USING RECYCLED WATER FOR FIREFIGHTING

Developed for the
Los Angeles Chapter of
the WateReuse Association

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1. PURPOSE

Health and safety concerns over the exposure of firefighters to recycled water have been expressed by some fire department personnel, not only in Los Angeles County (LA County) but in other states and countries as well. Several institutional members of the Los Angeles Chapter of the WateReuse Association (LACRWA)[1] who are producers of recycled water were involved in the production of this document, the purpose of which is to adequately address these concerns by detailing:

1. The regulatory agency oversight of the use of tertiary-treated recycled water;
2. The precautions necessary to protect the drinking water supply;
3. The quality and safety of the highly treated recycled water being produced in LA County that is available for firefighting; and
4. Best management practices for recycled water use by any and all fire departments throughout LA County.

The use of recycled water is becoming more commonplace throughout the State of California because of the on-again, off-again water supply crisis. With this increased use comes an increased potential for recycled water to ***supplement*** fire supply systems. It is the sincere intent of the water recycling industry to ensure the safety of all members of the public who may come into contact with recycled water. This includes firefighters, who should find the information contained in the document sufficient to address their health and safety concerns.

In addition, this document is designed to prompt the local recycled water regulatory entities, the Regional Water Quality Control Boards (RWQCB) serving the metropolitan Los Angeles area and Santa Clarita Valley (the Los Angeles Region), the Antelope Valley (the Lahontan Region), and the counties to the east (Santa Ana Region), to provide blanket permission for the use of tertiary-treated recycled water for unrestricted firefighting activities throughout LA County and adjacent areas on an as-needed basis in order to address the growing threat of massive wildfires.

This report was produced by staff of the Los Angeles County Sanitation Districts, in cooperation with staff of the City of Los Angeles Sanitation Department, the West Basin Municipal Water District, the City of Burbank Department of Water and Power, and the Las Virgenes Municipal Water District. For more information, please contact Mr. Earle Hartling of the Sanitation Districts at *ehartling@lacsd.org*.

1 LACWRA is a local association of water and wastewater agencies, consultants, companies, end users, regulators, and individuals involved in the safe and beneficial use of recycled water in the Los Angeles area, and is the local chapter of the WateReuse Association, California Section.

2. INTRODUCTION TO RECYCLED WATER IN LOS ANGELES COUNTY

"Recycled water" (sometimes referred to as "reclaimed water") is defined as highly treated municipal wastewater that may be used for a multitude of beneficial applications. Recycled water has been used safely and economically in LA County for over 55 years. The highest regulated level of treatment for direct, nonpotable reuse in the State of California, known as "tertiary treatment", is a roughly 12-hour process that consists of primary sedimentation, secondary biological oxidation, and clarification, followed by tertiary coagulation, filtration, and disinfection.

The effluent produced by tertiary treatment meets State and Federal drinking water standards and is generally indistinguishable from tap water to the senses. The high quality of tertiary-treated recycled water allows it to be used for literally any application other than direct drinking water or the processing of food or drink. The regulations governing these uses are presented in Section 3, below.

There are several agencies in LA County that produce tertiary-treated recycled water:

- Los Angeles County Sanitation Districts (Sanitation Districts) – *Long Beach, Los Coyotes, Pomona, San Jose Creek East and West, Whittier Narrows, Valencia, Saugus, Palmdale, and Lancaster Water Reclamation Plants (WRPs)*
- City of Burbank – *Burbank WRP*
- City of Los Angeles – *Tillman WRP*
- Cities of Los Angeles/Glendale – *LA-Glendale WRP (a joint venture between the two municipalities)*
- Las Virgenes Municipal Water District – *Tapia WRP*
- West Basin Municipal Water District – *Edward C. Little Water Recycling Facility*

