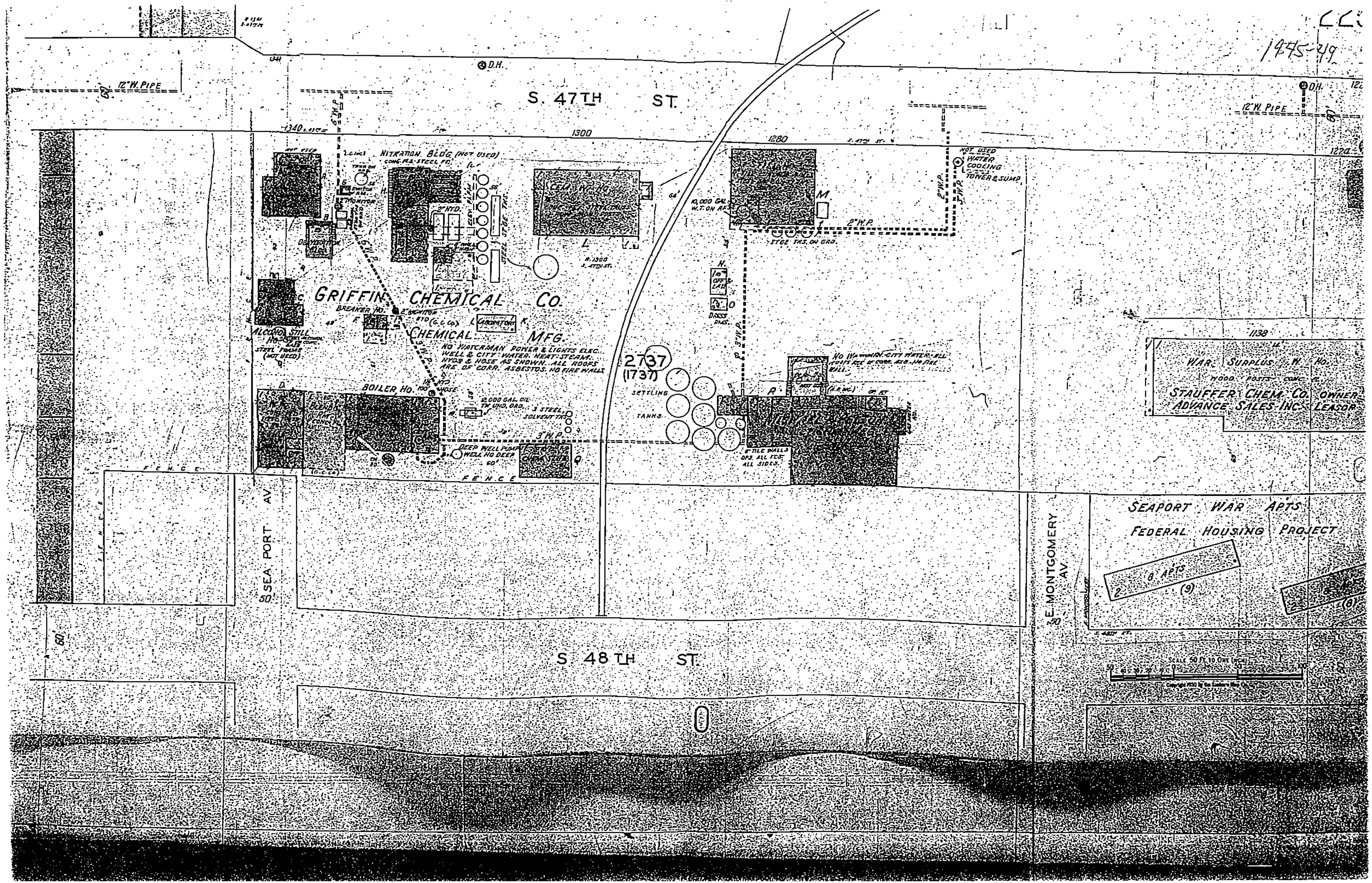
1945-49



WHEELER REYNOLDS & STAUFFER CO.
MFRS. BI-SULPHIDE OF CARBON.
OPERATES DAY & NIGHT, WATCHMAN WHEN NOT IN OPERATION. POWER ELEC. LIGHTS, ELEC. HEAT. STEAM, FUEL OIL. WATER FROM WELLS & CITY TO 25,000 GAL. TANK ELEV. 40, THENCE TO 15,000 GAL. W.T. ELEV. 34 & OTHER SMALLER TANKS & THRU SYSTEM BY GRAVITY, CITY WATER CAN BE USED DIRECT, HYDS. & HOSE AS SHOWN.

1945-49
(40)


221
CALIFORNIA CAP CO. OPPOSITE
PRIVATE RD
222
38'
WOOD FENCE 7' HIGH
(S.C.Co)
(A.P.Mil)
ACIC PLANT No. 2
57
STEEL INTER. BLENDE TK.
STEEL GAS CONVERTER TK.
STEEL CONVERTER TK.
FR. COOLING TOWER 25' HIGH
STEEL ACID TK.
2734
STAUFFER CHEMICAL CO.
MFG. SUPER PHOSPHATES (S.C.Co.)
For Report see sheet No. 223
SULPHUR METER PIT CONC.
SULPHUR STGE AREA
PLFM 3'
GATE
1350
S. 46TH ST.
50'
50
D.2½"HYD. 50' 1½" HOSE
CAL.
PHOSPHATE W. HO.
STEEL FR. & COLS. CONC. FLR.
TRACK NO. 2
SCREENING
TANKO
ACID TANKS: HOPPERS 3P SCREENS 2P
CONVERTER
STEEL STGE TK.
3 STEEL STGE TKS 30' HIGH
FR. HEAD HO. ON TOP OF TKS.
STEEL STGE BINS
PHOSPHATE W. HO.
STEEL FR. & TRUSSES
(S.C.Co)
2"W.P.
4"W.P.
1½" HYD. 1½" HOSE
RECEPTION BLDG.
55
PLATFORM 4'
141
1900
FENCE
C.W. PIPE
(S.C.Co)
56
2735
223
225
WIRE FENCE


