SURVEY OF TRIBUTARIES TO MUD SLOUGH (NORTH), MERCED COUNTY, CALIFORNIA

California Regional Water Quality Control Board
Central Valley Region
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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

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Special thanks goes to the land owners whose cooperation
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SUMMARY

Mud Slough (north) serves as a conveyance for subsurface agricultural drainage from its tributaries to the San Joaquin River. A detailed appraisal of the slough tributaries was conducted to determine their actual use and operation and how these might influence water quality in Mud Slough (north). The Slough has four major tributaries: Santa Fe Canal, Los Banos Creek, Fremont Canal, and Kesterson Ditch. Each of these tributaries has several tributaries, some of which carry agricultural drainage water. The water quality of all of these flows is highly influenced by management decisions which result in manipulation of the water system in the Grassland Water District. Because of this operation and the large fluctuations in water quality, the beneficial uses of the tributaries to Mud Slough (north) stand alone and can not be considered to be the same as the beneficial uses of the slough itself.

INTRODUCTION

Mud Slough (north) is a meandering, slow moving, valley floor slough. It runs from Kesterson Ditch northward through the North Grasslands Area to the San Joaquin River (Figure 1). Mud Slough (north) provides drainage for the surrounding duck clubs and National Wildlife Refuge wetlands while its major tributaries; Santa Fe Canal, Los Banos Creek, Fremont Canal, and Kesterson Ditch provide drainage for the agricultural land to the south and west of the Grassland Area.

Mud Slough (north) is one of the two major sources of subsurface agricultural pollutant load to the San Joaquin River. However, very little subsurface drainage is produced in the vicinity of Mud Slough (north). The large majority of the subsurface drainage is actually produced south of the Grassland Area and transported north through the South Grasslands to Mud Slough (north) via its tributaries. In this manner, Mud Slough (north) simply serves as a conveyance for the subsurface agricultural drainage from its tributaries to the San Joaquin River (Pierson, et al., 1989, and James et al., 1988).

To help control the discharges of subsurface agricultural drainage, it has been proposed that Mud Slough (north) be added to the list of 28 surface water bodies in the San Joaquin River Basin Plan. In so doing, Mud Slough (north) would be assigned certain water quality objectives. As stated previously, the large majority of subsurface agricultural drainage is actually discharged to the tributaries of Mud Slough (north). Therefore, to assist in maintaining Mud Slough's (north) water quality objectives information about its tributaries' hydrologic and operational features as well as water quality needs to be obtained.

In addition to water quality objectives, the basin plan would assign specific beneficial uses to Mud Slough (north). As a general rule, basin plans assume the same beneficial uses for tributaries as the water body to which they are tributary.

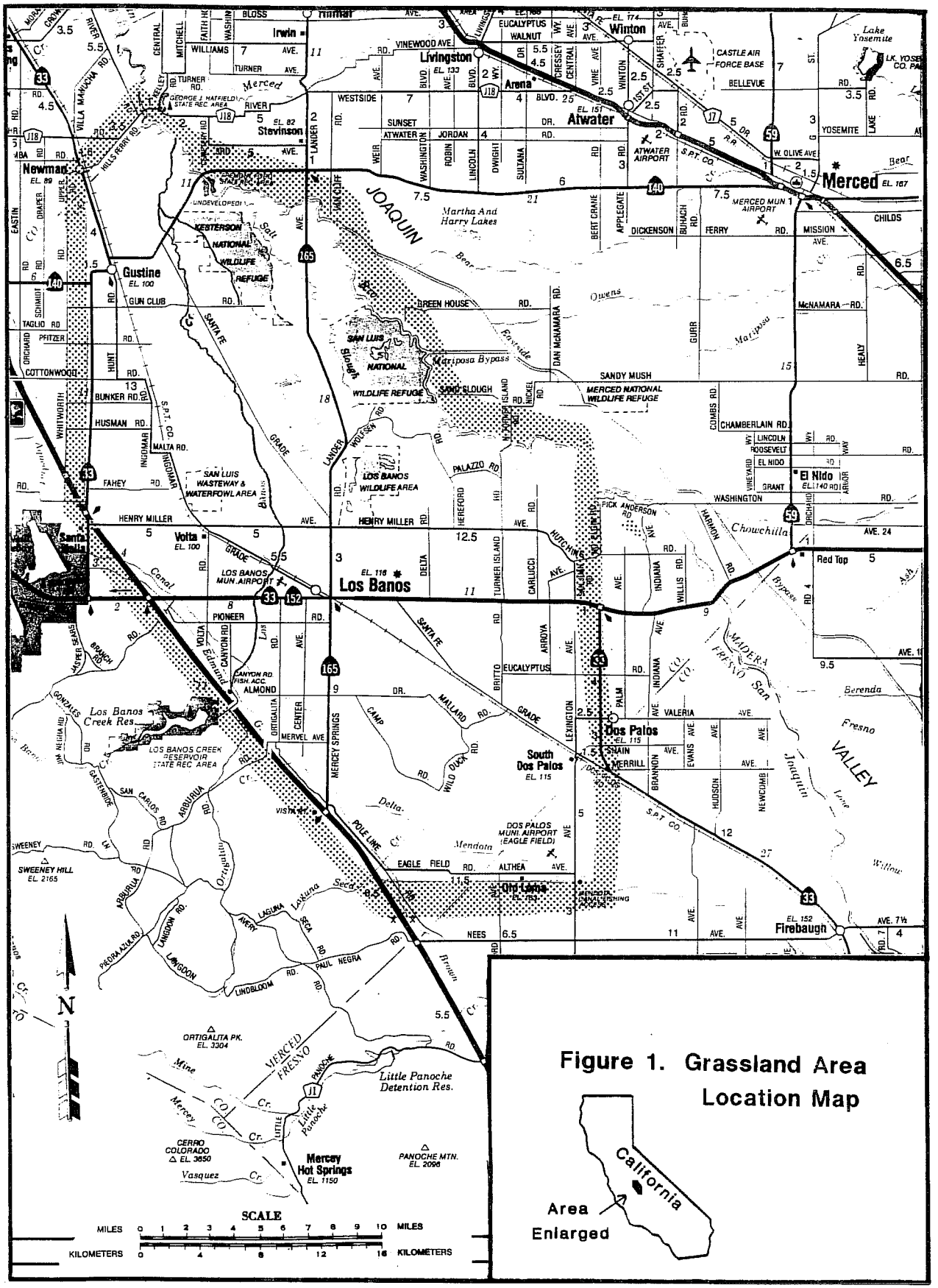
Figure 1. Grassland Area Location Map
California
Area Enlarged
SCALE
MILES 0 1 2 3 4 5 6 7 8 9 10 MILES
KILOMETERS 0 4 8 12 16 KILOMETERS
N
Los Banos
Los Banos Creek Res.
Los Banos Creek Reservoir State Rec. Area
Los Banos Wildlife Area
Los Banos Mun. Airport
San Luis Wasteway & Waterfowl Area
Gustine
Newman
Volta
Santa Nella
Dos Palos
South Dos Palos
Dos Palos Muni. Airport (Eagle Field)
Old Lanes
Firebaugh
Mercey Springs
Mercey Hot Springs
Little Panoche Detention Res.
Cerro Colorado
Panoche Mtn.
Sweeney Hill
Ortigalita Pk.
Livingston
Atwater
Winton
Merced
Arena
Stevinson
Irwin
El Nido
Red Top
Chowchilla
Gustine Gun Club
Merced National Wildlife Refuge
Kesterson National Wildlife Refuge
San Luis National Wildlife Refuge
Merced Mun Airport
Atwater Airport
Castle Air Force Base
Martha And Harry Lakes
Lake Yosemite
Joaquin
Fresno
Madera
Merced
Stanislaus
Valley

However, this is not an accurate assumption for the Mud Slough (north) tributaries. Because the Slough's major tributaries are maintained as man-made or man-altered agricultural drainage channels, they do not provide the same beneficial uses as Mud Slough (north). Therefore a detailed appraisal of these tributaries needs to be initiated to determine their actual beneficial uses and how to best maintain the water quality objectives of Mud Slough (north).

This report represents the first step in the appraisal of Mud Slough's (north) major tributaries; Santa Fe Canal, Los Banos Creek, Fremont Canal and Kesterson Ditch. This study was initiated to physically characterize each of the tributaries and to identify all discharges and diversions to or from them. In addition, it was to provide hydrologic information about each tributary and how they are operated. Lastly, this study was to provide some insight into the water quality of each tributary. The goal of this study was to provide information that could be used in assessing the beneficial uses of the tributaries and in the maintenance of Mud Slough's (north) water quality objectives.

METHODS

There were a number of methods used in gathering information for this study. Initially, the major tributaries of Mud Slough (north) were identified from information in Regional Board files. Additional information was obtained from U. S. Geological Survey Topographical Quadrangles and discussions with Grassland Water District personnel. Water quality data was obtained from Regional Board reports. Lastly, surveys of each tributary's entire length were conducted during the summer of 1988.

The surveys consisted of travelling the entire length of each tributary and noting the location and type of all discharges, diversions and hydraulic structures. The type of in-channel vegetation and surrounding land use was also noted. In addition, photographs showing the physical characteristics and significant discharges and diversions of each tributary were taken and are available in Regional Board files.

FINDINGS

PHYSICAL CHARACTERISTICS

The following is a discussion of the physical characteristics of each of Mud Slough's (north) major tributaries. It discusses the type of vegetation in and arround each tributary as well as surrounding land use. In addition, it describes the major discharges and diversions of each tributary. Lastly, it discusses the number and type of each minor discharge and diversion for each tributary.

More detailed descriptions of the minor discharges and diversions of each tributary are given in Appendix A. This appendix presents an index and flow diagrams. The

index identifies each discharge and diversion site by a unique site number, locates the site in miles from the tributary's origin, and describes the type of discharge or diversion of the site. The flow diagrams illustrate graphically the relative location of each discharge and diversion along each tributary.

Santa Fe Canal

The Santa Fe Canal begins 0.5 miles south of State Highway 152 at Mueller weir as irrigation spill from the Arroyo Canal (San Luis Canal Company). It ends approximately 20 miles to the northwest as it discharges to Mud Slough (north) 1.5 miles north of Gun Club Road. It is a man-made earth lined canal with little vegetation in the canal. However, vegetation lines the canal banks between the channel and the levee roads. The southern half of the canal is surrounded mainly by field crops and pasture land. The area surrounding the northern half is mainly gun club duck ponds with a few areas of pasture land. The only section of the canal that resembles a natural channel is the final 0.25 miles where the canal ends its straight path and meanders east to Mud Slough (north).

The Santa Fe Canal has five major tributaries; Agatha Canal; Mud Slough Bypass; San Luis Canal; San Luis Spillway Ditch; and Eagle Ditch. The Agatha Canal and Mud Slough Bypass both enter the canal within the first 0.5 mile. During the spring and summer they contain both surface and subsurface agricultural drainage as well as irrigation district spill water from a large area south of the Grassland Water District. During the fall and winter they contain supply water to and drainage from gun club duck ponds.

The San Luis Canal intersects with the Santa Fe Canal approximately 0.5 miles south of Henry Miller Avenue. At this point, there are two check structures on the Santa Fe Canal, one on either side of the San Luis Canal, and one on the San Luis Canal just north of Henry Miller Avenue. This configuration of check structures allows San Luis Canal water to be diverted into the Santa Fe Canal or Santa Fe Canal water to be diverted into the San Luis Canal. In the spring and summer the flow in the San Luis Canal is comprised of surface and subsurface agricultural drainage as well as some irrigation district spill water. In fall and winter the flow is mainly supply water from the Central California Irrigation District (CCID) Main Canal for use in flooding local gun club duck ponds.

The San Luis Spillway Ditch discharges to the Santa Fe Canal at the point where the Santa Fe Canal turns north away from the Santa Fe Grade Road. In spring and summer its flow is comprised of surface agricultural drainage from Los Banos Creek and spill water from the San Luis Holding Reservoir. In fall and winter the flow contains duck pond drainage from local gun clubs as well as spill water from the holding reservoir.

Eagle Ditch discharges to the canal approximately 0.2 miles before it enters Mud Slough (north). Eagle Ditch begins as a diversion from the Santa Fe Canal and is

primarily used to supply water to local gun club duck ponds in the fall and winter and to drain them in the spring. Before its discharge to the Santa Fe Canal, Eagle Ditch may be pooled in a Kesterson National Wildlife Refuge pond and allowed to drain at a later date.

There are four major diversions from the Santa Fe Canal: Santa Fe Diversion; San Luis Canal; Kesterson Ditch; and Eagle Ditch. The San Luis Canal and Eagle Ditch are also tributaries of the Santa Fe Canal and have been discussed above. The Santa Fe Diversion diverts water from the Santa Fe Canal just south of the Santa Fe Canal/San Luis Canal crossing. The diversion is regulated by a check structure between the Santa Fe Canal and the Santa Fe Diversion. The diverted water flows directly to Mud Slough (south) and is then used for flooding ponds in the Los Banos State Wildlife Area or allowed to flow north to Salt Slough. The Kesterson Ditch diversion is approximately three miles south of Gun Club Road. The diversion is regulated by a gate valve between the Santa Fe Canal and Kesterson Ditch. The diverted water is used in the fall to flood local gun club duck ponds.

There are currently 69 minor discharges to and diversions from the Santa Fe Canal. Forty-six of these are gated inlet/outlet structures, 38 of which are used for flooding and/or draining of duck ponds. Of the remaining eight gated structures five are used to irrigate or drain pasture land and three are used for draining field crops. There are thirteen pipes to the canal: two irrigation spills; two duck pond drains; and nine field drains from crop or pasture land, at least one of which contains subsurface agricultural drainage. Lastly, there are ten lift pumps on the Santa Fe Canal. Four are used for duck pond flooding; three for crop irrigation; two for pasture irrigation; and one is used at the Los Banos Wastewater Treatment Plant.

Los Banos Creek

Due to Los Banos Creek's length and diversity of surrounding land use it will be divided into seven reaches: Reach 1 - Upstream of the Los Banos Detention Reservoir; Reach 2 - Los Banos Detention Reservoir to the California Aqueduct; Reach 3 - California Aqueduct to Sunset Avenue; Reach 4 - Sunset Avenue to 0.5 miles south of Henry Miller Avenue; Reach 5 - 0.5 miles south of Henry Miller Avenue to 0.3 miles south of the San Luis Spillway Ditch; Reach 6 - 0.5 miles south of the San Luis Spillway Ditch to State Highway 140; Reach 7 - State Highway 140 to the Los Banos Creek discharge to Mud Slough (north).

Reach 1

Los Banos Creek is an ephemeral stream which begins on the eastern slope of the coastal range. Just west of Interstate 5 the creek is pooled in the Los Banos Detention Reservoir behind an earth fill dam. Upstream of the reservoir, the creek is a natural channel with vegetation both in the channel and along the banks. Most of the land surrounding the creek upstream of the reservoir is natural vegetaion and is used for

cattle grazing. The reservoir is operated by the U. S. Bureau of Reclamation and has an average storage of 34,500 acre feet. The reservoir's beneficial uses include domestic, fish culture, recreation, and fish and wildlife protection/enhancement.

Reach 2

Below the dam the creek bed winds its way through grassy hills down to and undercrosses Interstate 5. East of Interstate 5 the creek bed widens greatly before it is siphoned under the California Aqueduct, At this point the creek may receive some seepage water from the aqueduct. Between the detention dam and the aqueduct no discharges or diversions could be found. Therefore any flow in this reach would be either water released from the reservoir, seepage from the aqueduct or precipitation runoff from the surrounding hills.

Reach 3

Between the California Aqueduct and Sunset Avenue the creek bed runs through two abandoned and two operational gravel pits. In this section the creek bed has been almost entirely rechannelized by the gravel pit operations. Due to the gravel pits there is little or no vegetation in this reach of the creek. A small field drain from an orchard near Sunset Avenue is the only discharge or diversion in this reach. However, the creek may receive precipitation runoff from the surrounding gravel pits during the rainy season.

Reach 4

North of Sunset Avenue the creek again becomes a natural channel. This remains true for approximately seven miles to just north of Henry Miller Avenue where it returns to a man made channel. The majority of land surrounding the creek in this reach is used for growing field crops. However, only four small field drains were found in the reach. Therefore, very little of the area's agricultural drainage is provided by the creek. In addition, a number of dairies line the creek in this reach. No discharges from these dairies could be found, however, during the rainy season precipitation runoff could flow into the creek. In this reach the creek may also receive some irrigation district spill water from the CCID Main Canal just before the canal is siphoned under the creek bed.

In this reach there is a great deal of vegetation in the channel. With the exception of the area near Sunset Avenue the creek channel is filled with trees and bushes. Near Sunset Avenue the creek bed is mostly devoid of vegetation and is used as a motorcycle riding area as well as a garbage dump for such things as couches and refrigerators.

Water is pooled in two places along this stretch of the creek. The first is just north of State Highway 152 near a dairy and the second is just south of State Highway 33. Other than heavy vegetation in the downstream channel, no means for the pooling of water could be found for either pool. In addition, no water source could be found

for either pool. A portable lift pump was being used to pump water from the second pool to irrigate a small cotton field. No possible use for the first pool could be determined.

Reach 5

Approximately 0.5 miles north of Henry Miller Avenue the creek becomes a man made earth lined channel with levees on either side. This continues until approximately 0.3 miles south of the San Luis Spillway Ditch. Along this reach there is no vegetation in the channel but there is a fairly significant amount on the banks between the channel and the levee roads. For this reach most of the surrounding land is used for the growing of field crops.