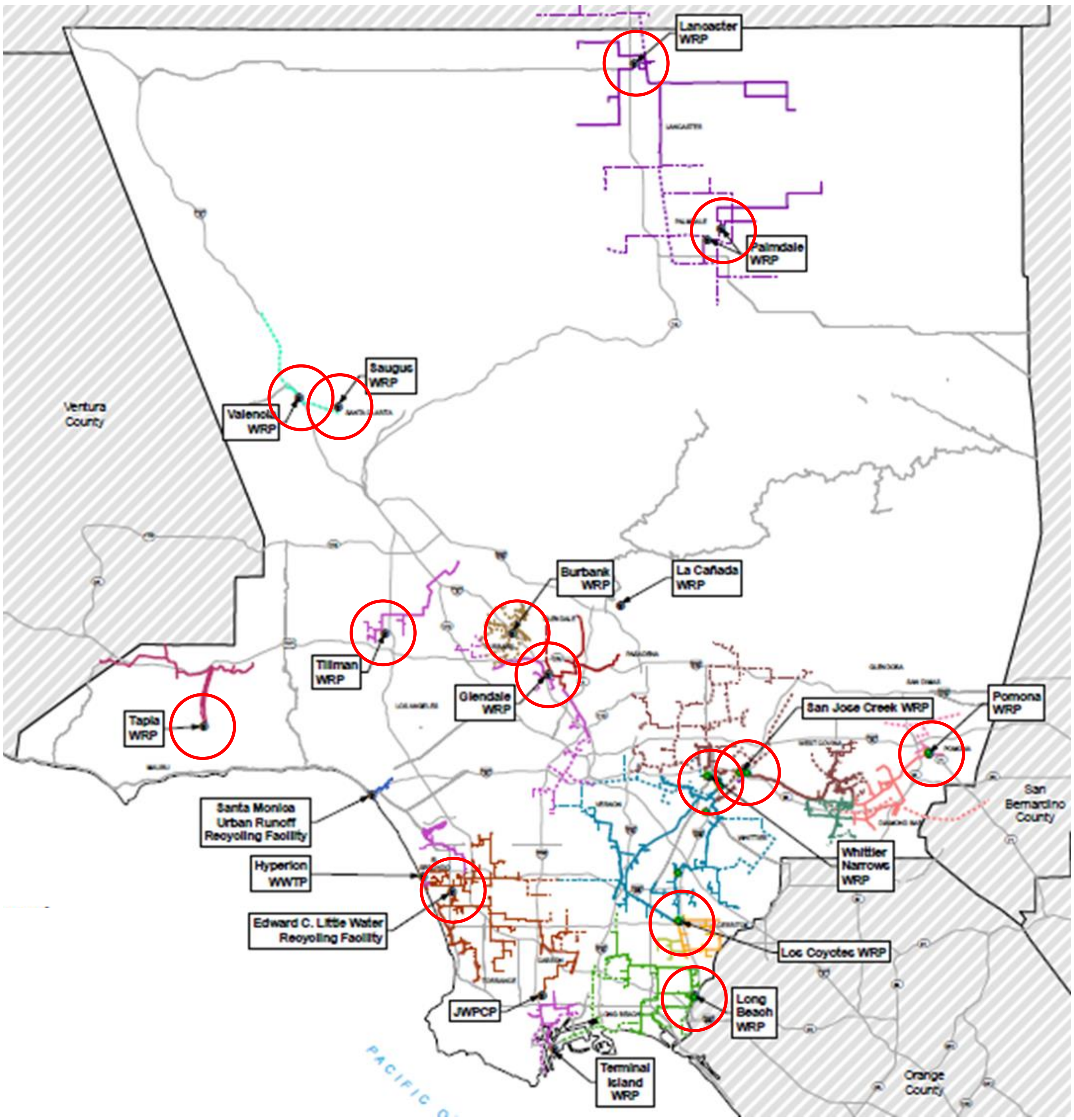
A location map for these facilities is presented in **Figure 1**.