1945-49
S. 47TH ST.
12" W. PIPE
D.H.
1340
1300
1280
1220
6" W.P.
NITRATION BLDG (NOT USED)
CONC. FLS. STEEL FR.
DEHYDRATION BLDG.
2" MONITOR
2" HYD.
STEEL STGE. TKS.
CEM. W. HO.
L
R. 1300 S. 47TH ST.
10,000 GAL. W.T. ON RF.
M.
2" W.P.
3" W.P.
STGE. TKS. ON GRD.
NOT USED WATER COOLING TOWER & SUMP
GRIFFIN CHEMICAL CO.
BREAKER HO.
2" MONITOR
HYD (G.C. Co)
LABORATORY
K
F
C
CHEMICAL MFG.
ALCOHOL STILL HO.
STEEL FRAME (NOT USED)
NO WATCHMAN. POWER & LIGHTS ELEC. WELL & CITY WATER. HEAT STEAM. HYDS & HOSE AS SHOWN. ALL ROOFS ARE OF CORR. ASBESTOS. NO FIRE WALLS
2737
(1737)
SETTLING TANKS
N.
OFF. & LAB.
O
DRESS. RMS.
NO WATCHMAN. CITY WATER. ALL ROOFS ARE OF CORR. ASB. NO FIRE WALL.
NOT USED
R
8" TILE WALLS OPS. ALL FLS. ALL SIDES.
D
BOILER HO.
1½" HYD 100' HOSE
2,000 GAL. OIL TK UND. GRD.
3 STEEL SOLVENT TKS
3" W.P.
DEEP WELL PUMP WELL HO DEEP 60'
Q
(G.C. Co)
FENCE
1138
WAR SURPLUS W. HO.
WOOD POSTS CONC. FL.
STAUFFER CHEM. CO. OWNER
ADVANCE SALES INC. LEASOR
SEA PORT AV.
50
E. MONTGOMERY AV.
SEAPORT WAR APTS
FEDERAL HOUSING PROJECT
8 APTS
2
(9)
S. 48TH ST.
60
SCALE 50 FT. TO ONE INCH
50 40 30 20 10 0 50 100
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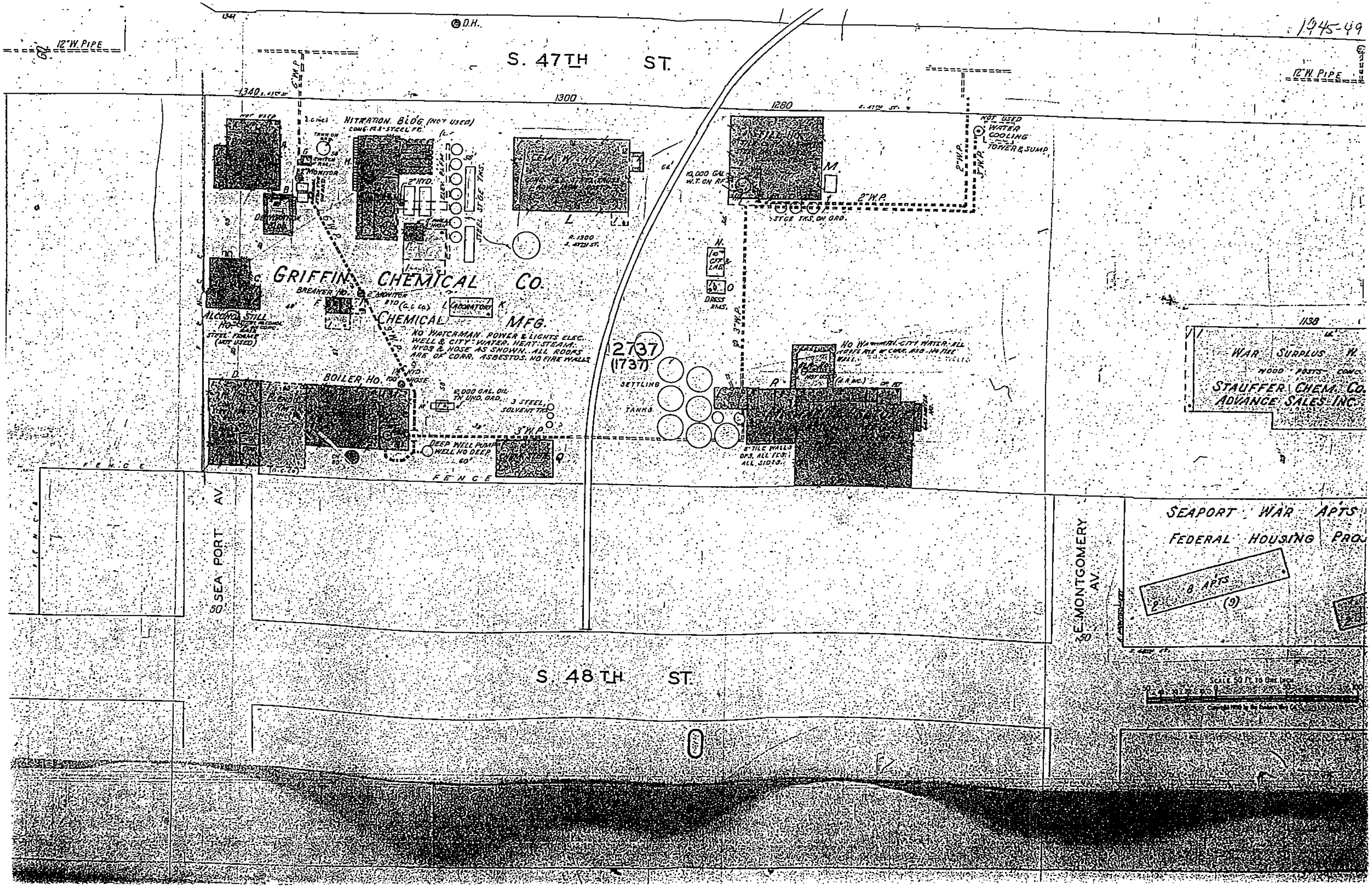
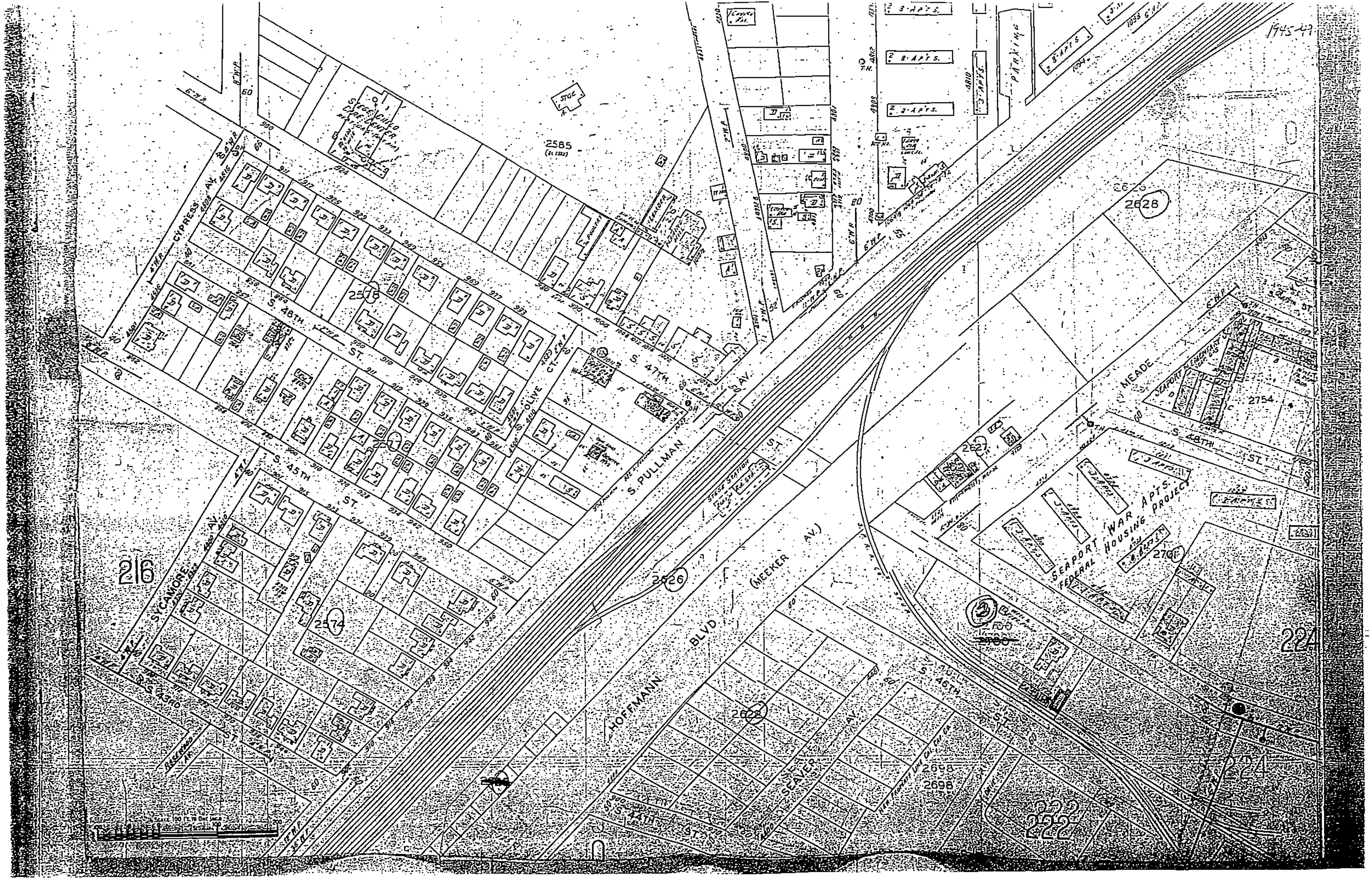
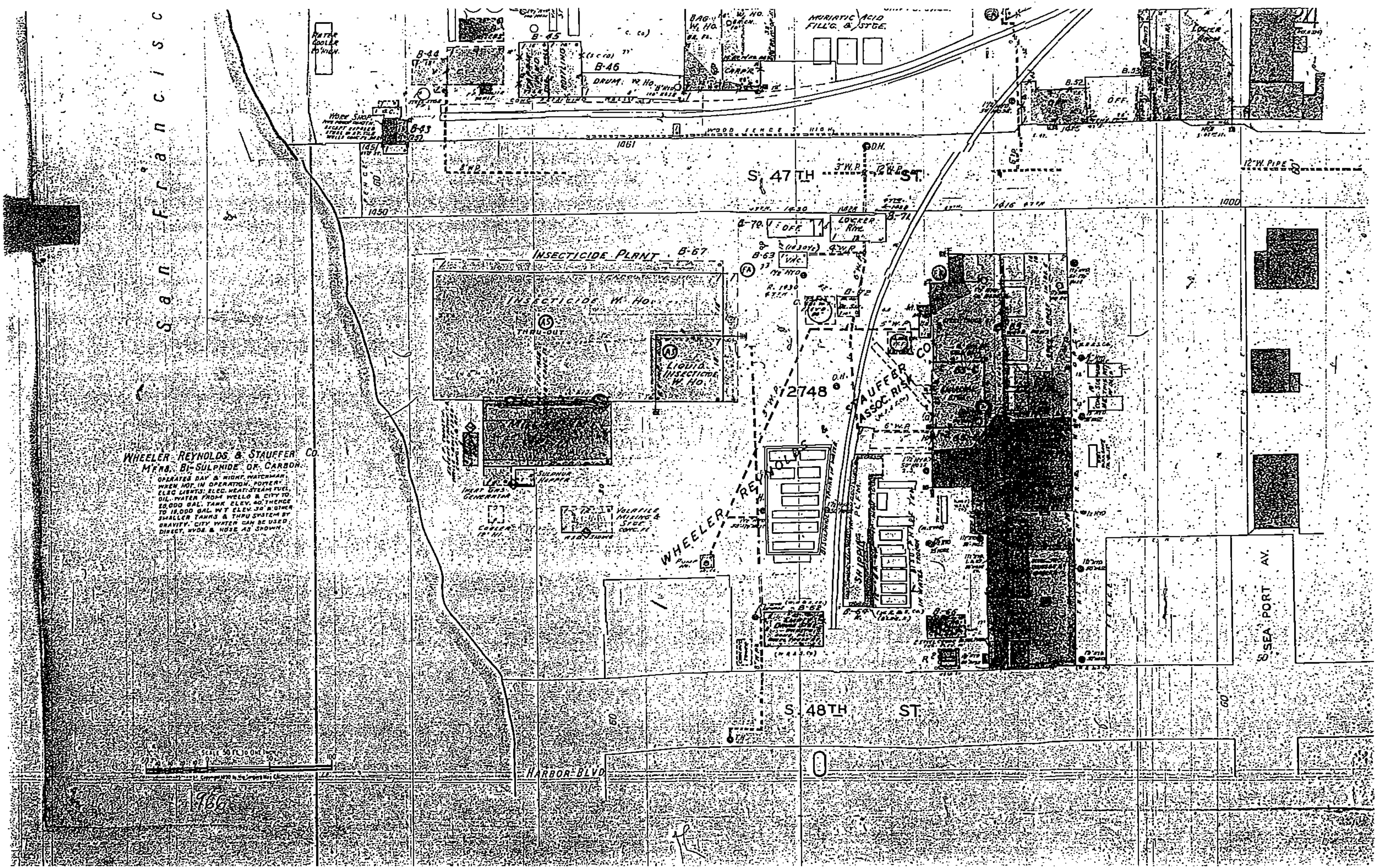
1945-49


12" W. PIPE
D.H.
S. 47TH ST.
12" W. PIPE
1340
1300
1280
6" W.P.
NOT USED
NITRATION. BLDG (NOT USED)
CONC. FLS. STEEL FR.
TANK ON
2" MONITOR
2" HYD.
STEEL STGE TKS.
CEM. W. HO.
L
R. 1300 S. 47TH ST.
10,000 GAL. W.T. ON RF.
M.
NOT USED WATER COOLING TOWER & SUMP.
2" W.P.
3" W.P.
STGE TKS. ON GRD.
DEHYDRATION
GRIFFIN CHEMICAL CO.
BREAKER HO.
2" MONITOR HYD (G. C. Co.)
LABORATORY
K
F
C
ALCOHOL STILL HO.
STEEL FRAME (NOT USED)
CHEMICAL MFG.
NO WATCHMAN. POWER & LIGHTS ELEC. WELL & CITY WATER. HEAT: STEAM. HYDS & HOSE AS SHOWN. ALL ROOFS ARE OF CORR. ASBESTOS. NO FIRE WALLS
N.
10" CITY LAB.
O
DRESS RMS.
2737
(1737)
SETTLING TANKS
NO WATCHMAN. CITY WATER. ALL ROOFS ARE OF CORR. ASB. NO FIRE WALLS
NOT USED
R
8" TILE WALLS OPS. ALL FLS. ALL SIDES.
D.
BOILER HO.
1 1/2" HYD 100' HOSE
2,000 GAL. OIL TK UND. GRD.
3 STEEL SOLVENT TKS.
3" W.P.
DEEP WELL PUMP WELL HO DEEP 60'
Q
FENCE
FENCE
1138
WAR SURPLUS W.
WOOD POSTS CONC.
STAUFFER CHEM. CO. ADVANCE SALES INC.
SEA PORT AV.
50
E. MONTGOMERY AV.
50
SEAPORT WAR APTS
FEDERAL HOUSING PRO
2 8 APTS
(9)
S. 48TH ST.
SCALE 50 FT. TO ONE INCH
O

1945-47



CYPRESS AV.
S. 46TH ST.
S. 45TH ST.
S. 43RD ST.
S. 44TH ST.
SYCAMORE AV.
OLIVE CT.
S. 47TH
S. PULLMAN AV.
STAGE STATION
HOFFMANN BLVD (MEEKER AV.)
SEAVER AV.
S. 46TH ST.
S. 48TH ST.
MEADE
SEAPORT WAR APTS.
FEDERAL HOUSING PROJECT
SEAPORT ELEMENTARY SCHOOL
PARKING
8 APTS.
3 APTS.
2585
2576
2577
2574
2626
2628
2627
2698
2754
2700
216
222
224