The drainage for most of the surrounding field crops flows north into two large drains, one on either side of the creek, and is then pumped to the creek approximately one mile south of the San Luis Spillway Ditch. In addition to the pumped drainage there are three other discharges to the creek in this reach; two small field drains and an irrigation spill from a small ditch. The water discharged to the creek in this reach may be pooled by two check structures downstream of the lift pumps. A series of five gated outlet structures allow the pooled water to be reused on other field crops and for flooding of duck ponds.

Reach 6

From approximately 0.3 miles south of the San Luis Spillway Ditch to State Highway 140 Los Banos Creek is a natural channel. For most of this reach the channel as well as its banks are covered in tules. With the exception of the reach's final mile, the land surrounding the creek is used exclusively as gun club duck ponds. The land surrounding the creek in the reaches final mile is used for cattle grazing and field crops as well as gun club duck ponds.

There are a number of minor discharges and diversions in this reach. Most of the discharges are duck pond drains, draining one or more local duck ponds. Other discharges to the creek include drainage from field crops and pasture land. Flow may also be discharged to the creek from the Gustine wastewater treatment plant in this reach or it may be diverted to a channel paralleling the Santa Fe Grade and discharged to the creek north of State Highway 140.

Most of the diversions from the creek in this reach are used to flood gun club duck ponds. They are usually gated structures allowing flow to a single duck pond or to a large ditch which supplies a number of duck ponds. One diversion is a set of two lift pumps used to flood the same duck pond just north of the Los Banos Creek/San Luis Wasteway Confluence.

The three major tributaries of Los Banos Creek; San Luis Wasteway; San Luis Creek; and Garza's Creek all enter the creek in this reach. During the fall, the San Luis Wasteway carries supply water from the Delta Mendota Canal to Los Banos Creek

via the San Luis Holding Reservoir. During the remainder of the year it primarily carries spillwater from the San Luis Holding Reservoir. However, it does receive some surface drainage from surrounding agricultural land in the spring, summer, and early fall.

San Luis Creek is an ephemeral stream originating on the eastern slope of the coast range. San Luis Creek is pooled in the San Luis Reservoir east of Interstate Highway 5 and essentially ends there. It begins again just east of the Outside Canal. From here it flows northeastward collecting surface drainage from agricultural crop land as well as some duck pond drainage. It discharges to Los Banos Creek at the same point as the San Luis Wasteway.

Garza's Creek also originates on the eastern slope of the coastal range. On its route to Los Banos Creek, it is allowed to mix with water from the Central California Irrigation District Main and Outside Canals. Therefore, during irrigation season (i.e. when water is in the canals), the water in the creek immediately downstream of the canals is more likely to be supply water from the canals than from any upstream discharges. From the Main Canal, the creek flows eastward collecting surface drainage from the surrounding agricultural land before discharging to Los Banos Creek approximately two miles south of Gun Club Road.

Reach 7

North of State Highway 140 Los Banos Creek is a natural channel until it discharges to Mud Slough (north) approximately two miles north of the highway crossing. Vegetation lines the creek's banks for this entire reach while tules fill most of the channel. Most of the surrounding land is used for cattle grazing and gun club duck ponds. However, there is also an area on the east side of the creek used for growing field crops.

There are twelve minor discharges to the creek in this reach. Seven of these are small field drains and drain the field crop land to the east. The remaining five are all larger open channels. Of these, three drain duck ponds and pasture land west of the creek. Of the remaining two, one is a naturally occurring channel which may contain both surface and subsurface agricultural drainage as well as duck pond drainage at various times. The final channel is a large drain draining agricultural land to the west and may contain both surface and subsurface agricultural drainage. It may also contain flow from the Gustine wastewater treatment plant if the water has been diverted at the Santa Fe Grade.

Fremont Canal

The Fremont Canal begins just south of the Underwood Gun Club on State Highway 165. The flow originates from the San Luis Canal via a 36 inch gate valve. The canal ends at the intersection of Mud Slough (north) and Gun Club Road. At this point the Fremont Canal discharges to Mud Slough (north) from the east just north of the road.

The Fremont Canal is a man made earth lined canal. Dirt roads line the canal's banks for most of its length. Vegetation grows between the canal and the roads. Vegetation also grows within the channel in a number of places. The surrounding land is used almost entirely for gun club duck ponds.

There are twelve gated inlet/outlet structures to/from duck ponds along the Fremont Canal. Seven are on the southern and western side of the canal and five are on the northern and eastern side. The largest is a 36 inch gate valve allowing for flooding of a large pond southwest of the canal near the Segaita and Coast Cattle gun clubs. In addition to the gated structures, four pipes enter the canal. The first drain is overflow from a windmill well and contributes very little flow even when operating. The next two drain duck ponds north of the canal. The fourth drains a small area between the canal and the Kesterson Reservoir levee.

Kesterson Ditch

Kesterson Ditch begins immediately upstream of a check structure on the Santa Fe Canal. This point is approximately four miles north of the San Luis Spillway Ditch/Santa Fe Canal confluence at the Santa Fe Grade Road. The flow originates from the Santa Fe Canal with two gate valve inlets. The ditch ends approximately three miles to the east as a gated outlet to a duck pond.

Kesterson Ditch is a man made, earth lined ditch with levees on either side. Vegetation lines the bank between the ditch and levee roads. Most of the channel, however, is free of vegetation. The surrounding land is used entirely as gun club duck ponds.

The only discharge to Kesterson Ditch is the Santa Fe Canal. As noted above, this discharge is used as supply for local duck ponds or as an alternative route to the Santa Fe Canal. There are eleven diversions from Kesterson Ditch, including one to Mud Slough (north). The Mud Slough (north) diversion is usually spill from the ditch during duck pond flooding. The remaining ten diversions are all gated outlets. These outlets are used in the fall for flooding duck ponds. Most of the drainage from these ponds discharges directly to Mud Slough (north) with none ever reentering Kesterson Ditch.

OPERATION

The tributaries of Mud Slough (north) are a complex network of canals and ditches. A schematic of this network is presented on the following page as Figure 2. The reason for the complexity of the system is that it is used for different purposes (sometimes incompatible) throughout the year. In the spring and summer it is used to convey agricultural drainage south of the Grassland Water District (GWD) to the San Joaquin River. In the fall it is used to supply relatively good quality water to local gun club duck ponds. In the winter and early spring it is used to drain the duck

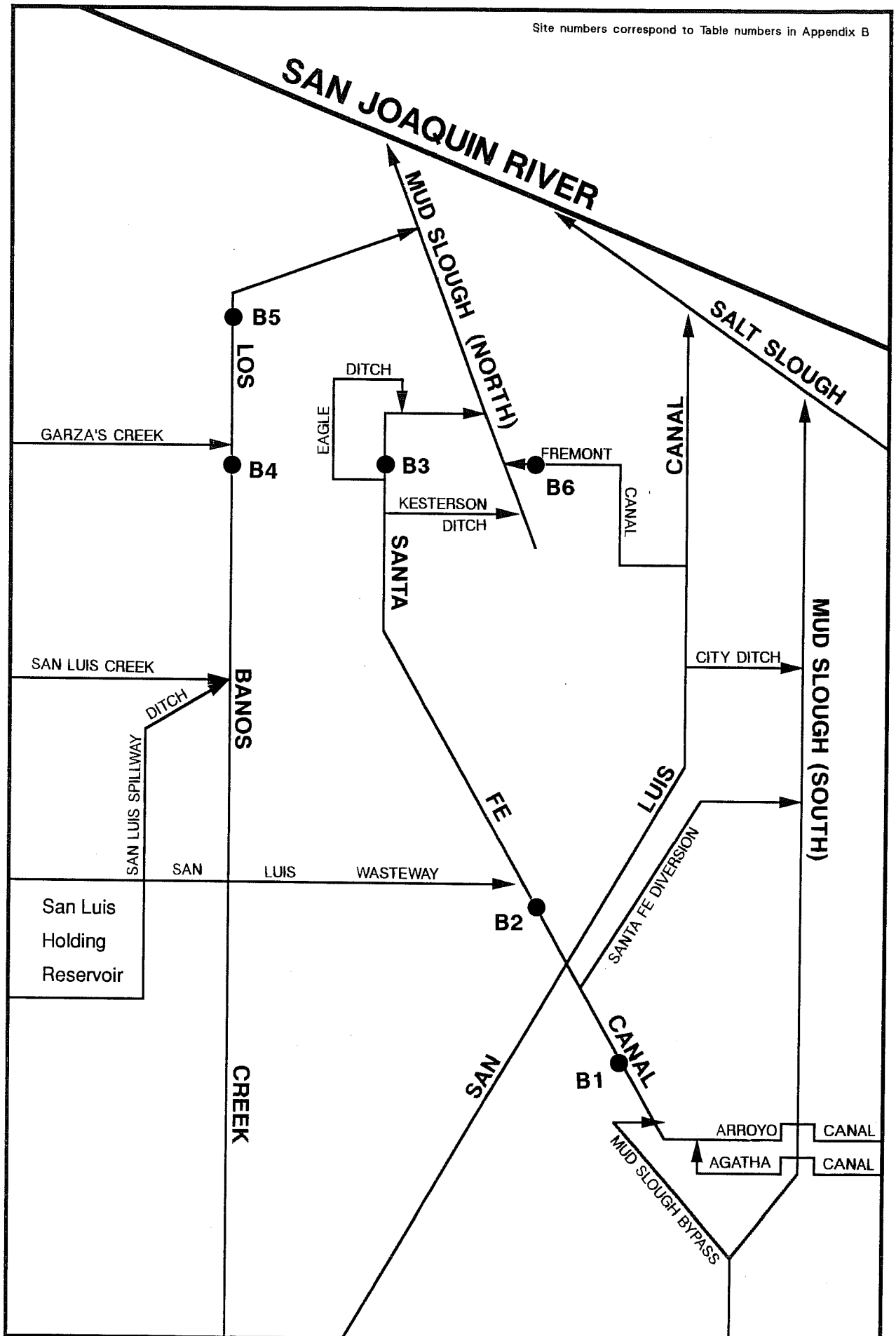

Figure 2. Flow schematic for the tributaries to Mud Slough (North) and their water quality monitoring sites.

ponds. The following is a discussion as to how each of the four main tributaries of Mud Slough (north) is operated under each of the above circumstances.

Santa Fe Canal

The Santa Fe Canal is owned and operated by GWD. In the spring and summer it is used as the primary conveyance of surface and subsurface agricultural drainage from land south of GWD to Mud Slough (north) and Salt Slough. The majority of drainage water enters the Santa Fe Canal via Mud Slough Bypass and Agatha Canal. The primary route of this drainage is from the Santa Fe Canal to the San Luis Canal to either City Ditch or Fremont Canal. However, during periods of high drainage flows, the water may be allowed to spill into the Santa Fe Diversion or to continue in the Santa Fe Canal to Mud Slough (north).

In the fall, the Santa Fe Canal is primarily used to supply water for duck pond flooding to the northern Grassland Area as well as continuing to convey drainage from agricultural land south of GWD through the district. This is accomplished by using the check structures at the Santa Fe Canal/San Luis Canal confluence. The drainage from the Agatha Canal and Mud Slough Bypass is routed through the Santa Fe Canal to the Santa Fe Diversion. Supply water for the Northern Grassland duck ponds is then delivered from the Delta Mendota Canal to the Santa Fe Canal via the San Luis Canal and the San Luis Spillway Ditch. Therefore, during the fall, the southern section of the Santa Fe Canal carries primarily agricultural drainage water whereas the northern section carries primarily supply water.

During the winter and early spring the Santa Fe Canal is primarily used to convey drainage from the duck ponds in the Grassland Area. However, it is also used to convey agricultural drainage from the area south of GWD. During this time, the canal is generally operated as it is in the summer. Water in the southern section of the Santa Fe Canal is routed through the San Luis Canal to either City Ditch or Fremont Canal. The water entering the southern section of the Canal comes from the Agatha Canal and Mud Slough Bypass. It is a mixture of duck pond drainage from the southern Grassland Area and agricultural drainage from the land south of GWD. The northern section of the Santa Fe Canal is primarily used at this time as a drainage channel for duck ponds in the northern Grassland Area. It receives duck pond drainage directly from surrounding ponds as well as from the San Luis Spillway Ditch and Eagle Ditch.

Los Banos Creek

Los Banos Creek is an ephemeral stream on the eastern slope of the coastal range. It is pooled in the Los Banos Reservoir behind an earth-fill dam. Water is released from the reservoir only during periods of very high runoff in the basin. From the dam to the San Luis Spillway Ditch there are very few discharges to the Creek and therefore there is usually little or no flow in this section. At the San Luis Spillway

Ditch, a check structure essentially ends Los Banos Creek except during periods of flooding. When flooding occurs, the check structure may be overtopped and the flow allowed to continue along its original course.

The creek begins again at the confluence of San Luis Wasteway and San Luis Creek. The section of creek downstream of this point is operated by GWD. In the spring and summer, the creek serves as a drainage channel. During the spring its flow is comprised of duck pond drainage from the surrounding duck ponds, agricultural drainage from its tributaries; San Luis Creek and Garza's Creek, and spillwater from the San Luis Holding Reservoir via the San Luis Wasteway. In the summer, the creek's flow is primarily agricultural drainage from San Luis Creek and Garza's Creek and spillwater from the San Luis Holding Reservoir.

During the fall and winter, the channel is used to convey supply water to local gun club duck ponds from the Delta Mendota Canal via the San Luis Wasteway. In addition, a number of check structures along this section of creek are used to form a series of duck ponds of the creek itself. Very little, if any, agricultural drainage from San Luis Creek and Garza's Creek reaches Los Banos Creek during this time. However, a significant flow to Los Banos Creek from Garza's Creek could occur during periods of heavy precipitation in the coastal range.

Fremont Canal

The Fremont Canal is owned and operated by GWD. The flow is regulated by an inlet gate valve from the San Luis Canal and four downstream check structures. It is primarily used in the fall to supply water to local gun club duck ponds. In the winter and early spring it is primarily used to drain the duck ponds just north of the canal. In the summer it is used to convey the agricultural drainage water in the San Luis Canal to Mud Slough (north).

Kesterson Ditch

Kesterson Ditch is also owned and operated by GWD. The flow is regulated by an inlet gate valve from the Santa Fe Canal and two downstream check structures. It is primarily used in the fall to convey supply water from the Santa Fe Canal to gun club duck ponds east of the Canal. It receives no drainage from any of the duck ponds, with most of that drainage discharging directly to Mud Slough (north) in the spring. Kesterson Ditch usually remains dry during the spring and summer. However, during these periods it may be used to convey excess water from the Santa Fe Canal to Mud Slough (north). Water in the Santa Fe Canal can be passed through Kesterson Ditch to Mud Slough (north) allowing for downstream construction on the Santa Fe Canal.

WATER QUALITY

The Agricultural Unit of the Regional Board periodically samples a number of sites in the Mud Slough (north) tributary system to monitor the water quality. Water quality results for selected constituents of each site are given in Appendix B. Figure 2 shows the relative locations of these sites with site identifications corresponding to the Table numbers in Appendix B. The four constituents; electrical conductivity (EC), boron (B), selenium (Se), and molybdenum (Mo) are presented because they are the most representative of subsurface agricultural drainage and they are included in the basin plan water quality objectives for Mud Slough (north). Water quality data presented in this report is taken from James, et al., 1988.

Santa Fe Canal

Tables B1-B3 in Appendix B present water quality data for the Santa Fe Canal at three different sites. The data for each site exhibit the same general trend. In the early fall the EC, B, and Se concentrations are relatively low, indicating that the canal carries very little subsurface agricultural drainage. During the remainder of the year, the EC, B, and Se concentrations are relatively high, indicating that the canal carries a significant amount of subsurface agricultural drainage. These data agree well the contention that the Santa Fe Canal is used to carry supply water in the early fall and to carry drainage water the rest of the year. The relatively high constituent concentrations of this drainage suggest that the Santa Fe Canal is a major contributor to the Mud Slough (north) subsurface agricultural drainage pollutant load.

Los Banos Creek

Water quality data for Los Banos Creek is presented in Appendix B as Tables B4 and B5. Table B4 gives water quality data for Los Banos Creek at Gun Club Road (site MER514). Table B5 gives water quality data for Los Banos Creek at State Highway 140 (site MER554). With the exception of the EC concentration at site MER514, the constituent concentrations are relatively low during the entire year. The elevated EC concentrations at site MER554 are most likely due to the Gustine Wastewater Treatment Plant discharge which enters just upstream of the site. The low concentrations throughout the year indicate that very little, if any, of Los Banos Creek's annual flow contains subsurface agricultural drainage. Therefore, Los Banos Creek should not be considered a major contributor to Mud Slough's (north) subsurface agricultural drainage pollutant load.

The water quality data for site MER514 exhibited a general trend. This trend was for the constituent concentrations to be relatively lower in the fall than during the rest of the year. This trend is indicative of the contention that the creek is used to carry supply water to local gun clubs during the fall. The water quality data for site MER554 does not exhibit this trend. This is probably due to the creek being ponded

at various points by check structures, during the fall, south of the monitoring site. The ponding of the creek allows less of the supply water to reach the site, making the Gustine Wastewater Treatment Plant discharge a larger portion of the flow during the fall.

Fremont Canal

Water quality data for the Fremont Canal at Gun Club Road (site MER515) is shown as Table B6 in Appendix B. The data for the Fremont Canal show the same general trend as the data for the Santa Fe Canal. The EC, B, and Se concentrations are relatively low in the early fall and relatively high during the remainder of the year. This indicates that in the early fall the canal is used to carry supply water and contains little or no subsurface agricultural drainage. The relatively high constituent concentrations during the rest of the year indicate that the Fremont Canal carries a significant amount of subsurface agricultural drainage. The relatively high concentrations during this time also suggest that the Fremont Canal is a significant contributor to the Mud Slough (north) subsurface agricultural drainage pollutant load.

