CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
REGIONAL WATER QUALITY CONTROL BOARD
COLORADO RIVER BASIN REGION

SILT TOTAL MAXIMUM DAILY LOAD FOR THE ALAMO RIVER

DRAFT PROBLEM STATEMENT

PREPARED BY
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1. INTRODUCTION

The Colorado River Basin Region is a desert region covering over 20,000 square miles in the southeastern corner of the State. Except for its southern boundary, the Region's boundaries are drawn from natural watershed divisions formed by mountain ranges to the north and west and by the Colorado River to the east. The southern boundary is the international border with the Republic of Mexico. Irrigated farmlands in the Coachella, Imperial, and Palo Verde Valleys are some of the most productive agricultural areas in the State and the major industry for the Region. Polluted runoff from agriculture is the main source of nonpoint source (NPS) pollution, the most severe water quality problem in the region, and the target of water pollution control efforts. This report focuses on the Imperial Valley portion of the Salton Sea Transboundary Basin Watershed, designated as the priority watershed for purposes of watershed management planning and targeted cleanup. The Salton Sea Transboundary Basin Watershed encompasses over one third of the Region. Drainage in the watershed flows from all directions into a natural sink over 200 feet below Mean Sea Level (MSL), now known as the Salton Sea. Very little of this drainage is "natural" drainage.

Approximately ninety percent of the Sea's freshwater inflows consist of wastes resulting from human activities--mainly wastewater runoff from irrigated agriculture. The Sea's two main tributaries, the Alamo and New Rivers, are dominated by agricultural runoff from the Imperial Valley and contribute about 75% of the Sea's inflows. To complicate matters, the Sea is closed basin. Consequently, nonpoint source (NPS) pollutants such as salts and nutrients from agricultural runoff concentrate and accumulate over time, causing increasing levels of salinity and eutrophic conditions, respectively. These unusual conditions have contributed to the severe impairment of Salton Sea and its major tributaries. Restoration of this watershed will require widespread implementation of NPS pollution control measures. This will be achieved through the Total Maximum Daily Load (TMDL) process.

1.1 Clean Water Act Section 303(d) List and TMDL Process

Section 303(d)(A)(1) of the Clean Water Act (CWA) requires the California Regional Water Quality Control Board, Colorado River Basin Region (hereafter Regional Board), to:

- Identify the Region's waters which do not comply with water quality standards applicable to such waters;
- Rank the impaired waterbodies taking into account, factors including, the severity of the pollution and the uses made of such waters; and
- Establish TMDLs for those pollutants causing the impairments to ensure that impaired waters attain their beneficial uses.

Title 40, Code of Federal Regulations (40 CFR), Section 130.3, defines a water quality standard as the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water and by setting criteria necessary to protect those uses. A TMDL can be defined as the sum of the individual waste load allocations (WLAs) for point sources of pollution, plus the load allocations (LAs) for nonpoint sources of pollution, plus the contribution from background sources of pollution, including naturally occurring pollution. It can be expressed in terms of either mass per time, toxicity, concentration, a specific chemical, or other appropriate measure.

During its January 1998 public meeting, the Regional Board adopted Resolution 98-006, which updated the list of impaired waterbodies for the Region. On November 3, 1998, USEPA approved the Regional Board's

303(d) list. The list identifies the Alamo as water quality limited, in part, because silt[1] concentrations violate the water quality standards (WQS) established by the Regional Board to protect the beneficial uses of the river, including the warm water fishery, wildlife habitat, rare, threatened, and endangered species, recreational uses, and freshwater replenishment. Table 1, located on the following page, shows the Region's 1998 § 303(d) List.

CWA Section 303(d) and 40 CFR Section 130.0 et seq., specify the components and requirements of a TMDL. Essentially, the TMDL is a numeric target developed to achieve water quality standards and must:

- Show how the TMDL will result in attainment of standards of concern in the specific waterbody;
- Identify and explain the basis for the total allowable load(s) such that the water body loading capacity is not exceeded;
- Identify and explain the basis for individual waste load allocations for point sources and load allocations for nonpoint sources of pollution;
- Explain how an adequate margin of safety is provided to account for uncertainty in the analysis;
- Account for seasonal variations and critical conditions concerning the flow, loading, and other water quality parameters.

If the State fails to develop a TMDL, or if USEPA rejects the State's TMDL, USEPA must develop one (CWA 303(d)(D)(2), 40 CFR 130.6(c)). Upon approval of the TMDL by USEPA, the State is required to incorporate the TMDL, along with appropriate implementation measures, into the State Water Quality Management Plan (40 CFR 130.6(c)(1), 130.7). The Water Quality Control Plan for the Colorado River Basin (Basin Plan) and applicable statewide plans serve as California's Water Quality Management Plan governing the New and Alamo Rivers and Imperial Valley Agricultural Drains.

Pursuant to a consent decree entered in the United States District Court, Northern District of California, (Pacific Coast Federation of Fishermen's Associations, et al. v. Marcus, No. 95-4474 MHP, March 11, 1997) USEPA committed to ensuring that TMDLs would be established for 18 waterbodies by December 31, 2007. The Alamo River was first added to the § 303(d) List because of silt impairments in 1992. The Regional Board has a commitment to USEPA to complete at least two TMDLs within the current two-year funding cycle (i.e. July 1998 – June 2000), a commitment being implemented statewide. To fulfill that commitment, Regional Board staff is developing a silt TMDL for the Alamo River, and, concurrently, a bacteria TMDL for the New River.

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[1] For the purposes of this Problem Statement, the terms silt, suspended solids, and suspended sediment are synonymous.

Table 1. Colorado River Basin Region 1998 Section 303(d) List.

Waterbody	Hydrologic Unit #	Size Affected	Problem Description	Specific Pollutants	Probable Source	TMDL Priority	Target Dates
New River	723.10	60 miles	Public health hazard, objectives violated, fish kills	Pesticides, silt, bacteria, nutrients, VOCs	Agricultural return flows and Mexico	high	*Silt*: Start 1998, complete 2002 *Bacteria*: Start 1998, complete 2005 *Nutrients*: Start 2002, complete 2010 *Pesticides*: Start 2002, complete 2013 *VOCs*: Start 2007, complete 2013
Alamo River	723.10	52 miles	Elevated fish tissue levels (pesticides and selenium), toxic bioassay results (pesticides), recreational impacts	Pesticides, selenium, silt	Agricultural return flows	high	*Silt*: Start 1998, complete 2000 *Selenium*: Start 2000, complete 2010 *Pesticide*: Start 2002, complete 2011
Imperial Valley Drains	723.10	1,305 miles	Elevated fish tissue levels (pesticides and selenium), toxic bioassay results (pesticides), recreational impacts	Pesticides, selenium, silt	Agricultural return flows	high	*Silt*: Start 1998, complete 2000 *Selenium*: Start 2000, complete 2010 *Pesticide*: Start 2005, complete 2011
Salton Sea	728.00	220,000 acres	Salinity objectives violated, elevated fish tissue levels (selenium), recreational impacts	Selenium, salt, nutrients	Agricultural return flows	medium	*Salt*: Start 1998, complete 2001 *Selenium*: Start 2002, complete 2007 *Nutrients*: Start 2002, complete 2010
Palo Verde Outfall Drain	715.40	16 miles	Bacteria objective violated, threat of toxic bioassay results, threat of sedimentation	Bacteria	Unknown	medium	*Bacteria*: Start 2005, complete 2011
Coachella Valley Stormwater Channel	719.47	20 miles	Bacteria objective violated, threat of toxic bioassay results	Bacteria	Unknown	low	*Bacteria*: Start 2004, complete 2009

A TMDL should have at least the components shown in Table 2, below:

Table 2. Basic Technical TMDL Components

Component	Purpose
Problem Statement	Identifies the context for TMDL development and WQS issues that prompted TMDL development
Numeric target	Identifies specific instream goals and endpoints for the TMDL which ensure attainment of applicable WQS
Source Analysis	Characterizes the amount of pollutants entering the receiving water from various sources (e.g., point, nonpoint, and natural sources of pollution)
Loading Capacity Linkage Analysis	Specifies the critical quantitative link between applicable WQS and the TMDL. Loading capacity reflects the amount of a pollutant that may be delivered to the waterbody and still achieve WQS
TMDL, LAs, WLAs, Margin of Safety	Provides the calculations for total allowable loads and allocation of these loads among different sources such that applicable WQS are attained, while accounting for seasonal variation and uncertainty in the analysis of the data
Monitoring Plan	Assesses TMDL implementation and effectiveness and provides for TMDL adjustment as needed
Implementation Plan	Specifies nonpoint source Best Management Practices, point source controls, and other actions necessary to implement the TMDL

This document contains the silt TMDL problem statement for the Alamo River. This report will be revised and updated such that it becomes an integral part of the Silt Total Maximum Daily Load (TMDL) document for the Alamo River. The TMDL document will identify allowable silt loads for point and non-point sources of pollution discharging into the Alamo River, such that, when the allowable loads are implemented, they are expected to eliminate the impairments silt is currently causing. The bacteria TMDL for the New River, including its problem statement, is being developed as a separate document.

Public participation is a cornerstone of the TMDL process. The silt TMDL is being developed with the benefit of significant public input. A silt TMDL Technical Advisory Committee (TAC) was formed in December 1998 to advise Regional Board staff regarding TMDL development and implementation. The committee members are representatives from stakeholder groups, agencies, and watershed communities, including:

- Audubon Society/Sierra Club
- Coachella Valley Water District
- Desert Wildlife Unlimited, Inc.
- Farmers from the Imperial Valley
- Imperial County Agricultural Commissioner
- Imperial County Farm Bureau and Imperial Valley Vegetable Growers Association
- Imperial Irrigation District
- Salton Sea Authority
- State Water Resources Control Board
- US Bureau of Reclamation
- US Fish and Wildlife Service
- Salton Sea Science Subcommittee

It is expected that this committee will bring expert knowledge, data, and resources to the TMDL forum to aid in the timely, on-schedule development of the TMDL and implementation plans. Additionally, this problem statement is being widely distributed for public review and comment.

2. PROBLEM STATEMENT

Figure 1. Discharge of Imperial Valley Tailwater.

The Alamo River is the main tributary to the Salton Sea and, unlike most rivers in the world, is sustained and dominated by agricultural return flows from the Imperial Valley. These return flows consist of surface run-off (tailwater) and subsurface drainage (tilewater), which mix with groundwater seepage and are discharged into the Alamo River via agricultural drains (hereafter "Ag Drains") operated by the Imperial Irrigation District (IID). Tailwater is the main source of silt, and silt is present in the Alamo River at concentrations that violate the water quality standards the Regional Board has established for the river. Other sources and activities that contribute to the current silt load of the Alamo River include dredging of the Ag Drains, channel scouring in areas of high velocity flow, and, to a lesser degree, stormwater runoff and wind deposition. For the purposes of this Problem Statement, the terms silt, suspended solids, and suspended sediment are synonymous. A comprehensive characterization of the silt sources will be presented in the Source Analysis section of the TMDL. This report specifies the segments of the river for which the silt TMDL is being developed, the reasons why silt is being addressed, the water quality standards applicable to silt, and the impairments that silt is causing. To provide context for this TMDL, the following sections also provide background information on the hydrogeology of Salton Sea Transboundary Basin Watershed and on key events in the development of agriculture in the Imperial Valley.

2.1 Hydrogeological Setting

The Salton Sea Transboundary Basin Watershed encompasses one-third (about 8,360 square miles) of the Colorado River Basin Region and contains five (out of a total of six) of the Region's impaired surface waterbodies. Most of the watershed is in Imperial County, but it also receives drainage from Coachella Valley in Riverside County and the Mexicali Valley in Mexico (via the New River). The watershed has been identified as a Category I (impaired) Watershed under the 1997 California Unified Watershed Assessment (UWA). The California UWA was developed and implemented in response to the federal Clean Water Action Plan released by President William Clinton and Vice-President Albert Gore on February 19, 1998. The UWA was a collaborative process between the State and the United States Environmental Protection Agency (USEPA) and was developed to guide allocation of new federal resources for watershed protection. Figure 2, on the next page, shows the boundaries and main metropolitan areas/cities of the watershed.

2.1.1 Salton Sea Basin

The central and most striking feature of the watershed (and of the region) is the Salton Trough, which contains the Salton Sea and is a geologically active spreading center. The Salton Trough is bounded on the northern, eastern and western sides by one of the largest earthquake fault systems in the world, the San Andreas Fault (the southern boundary is defined by the Mexicali Valley watershed drainage to the Salton Sea). The northern boundary is formed by the apex of the San Jacinto Fault on the western side joining the main branch of the San Andreas Fault coming from the east. The resulting geologic forces have created spectacular mountains rising over 10,000 feet above Palm Springs, a tremendous groundwater aquifer beneath the Coachella Valley, and fertile soils from historic meandering of the Colorado River.