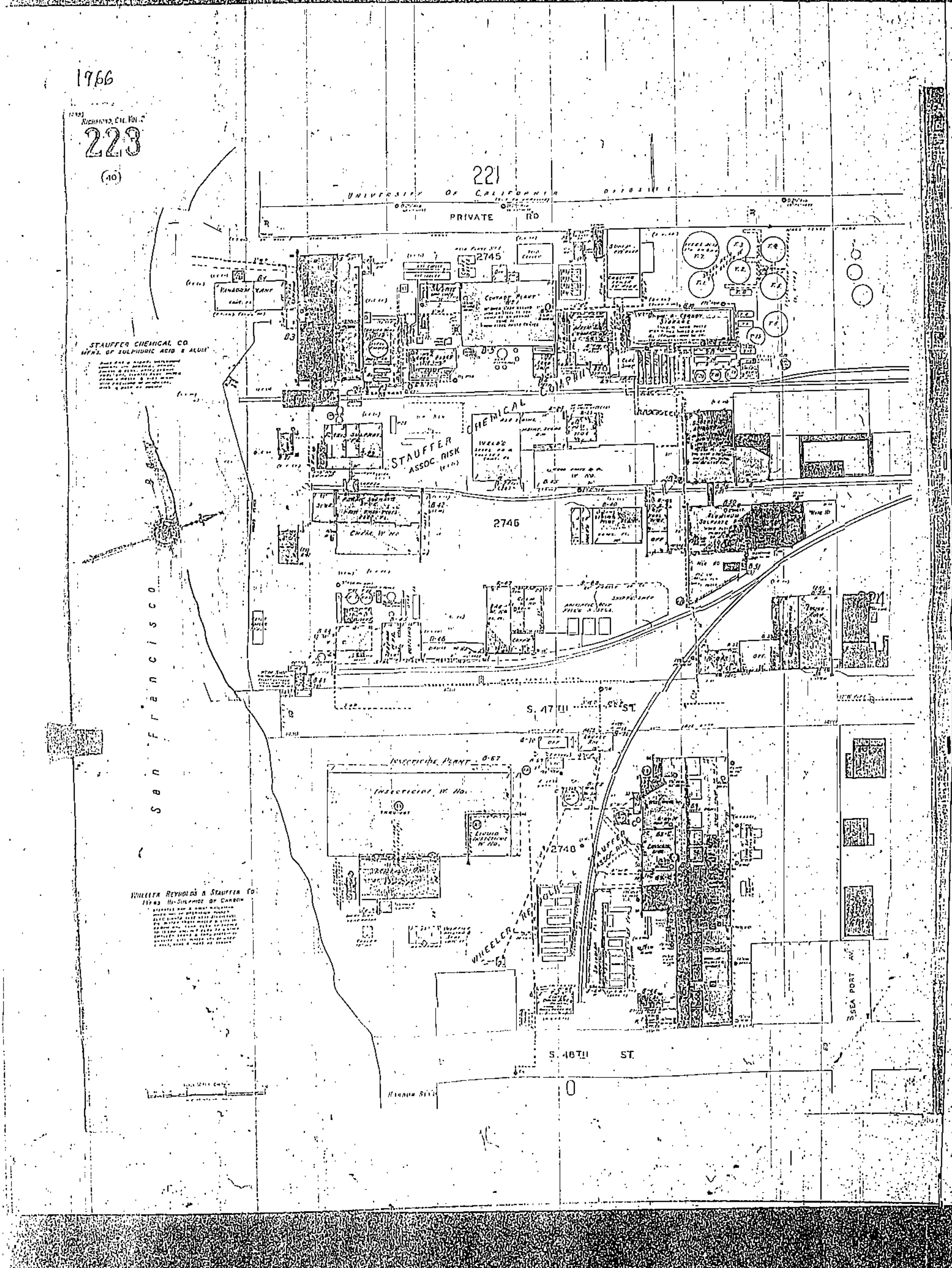

San Francisco
WHEELER REYNOLDS & STAUFFER CO.
M'F'RS. BI-SULPHIDE OF CARBON.
OPERATES DAY & NIGHT. WATCHMAN WHEN NOT IN OPERATION. POWER: ELEC. LIGHTS: ELEC. HEAT: STEAM FUEL, OIL. WATER FROM WELLS & CITY TO 50,000 GAL. TANK ELEV. 40' THENCE TO 15,000 GAL. W.T. ELEV. 30' & OTHER SMALLER TANKS & THRU SYSTEM BY GRAVITY. CITY WATER CAN BE USED DIRECT. HYDS. & HOSE AS SHOWN.
S. 47TH ST.
S. 48TH ST.
HARBOR BLVD.
SEA PORT AV.
INSECTICIDE PLANT B-67
INSECTICIDE W. HO.
THRU-OUT
LIQUID INSECTICIDE W. HO.
SULPHUR HOPPER
INERT GAS GENERATOR
COOLER
VOLATILE MIXING & STGE.
WHEELER REYNOLDS & STAUFFER CO.
ASSOC. RISK
2748
SHIPPING PLF.
OFF.
LOCKER RM.
B-70
B-71
B-63
B-72
B-68
B-69
B-66
WORK SHOP
B-43
B-44
B-45
B-46
DRUM W. HO.
BAG W. HO.
MURIATIC ACID FILL'G. & STGE.
CARP'R.
B-52
B-53
OFF.
WOOD FENCE 7' HIGH
1461
1451
1450
1430
1428
1416
1400
12" W. PIPE
WATER COOLER
PUMP HO.
SCALE 50 FT TO ONE INCH
100
1966

1966

Richmond, Cal. Vol. 2

223

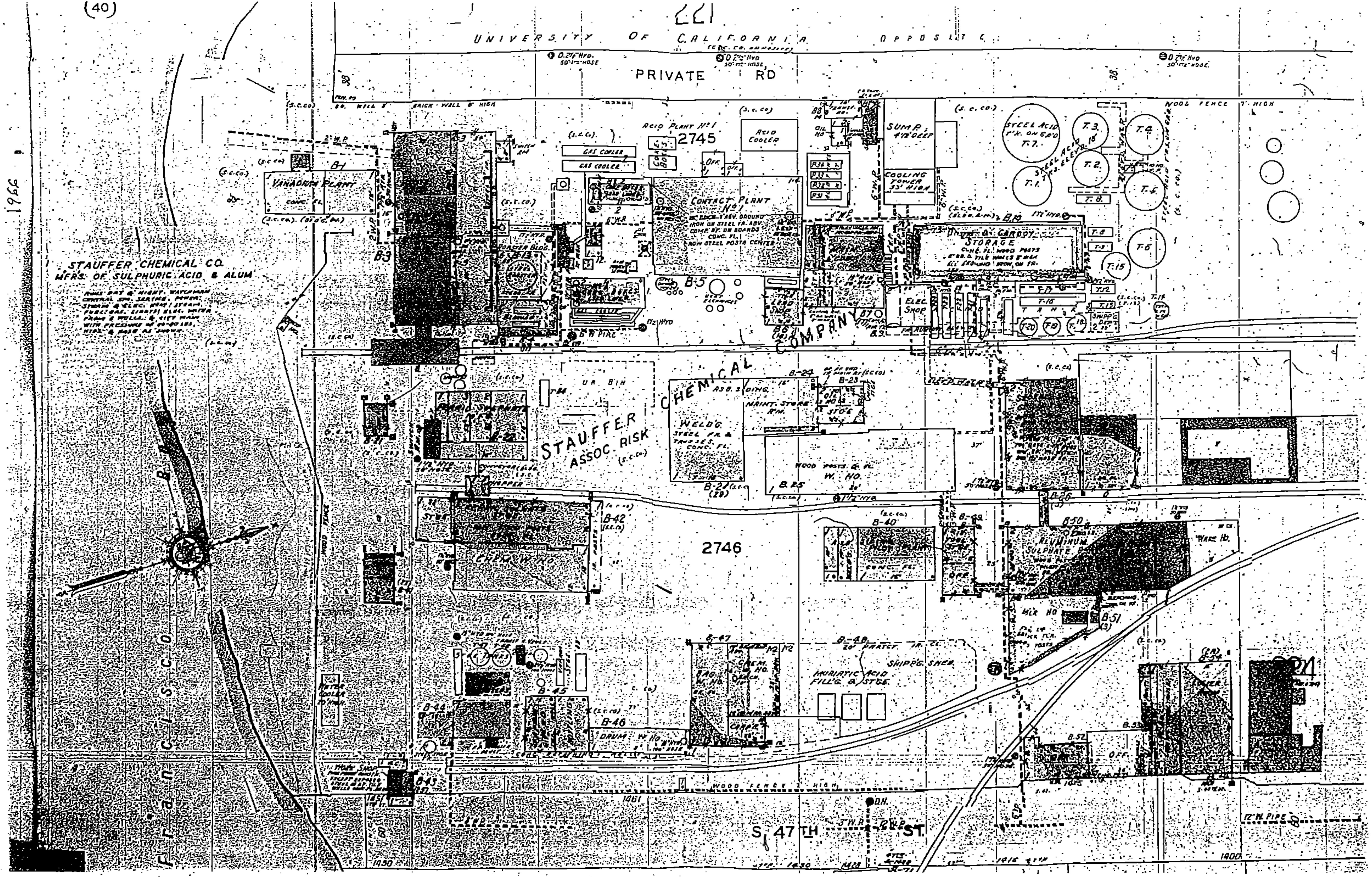
(40)



(40)