Kesterson Ditch

Kesterson Ditch is not monitored by the Regional Board. However, Kesterson Ditch's entire flow originates as a diversion from the Santa Fe Canal. Since there is only one discharge to the Santa Fe Canal between the Kesterson Ditch diversion and Gun Club Road, site MER517 (Santa Fe Canal at Gun Club Road, Table B3) is probably representative of Kesterson Ditch's water quality. The data at this site show relatively low EC, B, and Se concentrations in the early fall, indicating that subsurface agricultural drainage comprises little if any of the ditch's flow during this time. The data show much higher concentrations for the remainder of the year, indicating that a significant portion of the ditch's flow is subsurface agricultural drainage during this time.

As noted previously, Kesterson Ditch is used primarily in the early fall to supply water to local gun clubs. During other times of the year it is usually dry, being used only occasionally as an alternative route to the Santa Fe Canal. Therefore, the early fall data of site MER517 (Table B3) is representative of the majority of Kesterson Ditch's annual flow. Since this data indicates little or no subsurface agricultural drainage, Kesterson Ditch should not be considered as a major contributor to Mud Slough's (north) subsurface agricultural drainage pollutant load.

REFERENCES

James, E.W., Westcot, D.W., Grewell, B.J., Belden, K.K., Boyd, T.F., Waters, I.W., and Thomasson, R.R., 1988. Agricultural Drainage Contribution to Water Quality in the Grassland Area of Western Merced County, California. Central Valley Regional Water Quality Control Board Report, 169 pages.

Pierson, F.W., James, E.W., and Thomasson, R.R., 1989. Hydrology Study of Mud Slough (North), Merced County. Central Valley Regional Water Quality Control Board Report, 109 pages.

APPENDIX A

Index and Flow Diagrams for Tributaries to Mud Slough (North)

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INDEX TO SANTA FE CANAL DISCHARGE AND DIVERSION SITES

Site	Mile	Description
SFC001	0.00	Arroyo Canal discharge at Mueller Weir
SFC002	0.01E	Lift pump for pasture irrigation and stockwatering
SFC003	0.02W	Lift pump for field crop irrigation
SFC004	0.10W	Agatha Canal discharge
SFC005	0.15W	Mud Slough Bypass discharge
SFC006	0.44W	Gated outlet to pasture land
	0.60	State Highway 152
SFC007	0.62E	Irrigation spill from field crop ditch
SFC008	1.00E	Lift pump to field crops
SFC009	1.41E	Lift pump to field crops
SFC010	1.51E	Gated outlet to ditch
SFC011	1.73E	Gated outlet to ditch
SFC012	1.62W	Pipe from drain paralleling the canal
SFC013	1.99E	Lift pump to Los Banos WWTP
SFC014	3.14E	Lift pump to pasture land
SFC015	3.54E	Field drain from pasture land
SFC016	3.62E	Santa Fe Diversion out-take
SFC017	3.63W	San Luis Canal/Santa Fe Canal crossing
SF1	3.64	Santa fe Canal check structure #1
SFC018	3.70E	Gated outlet for pasture irrigation
SFC019	3.73W	Drain from field crops
SFC020	4.16W	Small field drain

INDEX TO SANTA FE CANAL DISCHARGE AND DIVERSION SITES

Site	Mile	Description
	4.17	Henry Miller Avenue
SFC021	4.41E	Large field drain
	4.66	Lander Avenue (State Highway 165)
SFC022	4.70W	Large field drain
SFC023	5.25E	Spill from an irrigation well
SFC024	5.70W	Large field drain
SFC025	6.03E	Large gated drain from field crop land
SFC026	6.11W	Large gated drain from field crop and pasture land
SFC027	6.12E	Gated inlet to pasture land and duck ponds
SFC028	6.29E	Gated inlet to pasture land
SF2	6.41	Santa Fe Canal check structure #2
SFC030	6.46W	Large drain from field crop land and duck ponds
SFC031	7.15W	Large field drain
SFC032	7.32E	Gated outlet to duck pond
SFC033	7.40E	Gated inlet and lift pump to duck ponds
SF3	7.51	Santa Fe Canal check structure #3
SFC035	7.80E	Gated inlet to duck pond ditch
SFC036	7.86W	San Luis Spillway Ditch discharge
SF4	7.93	Santa Fe Canal check structure #4
SFC038	7.96W	Possible wastewater discharge from gun club cabin
SFC039	8.54E	Gated inlet to duck pond
SFC040	8.71W	Gated outlet from duck pond and pasture land
SFC041	8.82W	Gated outlet from duck pond drain

INDEX TO SANTA FE CANAL DISCHARGE AND DIVERSION SITES

Site	Mile	Description
SFC042	8.89E	Gated inlet and lift pump to a duck pond ditch
SFC043	8.96W	Lift pump to duck pond ditch
SFC044	9.51W	Gated outlet to duck pond
SFC045	9.62E	Gated outlet to duck pond
SFC046	9.70E	Gated outlet to duck pond ditch
SFC047	9.76W	Gated inlet from duck pond
SFC048	9.77E	Gated outlet to duck pond ditch
SF5	9.80	Santa Fe Canal check structure #5
SFC050	9.96W	Lift pump to duck ponds and for stockwatering
SFC051	10.55W	Gated inlet/outlet to duck pond
SFC052	10.65W	Gated inlet from duck pond
SFC053	10.86W	Checked inlet/outlet to duck pond and pasture
SFC054	10.89E	Gated outlet to duck pond ditch
SFC055	11.01E	Gated outlet to duck pond ditch
SFC056	11.05W	Gated inlet from duck pond ditch
SFC057	11.17E	Gated outlet to duck pond ditch
SFC058	11.20W	Gated outlet to duck pond ditch
SFC059	11.26E	Kesterson Ditch diversion
SF6	11.30	Santa Fe Canal check structure #6
SFC061	11.77W	Gated outlet to duck pond
SFC062	12.01E	Gated outlet to duck pond ditch
SFC063	12.64W	Two gated outlets to a duck pond ditch
SFC064	12.74W	Gated outlet to duck pond

INDEX TO SANTA FE CANAL DISCHARGE AND DIVERSION SITES

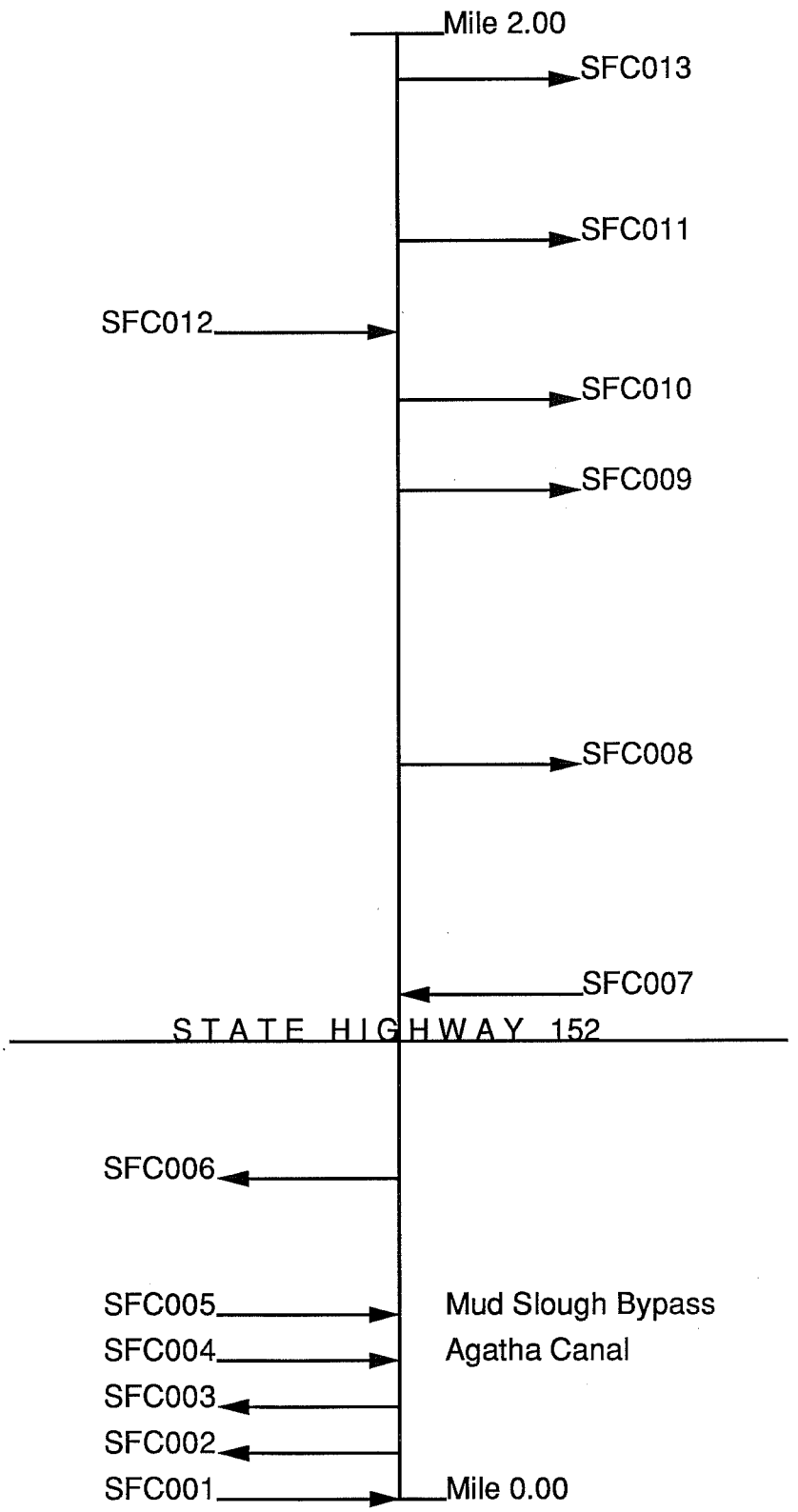
Site	Mile	Description
SFC065	12.70E	Gated outlet to duck pond
SF7	12.77	Santa Fe Canal check structure #7
SFC067	12.95W	Gated outlet to duck pond
SFC068	13.21E	Two gated outlets to a duck pond ditch
SFC069	13.27W	Eagle Ditch diversion
SFC070	13.29E	Gated outlet to duck pond ditch
SFC071	13.31W	Gated inlet from a duck pond ditch
SF8	13.39	Santa Fe Canal check structure #8
SFC073	13.36E	Gated outlet to a duck pond ditch
SFC074	14.23E	Gated outlet to duck pond ditch
SFC075	14.30W	Gated outlet to duck pond ditch
	14.59	Gun Club Road
SFC076	14.62E	Gated outlet to pasture land
SFC077	14.61W	Duck pond drain (pipe to canal)
SFC078	14.65W	Gated inlet/outlet to duck pond drain
SF9	14.68	Santa Fe Canal check structure #9
SFC080	15.18W	Gated inlet from duck ponds
SFC081	15.27E	Gated outlet to duck pond and for stockwatering
SFC082	15.56W	Gated inlet from duck pond
SF10	15.89	Santa Fe Canal check structure #10
SFC084	15.95W	Gated inlet from duck pond
SFC085	16.12W	Natural drainage channel

INDEX TO SANTA FE CANAL DISCHARGE AND DIVERSION SITES

Site	Mile	Description
SFC086	16.29W	Eagle Ditch discharge
SFC087	16.50	Santa Fe Canal discharge to Mud Slough (North)