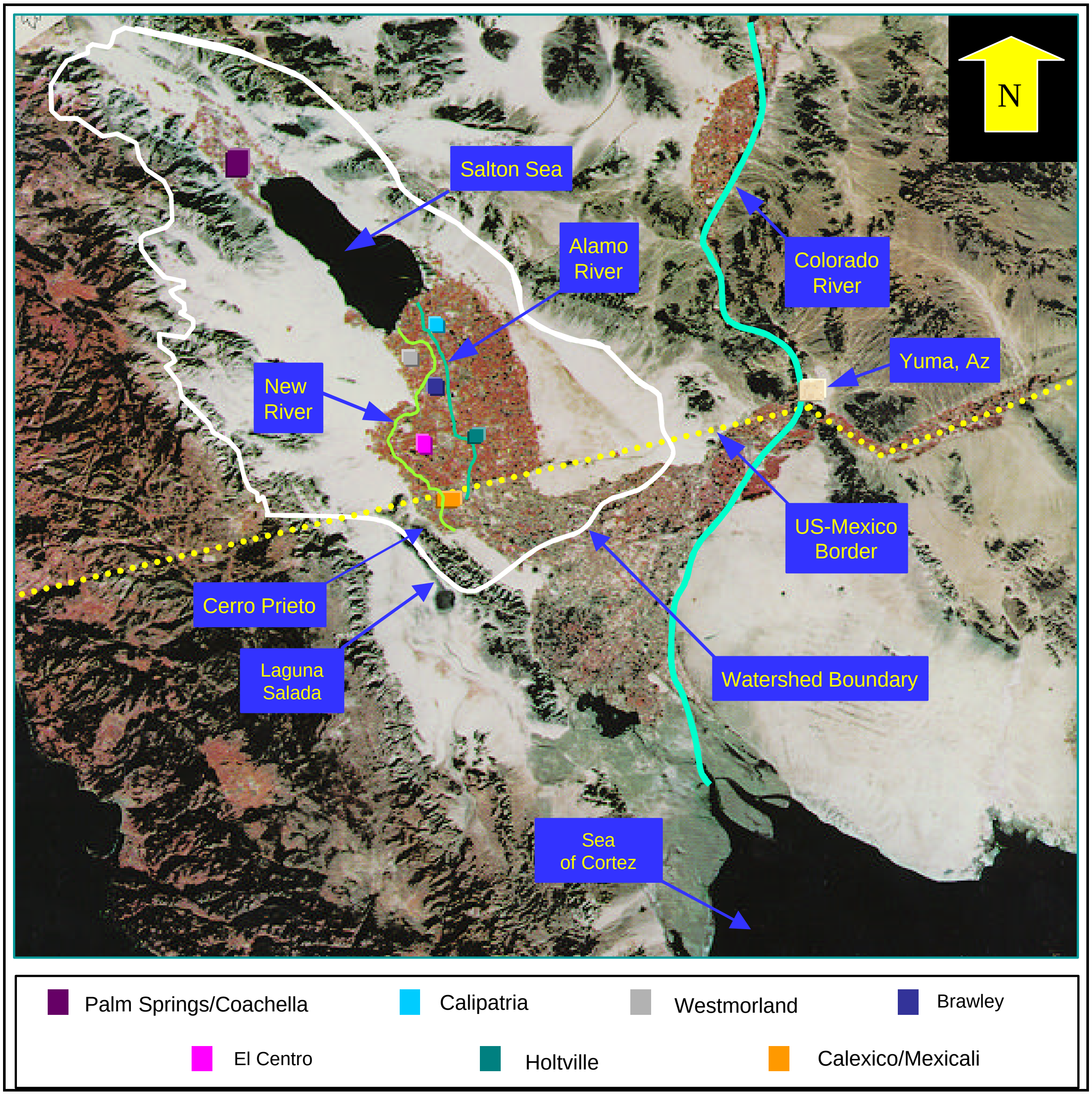

Figure 2 . Salton Sea Transboundary Watershed

For millions of years, the Colorado River has meandered across its delta with the Gulf of California. In fact, the hydrogeological features of the Coachella and Imperial Valleys can be traced back to several millions of years ago when an inland sea extended all the way to the San Joaquin and Sacramento Valleys in Central California. Subsequent geological forces created the mountain ranges to the east and west and elevated the entire area comprising the Coachella and Imperial Valleys. This land uplift was followed by a gradual settling of the area [2.1]. As this went on, the Colorado River began discharging its silty loads into the area. The silt eventually formed a natural dam that separated the Salton Sink from the Gulf of California [2.2], and the flow of the Colorado River ended into the closed basin creating a lake that occupied much of the Imperial and Coachella Valleys. In the 1850s, William Blake, a geologist who was with an early expedition party searching for possible railroad routes in the southeastern desert area of California, first identified the ancient lake in

1853 and named it Lake Cahuilla, after the Cahuilla Valley and the Cahuilla Indians who inhabited the area [2.3]. He described the lake as having been 100 miles long and about 35 miles at its widest point. The inflow of river water into the basin also deposited rich alluvial sediments, creating the rich agricultural environment of the Coachella and Imperial Valleys. With time, the Colorado River would return to its old course, south to the Gulf of California, and the Lake, lacking inflow, would eventually dry up and leave billions of tons of salt in the lake bed and lacustrine clay and alluvial sediments in the Coachella and Imperial Valleys. The historic Lake Cahuilla shoreline can be seen today along the base of the Santa Rosa Mountains to the west and northwest of the Salton Sea, and in the sand dunes on the southeast side near Niland [2.4]. This natural process went back and forth for millions of years. According to both Indian legends and carbon dating, the lake disappeared about 300 years ago [2.5].

For several centuries following the last formation of Lake Cahuilla, the Colorado River continued its meandering back and forth between the Delta and the closed basin. However, instead of reforming Lake Cahuilla, it would form the Salton Sea--a smaller lake within the lake bed of Lake Cahuilla. Periodically during years of heavy rainfall, large river discharges would spread over the Colorado River Delta and drain into the Salton Sea. Floodwaters were reported in the Salton Basin in 1828, 1840, 1849, 1852, 1859, 1862, and 1891 [2.5]. Once the Colorado River would regain its course into the Delta, the Salton Sea would also dry up--a natural process that would have continued to repeat itself had it not been for the development of agriculture in the Imperial Valley in the early 1900s.

The idea of constructing a canal from the Colorado River to the Salton Basin to irrigate what was then a desert that covered the Imperial Valley was first conceived in 1849. It was not until 1901 that the Imperial Canal was completed, and much of this canal was located in Mexico. By 1904, more than 12,000 people had moved to the area buying land at auctions for agricultural purposes. The area prospered and Imperial Valley towns such as Brawley, Holtville, and Calexico grew. Two important problems, the regular flooding in the region and the tons of silt that were carried along with the Colorado River water by Imperial Canal, had been ignored. By 1904, the Imperial Canal was blocked with sediment, and the Imperial Valley was without water [2.2]. To remedy this problem, a temporary diversion of the Colorado River on the Mexican side of the United States-Mexico International Boundary was constructed. On October 11, 1905, the temporary diversion failed during flood conditions, and the entire flow of the Colorado River was diverted in the Salton Basin. It was not until February 1907, 16 months later, that the breach in the dike was repaired, and the river returned to its old course to the Gulf of California. At the time the breach in the dike was repaired, the Salton Sea was 195 feet below MSL with a surface area of 520 square miles. This breach also created the current channels of the New River (thus the name "new") and the Alamo River [2.6]. By 1925, however, the lake's elevation had dropped to 250 feet below MSL due to evaporation and the low volume of agricultural wastewater draining to the Sea [2.4]. Since 1925, diversion of Colorado River water in the Imperial and Coachella valleys has raised the elevation of the lake to about 227 feet below MSL with a surface area of about 380 square miles [2.7]. Under normal circumstances, the Salton Sea would have again dried up like Lake Cahuilla. However, its recent accidental creation coincided with the development of agriculture in the Coachella, Imperial, and Mexicali Valleys. Since then, the Sea has been sustained by agricultural return flows.

2.1.2 Current Watershed Characteristics

For the purpose of TMDL development, the watershed can be divided into four main areas: the Coachella Valley, the Salton Sea, the Imperial Valley, and the Mexicali Valley. The most significant water quality problems within the U.S. portion of the watershed are associated with the Salton Sea and its major tributaries: the New and Alamo Rivers, and the Ag Drains, all in Imperial Valley. Table 3, below, shows the current Section 303(d) pollutants for the aforementioned surface waters.

Table 3. Imperial Valley Surface Waters 303(d) List

Waterbody	Pollutants of Concern
Imperial Valley Agricultural Drains	Silt, Pesticides, Selenium
Alamo River	Silt, Pesticides, Selenium
Salton Sea	Selenium, Salt, Nutrients
New River	Silt, Pesticides, Bacteria, Nutrients, Volatile Organic Compounds (VOCs)

The Salton Sea is California's largest lake and has been famous for its sport fishery and recreational uses. It is about 35 miles long and 9 to 15 miles wide with approximately 360 square miles of water surface and 105 miles of shoreline. The surface of the Sea lies approximately 227 feet below MSL. One of the major functions of the Salton Sea is to serve as a sump for agricultural wastewater for the Imperial and Coachella Valleys. In 1924 and 1928, the President of the United States executed Public Water Reserve Order Numbers 90 and 114, respectively, for withdrawal of 123,360 acres of public land lying at an elevation of 220 feet below MSL, in and surrounding the Salton Sea. These lands were designated as a repository to receive and store agricultural, surface, and subsurface drainage waters. The State of California designated the Sea for this same purpose in 1968. Currently, the Sea is 25% saltier than the ocean, with salinity increasing at approximately 1% per year. It can also be classified as a eutrophic lake. The Sea supports a National Wildlife Refuge and is a critical stop on the Pacific Flyway for migrating birds, including several state- and federally-listed endangered and threatened species. The Salton Sea National Wildlife Refuge was established in 1930 to preserve wintering habitat for waterfowl and other migratory birds. However, catastrophic die-offs of birds and fish between 1992 and 1997 indicate the Sea is in serious trouble, and may be unable to support these beneficial uses in the future. The current inflow into the Salton Sea is about 1.3-million acre-feet/year.