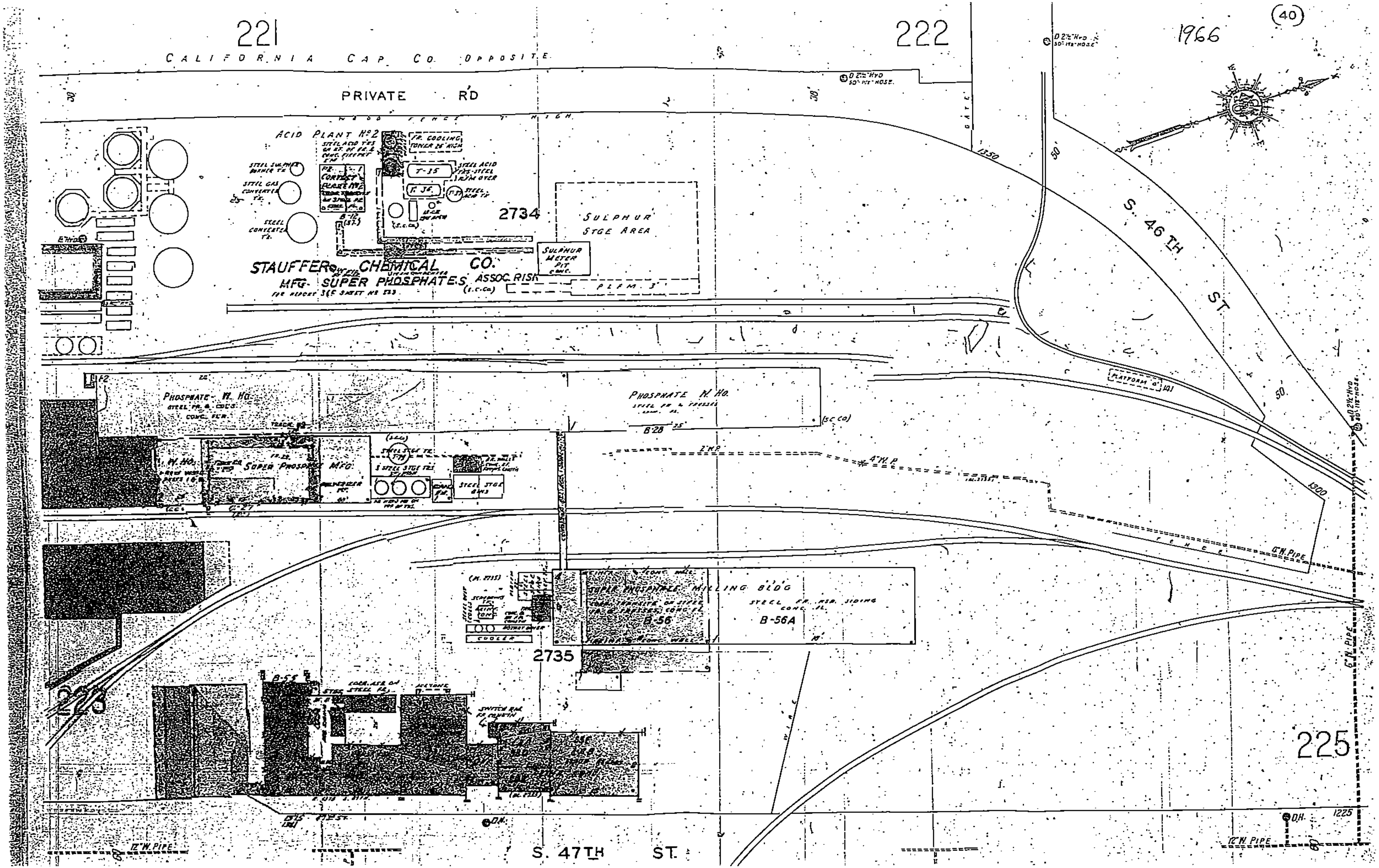
221

1966

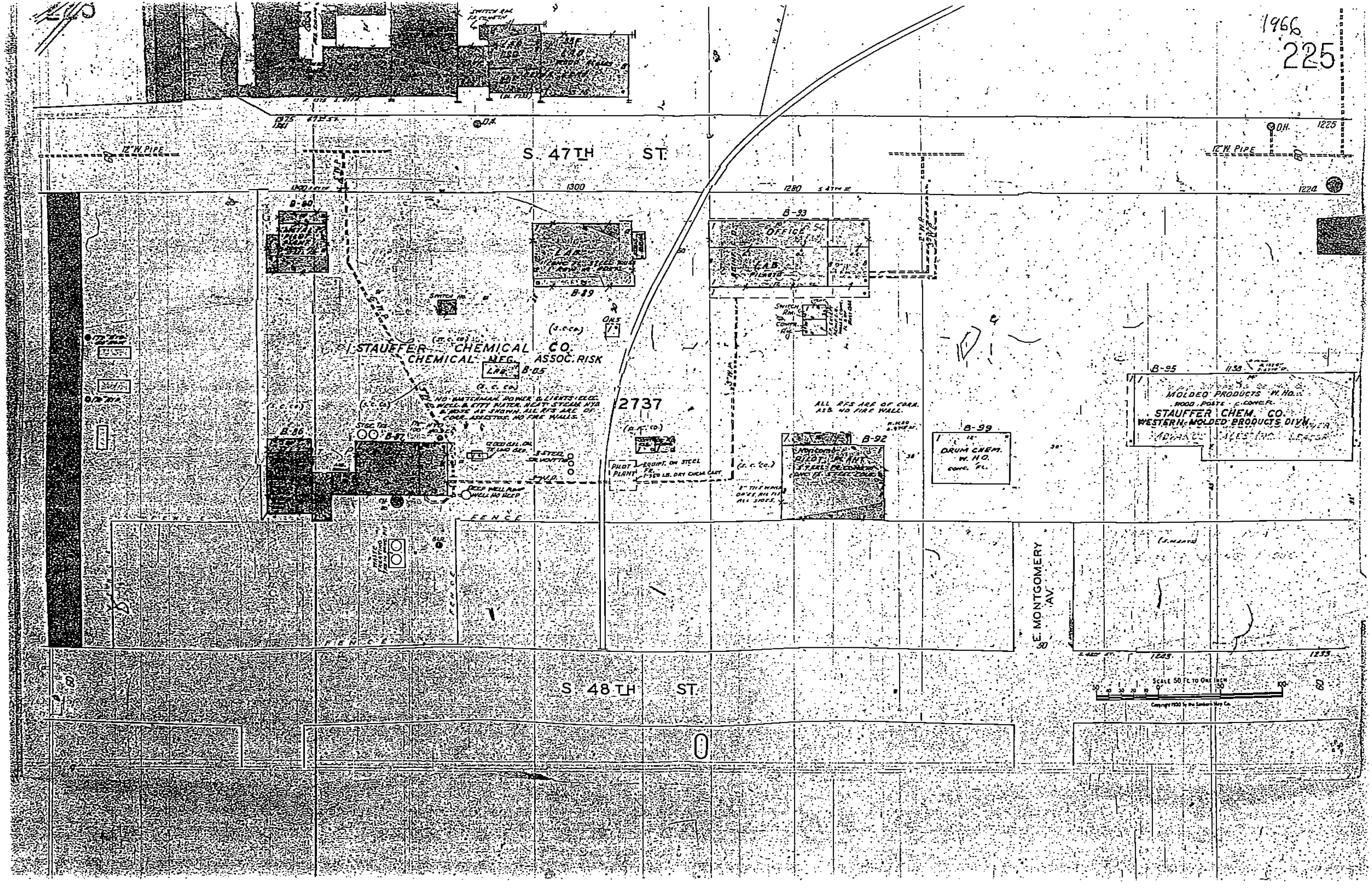


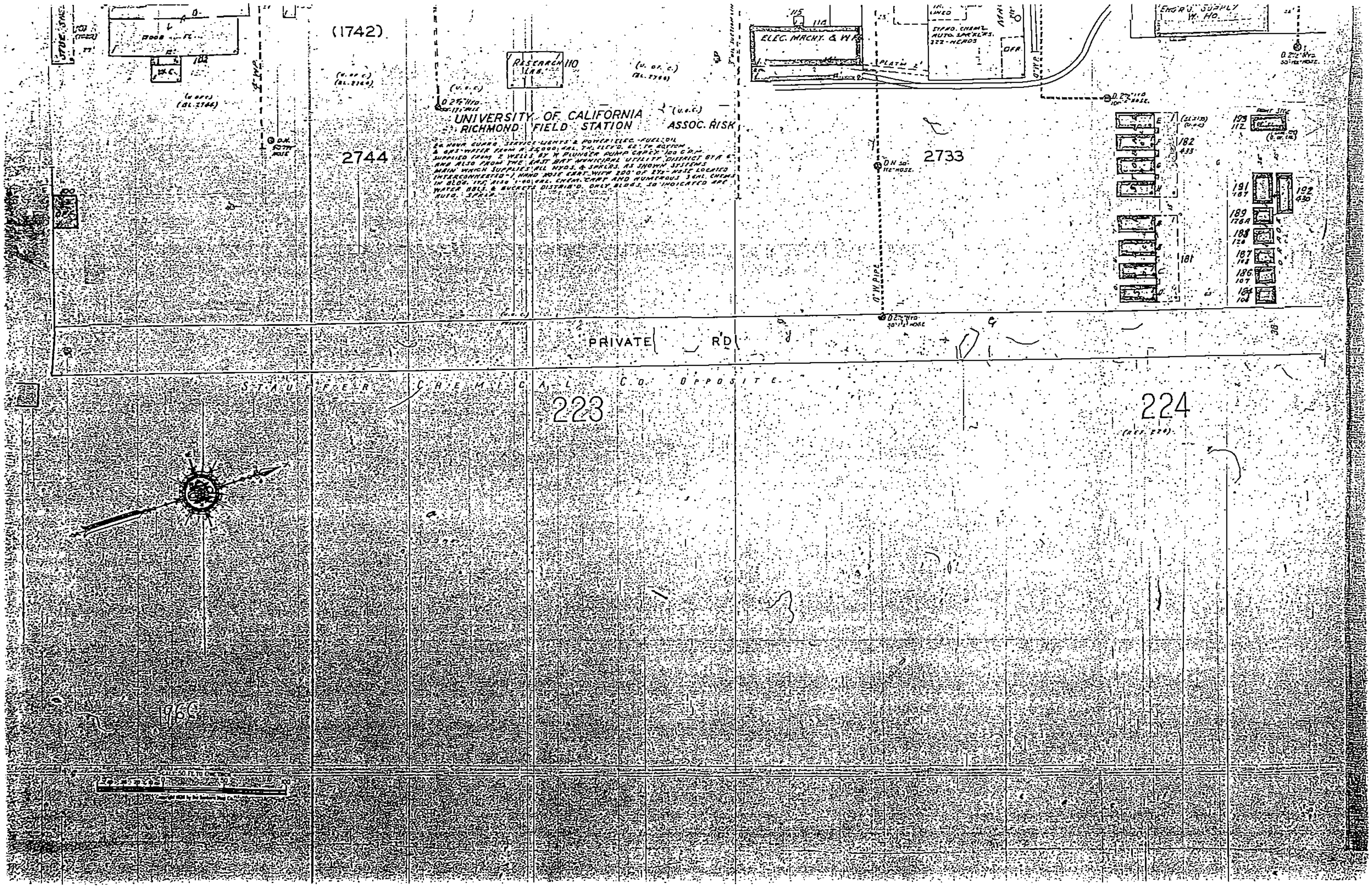
UNIVERSITY OF CALIFORNIA OPPOSITE
PRIVATE RD
STAUFFER CHEMICAL CO.
MFRS. OF SULPHURIC ACID & ALUM
VANADIUM PLANT
ACID PLANT Nº1
2745
ACID COOLER
GAS COOLER
CONTACT PLANT Nº1
IRON OR STEEL FR. ABV.
CONC. FL.
SUMP
COOLING TOWER
STEEL ACID T'K. ON GR'D
T.1
T.2
T.3
T.4
T.5
T.6
T.7
T.8
T.15
STORAGE
ELEC. SHOP
B-1
B3
B-5
B-6
B7
B.9
B.10
STAUFFER CHEMICAL COMPANY
STAUFFER ASSOC. RISK
WELD'G
MAINT. STORE RM.
B-23
B-24
B-25
W. HO.
B-27
B-42
CHEM. W. HO.
2746
B-40
B-48
B-50
ALUMINUM SULPHATE
B-51
B-44
B-45
B-46
DRUM W. HO.
B-47
B-49
MURIATIC ACID FILL'G & STGE.
SHIPP'G SHED
B.52
B.53
B-54
OFF.
WOOD FENCE HIGH
S. 47TH ST.
Francisco
1430
1451
1461
1400