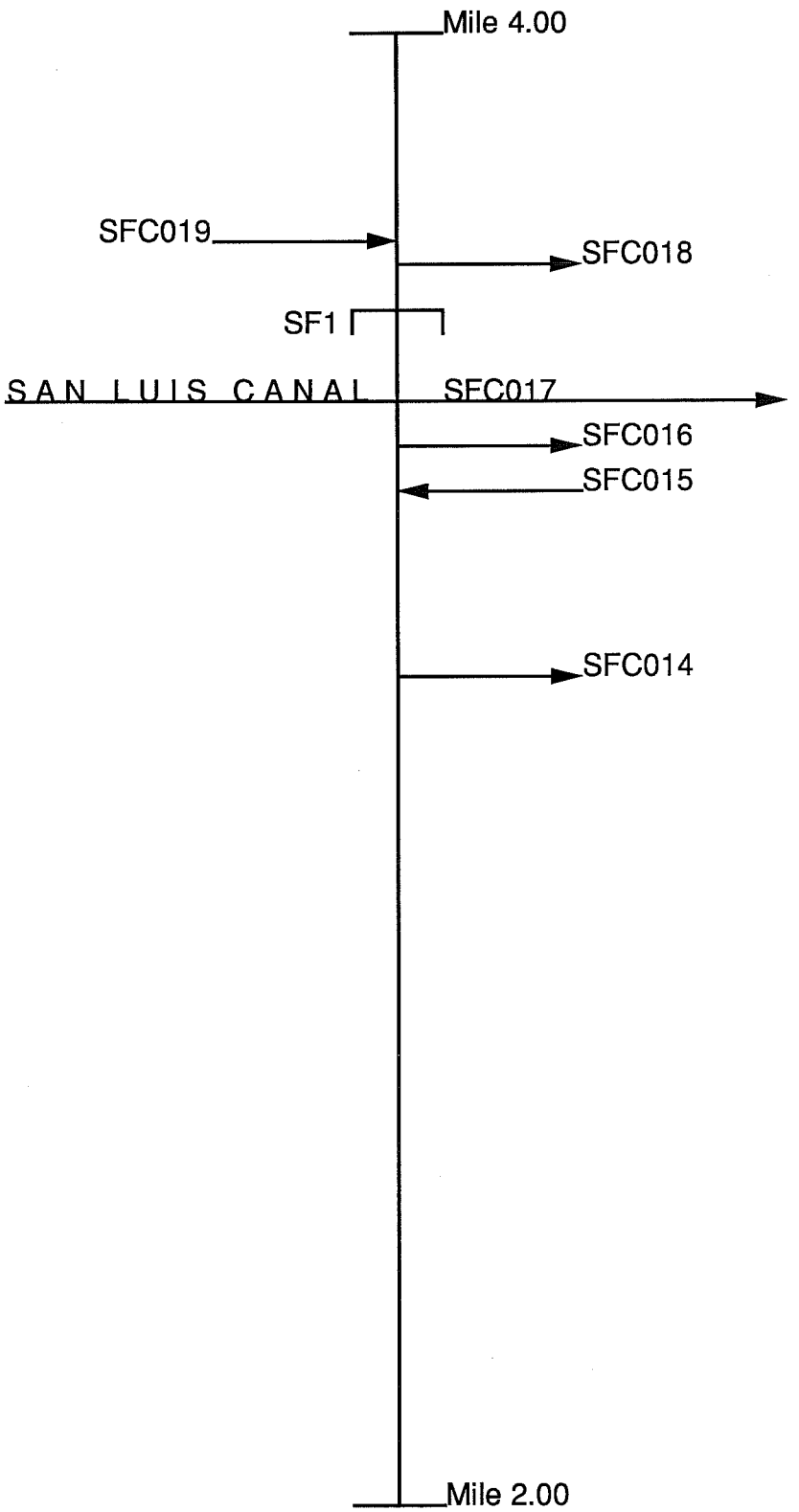
SANTA FE CANAL

Mile 0.00 - Mile 2.00



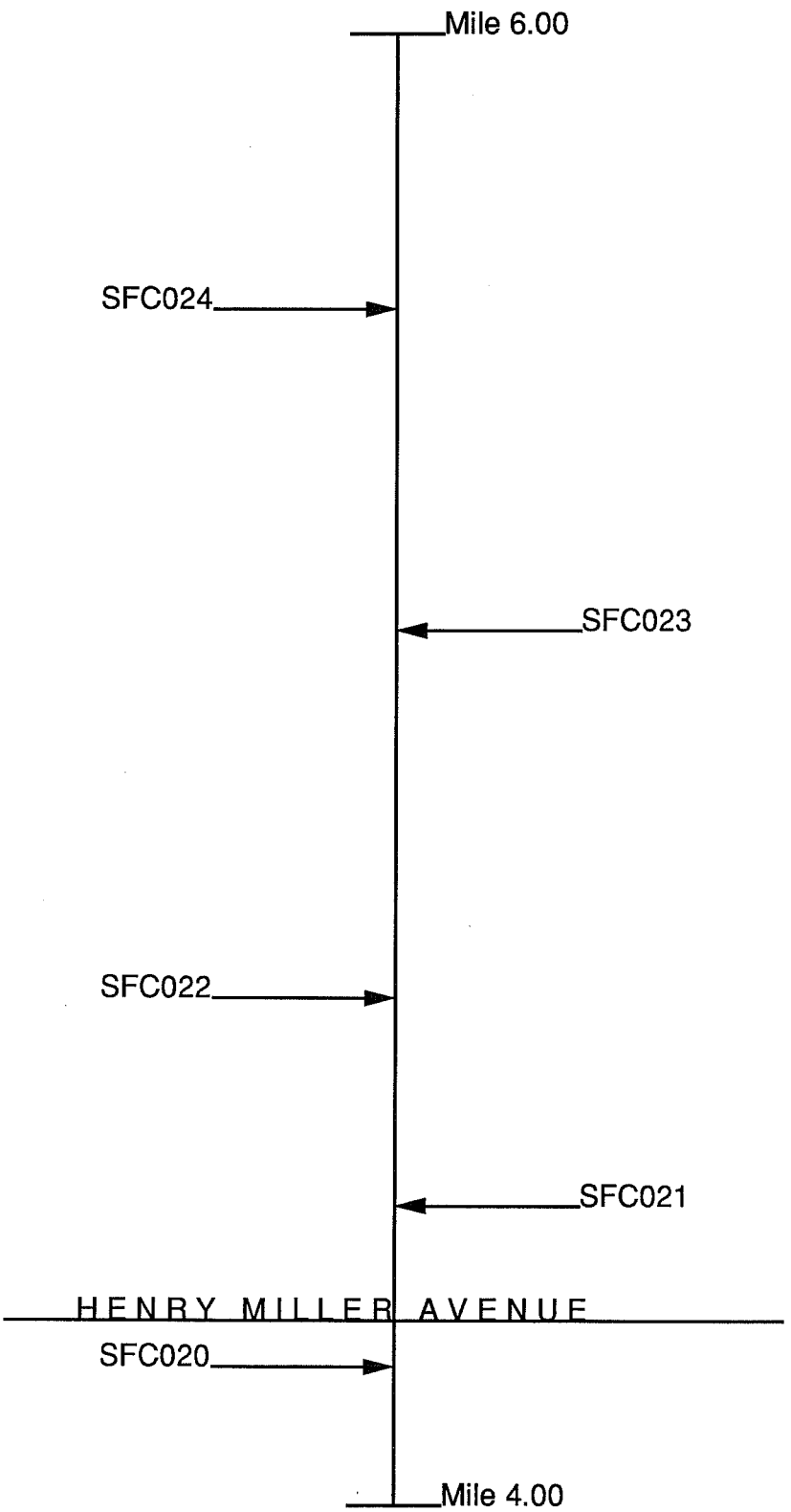
SANTA FE CANAL

Mile 2.00 - Mile 4.00



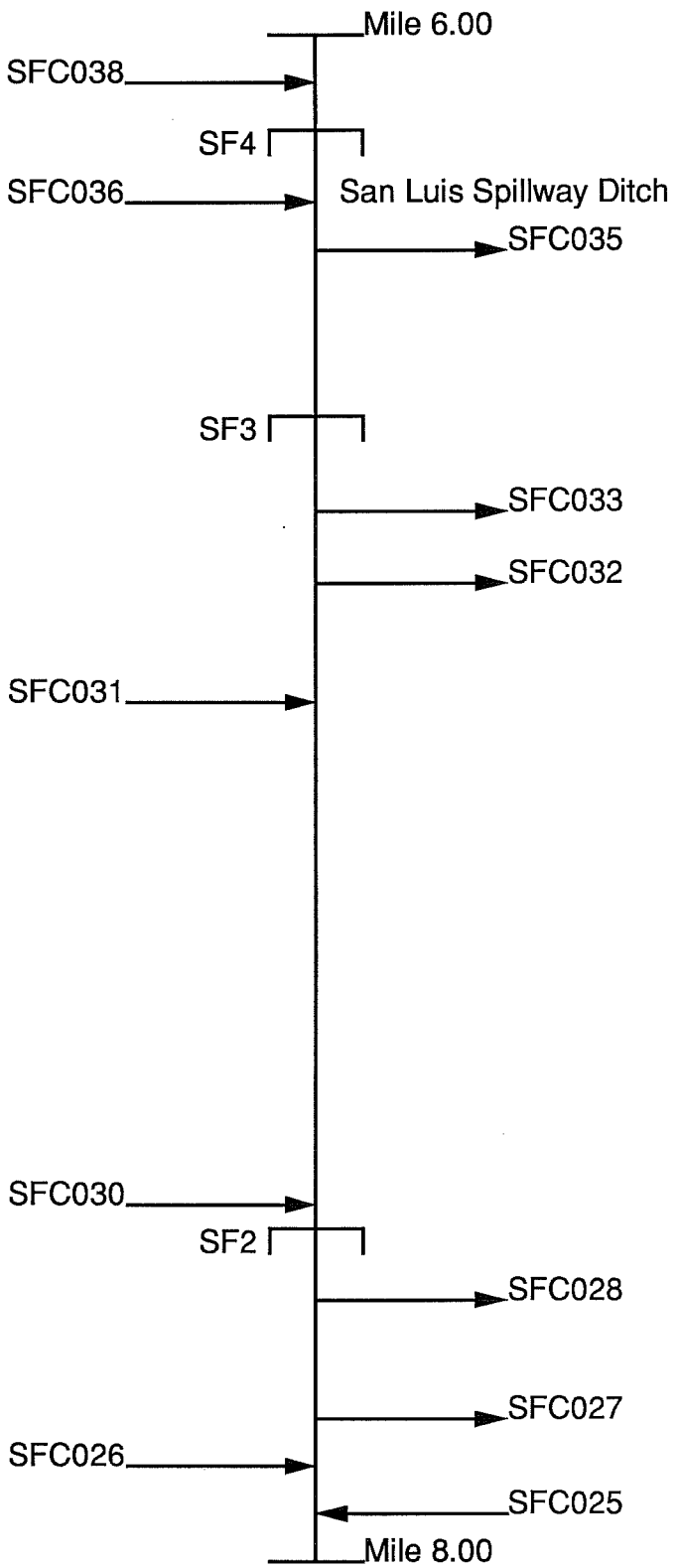
SANTA FE CANAL

Mile 4.00 - Mile 6.00



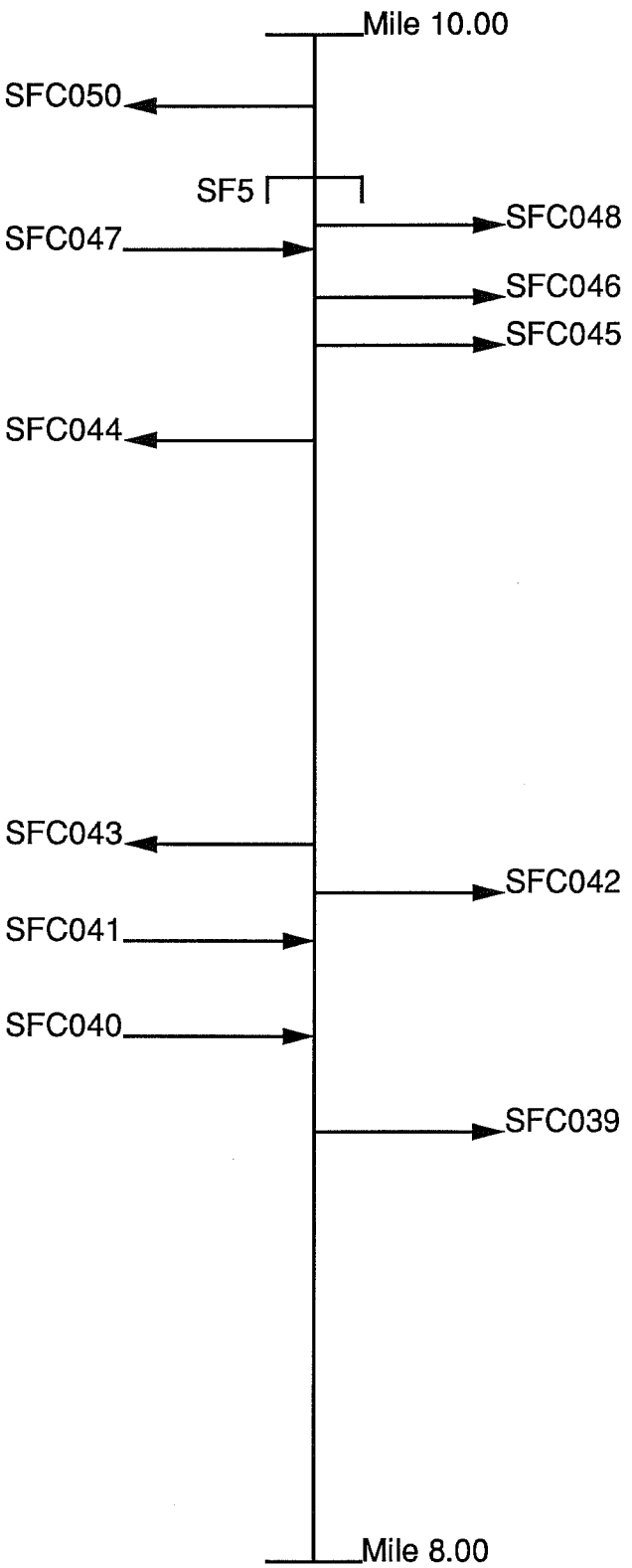
SANTA FE CANAL

Mile 6.00 - Mile 8.00



SANTA FE CANAL

Mile 8.00 - Mile 10.00



SANTA FE CANAL

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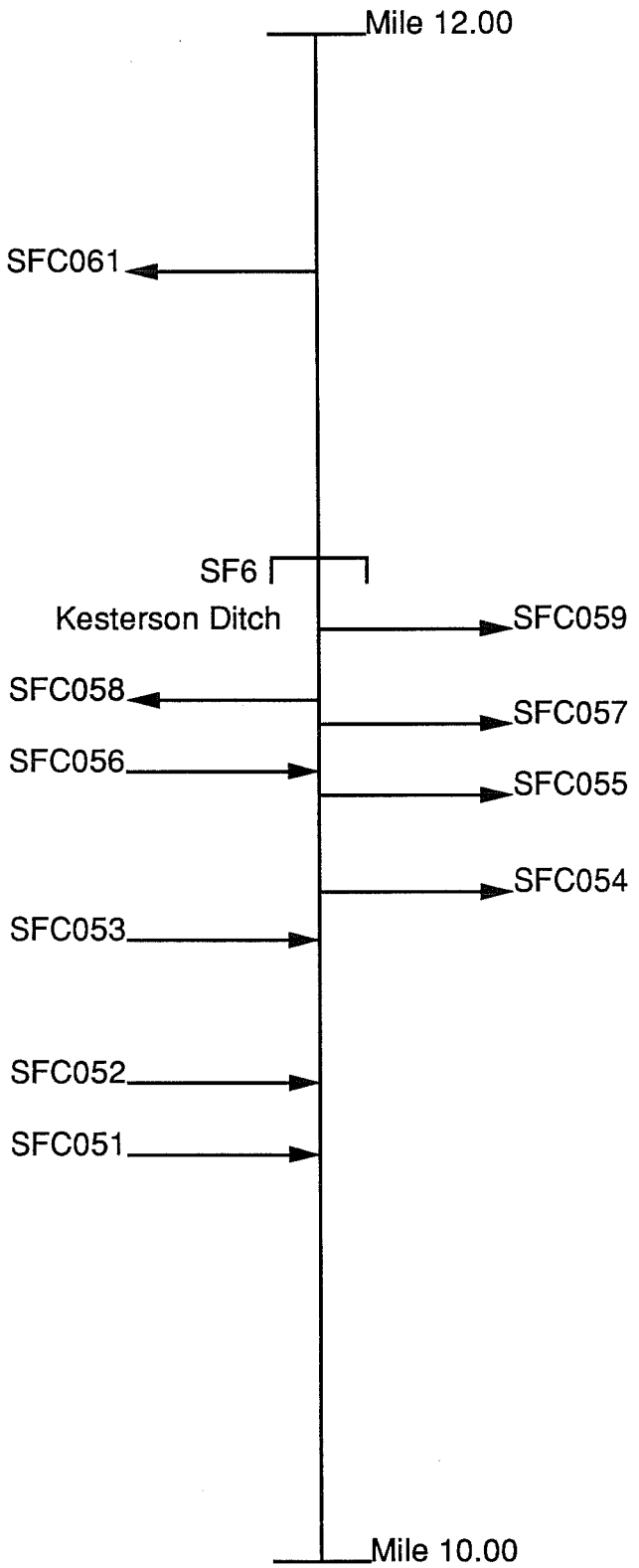

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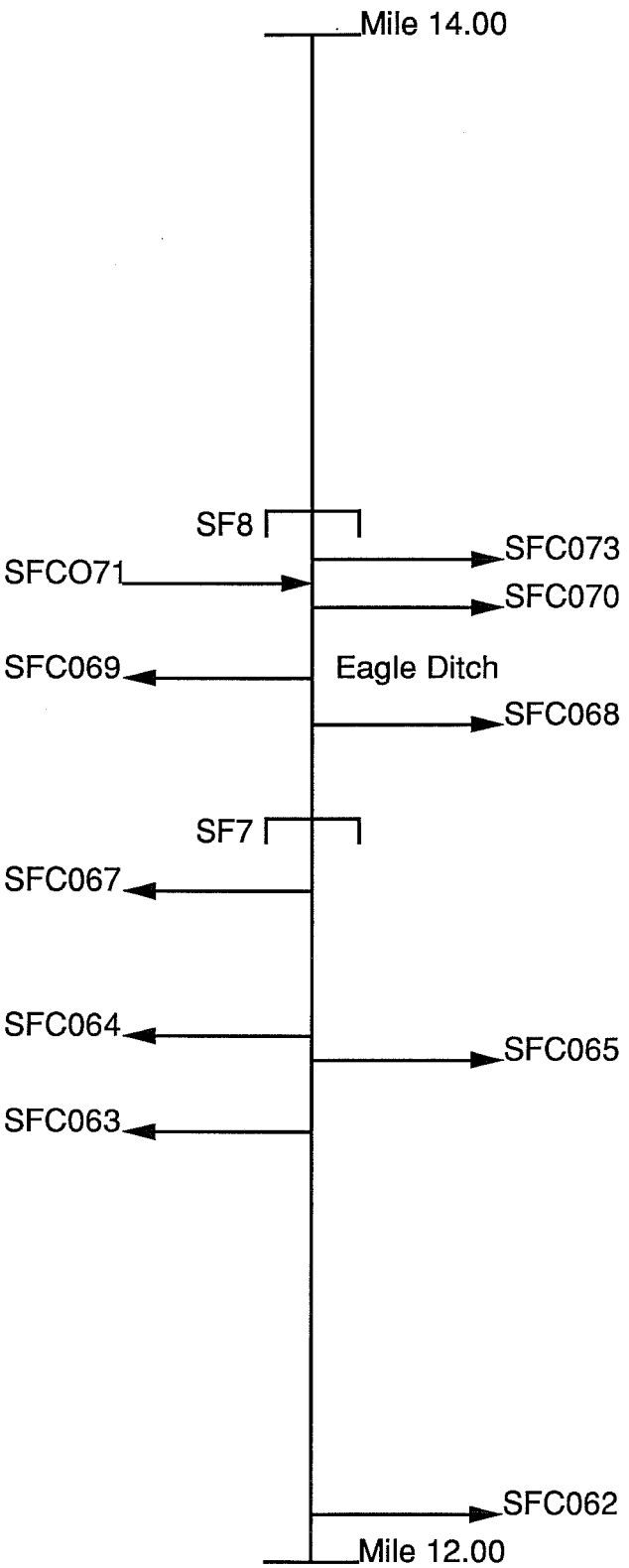