Figure 3. New River at International Boundary.

The New River originates in Mexico. It flows approximately 20 miles through the City of Mexicali, Mexico, crosses the International Boundary, continues through the City of Calexico in the United States, and travels northward about 60 miles until it empties into the Salton Sea. Its flow at the International Boundary is about 150 to 200 cubic feet per second (cfs) [108,400 to 145,000 acre-feet per year (AFY)]. The New River carries urban runoff, untreated and partially treated municipal wastes, untreated and partially treated industrial wastes, and agricultural runoff from the Mexicali Valley. In addition, the River carries urban runoff, agricultural runoff, treated industrial wastes, and treated, disinfected and non-disinfected domestic wastes from the Imperial Valley. It carries approximately 6 to 11 cfs (4,350 to 7,970 AFY) of treated wastewater, as permitted by the Regional Board under the National Pollutant Discharge Elimination System, from point sources in Imperial Valley. The New River flow at the Salton Sea is about 600 cfs (430,000 AFY).

The Alamo River originates approximately 2 miles south of the International Boundary with Mexico, and flows northward across the border for about 50 miles until it empties into the Salton Sea. The Alamo River is dominated by agricultural return flows from Imperial Valley. It also carries approximately 15 to 27 cfs (10,867 to 19,200 AFY) of treated wastewater from point sources in Imperial Valley. Its flow at the International Boundary is 1 to 2 cfs (725 to 1450 AFY), whereas at its delta with the Salton Sea it is about 800 to 1000 cfs (600,000 to 800,000 AFY).

Figure 4. Alamo River downstream of Brawley.

Figure 5. Discharge of Tailwater to Ag Drain.

The Ag Drain system comprises over 1,450 miles of surface drains, which discharge into the Alamo and New Rivers and the Salton Sea [2.8]. The Ag Drains primarily carry agricultural runoff from the Imperial Valley. Agricultural discharges in the Imperial Valley average about 830,000 acre-feet/year. Of this amount, approximately 36 percent is tailwater, 33 percent is seepage, and 30 percent is tilewater. The resulting mix of tailwater, tilewater, and seepage contains pesticides, nutrients, selenium, and silt in amounts that violate water quality standards.

2.1.3 Land Uses in Imperial County

Data provided by Imperial County Planning Department indicate that Imperial County covers approximately 4,597 square miles (2,942,080 acres). The data also state that about 50% of County lands are undeveloped and under the jurisdiction and ownership of the federal government. Further, of the developed acreage, approximately 588,000 acres are irrigated lands for agricultural purposes, most of which is Imperial Valley. The developed areas (e.g., cities, communities, and support facilities) occupy less than 1% of the land. The Salton Sea covers about 7% of the County's area. Table 4, below, shows the general land uses in Imperial County.

Table 4. Imperial County Land Use Distribution

Irrigated (Agriculture)	**Acres**
Imperial Valley	512,163
Bard Valley	14,737
Palo Verde	7,428
Developed	
Incorporated	9,274
Unincoporated	8,754
Desert/Mountains	
Federal	1,459,926
State	37,760
Indian	10,910
Private	669,288
Other	
Salton Sea	211,840

2.1.4 Weather

The climate of the Imperial Valley is typical of a desert area and is characterized by hot, dry summers, occasional thunderstorms, and gusty high winds with sandstorms. It is one of the most arid areas in the United States, has an average annual rainfall of 3 inches, and temperatures in excess of 100ºF for more than 100 days per year. The highest recorded temperature of 122ºF occurred last in 1995. The average January temperature is 54ºF, and the average July temperature is 92ºF. Evapotranspiration rates for Imperial Valley can exceed 7 ft/yr, and in hot summer months can be one-third inch per day. The frost-free period is greater than 300 days per year for 9 of 10 years, and greater than 350 days per year for 3 of 10 years [2.4].

2.1.5 Agriculture in the Imperial Valley

As stated in a previous paragraph, the idea to irrigate what was then a desert covering the Imperial Valley materialized in 1901, when the Imperial Canal was completed and the California Development Company began delivering water to the Imperial Valley. Several mutual water companies operated distribution canals for about 77,000 acres of land by 1904. The California Development Company, however, went bankrupt because of damage suits from the floods of 1905-1907, and the Southern Pacific Railroad Company (SPRC) acquired its assets [2.9]. IID was officially formed in 1911, and by 1923 it had acquired the California Development Company's assets from the SPRC and the distribution canals from the mutual water companies. By 1928, irrigated land had expanded to 406,943 acres. Problems with silt buildup and potential flooding, however, were still present. In addition, much of the canal and levee system was located in the Republic of Mexico. Negotiations between IID and the United States Bureau of Reclamation (USBR) began in 1917 for construction of an "All-American Canal" [2.10]. Congress passed the Boulder Canyon Project Act in 1928 authorizing the USBR to build the Hoover Dam, Imperial Dam, and the All-American Canal system. These facilities were completed in 1940, alleviating threats of flooding and silt buildup. In 1942, after a decade of construction, IID began receiving all of its water from the All American Canal. Underground tile-drainage systems were installed for the first time in 1929 to relieve salt accumulation in the fields. Today, there are approximately 433,892 tiled acres, resulting in 30,192 miles of tile drains.

Imperial Valley covers over 4,597 square miles [2.11]. Today, over 450,000 acres of irrigated land are in production in Imperial Valley. IID distributes approximately 2.8 million acre-feet of Colorado River water for irrigation purposes. The major crops in the Valley are alfalfa, sudan grass, and wheat, which account for most of the land under production. According to data from IID, about 448,238 acres were used for field crops, 95,030 for vegetables, and 21,605 for permanent crops in 1997. Imperial Valley has an agricultural based economy, and is ranked as the #1 agricultural county in the State of California, and #16 in the United States. Reportedly, for every $1,000 of total gross value produced in the agriculture sector, $209 of personal income is generated to agriculturally related jobs [2.12]. Imperial County generates almost $1 billion dollars in revenue annually; reportedly, one in every three jobs in the Valley is related to agriculture [2.13].

2.1.6 Soil Classifications

For soil classification purposes, a soil separate, silt is defined as individual mineral particles that range in diameter from the upper limit of clay (0.002 mm) to the lower limit of very fine sand (0.05 mm). As a soil textural class, silt is defined as soil that is 80 percent or more silt and less than 12 percent clay. The following three general soil associations dominate Imperial Valley: Imperial, Imperial-Holtville-Glenbar, and Meloland-Vint-Indio [2.14]. The Soil Conservation Service soil descriptions are as follows:

Imperial Soil Association: The Imperial soil association is comprised of nearly level, moderately well drained silty clay. This unit consists of very deep, calcareous soils formed in alluvial deposits. The largest area of the unit is around the town of Calipatria. Smaller areas are scattered throughout the lake basin. Natural drainage of soils has been altered by the seepage of water from irrigation canals and by extensive irrigation. Slopes are less then 2%. Elevation levels range from about 230 feet below to 30 feet above MSL. The unit is about 85 percent Imperial Soils and 15 percent minor soils. Imperial soils have a pinkish gray silty clay surface layer. Underlying this layer is pinkish gray is light brown silty clay. Minor soils are the well drained Glenbar, Holtville, Meloland, and Indio soils.