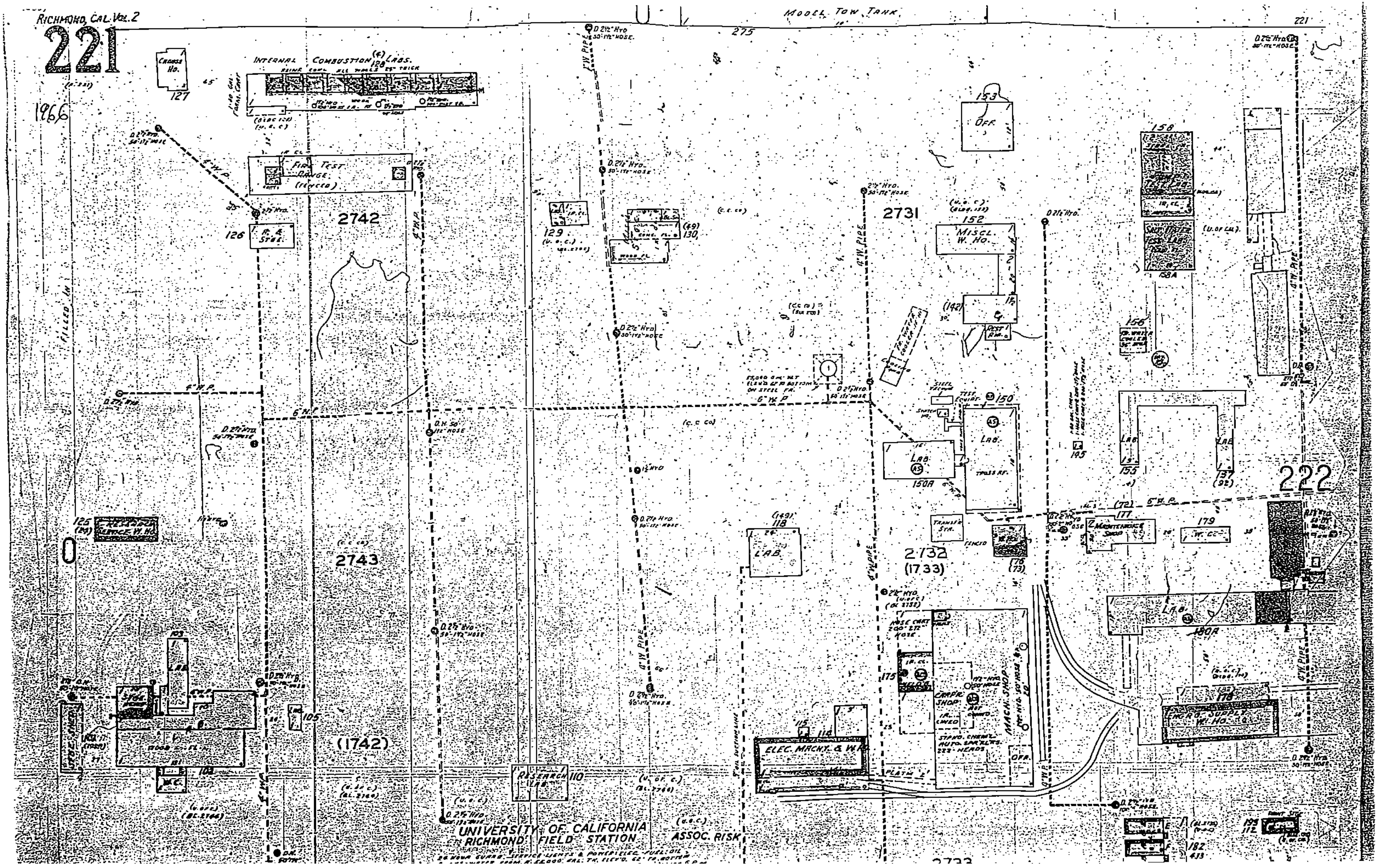
1966


221
222
225
226
CALIFORNIA CAP CO. OPPOSITE
PRIVATE R'D
WOOD FENCE 7' HIGH
30'
D 2½" HYD 50' HOSE
GATE
ACID PLANT Nº 2
STEEL ACID TKS
STEEL SULPHUR BURNER TK
STEEL GAS CONVERTER TK.
STEEL CONVERTER TK.
CONTACT PLANT Nº 2
FR. COOLING TOWER 25' HIGH
T-35
T-36
T-37
STEEL ACID TKS-STEEL R'F'S OVER
STEEL ACID TK
B-12 (S.T.)
(S.C.Co)
2734
SULPHUR STGE AREA
SULPHUR METER PIT CONC.
STAUFFER CHEMICAL CO.
MFG. SUPER PHOSPHATES
ASSOC. RISK
(S.C.Co)
FOR REPORT SEE SHEET Nº 223
PLFM. 3
1350
50'
S. 46TH ST.
PLATFORM "C" 101
50
D 2½" HYD 50' HOSE
1300
PHOSPHATE W. HO.
STEEL FR. & CORS. CONC. FLR.
TRACK 13
PHOSPHATE W. HO.
STEEL FR. & TRUSSES CONC. FL.
(SC CO)
B-28
25'
2" W.P.
4" W.P.
W. HO.
SUPER PHOSPHATE MFG.
STEEL STGE TK. T-19
3 STEEL STGE TKS
STEEL STGE BINS
FENCE
6" W. PIPE
(M. 2735)
SCREENING TK.
COOLER
SUPER PHOSPHATE MILLING BLD'G
B-56
STEEL FR. ASB. SIDING CONC. FL.
B-56A
2735
B-55
STEEL FR.
ACETONE
SWITCH RM.
WIRE
D.H.
12" W. PIPE
S. 47TH ST.
1225
6" W. PIPE
60'

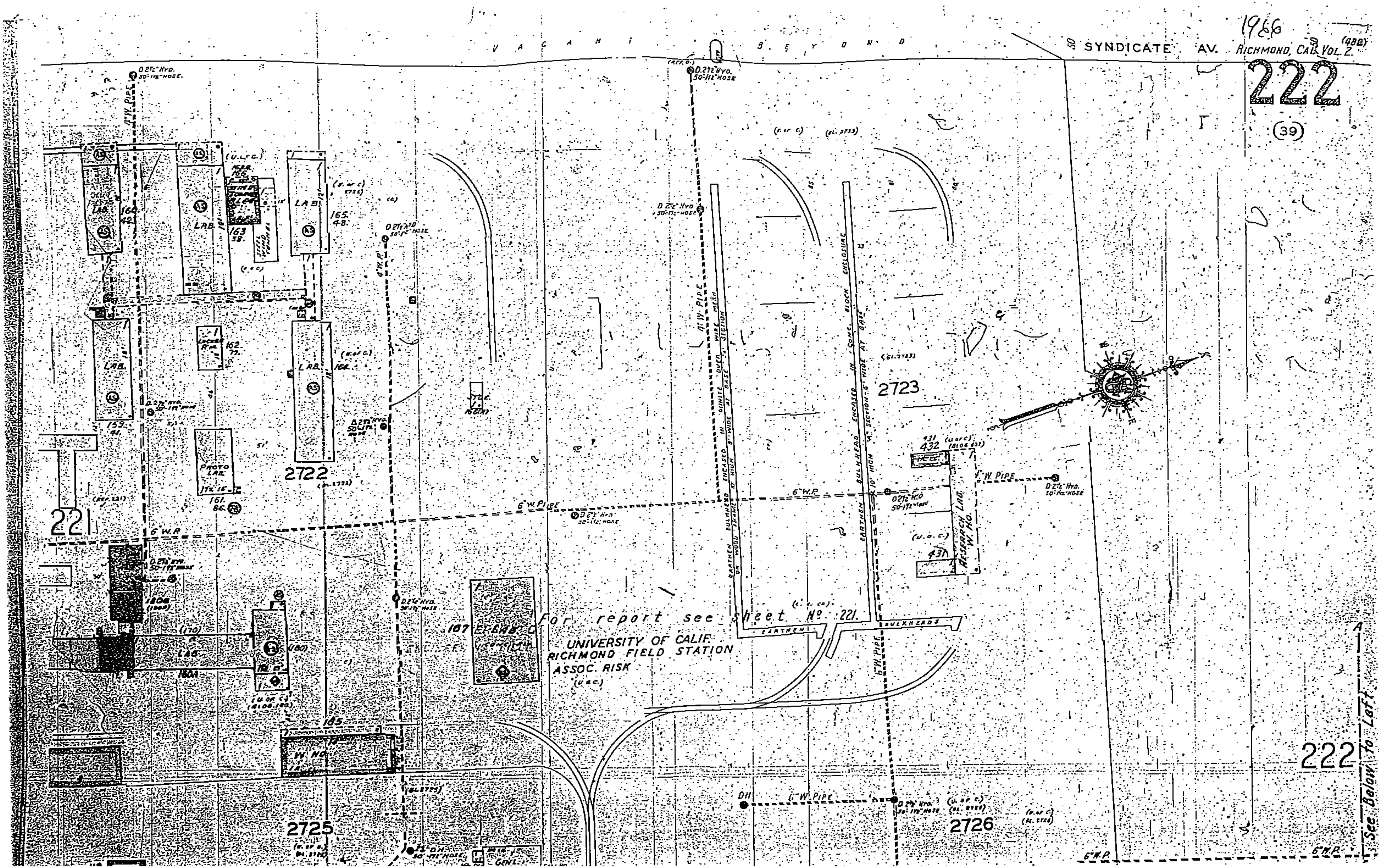
1966


S. 47TH ST.
12" W. PIPE
1300
1280 S. 47TH ST.
1224
1225
B-90
METAL PILOT PLANT
B-89
LAB
SWITCH HO.
OHS
(S. C. CO.)
1. STAUFFER CHEMICAL CO.
CHEMICAL MFG. ASSOC. RISK
LAB. B-05
NO WATCHMAN. POWER & LIGHTS: ELEC. WELL & CITY WATER. HEAT: STEAM NYA & HOSE AS SHOWN. ALL RFS ARE OF CORR. ASBESTOS. NO FIRE WALLS.
2737
B-86
STGE. TKS.
B-87
12000 GAL. OIL TK. UND GRD.
3-STEEL SK. VOLTS
DEEP WELL PUMP WELL NO. DEEP
PILOT PLANT
EQUIPT. ON STEEL FR. 1-350 LB. DRY CHEM. CART
FENCE
B-93
OFFICE
LAB.
SWITCH RM.
COMPR. RM.
ALL RFS ARE OF CORR. ASB. NO FIRE WALL.
B-92
PILOT PLANT
B-99
DRUM CHEM. W. HO. CONC. FL.
B-95
MOLDED PRODUCTS W. HO.
WOOD POSTS CONC. FL.
STAUFFER CHEM. CO.
WESTERN MOLDED PRODUCTS DIVN.
E. MONTGOMERY AV.
S. 48TH ST.
1243
1233
SCALE 50 FT. TO ONE INCH
Copyright 1950 by the Sanborn Map Co.