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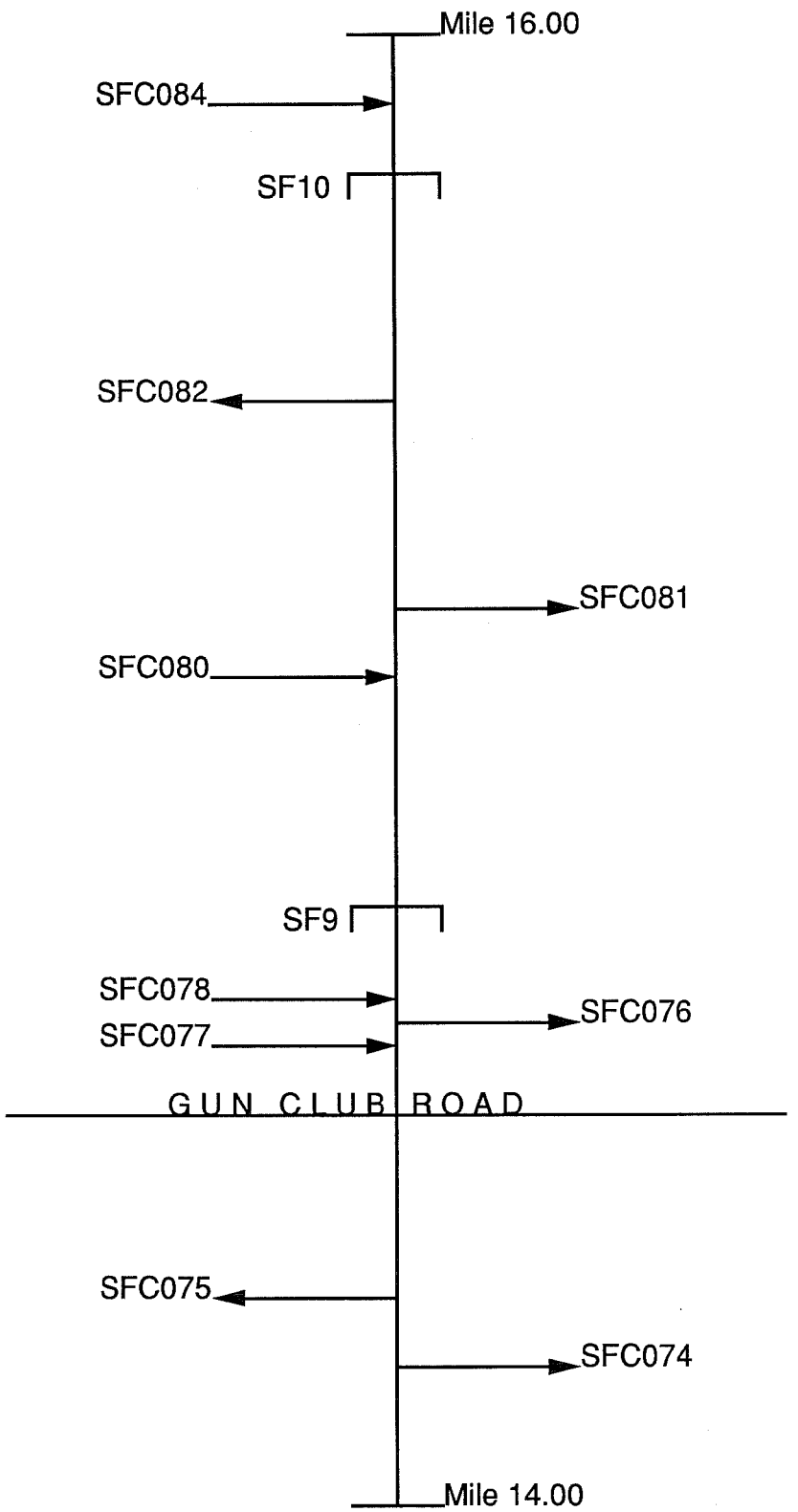
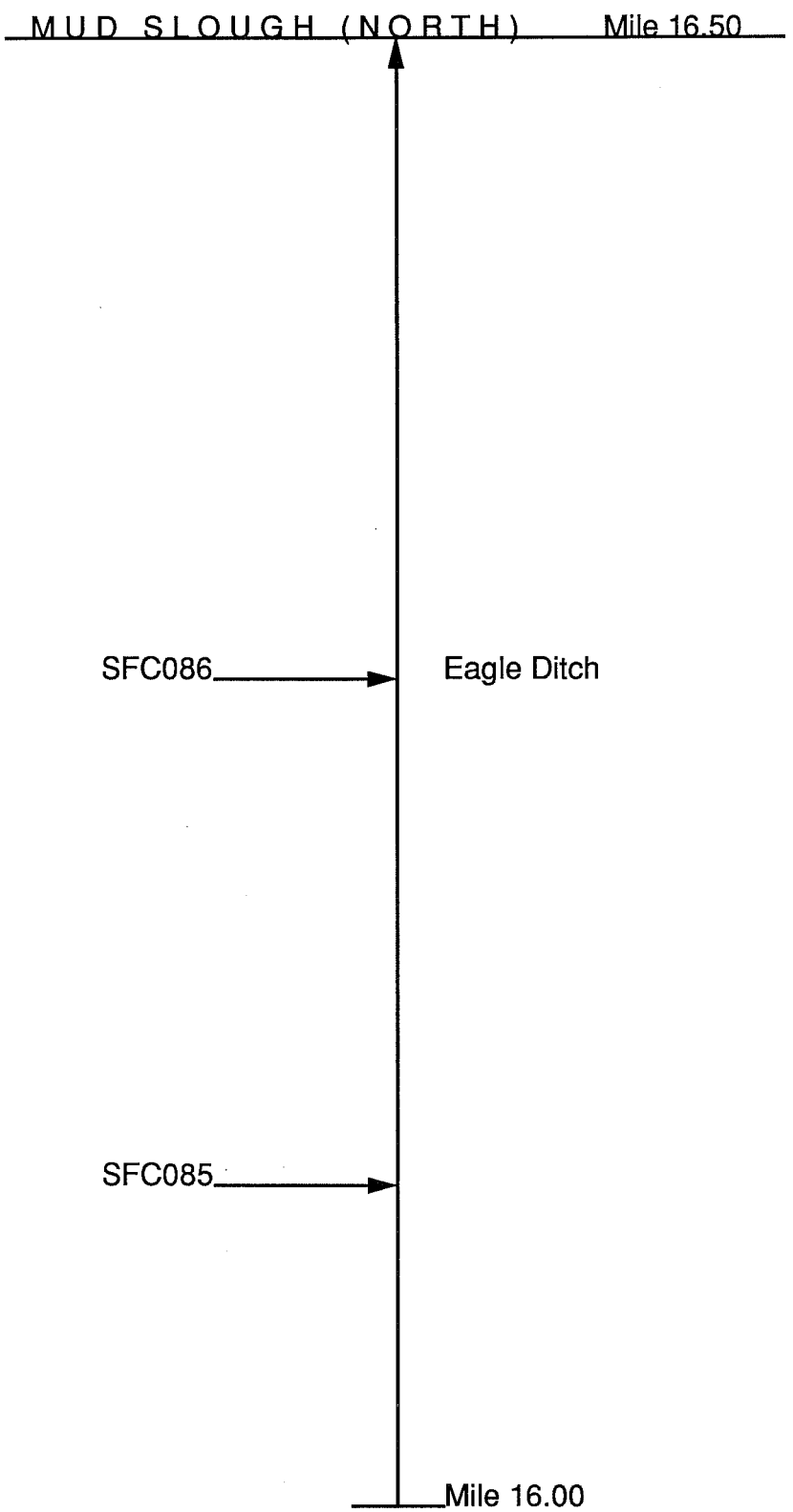
Mile 14.00 - Mile 16.00



SANTA FE CANAL

Mile 16.00 - Mile 16.50



INDEX TO LOS BANOS CREEK DISCHARGE AND DIVERSION SITES

Site	Mile*	Description
LBC001	0.00	Discharge from Los Banos Reservoir
	1.04	Creek undercrosses Interstate 5
	1.39	Creek undercrosses California Aqueduct
	2.54	Creek crosses over Delta-Mendota Canal
LBC002	3.16E	Drain from orchard (pipe)
	3.36	Sunset Avenue
	4.36	Creek crosses over Outside Canal
	4.48	Pioneer Road
	5.66	State Highway 152
LBC003	6.81W	Gated irrigation spill from orchard
LBC004	6.85E	Irrigation spill from orchard (pipe)
LBC005	7.03W	Large drain from field crop land
	7.04	Creek crosses over CCID Main Canal
LBC006	7.05E	Spill from CCID Main Canal (2 gates)
LBC007	7.24W	Portable lift pump to field crop land
LBC008	7.25E	Gated outlet drain from orchard
	7.26	State Highway 33
LBC009	8.78E	Drain from field crop land (pipe)
LBC010	9.06E	Irrigation spill from field crop land
	9.07	Henry Miller Avenue
LBC011	10.18W	Gated drain from field crop land
	10.19	China Camp Road
LBC012	10.97E	Gated outlet to field crop land

INDEX TO LOS BANOS CREEK DISCHARGE AND DIVERSION SITES

Site	Mile*	Description
LBC013	11.01E	Pumped drainage from field crop land
LBC014	11.10E	Irrigation spill from field crop land
LBC015	11.11W	2 large pumps to creek (field crop drainage)
LBC016	11.22E	Gated outlet to field crop land
LBC017	11.64E	Gated outlet to field crop land
LBC018	11.72E	Gated outlet to field crop land
LBC019	11.72W	Gated outlet to field crop land
LBC1	11.75	Los Banos Creek check structure #1
LBC021	11.81E	Gated outlet to duck ponds
LBC022	11.82W	Drain from field crop land (pipe)
LBC023	11.83E	Gated outlet to duck ponds
LBC024	11.84W	Gated inlet from field crop land
LBC2	11.85	Los Banos Creek check structure #2
LBC026	12.12W	Drain from duck pond (pipe)
LBC027	12.15W	San Luis Spillway Ditch/Los Banos Creek confluence
LBC3	12.16	Los Banos Creek check structure #3
LBC4	13.21	Los Banos Creek check structure #4 (used to flood the creek for use as a duck pond)
LBC028	15.60W	San Luis Wasteway/San Luis Creek discharge
LBC029	15.70W	Drain from duck pond
LBC030	15.76W	2 lift pumps to duck pond
LBC031	18.37W	Large duck pond drain
LBC5	18.61	Los Banos Creek check structure #5

INDEX TO LOS BANOS CREEK DISCHARGE AND DIVERSION SITES

Site	Mile*	Description
LBC033	18.99W	Drain from duck ponds
LBC6	19.37	Los Banos Creek check strructure #6 (used to flood the creek for use as a duck pond)
LBC035	19.43W	Garza's Creek discharge
LBC036	19.76W	Drain from duck pond (pipe)
LBC037	19.87W	Large drainage channel from duck pond
LBC038	19.96W	Drain from duck pond (pipe)
LBC039	20.39W	Drain from duck pond (pipe)
LBC040	20.66W	Drain from duck pond (pipe)
LBC7	20.67	Los Banos Creek check structure #7 (used to flood creek for use as a duck pond)
LBC042	21.49W	Gated outlet to duck pond
LBC043	21.70W	Drainage channel to creek
LBC044	21.78E	Drainage channel from duck pond
LBC045	21.79W	Gated outlet to duck pond
LBC046	21.94E	Drainage channel from duck pond
LBC8	22.01	Los Banos Creek check structure #8 (abandoned)
LBC047	22.10E	Large drainage channel from duck pond
LBC048	22.87W	Large drainage channel from duck ponds; gated at Santa Fe Grade (drainage can flow north along road or discharge directly to creek
LBC049	23.33E	Large gated outlet for flooding of Lone Tree Gun Club duck ponds
LBC9	23.36	Los Banos Creek check structure #9
LBC050	23.55W	Natural drainage channel from pasture land

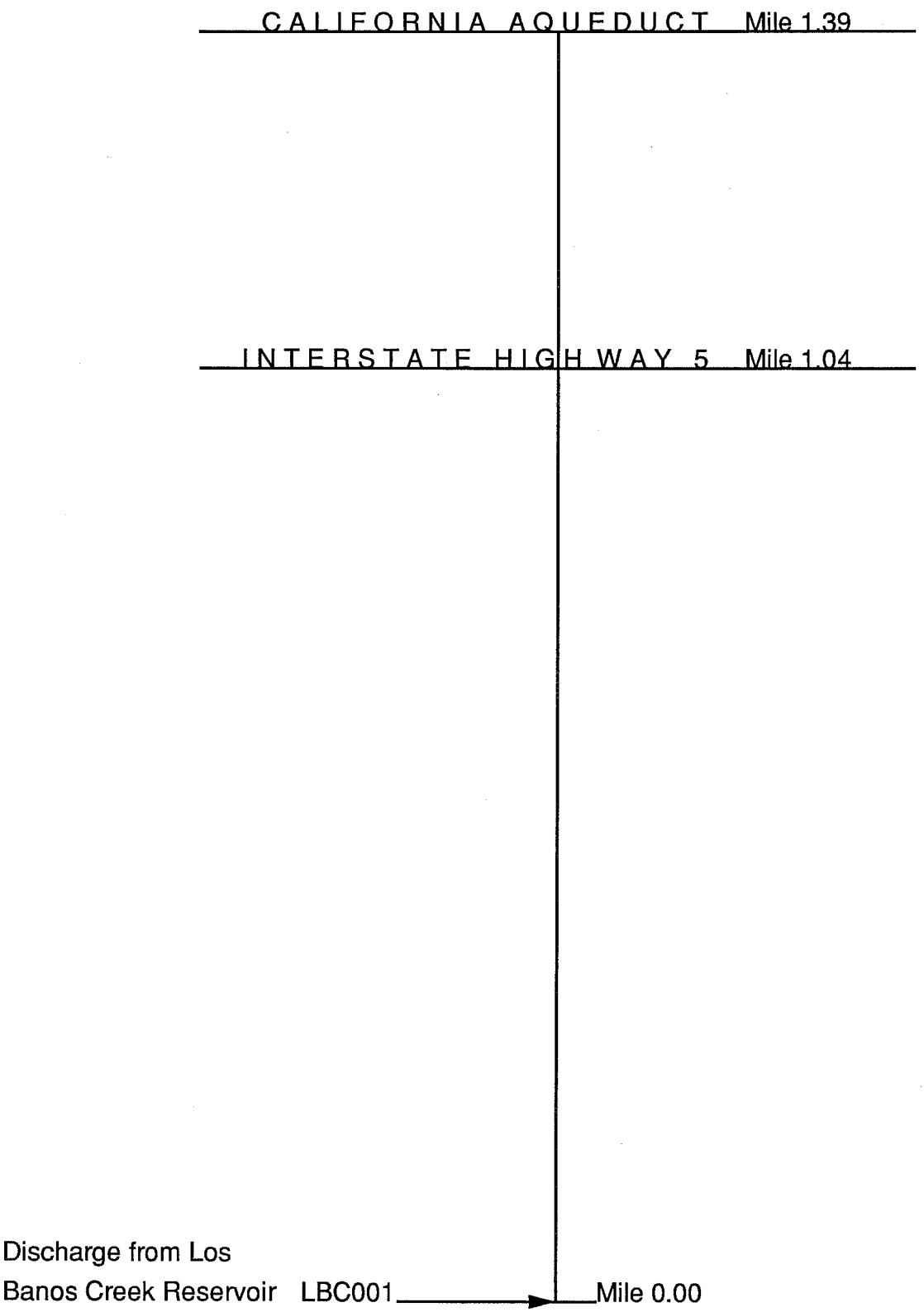
INDEX TO LOS BANOS CREEK DISCHARGE AND DIVERSION SITES

Site	Mile*	Description
LBC051	23.72W	Natural drainage channel from pasture land
LBC052	23.82W	Natural drainage channel from pasture land
LBC053	24.46E	Drainage channel from field crop land
LBC054	24.47W	Drainage channel from field crop land
LBC055	24.73W	Small drainage channel (carries runoff from State Highway 140)
	24.74	State Highway 140
LBC056	25.06W	Large drainage channel (carries both agricultural and duck pond drainage)
LBC057	25.31E	Drainage channel from field crop land
LBC058	25.40E	Drainage channel from field crop land
LBC059	25.45W	Large drainage channel from pasture land
LBC060	25.61E	Drainage channel from field crop land
LBC061	25.64E	Drainage channel from field crop land
LBC062	25.79E	Drainage channel from field crop land
LBC063	25.82E	Drainage channel from field crop land
LBC064	25.93E	Large natural drainage channel (receives surface and subsurface agricultural drainage and some duck pond drainage)
LBC065	26.00E	Drainage channel from field crop land
LBC066	26.28W	Large drainage channel from duck pond
LBC067	26.70W	Large drainage channel from duck pond
LBC068	26.85	Los Banos Creek discharge to Mud Slough (North)

*For reference purposes Los Banos Creek at the base of the Los Banos Detention Dam was taken as mile 0.00