Imperial-Holtville-Glenbar Soil Association: The Imperial-Holtville-Glenbar soil association is nearly level, moderately well drained and well drained silty clay, silty clay loam, and clay loam. This map unit consists of very deep calcareous soils formed in alluvial deposits throughout the lake basin. Natural drainage of soils has been altered by the seepage of water from irrigation canals and by extensive irrigation. Slopes are less then 2%. Elevation is about 230 feet below to 30 feet above MSL. The unit is about 40 percent Imperial soils, 20 percent Holtville soils, 20 percent Glenbar soils, and 20 percent minor soils:

- Imperial soils are moderately well drained. They have a pinkish gray silty clay surface layer. Underlying this layer is pinkish gray and light brown silty clay.
- Holtville soils are well drained. They have light brown silty clay loam or silty clay layers about two feet thick. Underlying these are stratified very pale brown silt loam and loamy very fine sand.
- Glenbar soils are well drained. They have a pinkish gray clay loam or silty clay loam surface layer. Underlying this is stratified light brown clay loam and silty clay loam.
- Minor soils are the well drained Meloland, Indio, and Vint soils, and the somewhat excessively drained Rositas soils.

Meloland-Vint-Indio Soil Association: The Meloland-Vint-Indio soil association is nearly level, well drained fine sand, loamy very fine sand, fine sandy loam, very fine sandy loam, loam and silt loam. This map unit consists of very deep, calcareous soils formed in alluvial deposits and in eolian material. Natural drainage of soils has been altered by the seepage of water from irrigation canals and by extensive irrigation. Slopes are less then 2%. Elevation is about 230 feet below to 30 feet above MSL. The map unit is about 30 percent Meloland soils, 25 percent Vint soils, 20 percent Indio soils, and 25 percent minor soils:

- Meloland soils have a light brown, very fine sandy loam or fine sand surface layer. Underlying this is stratified very pale brown loamy fine sand and silt loam to a depth of about 2 feet. Below this is pink silty clay.
- Vint soils have a light brown loamy very fine sand, fine sandy loam, or very fine sandy loam surface layer. Underlying this is stratified pink and light brown loamy fine sand.
- Indio soils have a pinkish gray loam or very fine sandy loam surface layer. This is underlain by stratified very pale brown and pink layers of silt loam and loamy very fine sand.
- Minor soils are the somewhat excessively well drained Holtville, Antho, and Glenbar.

2.2 Water Quality Standards (WQS)

Water quality standards (WQS) adopted for the Colorado River Basin Region are contained in the Water Quality Control Plan for the Colorado River Basin Region [2.15]. The WQS for the Alamo River are comprised of the beneficial uses of water and the water quality objectives (which are either numerical or narrative) designed to protect the most sensitive of the beneficial uses. For the Alamo River, the most sensitive designated beneficial uses to be addressed in the silt TMDL include: warm freshwater habitat (WARM), wildlife habitat (WILD), preservation of rare, threatened, and endangered species (RARE), contact and non-contact recreation (REC I and REC II), and freshwater replenishment (FRSH). Tables 5 and 6, located on the following page, summarize the beneficial uses and water quality objectives being addressed in this TMDL, respectively:

Table 5. Beneficial Uses Addressed in Silt TMDL for Alamo River

Designated Beneficial Uses of Water	Description
Warm Freshwater Habitat (WARM)	Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
Wildlife Habitat (WILD)	Uses of water that support terrestrial ecosystems including, but not limited to, the preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.
Preservation of Rare, Threatened, and Endangered Species (RARE)	Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.
Water Contact Recreation (REC I)[2]	Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, and use of natural hot springs.
Non-Contact Recreation (REC II)	Uses of water for recreational activities involving proximity to water, but not normally involving contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.
Freshwater Replenishment (FRSH)	Use of water for natural or artificial maintenance of surface water quality or quantity.

Table 6. Summary of Water Quality Objectives Addressed in Silt TMDL

Suspended Solids: Discharges of wastes or wastewater shall not contain suspended or settleable solids in concentrations which increase the turbidity of receiving waters, unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in turbidity does not adversely affect beneficial uses.
Sediment: The suspended sediment load and suspended sediment discharge rate to surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
Turbidity: Waters shall be free from changes in turbidity that cause nuisance or adversely affect beneficial uses.
Aesthetic Qualities: All waters shall be free from substances attributable to wastewater of domestic or industrial origin or other discharges which adversely affect beneficial uses not limited to: • settling to form objectionable deposits; • floating as debris, scum, grease, oil, wax, or other matter that may cause nuisances; • and producing objectionable color, odor, taste, or turbidity.

[2] The only REC I usage that is known to occur is from infrequent fishing activity.

2.3 Problem Statements / Summary of Existing Conditions

2.3.1 General Problem Statement

Excess delivery of silt to the Alamo River has resulted in degraded conditions that impair the following designated beneficial uses: warm freshwater habitat; wildlife habitat; preservation of threatened, rare, and endangered species habitat; contact- and non-contact recreation; freshwater replenishment. As the Alamo River discharges into the Salton Sea, silt also threatens the same beneficial uses of the Salton Sea. Specifically, silt serves as a carrier for DDT, DDT metabolites, and other insoluble pesticides including toxaphene, which pose a threat to aquatic and avian communities. Currently, suspended solids concentrations, sediment loads, and turbidity levels are in violation of water quality objectives. These current concentrations, loads, and levels are also forming objectionable bottom deposits, which are also adversely affecting the beneficial uses of Alamo River. The silt levels in the entire length of the Alamo River violate these objectives.

2.3.1.1 Silt Transport as a Mechanism for DDT, DDT Metabolites, and Toxaphene Mobilization and Formation of Bottom Deposits, which Violate Water Quality Standards

DDT (1,1,1-Trichloro-2,2-bis(p-chlorophenyl) ethane) is an insecticide that was widely used in the United States after 1942. The breakdown products of DDT include DDE (Dichlorodiphenyldichloroethylene) and DDD ((1,1-Dichloro-2,2-bis(p-chlorophenyl) ethane), and they are commonly referred to collectively as "Total DDT". DDT, DDD, and DDE are known carcinogens and are listed in the Governor's Proposition 65 List of Chemicals Known to the State of California to Cause Cancer or Reproductive Toxicity. In addition DDT is a recognized developmental toxicant and reproductive toxicant.

DDT was used in the Imperial Valley as a low cost broad-spectrum insecticide (technical DDT) and to a lesser extent as a minor component of dicofol, an acaricide used on cotton, which formerly was a major crop [2.16]. DDT was banned in the United States in 1973 (in Arizona in 1969) and in Mexico in 1983. Since 1998, DDT has also been regulated in dicofol (now required to be less than 0.1 percent DDT). Silt particles are negatively charged. As such, the strongly hydrophobic (water-fearing) organochlorine pesticides (including DDT and its metabolites) have an affinity for sorption by soil particles. Therefore, silt transport also serves to transport DDT and its metabolites into the system, making DDT bio-available to organisms in the food chain. DDT metabolites have been detected in bottom sediment samples in the Alamo River [2.4][2.17][2.18]. DDT compounds are mobilized by tailwater runoff, which carries soil with the sorbed metabolites, or by resuspension of sediment in the Ag Drains and Rivers. DDE is the main metabolite in the breakdown of DDT, and it is the metabolite detected in the greatest concentrations in aquatic organisms [2.19]. DDT and its breakdown products have been shown to bioaccumulate in wildlife, with severe consequences for wildlife at the top of the food chain. Relatively low concentrations of DDT in the water column can be lethal to aquatic organisms, including catfish, tilapia, and carp. The low water solubility and high lipophilicity (i.e., propensity to attach to lipid molecules) of DDT and its metabolites have resulted in their bioaccumulation in fish and wildlife throughout the United States.