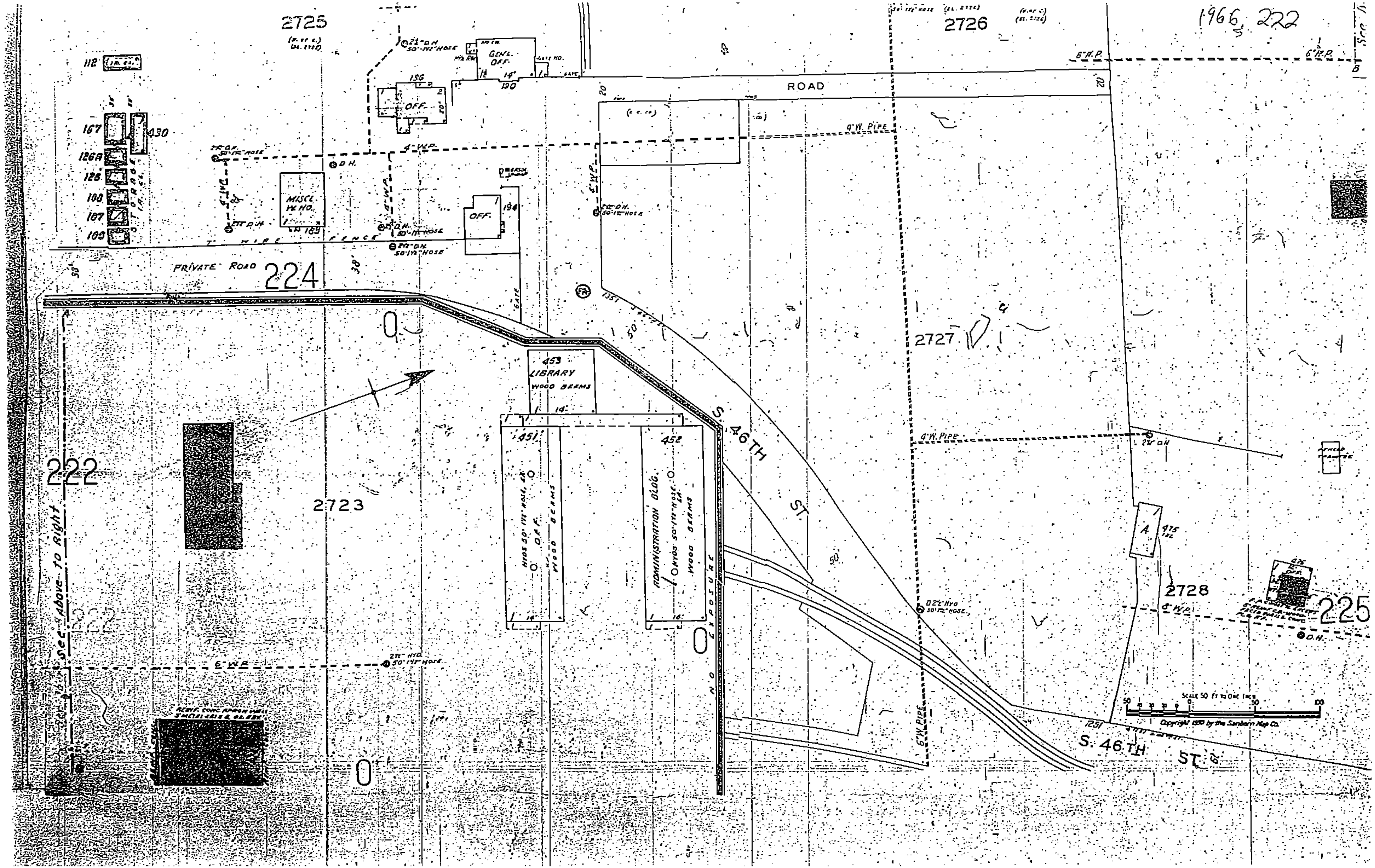

(1742)
RESEARCH LAB. 110
(U. of C.)
(BL. 2744)
(U. of C.)
0 2½" HYD.
UNIVERSITY OF CALIFORNIA
RICHMOND FIELD STATION
ASSOC. RISK
24 HOUR GUARD. SERVICE-LIGHTS & POWER: ELEC.-FUEL: OIL & GAS-WATER FROM A 55000 GAL. TK. ELEV'D. 62' TO BOTTOM SUPPLIED FROM 2 WELLS BY A PLUNGER PUMP CAPCY. 100 G.P.M. AND ALSO FROM THE EAST BAY MUNICIPAL UTILITY DISTRICT BY A 6" MAIN WHICH SUPPLIES ALL HYDS. & SPKLRS. AS SHOWN SYSTEMS INTERCONNECTED - 1 HAND HOSE CART WITH 200' OF 2½" HOSE LOCATED IN BLDG. 115, ALSO 1-40 GAL. CHEM. CART AND NUMEROUS 3 GAL. CHEMS WATER BBLS. & BUCKETS DISTRIB'D. ONLY BLDGS. SO INDICATED ARE AUTO. SPKLD.
2744
2733
115
116
ELEC. MACHY. & W.
PLATM 2'
STPRD. CHEM'L
AUTO. SPK'L'RS.
222-HEADS
OFF.
6" W.P.
ENG'R'G SUPPLY W. HO.
0.2½" HYD. 50' 1½" HOSE
0.2½" HYD. 100' 2" HOSE
D.H. 50' 1½" HOSE
182
433
181
191
187
192
430
193
112
189
176A
188
187
186
107
184
106
6" W. PIPE
0.2½" HYD. 50' 1½" HOSE
PRIVATE RD
STAUFFER CHEMICAL CO. OPPOSITE
223
224
(REF. 224)
38
1965
SCALE 50 FT. TO ONE INCH


RICHMOND, CAL. VOL. 2
221
1966
221
MODEL TOW TANK
275
CHANGE HO.
127
INTERNAL COMBUSTION LABS.
128
FIRE TEST RANGE (FENCED)
126
R. R. STGE.
2742
129
130
2731
153
OFF.
152
MISCL. W. HO.
158
158A
156
155
LAB.
LAB.
157
150
LAB.
150A
LAB.
222
4" W. P.
6" W. P.
6" W. P.
6" W. P.
FILLED IN
125
RESEARCH SERVICE W. HO.
2743
118
LAB.
2732
(1733)
177
MAINTENANCE SHOP
179
TRANSF. STA.
LAB.
180A
178
ENGRG. SUPPLY W. HO.
175
CARPR. SHOP
MACH. SHOP
OFF.
115
116
ELEC. MACHY. & W. HO.
103
LAB.
105
(1742)
RESEARCH LAB.
110
182
UNIVERSITY OF CALIFORNIA
RICHMOND FIELD STATION
ASSOC. RISK
24 HOUR GUARD SERVICE LIGHTS & POWER ELEC. FUEL: OIL
FROM A 56000 GAL. TK. ELEV'D. 62' TO BOTTOM
D. 2½" HYD. 50'-1½" HOSE
2733

1966


VACANT BEYOND
SYNDICATE AV.
RICHMOND, CAL. VOL. 2.
(48E)
222
(39)
LAB.
LAB.
LAB.
LAB.
LAB.
LAB.
Locker Rm.
PHOTO LAB.
160
163
165
166
162
161
159
2722
2723
221
6" W. PIPE
6" W. P.
D 2½" HYD. 50-1½" HOSE
4" W.P.
EARTHEN BULKHEAD ENCASED IN DIMITE OVER WIRE MESH
CARTHEN BULKHEAD ENCASED IN CONC. BLOCK ENCLOSURE
EARTHEN
BULKHEADS
RESEARCH LAB. W. HO.
431
432
(U. of C.)
167 EL. LAB.
For report see sheet No 221.
UNIVERSITY OF CALIF.
RICHMOND FIELD STATION
ASSOC. RISK
(U. of C.)
185
W. HO.
180
2725
2726
DH
6" W. PIPE
See Below to Left
222
6" W.P.

1966, 222


2725
2726
GENL. OFF.
OFF.
ROAD
4" W.P.
4" W. PIPE
6" W.P.
MISCL. W. HO.
OFF.
STORAGE
118
167
126A
128
188
187
183
430
189
190
194
PRIVATE ROAD
WIRE FENCE
224
2½" O.H. 50' 1½" HOSE
O.H.
S. 46TH ST.
453 LIBRARY WOOD BEAMS
451
452
ADMINISTRATION BLDG.
WOOD BEAMS
HYDS 50' 1½" HOSE
NO EXPOSURE
2723
222
See above to Right
2727
2728
225
A
4" W. PIPE
6" W. PIPE
6" W.P.
2½" HYD. 50' 1½" HOSE
D 2½" HYD 50' 1½" HOSE
50'
1351
1251
SCALE 50 FT TO ONE INCH
50
0
50
100
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# APPENDIX E

# Appendix E

# California Natural Diversity Database List

## List of Elements and Status by Scientific Name

| Scientific/Common Name | Federal/ State Status | Global/ State Rank | CNPS/ R-E-D | CDFG Status |
|---|---|---|---|---|
| *ACCIPITER COOPERII (NESTING)*<br>*COOPER'S HAWK* | None/<br>None | G4/<br>S3 | | SC |
| *ACCIPITER STRIATUS (NESTING)*<br>*SHARP-SHINNED HAWK* | None/<br>None | G4/<br>S3 | | SC |
| *AGELAIUS TRICOLOR (NESTING COLONY)*<br>*TRICOLORED BLACKBIRD* | Species of Concern/<br>None | G3/<br>S3 | | SC |
| *ALKALI MEADOW* | None/<br>None | G3/<br>S2.1 | | |
| *ALKALI SEEP* | None/<br>None | G3/<br>S2.1 | | |
| *ALLIUM SHARSMITHAE*<br>*SHARSMITH'S ONION* | None/<br>None | G2/<br>S2? | 1B/<br>2-1-3 | |
| *AMBYSTOMA CALIFORNIENSE*<br>*CALIFORNIA TIGER SALAMANDER* | Candidate/<br>None | G2G3/<br>S2S3 | | SC |
| *AMSINCKIA GRANDIFLORA*<br>*LARGE-FLOWERED FIDDLENECK* | Endangered/<br>Endangered | G1/<br>S1.1 | 1B/<br>3-3-3 | |
| *ANTHICUS ANTIOCHENSIS*<br>*ANTIOCH DUNES ANTHICID BEETLE* | Species of Concern/<br>None | GH/<br>SH | | |
| *APODEMIA MORMO LANGEI*<br>*LANGE'S METALMARK BUTTERFLY* | Endangered/<br>None | G5T1/<br>S1 | | |
| *AQUILA CHRYSAETOS (NESTING AND WINTERING)*<br>*GOLDEN EAGLE* | None/<br>None | G4/<br>S3 | | SC |
| *ARCHOPLITES INTERRUPTUS*<br>*SACRAMENTO PERCH* | Species of Concern/<br>None | G3/<br>S1 | | SC |
| *ARCTOSTAPHYLOS AURICULATA*<br>*MT. DIABLO MANZANITA* | None/<br>None | G2/<br>S2.2 | 1B/<br>3-1-3 | |