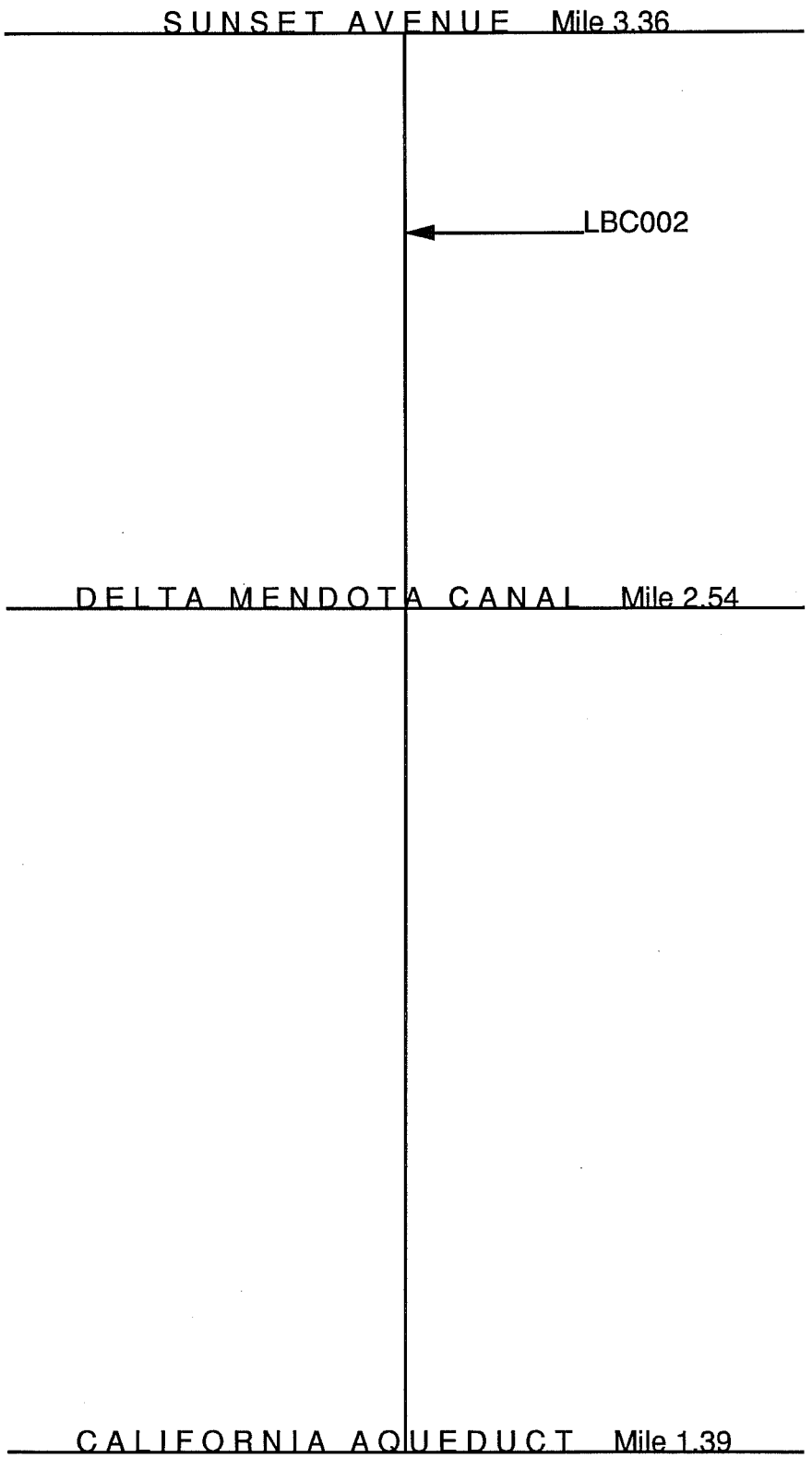
LOS BANOS CREEK

Reach 2: Mile 0.00 - Mile 1.39



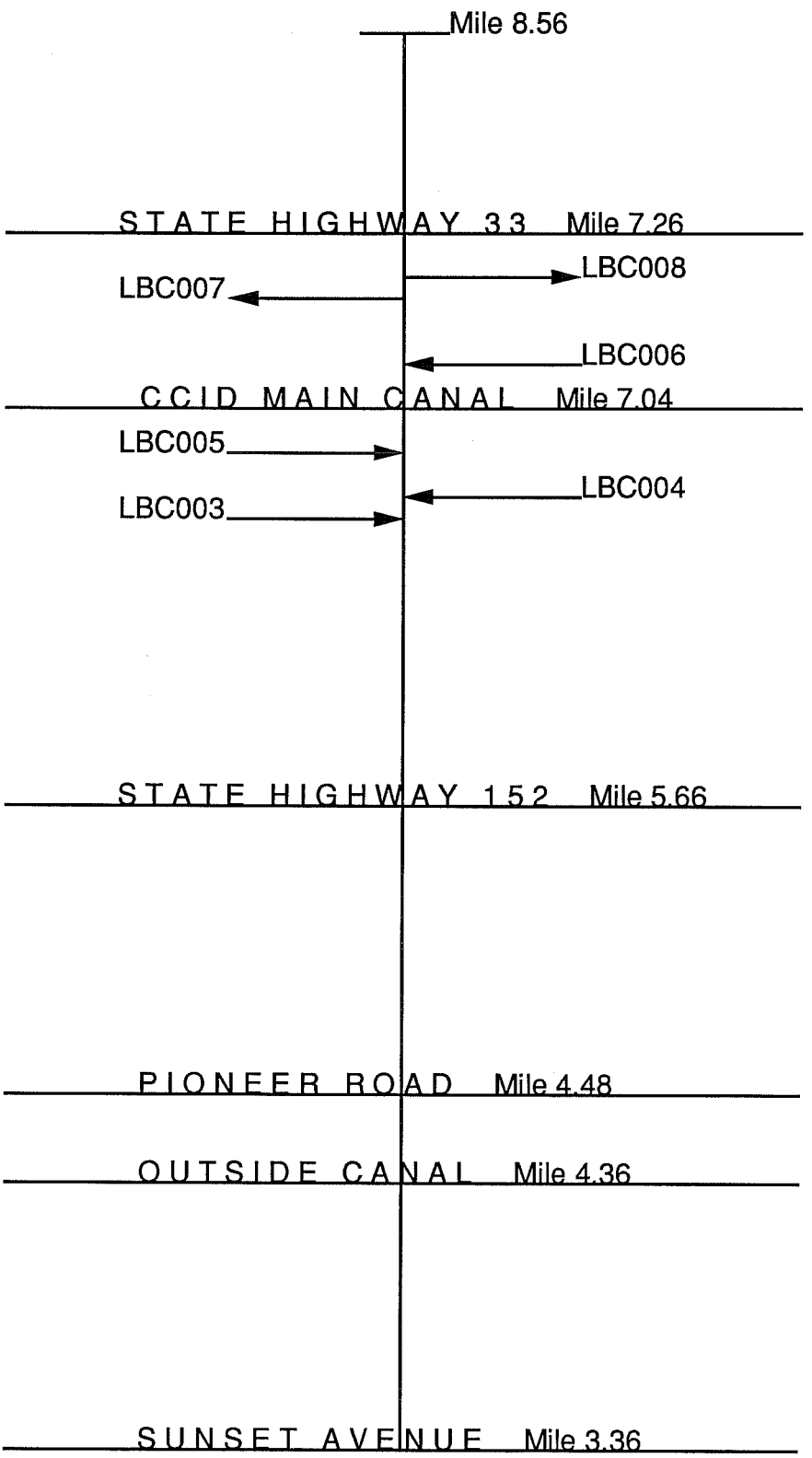
LOS BANOS CREEK

Reach 3: Mile 1.39 - Mile 3.36



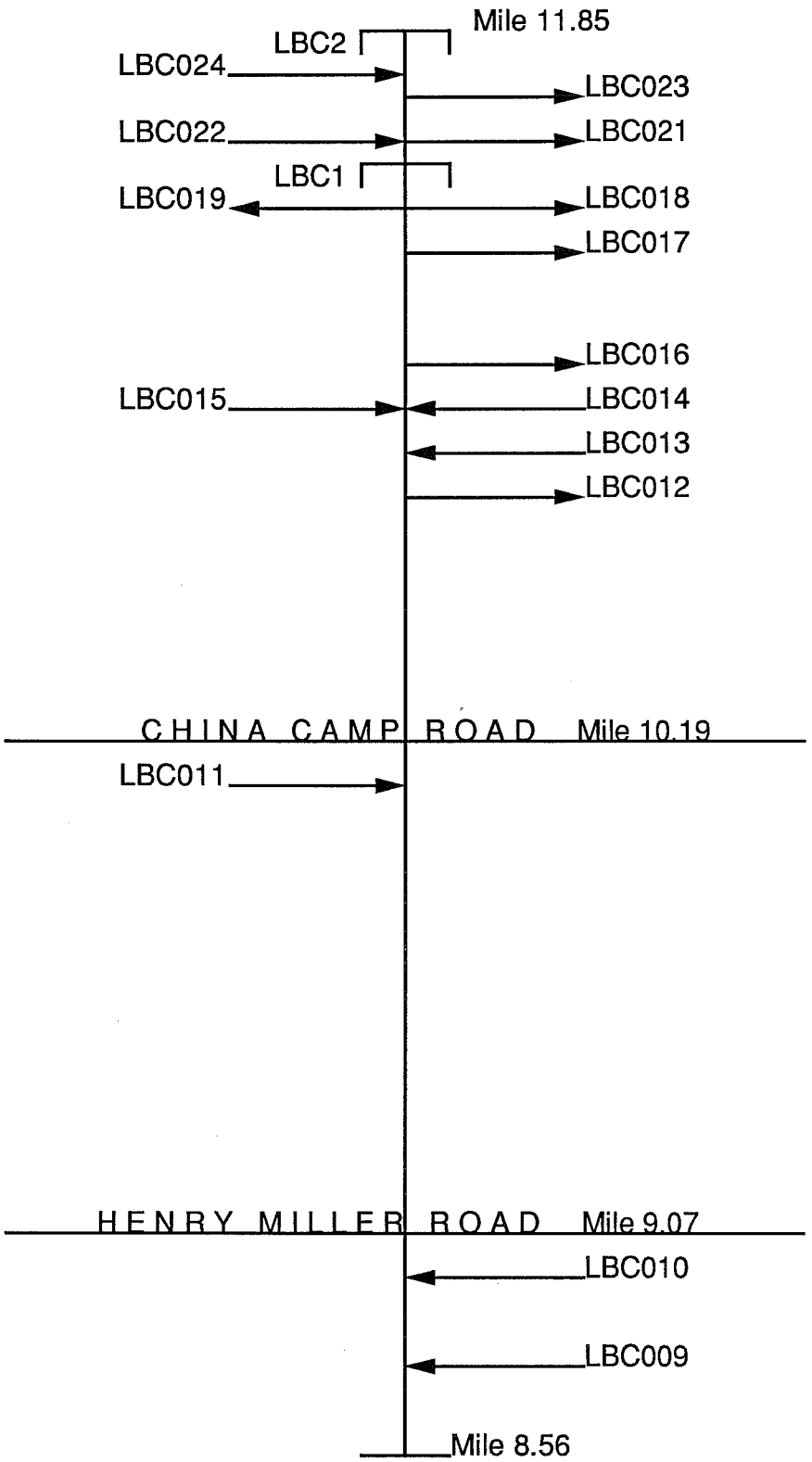
LOS BANOS CREEK

Reach 4: Mile 3.36 - Mile 8.56



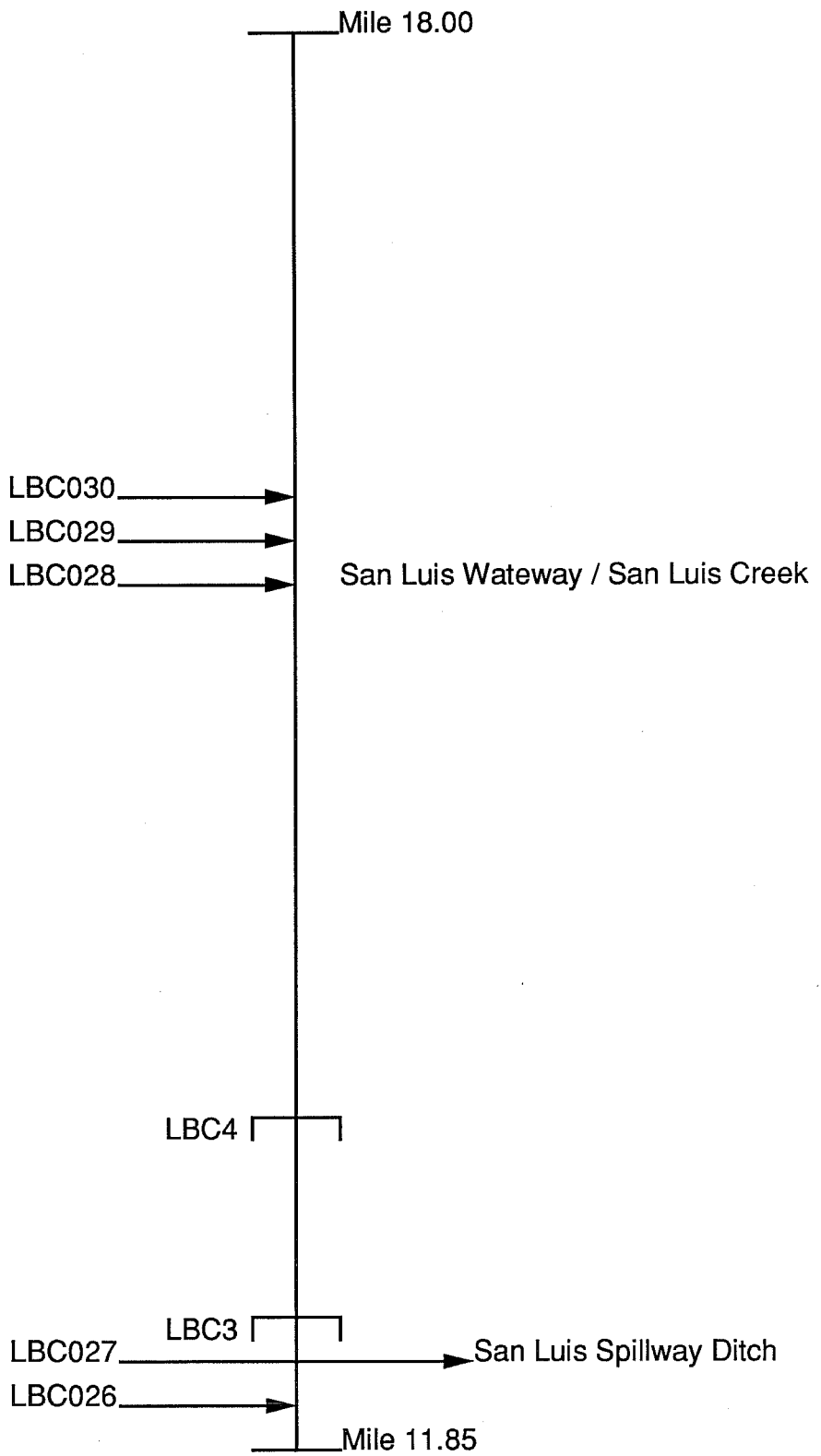
LOS BANOS CREEK

Reach 5: Mile 8.56 - Mile 11.85



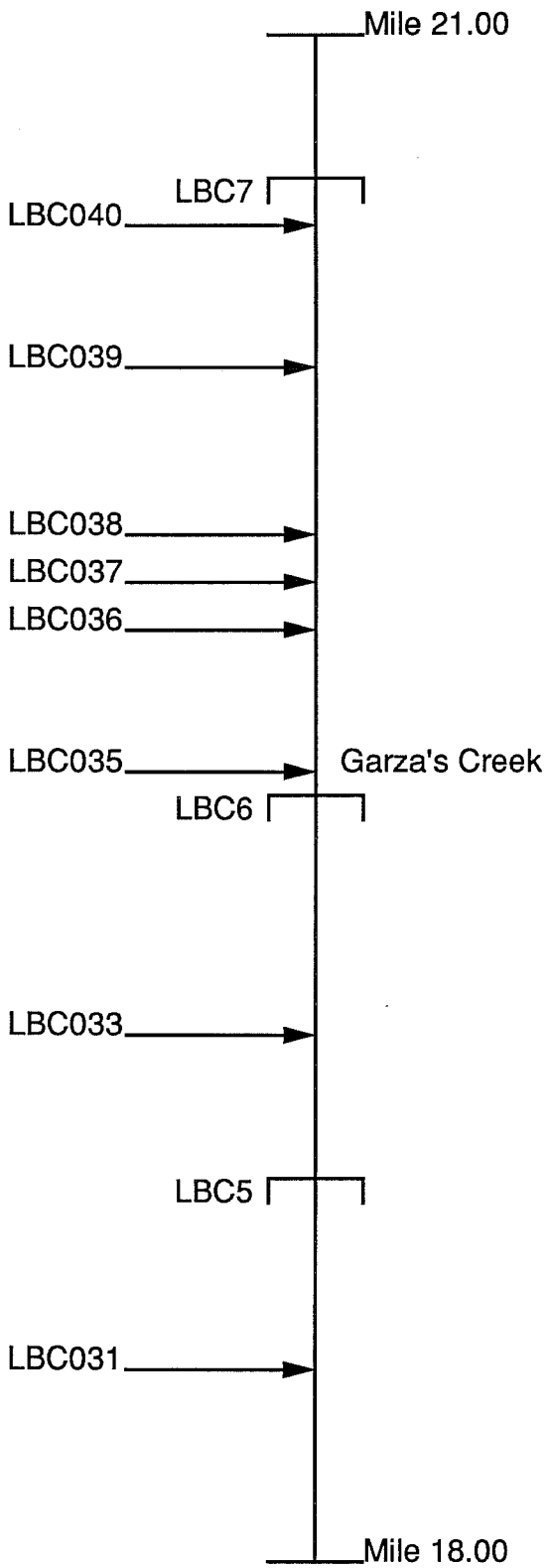
LOS BANOS CREEK

Reach 6A: Mile 11.85 - Mile 18.00



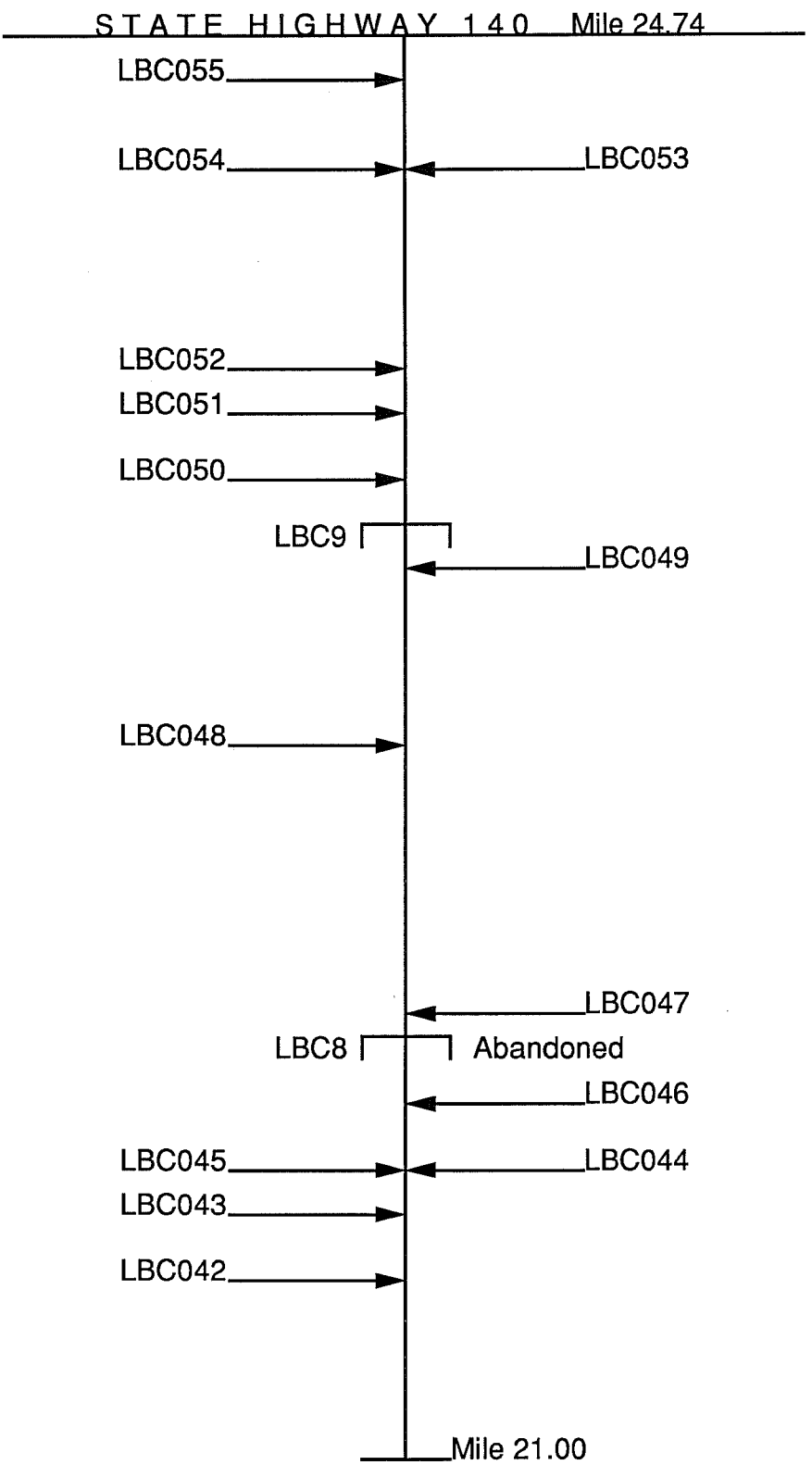
LOS BANOS CREEK

Reach 6B: Mile 18.00 - Mile 21.00



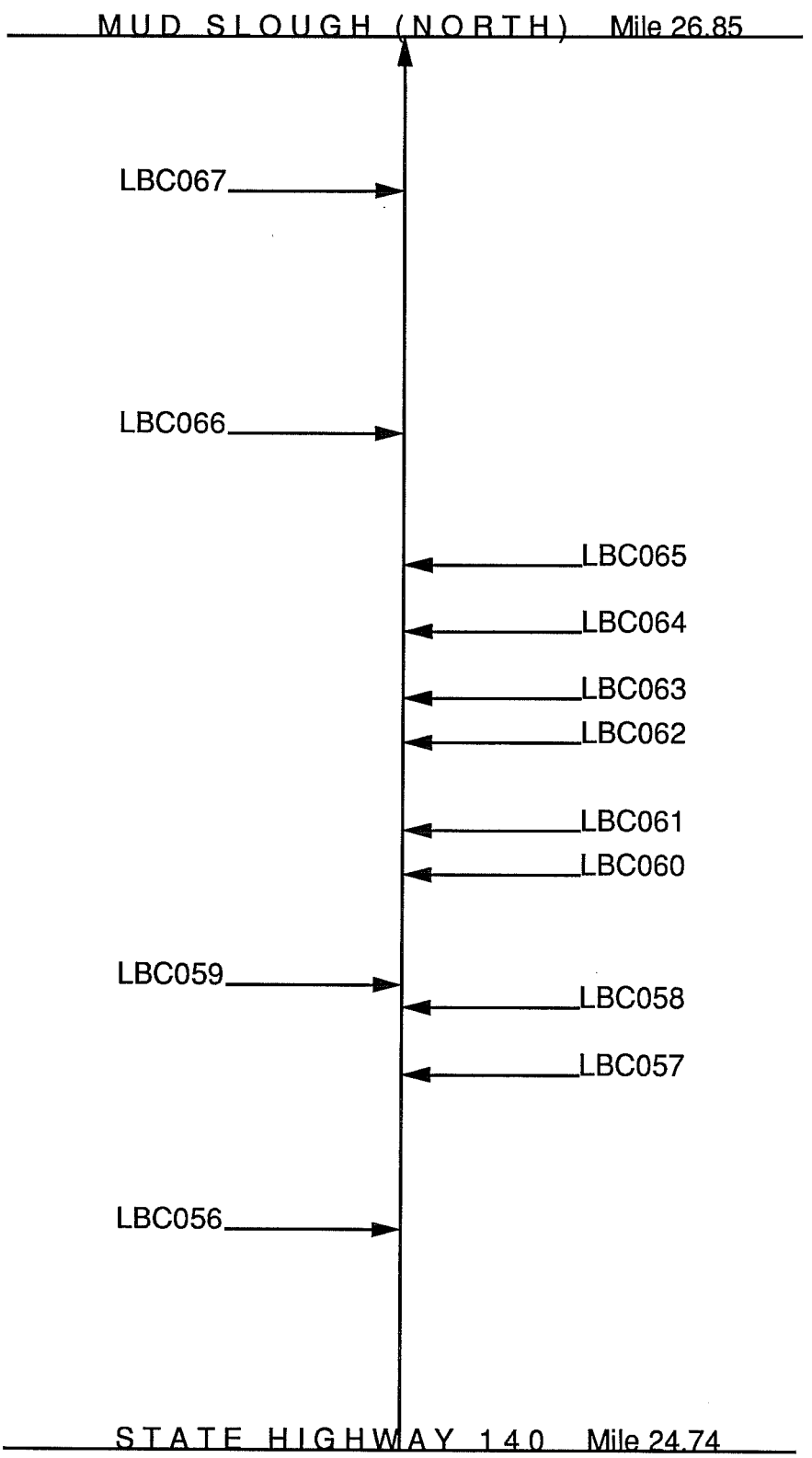
LOS BANOS CREEK

Reach 6C: Mile 21.00 - Mile 24.74



LOS BANOS CREEK

Reach 7: Mile 24.74 - Mile 26.85

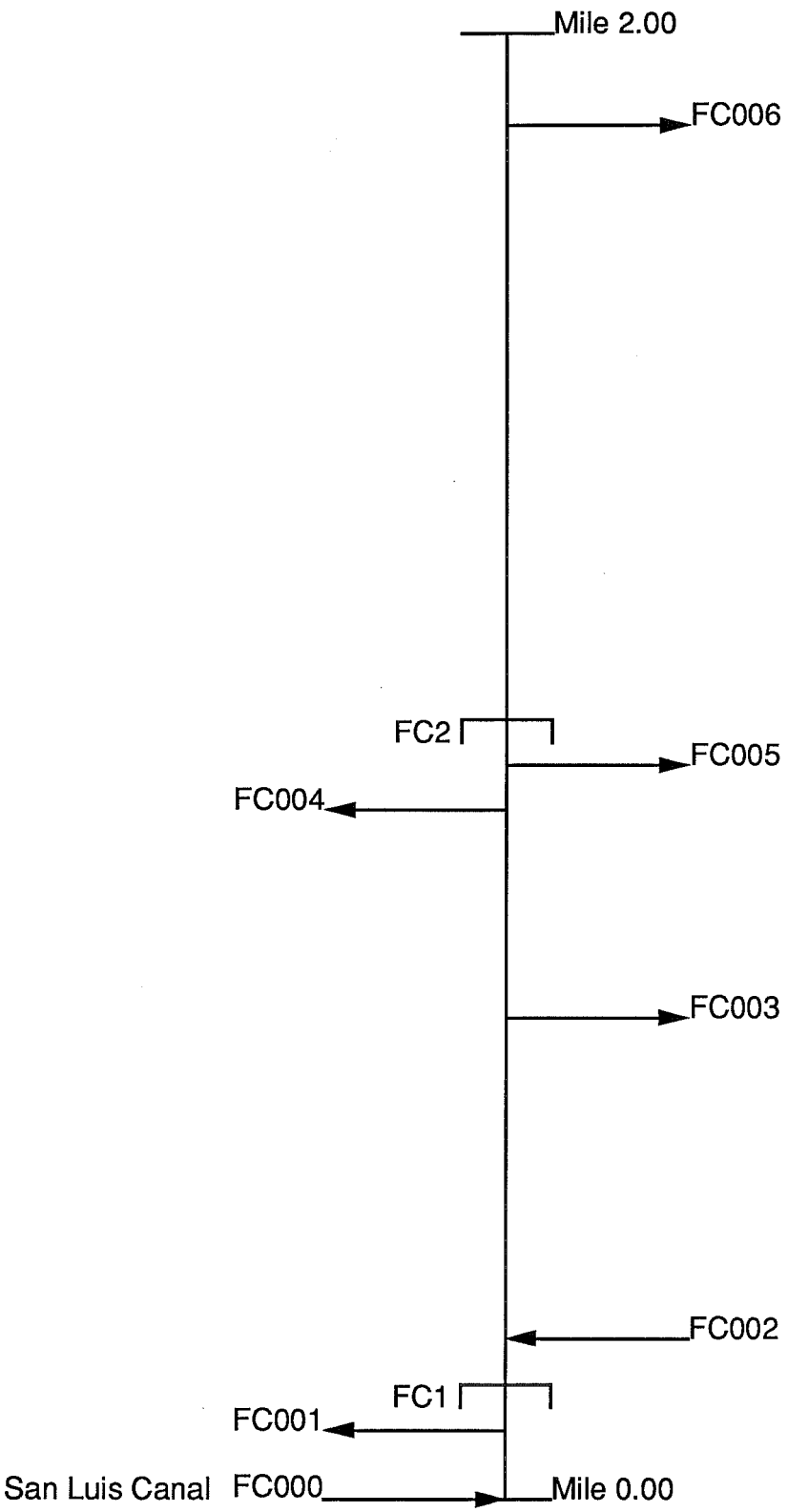


INDEX TO FREMONT CANAL DISCHARGE AND DIVERSION SITES

Site	Mile	Description
FC000	0.00	San Luis Canal discharge to Fremont Canal
FC001	0.07W	Gated outlet to duck pond
FC1	0.09	Fremont Canal check structure #1
FC002	0.12E	Windmill discharge (very small flow when operating)
FC003	0.63E	Gated outlet to duck pond
FC004	0.94W	Gated outlet to duck pond
FC005	0.99E	Gated outlet to duck pond
FC2	1.04	Fremont Canal check structure #2
FC006	1.90E	Gated outlet to duck pond
FC007	2.25E	Duck pond drain (pipe)
FC3	2.31	Fremont Canal check structure #3
FC008	2.37W	Gated outlet to duck pond
FC009	2.57E	Gated outlet to duck pond
FC010	2.63W	Duck pond drain (pipe)
FC011	2.72W	Gated outlet to duck pond
FC012	2.94E	Duck pond drain (pipe)
FC013	3.08W	Gated duck pond drain
FC014	3.09W	36 inch gated outlet to duck pond
FC015	3.26E	Gated outlet to duck pond
FC016	4.19E	Pipe draining area between canal and Kesterson Reservoir levees
	4.29	Gun Club Road
FC017	4.76	Fremont Canal discharge to Mud Slough (North)