A US Department of Interior National Irrigation Water Quality Program (NIWQP) report on the Salton Sea area [2.20] found levels of DDE in the eggs of snowy and great egrets that approach and exceed the amount associated with reduced reproductive success in Black-crowned night herons (the level of DDE associated with reproductive failure in egrets is not specifically known). Nearly half of the egret eggs contained 1.5 to 6 times the amount of DDE associated with reproductive effects in night-herons. The NIWQP concluded that reported declines in colonial nesting bird success at the Salton Sea is likely related to the high levels of multiple contaminants, particularly organochlorines. Moreover, one of the report's conclusions was that reproductive depression in birds due to DDE has emerged as a serious concern in the Salton Sea area.

The Alamo River has some of the highest DDE concentrations recorded in the State of California in fish [2.19] and birds [2.21][2.22][2.23]. Measured Total DDT concentrations have exceeded the National Academy of Sciences (NAS) recommended guideline and the Federal Department of Agriculture (FDA) Action Level for Total DDT in fish tissue. The NAS recommended guideline is 1,000 parts per billion (ppb), wet weight; the FDA Action Level is 5,000 ppb, wet weight. These levels are based on specific assumptions of the quantity of food consumed by humans and upon the frequency of their consumption. The NAS has established a recommended maximum concentration of toxic substance concentrations in fish tissue. The guidelines were established not only to protect the organisms containing the DDT, but also to protect the species that consume the organisms contaminated with DDT. The FDA Action Level is intended to protect humans from the chronic effects of DDT consumed in foodstuffs.

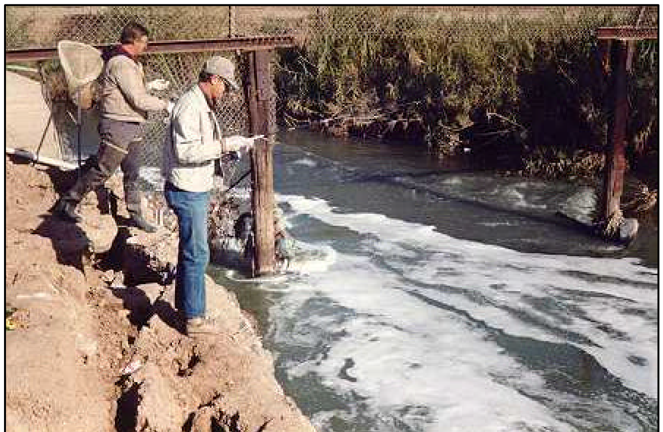

Figure 6. TSM Sampling of New River, Dec. 1992.

Since 1978, the State Water Resources Control Board (State Board) has conducted the Toxic Substances Monitoring (TSM) Program in order to provide a uniform statewide approach to the detection and evaluation of the occurrence of toxic substances in waters of the state. The California Department of Fish and Game (DFG) carries out the statewide TSM Program for the State Board by collecting and analyzing fish and other aquatic organisms from selected sampling stations. Composite samples, using six organisms of each species, are used whenever possible. Analysis of the same species from the same station is desirable to minimize possible variation in the data due to differences in pollutant uptake between species. Tables 7, 8 and 9 in Appendix A of this report show TSM DDT results. Table 7 summarizes the DDT results from the Imperial Valley and Salton Sea for each species. For comparison purposes, Table 8 shows the TSM results for all surface waters monitored by the State Board for the Region. Table 9 summarizes the DDT concentrations by species for samples from the Alamo River. A summary of the information contained in the tables follows:

- About 35 percent of the samples collected from the Alamo River, New River, Ag Drains, Salton Sea, and Fig Lake exceeded the NAS recommended guideline for Total DDT. Also, 5 percent of the samples from the Alamo River, New River, Ag Drains, Salton Sea, and Fig Lake exceeded the FDA Action Level. The average concentration of samples from the Alamo River, New River, Ag Drains, Salton Sea, and Fig Lake was 1251 ppb, wet weight, and exceeds the NAS recommended guideline.

- About 78 percent of the samples from the Alamo River exceeded the NAS recommended guideline for Total DDT. Also, 26 percent of the samples from the Alamo River exceeded the FDA Action Level. The average concentration of Total DDT in samples from the Alamo River was 2816 ppb, wet weight, and exceeds the NAS recommended guideline.

- Approximately 30 percent of the samples from the Ag Drains exceeded the NAS recommended guideline. The average concentration of Total DDT in samples from the Ag Drains was 1087 ppb, wet weight, and exceeds the NAS recommended guideline.

- No samples from the Colorado River were found to exceed the NAS recommended guideline. The average concentration of Total DDT in samples from the Salton Sea was 97 ppb, wet weight.

- The average Total DDT concentration in carp (Cyprinus carpio) from the Alamo River was 3833 ppb, wet weight, and exceeds the NAS recommended guideline. The highest Total DDT concentration measured in carp was 9153 ppb, wet weight, exceeding both the NAS recommended guideline and the FDA Action Level. Also, 92 percent of carp samples from the Alamo River exceeded the NAS recommended guideline, and 33 percent of carp exceeded the FDA Action Level.

- The average Total DDT concentration in channel catfish (Ictalurus punctatus) from the Alamo River was 2280 ppb, wet weight, and exceeds the NAS recommended guideline. The highest Total DDT concentration measured in channel catfish was 5300 ppb, wet weight, exceeding both the NAS recommended guideline and the FDA Action Level. Also, 67 percent of channel catfish samples from the Alamo River exceeded the NAS recommended guideline, and 0.8 percent of channel catfish exceeded the FDA Action Level.

- The average Total DDT concentration in mosquitofish (Gambusia affinis) from the Alamo River was 1371 ppb, wet weight, and exceeds the NAS recommended guideline.

- The average Total DDT concentration in red shiner from the Alamo River was 1127 ppb, wet weight, and exceeds the NAS recommended guideline.

Toxaphene, like DDT, is an organochlorine chemical with low water solubility, an affinity for soil particles, and a tendency to bioaccumulate in fish and wildlife. All registered uses of toxaphene were cancelled in 1983 by US EPA [2.24]. The substance is a recognized Proposition 65 carcinogen. Toxaphene has a half life in soil of up to 11 years. The National Academy of Sciences Recommended Guideline for toxaphene is 100 ppb, wet weight; the FDA Action Level is 5,000 ppb. Toxaphene has high chronic toxicity to aquatic life [2.25]. The State Board TSM program data for toxaphene within the Region are summarized in Tables 10, 11 and 12 in Appendix A. Table 10 summarizes the toxaphene results for each species from the Imperial Valley and the Salton Sea. For comparison purposes, Table 11 shows the TSM results for all surface waters monitored by the State Board for the Region. Table 12 summarizes the toxaphene concentrations by species for samples from the Alamo River. A summary of the information contained in the tables follows

- About 74 percent of the samples from the Alamo River exceeded the NAS recommended guideline of 100 ppb for toxaphene. None of the samples from the Alamo River exceeded the FDA action level. The average concentration of toxaphene in samples from the Alamo River was 571 ppb, wet weight and exceeds the NAS recommended guideline.

- Approximately 52 percent of the samples from the Ag Drains exceeded the NAS recommended guideline. None of the samples from the Ag Drains exceeded the FDA Action Level. The average concentration of toxaphene in samples from the Ag Drains was 399 ppb, wet weight and exceeds the NAS recommended guideline.

- No samples from the Colorado River were found to contain toxaphene.

- The average toxaphene concentration in channel catfish samples from the Alamo River was 798 ppb, wet weight, and exceeds the NAS recommended guideline. The highest toxaphene concentration in channel catfish samples from the Alamo River was 2200 ppb. 83 percent of the channel catfish samples exceeded the NAS recommended guideline.