| Scientific/Common Name | Federal/ State Status | Global/ State Rank | CNPS/ R-E-D | CDFG Status |
|---|---|---|---|---|
| *ARCTOSTAPHYLOS MANZANITA SSP LAEVIGATA*<br>*CONTRA COSTA MANZANITA* | None/ None | G5T2/ S2 | 1B/ 3-2-3 | |
| *ARCTOSTAPHYLOS PALLIDA*<br>*PALLID MANZANITA* | Threatened/ Endangered | G1/ S1.2 | 1B/ 3-3-3 | |
| *ARDEA HERODIAS (ROOKERY)*<br>*GREAT BLUE HERON* | None/ None | G5/ S4 | | |
| *ASIO FLAMMEUS (NESTING)*<br>*SHORT-EARED OWL* | None/ None | G5/ S3 | | SC |
| *ASTER LENTUS*<br>*SUISUN MARSH ASTER* | Species of Concern/ None | G2/ S2.2 | 1B/ 2-2-3 | |
| *ASTRAGALUS TENER VAR FERRISIAE*<br>*FERRIS'S MILK-VETCH* | Species of Concern/ None | G2T1/ S1.1 | 1B/ 3-3-3 | |
| *ASTRAGALUS TENER VAR TENER*<br>*ALKALI MILK-VETCH* | None/ None | G2T1/ S1.2 | 1B/ 3-2-3 | |
| *ATHENE CUNICULARIA (BURROW SITES)*<br>*BURROWING OWL* | Species of Concern/ None | G4T2/ S2 | | SC |
| *ATRIPLEX CORDULATA*<br>*HEARTSCALE* | Species of Concern/ None | G2?/ S2.2? | 1B/ 2-2-3 | |
| *ATRIPLEX DEPRESSA*<br>*BRITTLESCALE* | None/ None | G2Q/ S2.2 | 1B/ 2-2-3 | |
| *ATRIPLEX JOAQUINIANA*<br>*SAN JOAQUIN SALTBUSH* | Species of Concern/ None | G2/ S2.2 | 1B/ 2-2-3 | |
| *BALSAMORHIZA MACROLEPIS VAR MACROLEPIS*<br>*BIG-SCALE BALSAMROOT* | None/ None | G3T2/ S2.2 | 1B/ 2-2-3 | |

## List of Elements and Status by Scientific Name

| Scientific/Common Name | Federal/ State Status | Global/ State Rank | CNPS/ R-E-D | CDFG Status |
|---|---|---|---|---|
| *BLEPHARIZONIA PLUMOSA SSP PLUMOSA*<br>*BIG TARPLANT* | None/<br>None | G4T1/<br>S1.1 | 1B/<br>3-3-3 | |
| *BRANCHINECTA LONGIANTENNA*<br>*LONGHORN FAIRY SHRIMP* | Endangered/<br>None | G1/<br>S1 | | |
| *BRANCHINECTA LYNCHI*<br>*VERNAL POOL FAIRY SHRIMP* | Threatened/<br>None | G2G3/<br>S2S3 | | |
| *CALOCHORTUS PULCHELLUS*<br>*MT. DIABLO FAIRY-LANTERN* | None/<br>None | G2/<br>S2.2 | 1B/<br>2-2-3 | |
| *CAREX COMOSA*<br>*BRISTLY SEDGE* | None/<br>None | G5/<br>S1.1 | 2/<br>3-3-1 | |
| *CHARADRIUS ALEXANDRINUS NIVOSUS (NESTING)*<br>*WESTERN SNOWY PLOVER* | Threatened/<br>None | G4T2/<br>S2 | | SC |
| *CHORIZANTHE CUSPIDATA VAR CUSPIDATA*<br>*SAN FRANCISCO BAY SPINEFLOWER* | Species of Concern/<br>None | G3T2/<br>S2.2 | 1B/<br>2-2-3 | |
| *CHORIZANTHE ROBUSTA VAR ROBUSTA*<br>*ROBUST SPINEFLOWER* | Endangered/<br>None | G2T1/<br>S1.1 | 1B/<br>3-3-3 | |
| *CIRCUS CYANEUS (NESTING)*<br>*NORTHERN HARRIER* | None/<br>None | G5/<br>S3 | | SC |
| *CIRSIUM FONTINALE VAR CAMPYLON*<br>*MT. HAMILTON THISTLE* | Species of Concern/<br>None | G2T2/<br>S2.2 | 1B/<br>2-2-3 | |
| *CISMONTANE ALKALI MARSH* | None/<br>None | G1/<br>S1.1 | | |
| *CLARKIA CONCINNA SSP AUTOMIXA*<br>*SANTA CLARA RED RIBBONS* | Species of Concern/<br>None | G4?T1/<br>S1.2 | 1B/<br>2-2-3 | |
| *CLARKIA FRANCISCANA*<br>*PRESIDIO CLARKIA* | Endangered/<br>Endangered | G1/<br>S1.1 | 1B/<br>3-3-3 | |

## List of Elements and Status by Scientific Name

| Scientific/Common Name | Federal/ State Status | Global/ State Rank | CNPS/ R-E-D | CDFG Status |
|---|---|---|---|---|
| *CLEMMYS MARMORATA*<br>*WESTERN POND TURTLE* | Species of Concern/ None | G4/ S3 | | SC |
| *CLEMMYS MARMORATA PALLIDA*<br>*SOUTHWESTERN POND TURTLE* | Species of Concern/ None | G4T2T3 / S2 | | SC |
| *COASTAL AND VALLEY FRESHWATER MARSH* | None/ None | G3/ S2.1 | | |
| *COASTAL BRACKISH MARSH* | None/ None | G2/ S2.1 | | |
| *COELUS GRACILIS*<br>*SAN JOAQUIN DUNE BEETLE* | Species of Concern/ None | G1/ S1 | | |
| *COPHURA HURDI*<br>*ANTIOCH COPHURAN ROBBERFLY* | Species of Concern/ None | GH/ SH | | |
| *CORDYLANTHUS MOLLIS SSP HISPIDUS*<br>*HISPID BIRD'S-BEAK* | Species of Concern/ None | G2T2/ S2.1 | 1B/ 2-3-3 | |
| *CORDYLANTHUS MOLLIS SSP MOLLIS*<br>*SOFT BIRD'S-BEAK* | Endangered/ Rare | G2T1/ S1.2 | 1B/ 3-2-3 | |
| *CORDYLANTHUS NIDULARIUS*<br>*MT. DIABLO BIRD'S-BEAK* | Species of Concern/ Rare | G1/ S1.2 | 1B/ 3-3-3 | |
| *CORDYLANTHUS PALMATUS*<br>*PALMATE-BRACTED BIRD'S-BEAK* | Endangered/ Endangered | G1/ S1.1 | 1B/ 3-3-3 | |
| *CORYNORHINUS TOWNSENDII TOWNSENDII*<br>*TOWNSEND'S WESTERN BIG-EARED BAT* | Species of Concern/ None | G5T3T4 / S2S3 | | SC |
| *DANAUS PLEXIPPUS*<br>*MONARCH BUTTERFLY* | None/ None | G5/ S3 | | |

## List of Elements and Status by Scientific Name

| Scientific/Common Name | Federal/ State Status | Global/ State Rank | CNPS/ R-E-D | CDFG Status |
|---|---|---|---|---|
| *DELPHINIUM CALIFORNICUM SSP INTERIUS*<br>*HOSPITAL CANYON LARKSPUR* | Species of Concern/ None | G3T2/ S2? | 1B/ 3-2-3 | |
| *DELPHINIUM RECURVATUM*<br>*RECURVED LARKSPUR* | Species of Concern/ None | G2/ S2.2 | 1B/ 1-2-3 | |
| *DIPODOMYS HEERMANNI BERKELEYENIS*<br>*BERKELEY KANGAROO RAT* | Species of Concern/ None | G5TH/ SH | | |
| *DIRCA OCCIDENTALIS*<br>*WESTERN LEATHERWOOD* | None/ None | G2G3/ S2S3 | 1B/ 2-2-3 | |
| *EFFERIA ANTIOCHI*<br>*ANTIOCH EFFERIAN ROBBERFLY* | Species of Concern/ None | G1G3/ S1S3 | | |
| *EGRETTA THULA (ROOKERY)*<br>*SNOWY EGRET* | None/ None | G5/ S4 | | |
| *ELANUS LEUCURUS (NESTING)*<br>*WHITE-TAILED KITE* | None/ None | G5/ S3 | | |
| *EREMOPHILA ALPESTRIS ACTIA*<br>*CALIFORNIA HORNED LARK* | None/ None | G4G5T3 / S3 | | SC |
| *ERIOGONUM TRUNCATUM*<br>*MT. DIABLO BUCKWHEAT* | None/ None | GH/ SH | 1A/ * | |
| *ERYSIMUM CAPITATUM SSP ANGUSTATUM*<br>*CONTRA COSTA WALLFLOWER* | Endangered/ Endangered | G5T1/ S1.1 | 1B/ 3-3-3 | |
| *ESCHSCHOLZIA RHOMBIPETALA*<br>*DIAMOND-PETALED CALIFORNIA POPPY* | Species of Concern/ None | G1/ S1.1 | 1A/ * | |
| *EUCYCLOGOBIUS NEWBERRYI*<br>*TIDEWATER GOBY* | Endangered/ None | G2G3/ S2S3 | | SC |

## List of Elements and Status by Scientific Name

| Scientific/Common Name | Federal/ State Status | Global/ State Rank | CNPS/ R-E-D | CDFG Status |
|---|---|---|---|---|
| *EUPHYDRYAS EDITHA BAYENSIS*<br>*BAY CHECKERSPOT BUTTERFLY* | Threatened/<br>None | G5T2/<br>S2 | | |
| *FRITILLARIA FALCATA*<br>*TALUS FRITILLARY* | Species of Concern/<br>None | G2/<br>S2.2 | 1B/<br>3-3-3 | |
| *FRITILLARIA LILIACEA*<br>*FRAGRANT FRITILLARY* | Species of Concern/<br>None | G2/<br>S2.2 | 1B/<br>1-2-3 | |
| *GEOTHLYPIS TRICHAS SINUOSA*<br>*SALTMARSH COMMON YELLOWTHROAT* | Species of Concern/<br>None | G5T2/<br>S2 | | SC |
| *HALIAEETUS LEUCOCEPHALUS (NESTING & WINTERING)*<br>*BALD EAGLE* | Threatened/<br>Endangered | G4/<br>S2 | | |
| *HELIANTHELLA CASTANEA*<br>*DIABLO HELIANTHELLA* | Species of Concern/<br>None | G3/<br>S3.2 | 1B/<br>3-2-3 | |
| *HELMINTHOGLYPTA NICKLINIANA BRIDGESI*<br>*BRIDGES' COAST RANGE SHOULDERBAND (SNAIL)* | Species of Concern/<br>None | G2T1/<br>S1 | | |
| *HEMIZONIA PARRYI SSP CONGDONII*<br>*CONGDON'S TARPLANT* | Species of Concern/<br>None | G5T1/<br>S1.1 | 1B/<br>3-3-3 | |
| *HESPEROLINON BREWERI*<br>*BREWER'S WESTERN FLAX* | Species of Concern/<br>None | G2/<br>S2.2 | 1B/<br>2-2-3 | |
| *HESPEROLINON SP NOV "SERPENTINUM"*<br>*NAPA WESTERN FLAX* | None/<br>None | G1/<br>S1.2 | 1B/<br>3-2-3 | |
| *HIBISCUS LASIOCARPUS*<br>*ROSE-MALLOW* | None/<br>None | G4/<br>S2.2 | 2/<br>2-2-1 | |
| *HOLOCARPHA MACRADENIA*<br>*SANTA CRUZ TARPLANT* | Proposed Threatened/<br>Endangered | G1/<br>S1.1 | 1B/<br>2-3-3 | |