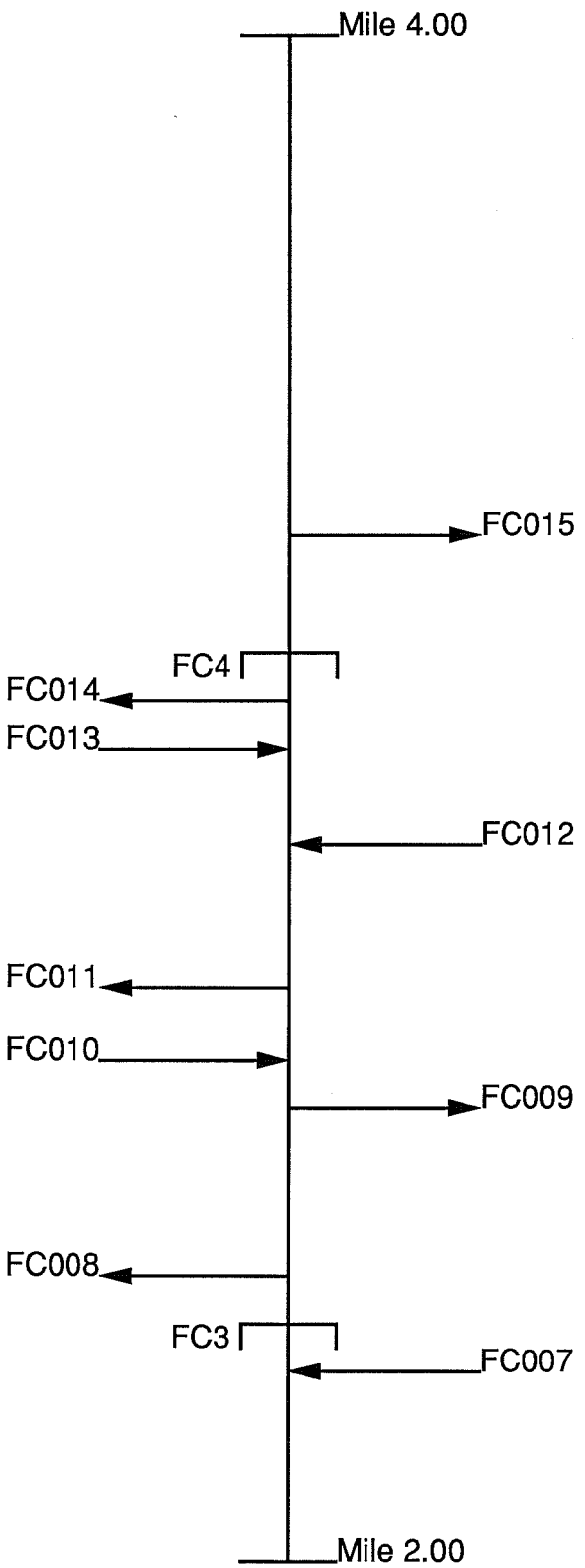
FREMONT CANAL

Mile 0.00 - Mile 2.00



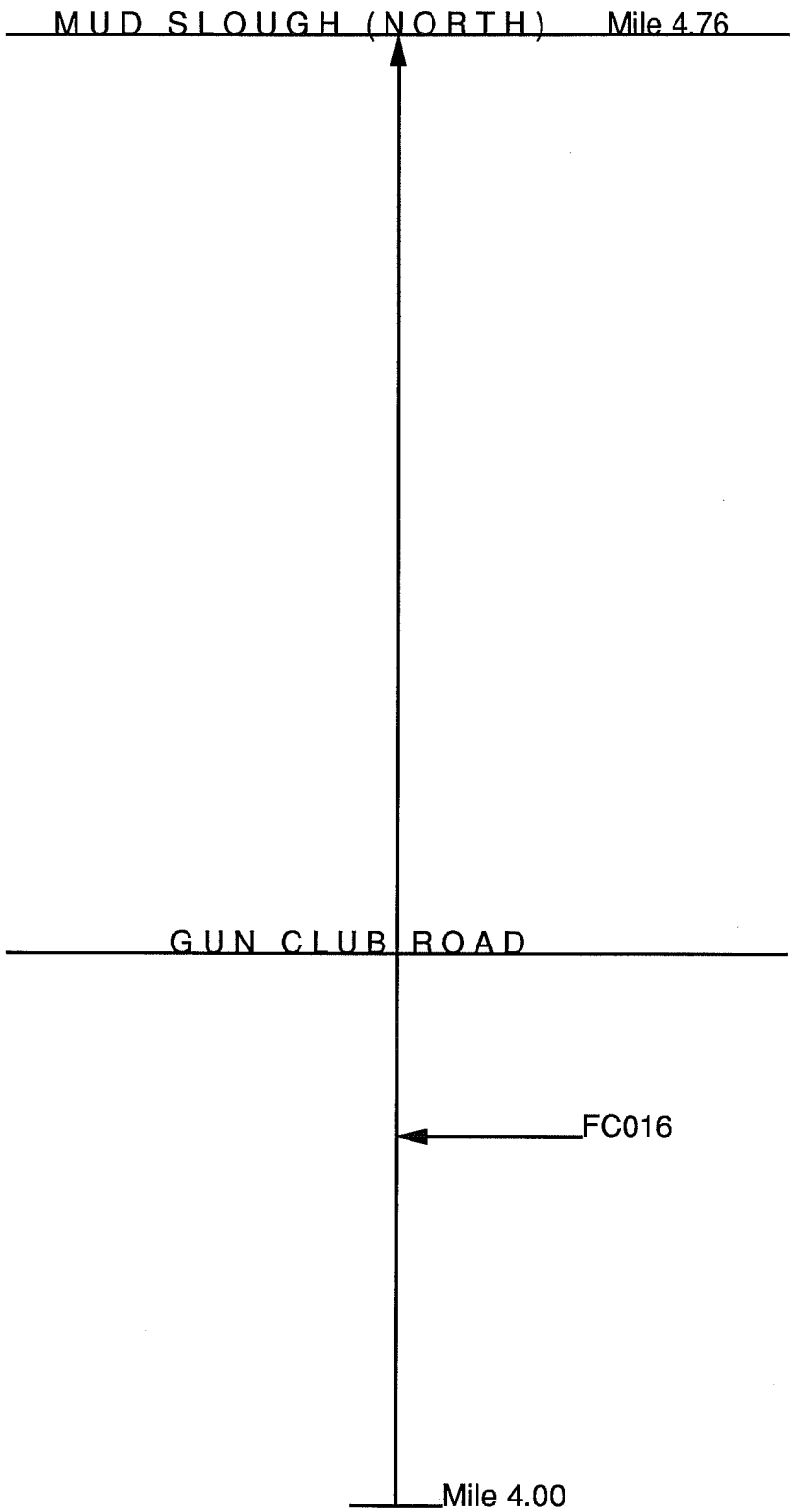
FREMONT CANAL

Mile 2.00 - Mile 4.00



FREMONT CANAL

Mile 4.00 - Mile 4.76

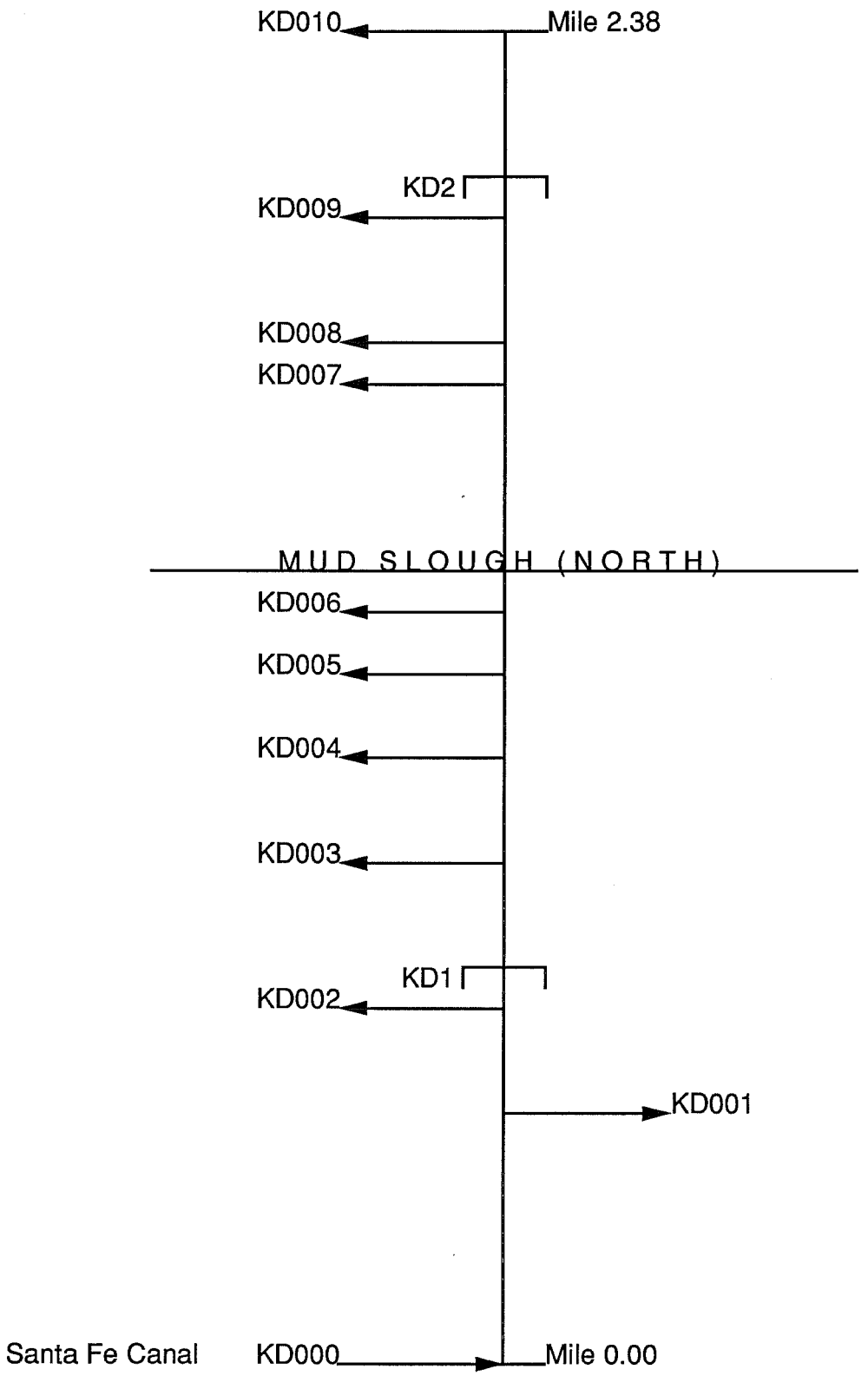


INDEX TO KESTERSON DITCH DISCHARGE AND DIVERSION SITES

Site	Mile	Description
KD000	0.00	Santa Fe discharge to Kesterson Ditch
KD001	0.49S	Gated outlet to duck pond
KD002	0.66N	Gated outlet to duck pond
KD1	0.69	Kesterson Ditch check structure #1
KD003	0.99N	Gated outlet to duck pond
KD004	1.38N	Gated outlet to duck pond
KD005	1.56N	Gated outlet to duck pond ditch
KD006	1.58N	Gated outlet to Mud Slough (North)
	1.59	Mud Slough (North) undercrossing
KD007	1.90N	Gated outlet to duck pond ditch
KD008	1.96N	Gated outlet to duck pond ditch
KD009	2.09N	Gated outlet to duck pond ditch
KD2	2.10	Kesterson Ditch check structure #2
KD010	2.38N	Gated outlet to duck pond (end of Kesterson Ditch)

KESTERSON DITCH

Mile 0.00 - Mile 2.38



APPENDIX B

Water Quality Data for Selected Sites on
Tributaries to Mud Slough (North)

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Santa Fe Canal at Highway 152	B-1
Santa Fe Canal at Henry Miller Road	B-2
Santa Fe Canal at Gun Club Road	B-3
Los Banos Creek at Gun Club Road	B-4
Los Banos Creek at Highway 140	B-5
Fremont Canal at Gun Club Road	B-6

Table B1 ...Santa Fe Canal at Highway 152 (MER540)

Location ....Latitude 37 03'22", Longitude 120 47'11"
In SW 1/4, SW 1/4, SE 1/4, sec. 17, T.10S, R.11E
N side of Hwy. 152, 3.5 miles E of Los Banos.

DATE	TIME	EC umhos/cm	B mg/L	Se ug/L	Mo ug/L
05/02/85	1220	2800	4.2	31	
06/03/85	1135	2000	3.0	17	
07/02/85	0850	2200	3.4	27	
08/15/85	0910	2000	2.4	17	
08/28/85	1720	1800	2.9	21	
09/28/85	1045	1080	0.99	4.0	
10/31/85	1005	1880	2.6	14	
12/07/85	1205	3200	4.8	27	11
01/04/86	1030	4000	7	30	21
01/14/86	1315	3200	6	18	10
03/02/86	1025	2800	4.7	31	14
04/02/86				33	
04/19/86	0800	2600	4.1	34	6
04/27/86	1030	2700	4.6	36	
05/13/86	0945	2000	2.6	27	6
06/04/86	1040	2200	3.6	24	10
06/17/86	0910	2300	3.3	29	<5
06/26/86	1830	2200	3.4	28	<5
08/05/86	1040	2000	3.2	25	<5
09/02/86	1400	2000	2.8	23	<5
09/27/86	1655	1100	1.6	11	<5
11/03/86			2.0	19	<5
12/04/86	1320		3.4	39	<5
01/03/87	0945	3000	4.4	36	12
85 WY*	MIN	1080	0.99	4	
	MED	2000	2.9	19	
	MAX	2800	4.2	31	
	# DATA	6	6	6	
86 WY*	MIN	1100	1.6	11	<5
	MED	2200	3.4	27	6
	MAX	4000	7	36	21
	# DATA	13	15	15	12
87 WY*	MIN	2300	3.3	19	<5
	MED	2250	4.3	36	<5
	MAX	2800	4.7	39	12
	# DATA	2	2	3	3
TOTAL	MIN	1080	0.99	4	<5
	MED	2200	3.4	27	26
	MAX	4000	7	39	21
	# DATA	21	23	24	15

* Water year: extending from 1 October of one year to 1 October of the following year

Table B2 ...Santa Fe Canal at Henry Miller Road (MER519)

Loacation ...Latitude 37 05'59", Longitude 120 49'44"
In NW 1/4, NE 1/4, NW 1/4, sec. 1, T.10S, R.10E
0.3 miles E of Lander Ave., 3.0 miles N of Gustine.

DATE	TIME	EC umhos/cm	B mg/L	Se ug/L	Mo ug/L
07/02/85	0925	2000	2.4	27	
08/15/85	1005	1800	2.5	14	
08/29/85	0725	1800	2.8	17	
09/28/85	1135	0840	0.58	3.0	
10/31/85	1045	1930	2.8	11	
12/07/85	1300	3100	4.8	26	14
01/04/86	1130	3600	5.5	36	17
01/14/86	1345	3200	5.1	22	32
03/02/86	1120	2800	4.0	27	14
04/26/86	1650	2600	4.4	35	
06/03/86	1640	2200	3.9	29	
06/26/86	1435	2400	3.1	24	<5
08/05/86	1105	2000	2.9	25	<5
09/02/86	1310	1700	2.2	17	<5
09/27/86	1635	0560	0.77	2.2	<5
11/03/86	1320		0.46	2.5	<5
12/04/86	1350		3.3	37	<5
01/02/87	1645	2700	3.8	30	10
85 WY*	MIN	840	0.58	3	
	MED	1800	2.5	16	
	MAX	2000	2.8	27	
	# DATA	4	4	4	
86 WY*	MIN	560	0.46	2.2	<5
	MED	2400	3.3	25	10
	MAX	3200	5.1	36	32
	# DATA	9	11	11	8
87 WY*	MIN	1700	2.2	2.5	<5
	MED	2800	3.8	30	<5
	MAX	3600	5.5	37	10
	# DATA	3	3	3	3
TOTAL	MIN	560	0.46	2.2	<5
	MED	2100	3.0	25	<5
	MAX	3600	5.5	37	32
	# DATA	16	18	18	11

* Water year: extending from 1 October of one year to 1 October of the following year

Table B3 ...Santa Fe Canal at Gun Club Road (MER517)

Location ....Latitude 37 13'53", Longitude 120 54'16"
In NE 1/4, NE 1/4, NE 1/4, sec. 19, T.8S, R.10E
4.9 miles E of Hunt Rd., 5.4 miles SE of Gustine.

DATE		TIME	EC umhos/cm	B mg/L	Se ug/L	Mo ug/L
06/13/85		0915	2800	4.0	35	
07/02/85		1210	2100	2.4	24	
08/14/85		1735	1900	2.6	12	
08/29/85		1005	1700	2.2	12	
09/28/85		1410	710	0.03	<1	
10/30/85		1605	1210	3.2	5.0	
12/07/85		1620	1660	1.7	2.0	8
01/04/86		1435	2400	2.6	4.0	11
01/14/86		1230	2800	1.6	11	11
02/16/86		1400	2700	3.6	27	8
03/02/86		1515	860	0.97	2.0	<5
04/02/86					4.0	
04/26/86		1245	2400	3.7	27	
06/03/86		1245	2400	4.2	30	
06/26/86		1130	2300	3.3	23	<5
08/04/86		1320	2000	2.7	21	<5
09/02/86		1350	1700	2.0	9.9	<5
09/27/86		1300	580	0.56	1.2	<5
11/04/86		0830		0.96	1.2	7
12/04/86				1.2	1.2	<5
01/02/87		1310	1800	1.6	1.1	9
02/24/88			1250	0.90	1.5	
85 WY*	MIN		710	0.03	<1	
	MED		1900	2.4	12	
	MAX		2800	4	35	
	# DATA		5	5	5	
86 WY*	MIN		580	0.56	1.2	<5
	MED		2150	2.7	9.9	<5
	MAX		2800	4.2	30	11
	# DATA		12	12	13	9
87 WY*	MIN		1800	0.96	1.1	<5
	MED		1800	1.2	1.2	7
	MAX		1800	1.6	1.2	9
	# DATA		1	3	3	3
88 WY*	MIN		1250	0.9	1.5	
	MED		1250	0.9	1.5	
	MAX		1250	0.90	1.5	
	# DATA		1	1	1	
TOTAL	MIN		580	0.03	<1	<5
	MED		1900	2.4	7.5	6
	MAX		2800	4.2	35	11
	# DATA		19	21	22	12

* Water year: extending from 1 October of one year to 1 October of the following year

Table B4 ...Los Banos Creek at Gun Club Road (MER514)

Location ....Latitude 37 13'56", Longitude 120 56'30"
In SW 1/4, SE 1/4, SE 1/4, sec. 14, T.8S, R.9E
2.8 miles E of Hunt Rd., 3.7 miles SE of Gustine.

DATE		TIME	EC umhos/cm	B mg/L	Se ug/L	Mo ug/L
07/02/85		1300	1200	1.1	2.0	
08/14/85		1725	2200	2.0	3.0	
08/29/85		1035	1800	1.8	3.0	
09/27/85		1825	750	0.80	2.0	
10/30/85		1540	770	0.51	1.0	
12/07/85		1650	2100	2.2	1.0	9
01/04/86		1510	3000	3.2	1.0	9
01/14/86		1310	2700	2.3	1.0	12
02/16/86		1330	1050	0.70	1.0	<5
03/01/86		1445	1800	2.1	1.0	5
04/02/86					<1	
04/26/86		1220	1200	1.2	<1	
06/03/86		1220	1300	1.5	1.7	
06/26/86		1115	1500	1.3	3.8	5
08/04/86		1305	740	0.48	1.1	<5
09/02/86		1340	450	0.28	0.7	<5
09/27/86		1235	470	0.29	1.0	<5
11/04/86		0850		0.67	0.9	<5
12/04/86				0.53	1.1	<5
01/02/87		1240	1750	1.6	0.9	<5
85 WY*	MIN		750	0.80	2.0	
	MED		1500	1.5	2.5	
	MAX		2200	2.0	3.0	
	# DATA		4	4	4	
86 WY*	MIN		450	0.28	<1	<5
	MED		1250	1.3	1	5
	MAX		3000	3.2	3.8	12
	# DATA		12	12	13	9
87 WY*	MIN		1750	0.53	0.9	<5
	MED		1750	0.67	0.9	<5
	MAX		1750	1.6	1.1	<5
	# DATA		1	3	3	3
TOTAL	MIN		450	0.28	<1	<5
	MED		1300	1.2	1	<5
	MAX		3000	3.2	3.8	12
	# DATA		17	19	20	12

* Water year: extending from 1 October of one year to 1 October of the following year

Table B5 ...Los Banos Creek at Highway 140 (MER554)

Location ....Latitude 37 16'35", Longitude 120 57'14"
In NE 1/4, SW 1/4, SW 1/4, sec. 35, T.7S, R.9E
S side of Hwy 140, 2.7 miles NE of Gustine.

DATE	TIME	EC umhos/cm	B mg/L	Se ug/L	Mo ug/L
12/18/85	0915	2600	2.3	1	5
01/09/86	1035	3600	2.4	1	15
01/14/86	1340	2700	1.4	1	<5
02/07/86	1140	3000	2.9	1	13
04/03/86				1	4
04/19/86	1030	1300	1.6	<1	<5
01/30/87	1020	2400	2.1	0.9	
02/27/87	1020	2670	2.5	1.4	
04/01/87	1025	3350	4.2	1.1	
05/01/87	1140	2300	2.0	3.7	
06/01/87	1230	1320	1.1	1.4	
07/01/87	1220	1300	0.94	2.3	
07/31/87	1315	1200	0.60	1.4	
09/01/87	1325	1410	0.84	1.5	
10/01/87	1315	2040	2.9	0.6	
11/03/87	1135	1100	0.52	0.9	
12/01/87	1230	1480	0.82	1.0	
01/05/88	1210	2200	1.3	0.4	
01/28/88	1300	1900	1.3	1.0	
03/09/88	1140	7450	6.6	0.5	
03/30/88	1150	2850	2.8		
05/05/88	1340	4500	3.3	1.6	
06/01/88	1145	1300	1.1	1.5	
06/29/88		1350	0.9	1.5	
08/01/88		1250	0.76	1.2	
09/01/88	1225	1400	0.88	1.4	
86 WY*	MIN	1300	1.4	<1	4
	MED	2200	2.3	1	<5
	MAX	3600	2.9	1	15
	# DATA	5	5	6	6
87 WY*	MIN	1200	0.6	0.9	
	MED	1855	1.6	1.4	
	MAX	3350	4.2	3.7	
	# DATA	8	8	8	
88 WY*	MIN	1100	0.52	0.4	
	MED	2040	1.3	0.8	
	MAX	7500	6.6	1	
	# DATA	7	7	6	
TOTAL	MIN	1100	0.52	0.4	4
	MED	2250	1.8	1	<5
	MAX	7450	6.6	3.7	15
	# DATA	20	20	20	6

* Water year: extending from 1 October of one year to 1 October of the following year

Table B6 ...Fremont Canal at Gun Club Road (MER515)

Location ....Latitude 37 13'54", Longitude 120 52'55"
In SE 1/4, SW 1/4, SE 1/4, sec. 15, T.8S, R.10E
5.7 miles E of Hunt Rd., N side of Gun Club Rd., SE of Gustine.

DATE	TIME	EC umhos/cm	B mg/L	Se ug/L	Mo ug/L
07/02/85	1235	2300	3.2	28	
08/14/85	1715	2000	2.2	15	
08/29/85	1015	1700	2.6	15	
09/28/85	1425	920	2.0	4.0	
10/30/85	1615	3200	2.8	7.0	
12/07/85	1640	3100	4.1	16	24
01/04/86	1455	4500	6.7	26	36
01/14/86	1210	3300	5.9	28	9
02/16/86	1430	2000	1.0	6.0	11
03/01/86	1540	3200	4.4	33	13
04/02/86				10	
04/26/86	1310	3100	4.5	10	
06/03/86	1310	2100	3.5	32	
06/15/86	1235	1840	1.8	11	
06/26/86	1150	2600	3.6	27	<5
08/04/86	1340	2700	4.1	24	5
09/02/86	1410	2550	3.8	28	7
09/27/86	1315	1600	2.2	16	8
11/04/86	0810		1.0	6.9	15
12/04/86			1.5	4.4	<5
01/02/87	1325	2700	3.8	31	12
02/24/88		3350	5.0	40	

85 WY*	MIN	920	2	4	
	MED	1850	2.4	15	
	MAX	2300	3.2	28	
	# DATA	4	4	4	
86 WY*	MIN	1600	1	6	<5
	MED	2700	3.8	20	9
	MAX	4500	6.7	33	36
	# DATA	13	13	14	9
87 WY*	MIN	2700	1	4.4	<5
	MED	2700	1.5	6.9	12
	MAX	2700	3.8	31	15
	# DATA	1	3	3	3
88 WY*	MIN	3350	5	40	
	MED	3350	5	40	
	MAX	3350	5	40	
	# DATA	1	1	1	
TOTAL	MIN	920	1	4	<5
	MED	2600	3.5	16	10
	MAX	4500	6.7	40	36
	# DATA	19	21	22	12

* Water year: extending from 1 October of one year to 1 October of the following year