- The average toxaphene concentration in carp from samples from the Alamo River was 447 ppb, wet weight, and exceeds the NAS recommended guideline. The highest concentration in carp samples from the Alamo River was 1100 ppb. About 67 percent of the carp samples from the Alamo River exceeded the NAS recommended guideline.

- The average toxaphene concentrations in Mosquitofish and Red Shiner from the Alamo River, 230 ppb wet weight and 260 ppb wet weight, respectively, both exceeded the NAS recommended guideline.

The TSM results indicate that the samples from the Alamo River had the worst DDT concentrations for the Region and amongst the worst for the whole State. Similarly, the samples from the Alamo River had some of the highest toxaphene concentrations. Ultimately, fish-eating birds in Imperial Valley are at the greatest risk of impairment from these pesticides. In Imperial Valley, resident birds typically had higher DDE concentrations than migratory species. Several avian species including the endangered California brown pelican, endangered Bald eagle, and endangered Peregrine falcon are exposed to levels of DDE that pose a high level of concern and an increased risk of adverse effects [2.17]. The state and federally-listed endangered desert pupfish is also at risk from DDT pollution [2.20].

The metabolism of organochlorine pesticides (OCPs) in the cells involves several mechanisms, such as oxidation and hydrolysis. They have a strong tendency to penetrate cell membranes and store themselves in the body fat. Due to this lipotrophic tendency, OCPs are fixed in lipid-rich cells, i.e., the central nervous system, liver, and kidneys. In these organs, they damage the functioning of important enzymes and disrupt the biochemical activity of the cells [2.25]. The effects of DDT on different bird species and aquatic organisms are well documented by USEPA, USBR, USFWS, USGS, U.S. Bureau of Indian Affairs, and other scientists throughout the world. The adverse effects include egg thinning, egg breakage, decreased egg productivity, decreased hatching and fledging success, decrease in nesting success, chick mortality during hatching, and death [2.26].

Based on the foregoing, the current discharges of silt laden with DDT and toxaphene into the Alamo River are adversely impacting the following beneficial uses: (1) Warm Freshwater Habitat; (2) Wildlife Habitat; and (3) Preservation of Rare, Threatened and Endangered Species; (4) Freshwater Replenishment; and (5) Water Contact Recreation (e.g., fishing). These discharges are taking place in a manner that violate the Basin Plan narrative WQOs for sediment and aesthetic qualities.

2.3.1.2 Silt as an Impairment to Aquatic Habitat

Silt can significantly and adversely impact aquatic life, in particular in the Alamo River and its delta with the Salton Sea. It is unknown to what extent silt itself impairs the aquatic habitat in the Alamo River. The river has historically been overloaded with silt as compared to natural streams. In general though, silt effects can be divided into those that occur in the water column and those that occur following siltation (gravity or geomorphological removal of silt from the water column). In the water column, it has at least four effects on the fish and fish populations: (1) it can clog the gills of the fish in water, and can either kill them or inhibit their growth; (2) it can prevent the successful development of fish eggs and larvae; (3) it modifies natural movements and migration of fish; and (4) it reduces the abundance of food available to the fish [2.27]. Silt also reduces light penetration, which in turn reduces the ability of algae to produce food and oxygen. Siltation may result in the smothering of bottom-dwelling organisms, covering of breeding areas, and smothering of eggs. Siltation also causes an imbalance in stream biota by increasing bottom animal density (principally worm populations), and diversity is reduced as pollution-sensitive forms disappear [2.27]. Indirectly, silt affects other parameters such as temperature and dissolved oxygen and interferes with mixing, decreasing the dispersion of oxygen and nutrients to deeper layers. As biomonitoring data become available, the full impact of silt on the aquatic habitat can be evaluated.

2.3.1.3 Silt as a Violation of Narrative Water Quality Objectives for Suspended Solids, Sediment, and Turbidity

Regional Board Trend Monitoring Data (TMD) for TSS and turbidity collected from 1980 to 1993 indicate that the Alamo River carries significant concentrations of silt. The silt load causes significant changes in turbidity in the Rivers. Table 13 in Appendix A shows the 1980 through 1993 TMD average concentrations for TSS and turbidity for Imperial Valley waters. A summary of the data follows:

- TSS concentrations in the Alamo River at the outlet to the Salton Sea are about 5 times greater than the concentrations of the Alamo River at the International Boundary;
- Turbidity concentrations in the Alamo River at the outlet to the Salton Sea are at least 5 times greater than the concentrations of the New River at the International Boundary.

Current monitoring data collected by IID for the New and Alamo Rivers at their outlets to the Salton Sea and for selected Ag Drains indicate that silt and turbidity conditions in the aforementioned Imperial Valley waters continues to be a problem. Table 14 in Appendix A show a summary of IID's silt and turbidity data.

Based on the foregoing, the wastewater discharges in Imperial Valley contain concentrations of suspended solids which result in a direct increase of turbidity in Alamo River, New River, and Ag Drains, in violation of the Basin Plan narrative WQO for suspended solids. Moreover, discharges in Imperial Valley are causing an alteration in suspended load and sediment discharge rate in a manner that is affecting beneficial uses, in violation of the Basin Plan narrative WQO for sediment. Further, because the current silt loading is directly responsible for changes in turbidity in the aforementioned waters, and the changes affect the beneficial uses, it also violates the Basin Plan narrative WQO for turbidity.

2.3.1.4 Silt as an Aesthetic Nuisance Affecting Recreational Uses

To the degree that the Alamo River has beneficial uses that include activities where ingestion of water is reasonably possible and aesthetic enjoyment essential (i.e., Water Contact and Non-contact Recreational beneficial uses), the current silt levels have an adverse impact on these activities. Of particular concern is the River and its delta with the Salton Sea. The delta is known for the myriad bird populations it supports. The Alamo River is currently chocolate brown in color. This results in a large brown plume in the mixing zone in the Salton Sea at its delta with the Alamo River.

2.3.1.5 Silt as an Impairment to Freshwater Replenishment

It is important that the freshwater replenishment beneficial use be addressed in this TMDL for two reasons First, the Alamo River is the single largest source of freshwater replenishment to the Sea. Second, consequently, it is a critical factor for the Sea's water quality and water quantity. Future implementation actions to address silt pollution in tailwater (e.g., tailwater pump-back systems) could result in significant reduction of tailwater flows, which would result in less inflow into the Sea. This is critical because such actions by themselves would lead to unacceptable increases in concentrations of constituents already causing impairments (e.g., salt and selenium) to the Salton Sea. Therefore, throughout development of the TMDL, and particularly during development of the implementation plan for the TMDL, the freshwater replenishment designated beneficial use must remain a concern.

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APPENDIX A

Table 7. TSM DDT Data for Samples from the Imperial Valley by Fish Species

SPECIES	NUMBER OF SAMPLES	NUMBER OF ORGANISMS	NUMBER EXCEEDING NAS CRITERIA	NUMBER EXCEEDING FDA ACTION LEVEL	MAX (ppb, wet weight)	MEAN (ppb, wet weight)
Bairdiella	4	24	0	0	180	84
Carp	38	128	15	4	9153	1667
Channel Catfish	34	117	20	1	5300	1861
Largemouth Bass	2	6	0	0	170	104
Flathead Catfish	2	2	0	0	241	193
Mosquitofish	9	266	5	1	5106	1413
Orangemouth Corvina	10	42	0	0	276	127
Red Shiner	1	27	1	0	1127	1127
Sailfin Molly	7	198	1	0	2577	584
Sargo	2	10	0	0	152	151
Tilapia*	7	32	0	0	326	68
Yellow Bullhead	2	3	0	0	991	550
Total	118	855	42	6		

* Tilapia refers to all species of tilapia in the Colorado River Basin Region which were analyzed in the Toxic Substances Monitoring Program.