## List of Elements and Status by Scientific Name

| Scientific/Common Name | Federal/ State Status | Global/ State Rank | CNPS/ R-E-D | CDFG Status |
|---|---|---|---|---|
| *HORKELIA CUNEATA SSP SERICEA*<br>*KELLOGG'S HORKELIA* | Species of Concern/ None | G4T1/ S1.1 | 1B/ 3-3-3 | |
| *HYGROTUS CURVIPES*<br>*CURVED-FOOT HYGROTUS DIVING BEETLE* | Species of Concern/ None | G1/ S1 | | |
| *IDIOSTATUS MIDDLEKAUFI*<br>*MIDDLEKAUF'S SHIELDBACK KATYDID* | Species of Concern/ None | G1G2/ S1 | | |
| *JUGLANS HINDSII*<br>*NORTHERN CALIFORNIA BLACK WALNUT* | Species of Concern/ None | G1/ S1.1 | 1B/ 3-3-3 | |
| *LASTHENIA CONJUGENS*<br>*CONTRA COSTA GOLDFIELDS* | Endangered/ None | G1/ S1.1 | 1B/ 3-3-3 | |
| *LATERALLUS JAMAICENSIS COTURNICULUS*<br>*CALIFORNIA BLACK RAIL* | Species of Concern/ Threatened | G4T1/ S1 | | |
| *LATHYRUS JEPSONII VAR JEPSONII*<br>*DELTA TULE PEA* | Species of Concern/ None | G5T2/ S2.2 | 1B/ 2-2-3 | |
| *LEPIDURUS PACKARDI*<br>*VERNAL POOL TADPOLE SHRIMP* | Endangered/ None | G2G3/ S2S3 | | |
| *LILAEOPSIS MASONII*<br>*MASON'S LILAEOPSIS* | Species of Concern/ Rare | G3/ S3.2 | 1B/ 2-2-3 | |
| *LIMOSELLA SUBULATA*<br>*DELTA MUDWORT* | None/ None | G4?/ S2.1 | 2/ 2-3-1 | |
| *LINDERIELLA OCCIDENTALIS*<br>*CALIFORNIA LINDERIELLA* | None/ None | G2G3/ S2S3 | | |

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| Scientific/Common Name | Federal/<br>State Status | Global/<br>State Rank | CNPS/<br>R-E-D | CDFG Status |
|---|---|---|---|---|
| *LYTTA MOLESTA*<br>*MOLESTAN BLISTER BEETLE* | Species of Concern/<br>None | G2/<br>S2 | | |
| *MADIA RADIATA*<br>*SHOWY MADIA* | None/<br>None | G2/<br>S2.1 | 1B/<br>2-3-3 | |
| *MALACOTHAMNUS HALLII*<br>*HALL'S BUSH MALLOW* | None/<br>None | G1Q/<br>S1.2 | 1B/<br>3-2-3 | |
| *MASTICOPHIS FLAGELLUM RUDDOCKI*<br>*SAN JOAQUIN WHIPSNAKE* | Species of Concern/<br>None | G5T2?/<br>S2? | | SC |
| *MASTICOPHIS LATERALIS EURYXANTHUS*<br>*ALAMEDA WHIPSNAKE* | Threatened/<br>Threatened | G4T2/<br>S2 | | |
| *MELOSPIZA MELODIA MAXILLARIS*<br>*SUISUN SONG SPARROW* | Species of Concern/<br>None | G5T2/<br>S2 | | SC |
| *MICROTUS CALIFORNICUS SANPABLOENSIS*<br>*SAN PABLO VOLE* | None/<br>None | G5T1T2<br>/<br>S1S2 | | SC |
| *MONARDELLA VILLOSA SSP GLOBOSA*<br>*ROBUST MONARDELLA* | None/<br>None | G5T1/<br>S1.1 | 1B/<br>3-2-3 | |
| *MYRMOSULA PACIFICA*<br>*ANTIOCH MULTILID WASP* | Species of Concern/<br>None | GH/<br>SH | | |
| *NORTHERN CLAYPAN VERNAL POOL* | None/<br>None | G1/<br>S1.1 | | |
| *NORTHERN COASTAL SALT MARSH* | None/<br>None | G3/<br>S3.2 | | |
| *NORTHERN MARITIME CHAPARRAL* | None/<br>None | G1/<br>S1.2 | | |

## List of Elements and Status by Scientific Name

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|---|---|---|---|---|
| *NYCTICORAX NYCTICORAX*<br>*BLACK-CROWNED NIGHT HERON* | None/<br>None | G5/<br>S3 | | |
| *OENOTHERA DELTOIDES SSP HOWELLII*<br>*ANTIOCH DUNES EVENING-PRIMROSE* | Endangered/<br>Endangered | G5T1/<br>S1.1 | 1B/<br>3-3-3 | |
| *ONCORHYNCHUS MYKISS IRIDEUS*<br>*STEELHEAD-CENTRAL CALIFORNIA COAST ESU* | Threatened/<br>None | G5T2/<br>S2 | | |
| *PERDITA HIRTICEPS LUTEOCINCTA*<br>*YELLOW-BANDED ANDRENID BEE* | Species of Concern/<br>None | GX/<br>SX | | |
| *PERDITA SCITUTA ANTIOCHENSIS*<br>*ANTIOCH ANDRENID BEE* | Species of Concern/<br>None | G1T1/<br>S1 | | |
| *PEROGNATHUS INORNATUS INORNATUS*<br>*SAN JOAQUIN POCKET MOUSE* | Species of Concern/<br>None | G4T2T3<br>/<br>S2S3 | | |
| *PHACELIA PHACELIOIDES*<br>*MT. DIABLO PHACELIA* | Species of Concern/<br>None | G1/<br>S1.2 | 1B/<br>2-2-3 | |
| *PHALACROCORAX AURITUS (ROOKERY SITE)*<br>*DOUBLE-CRESTED CORMORANT* | None/<br>None | G5/<br>S3 | | SC |
| *PHILANTHUS NASALIS*<br>*ANTIOCH SPECID WASP* | Species of Concern/<br>None | GX/<br>SX | | |
| *PHRYNOSOMA CORONATUM FRONTALE*<br>*CALIFORNIA HORNED LIZARD* | Species of Concern/<br>None | G4T3T4<br>/<br>S3S4 | | SC |
| *PLAGIOBOTHRYS GLABER*<br>*HAIRLESS POPCORN-FLOWER* | None/<br>None | GH/<br>SH | 1A/<br>* | |
| *PLAGIOBOTHRYS HYSTRICULUS*<br>*BEARDED POPCORN-FLOWER* | None/<br>None | GH/<br>SH | 1A/<br>* | |

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|---|---|---|---|---|
| *RALLUS LONGIROSTRIS OBSOLETUS*<br>*CALIFORNIA CLAPPER RAIL* | Endangered/<br>Endangered | G5T1/<br>S1 | | |
| *RANA AURORA DRAYTONII*<br>*CALIFORNIA RED-LEGGED FROG* | Threatened/<br>None | G4T2T3<br>/<br>S2S3 | | SC |
| *RANA BOYLII*<br>*FOOTHILL YELLOW-LEGGED FROG* | Species of<br>Concern/<br>None | G3/<br>S2S3 | | SC |
| *REITHRODONTOMYS RAVIVENTRIS*<br>*SALT-MARSH HARVEST MOUSE* | Endangered/<br>Endangered | G1G2/<br>S1S2 | | |
| *RIPARIA RIPARIA (NESTING)*<br>*BANK SWALLOW* | None/<br>Threatened | G5/<br>S2S3 | | |
| *RYNCHOPS NIGER (NESTING COLONY)*<br>*BLACK SKIMMER* | None/<br>None | G5/<br>S1S3 | | SC |
| *SANICULA SAXATILIS*<br>*ROCK SANICLE* | Species of<br>Concern/<br>Rare | G2/<br>S2.2 | 1B/<br>3-2-3 | |
| *SCAPHIOPUS HAMMONDII*<br>*WESTERN SPADEFOOT* | Species of<br>Concern/<br>None | G3?/<br>S3? | | SC |
| *SCUTELLARIA GALERICULATA*<br>*MARSH SKULLCAP* | None/<br>None | G5/<br>S2.2? | 2/<br>2-2-1 | |
| *SCUTELLARIA LATERIFLORA*<br>*BLUE SKULLCAP* | None/<br>None | G5/<br>S1.2 | 2/<br>3-2-1 | |
| *SENECIO APHANACTIS*<br>*RAYLESS RAGWORT* | None/<br>None | G3?/<br>S1.2 | 2/<br>3-2-1 | |
| *SERPENTINE BUNCHGRASS* | None/<br>None | G2/<br>S2.2 | | |
| *SOREX VAGRANS HALICOETES*<br>*SALT-MARSH WANDERING SHREW* | Species of<br>Concern/<br>None | G5T1/<br>S1 | | SC |

List of Elements and Status by Scientific Name

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|---|---|---|---|---|
| *STABILIZED INTERIOR DUNES* | None/ None | G1/ S1.1 | | |
| *STERNA ANTILLARUM BROWNI (NESTING COLONY)*<br>*CALIFORNIA LEAST TERN* | Endangered/ Endangered | G4T2T3 / S2S3 | | |
| *STERNA CASPIA (NESTING COLONY)*<br>*CASPIAN TERN* | None/ None | G5/ S4 | | |
| *STREPTANTHUS ALBIDUS SSP PERAMOENUS*<br>*MOST BEAUTIFUL JEWEL-FLOWER* | Species of Concern/ None | G2T2/ S2.2 | 1B/ 2-2-3 | |
| *STREPTANTHUS HISPIDUS*<br>*MT. DIABLO JEWEL-FLOWER* | Species of Concern/ None | G1/ S1.2 | 1B/ 3-1-3 | |
| *SUAEDA CALIFORNICA*<br>*CALIFORNIA SEABLITE* | Endangered/ None | G1/ S1.1 | 1B/ 3-3-3 | |
| *SYCAMORE ALLUVIAL WOODLAND* | None/ None | G1/ S1.1 | | |
| *THAMNOPHIS GIGAS*<br>*GIANT GARTER SNAKE* | Threatened/ Threatened | G2G3/ S2S3 | | |
| *TROPIDOCARPUM CAPPARIDEUM*<br>*CAPER-FRUITED TROPIDOCARPUM* | Species of Concern/ None | GH/ SH | 1A/ * | |
| *TRYONIA IMITATOR*<br>*MIMIC TRYONIA (=CALIFORNIA BRACKISHWATER SNAIL)* | Species of Concern/ None | G2G3/ S2S3 | | |
| *VALLEY NEEDLEGRASS GRASSLAND* | None/ None | G1/ S3.1 | | |
| *VALLEY SINK SCRUB* | None/ None | G1/ S1.1 | | |

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|---|---|---|---|---|
| *VULPES MACROTIS MUTICA*<br>*SAN JOAQUIN KIT FOX* | Endangered/<br>Threatened | G4T2T3<br>/<br>S2S3 | | |