Table 8. TSM DDT Data for the Colorado River Basin Region by Surface Water

STATION LOCATION	NUMBER OF SAMPLES	NUMBER OF ORGANISMS	NUMBER EXCEEDING NAS CRITERIA	NUMBER EXCEEDING FDA ACTION LEVEL	MAX (ppb, wet weight)	MEAN (ppb, wet weight)	90th PERCENTILE (ppb, wet weight)
IMPERIAL VALLEY	116	848	41	6	9153	1251	3308
ALAMO RIVER (ALL STATIONS)	27	137	21	5	9153	2816	5468
ALAMO RIVER/INTERNATIONAL BOUNDARY	4	56	3	0	1371	955	1305
ALAMO RIVER/HOLTVILLE	1	3	0	0	515	515	
ALAMO RIVER/BRAWLEY	1	3	0	0	460	460	
ALAMO RIVER/CALIPATRIA	21	75	17	5	9153	3392	5517
NEW RIVER (ALL STATIONS)	34	176	12	0	3368	1090	2584
NEW RIVER/INTERNATIONAL BOUNDARY	8	85	1	0	1209	539	825
NEW RIVER/WESTMORLAND	26	91	11	0	3368	1259	2687
AG DRAINS (ALL)	30	399	9	1	5106	1087	3324
SALTON SEA	21	102	0	0	276	97	180
FIG LAKE	7	40	0	0	592	145	321
WIEST LAKE	1	4	0	0	38	38	
SALT CREEK SLOUGH	3	6	1	0	3319	1193	
COACHELLA VALLEY STORMWATER CHANNEL	7	84	2	0	2883	1224	2695
PALO VERDE OUTFALL DRAIN	9	45	1	0	1475	354	632
COLORADO RIVER (ALL STATIONS)	17	90	0	0	855	102	165
COLORADO RIVER/NEEDLES	3	12	0	0	77	38	
COLORADO RIVER/PICHACO	2	11	0	0	46	28	
COLORADO RIVER/UPSTREAM OF IMPERIAL DAM	3	21	0	0	27	15	
COLORADO RIVER/CIBOLA	6	34	0	0	175	96	
COLORADO RIVER/INTERNATIONAL BOUNDARY	3	12	0	0	855	313	

Table 9. TSM DDT Data for Samples from the Alamo River by Species

SPECIES	NUMBER OF SAMPLES	NUMBER OF ORGANISMS	NUMBER OF SAMPLES EXCEEDING NAS CRITERIA	NUMBER OF SAMPLES EXCEEDING FDA ACTION LEVEL	MAX (ppb, wet weight)	MEAN (ppb, wet weight)
Carp	12	40	11	4	9153	3833
Channel Catfish	12	43	8	1	5300	2280
Largemouth Bass	1	2	0	0	170	170
Mosquitofish	1	25	1	1	1371	1371
Red Shiner	1	27	1	1	1127	1127

Table 10. TSM Toxaphene Data for Samples from the Imperial Valley by Fish Species

SPECIES	NUMBER OF SAMPLES	NUMBER OF ORGANISMS	NUMBER EXCEEDING NAS CRITERIA	MAX (ppb, wet weight)	MEAN (ppb, wet weight)
Bairdiella	4	24	0	ND	ND
Carp	38	128	17	1800	251
Channel Catfish	34	119	26	3400	647
Largemouth Bass	1	2	0	ND	ND
Flathead Catfish	2	2	0	ND	ND
Mosquitofish	9	266	4	2800	407
Orangemouth Corvina	10	42	0	ND	ND
Red Shiner	1	27	1	260	260
Sailfin Molly	7	163	2	2000	321
Sargo	2	10	0	ND	ND
Tilapia*	50	548	0	ND	ND
Yellow Bullhead	2	3	1	120	60

* Tilapia refers to all species of tilapia in the Colorado River Basin Region which were analyzed in the Toxic Substances Monitoring Program.

Table 11. TSM Toxaphene Data for the Colorado River Basin Region by Surface Water

STATION LOCATION	NUMBER OF SAMPLES	NUMBER OF ORGANISMS	NUMBER EXCEEDING NAS CRITERIA	NUMBER EXCEEDING FDA ACTION LEVEL	MAX (ppb, wet weight)	MEAN (ppb, wet weight)	90th PERCENTILE
IMPERIAL VALLEY	117	853	51	0	3400	323	940
ALAMO RIVER (ALL STATIONS)	27	137	20	0	2200	571	1588
ALAMO RIVER/INTERNATIONAL BOUNDARY	4	56	3	0	300	198	288
ALAMO RIVER/HOLTVILLE	1	3	0	0	0	0	
ALAMO RIVER/BRAWLEY	1	3	0	0	0	0	
ALAMO RIVER/CALIPATRIA	21	75	17	0	2200	697	1870
NEW RIVER (ALL STATIONS)	35	181	17	0	3400	333	810
NEW RIVER/INTERNATIONAL BOUNDARY	8	85	0	0	0	0	0
NEW RIVER/WESTMORLAND	27	96	17	0	3400	431	858
AG DRAINS (ALL)	27	393	14	0	2800	399	1128
SALTON SEA	21	102	0	0	0	0	0
FIG LAKE	7	40	0	0	0	0	
WIEST LAKE	1	4	0	0	0	0	
SALT CREEK SLOUGH	3	6	0	0	0	0	
COACHELLA VALLEY STORMWATER CHANNEL	7	84	3	0	440	133	368
PALO VERDE OUTFALL DRAIN	9	45	2	0	1200	148	344
COLORADO RIVER (ALL STATIONS)	17	90	0	0	0	0	
COLORADO RIVER/NEEDLES	3	12	0	0	0	0	
COLORADO RIVER/PICHACO	2	11	0	0	0	0	
COLORADO RIVER/UPSTREAM OF IMPERIAL DAM	3	21	0	0	0	0	
COLORADO RIVER/CIBOLA	6	34	0	0	0	0	
COLORADO RIVER/INTERNATIONAL BOUNDARY	3	12	0	0	0	0	

Table 12. TSM Toxaphene Data for Samples from the Alamo River by Species

SPECIES	NUMBER OF SAMPLES	NUMBER OF ORGANISMS	NUMBER OF SAMPLES EXCEEDING NAS CRITERIA	MAX (ppb, wet weight)	MEAN (ppb, wet weight)
Carp	12	40	10	1100	447
Channel Catfish	12	43	8	2200	798
Largemouth Bass	1	2	0	ND	ND
Mosquitofish	1	25	1	230	230
Red Shiner	1	27	1	260	260

Table 13. Summary of Trend Monitoring Data for TSS and Turbidity for Imperial County

LOCATION	AVERAGE TSS (mg/l)	AVERAGE TURBIDITY (NTU)
Alamo River at the International Boundary	77.6	38.8
Alamo River at Outlet to the Salton Sea	429.1	215.4
New River at the International Boundary	59.1	40.7
New River at Outlet to the Salton Sea	359.3	177.6
Rose Drain by Outlet to the Alamo River	428.2	225.6
Holtville Main Drain by Outlet to the Alamo River	188.8	96.7
Central Drain by Outlet to the Alamo River	351.9	149.6

Table 14. Summary of IID DWQIP Data for TSS and Turbidity (1/96 to 3/98)

	Total Suspended Solids (mg/l)			Turbidity (NTU)		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Alamo River at Garst Road Bridge	140	289	430	89	210	300
New River at the USGS Gauging Station north of Westmorland	130	235	340	80	169	250