For years, tertiary-treated recycled water has been supplied to a number of reuse sites for fire protection throughout LA County. At these existing recycled water use sites, as well as some potential use sites, the fire suppression system is tied into the site's primary source of water, whether it is for irrigation or industrial processes, because of storage and gravity flow requirements for firefighting. For example:

- The fire system at Bonelli County Regional Park in Pomona is connected to a 5 million gallon recycled water irrigation reservoir located at an elevation to ensure gravity flow during power outages.
- The fire system at the Puente Hills Gas-to-Energy (PERG) power plant facility in Whittier is connected to the cooling tower reservoir, which is, in turn, supplied by a 500,000 gallon recycled water storage tank that also serves the former Puente Hills Landfill site and its fire system.
- Rose Hill Memorial Park's Sky Rose Chapel in Whittier has its interior fire suppression system connected to the cemetery's 1 million gallon recycled water irrigation tank located at elevation to ensure gravity flow. In addition, several newly developed cemetery areas have their fire hydrants supplied with recycled water per the 2013 Fire Code flow and pressure requirements.
- Inglewood Park Cemetery has seven fire hydrants throughout the property that are connected to its irrigation system and supplied by a 1 million gallon recycled water storage reservoir located onsite.
- The City of Burbank supplies recycled water fire services to its Stough Canyon Nature Center, the nearby Castaway Restaurant and Luau Grounds, Debell Golf Course Club House, designated recycled water fire hydrants, and the Burbank Fire Department's helipads, all from various storage tanks located in hillside Burbank.
- Most, if not all, of the WRPs in LA County have on-site fire systems supplied with recycled water produced onsite.

Therefore, in many of these cases, a separate potable fire service is not physically possible unless the entire reuse site is converted back to using potable water. To abandon the successful use of recycled water and return to using increasingly scarce potable water is not only in direct conflict with the mandate of the State Legislature, which has declared the use of potable water for such nonpotable applications to be a "waste" and a violation of the State Constitution, but also in direct conflict past emergency drought declarations from the Governor's office in 2014 and 2015 and again in 2021.

Figure 1: Location of Water Reclamation Plants in Los Angeles County



3. REGULATORY REQUIREMENTS

3.1 *Water Recycling Criteria*

The State Water Resources Control Board's (SWRCB's) Division of Drinking Water (DDW), successor to the California Department of Public Health (CDPH), is the agency with authority to regulate the use of recycled water that ensures full protection of public health. Such regulations are contained in the California Code of Regulations, Title 22, Division 4, Chapter 3, Water Recycling Criteria (commonly referred to as "Title 22"), which was last revised for direct, non-potable uses in December 2000. In addition to high public contact uses such as landscape irrigation of parks and schools, food crop irrigation, and full-body contact impoundments, as well as the indirect replenishment of the underground drinking water supply, recycled water has been approved by DDW for use in both structural and nonstructural firefighting, depending on the level of treatment. The following are the relevant sections from Title 22:

> ***Section 60307. Use of Recycled Water for Other Purposes***
> *(a) Recycled water used for the following shall be disinfected tertiary recycled water:*
> *(4) Structural firefighting.*
> *(b) Recycled water used for the following shall be at least disinfected secondary-23 recycled water:*
> *(2) Nonstructural firefighting*

Since nearly all available recycled water produced in LA County is tertiary-treated, it may be used, per Title 22, for either structural or non-structural (i.e., wildfires) firefighting.

California is not the only state to allow the use of highly treated recycled water for firefighting. The following is a partial list of some of the other states' regulations that permit the use of the equivalent to Title 22 tertiary-treated recycled water for firefighting and fire protection:[2]

- Arizona Department of Environmental Quality, Administrative Code Title 18
- Colorado Department of Public Health and Environment, 5 CCR 1002-84
- Florida Administrative Code 62-610
- Texas Administrative Code, Title 30, Part 1 Chapter 201(C)
- Virginia Water Reclamation and Reuse Regulations
- Washington State Departments of Health and Ecology Water Reclamation and Reuse Standards
- Nevada Administrative Code 445A
- Utah Rule 317-3-11
- Oregon Department of Environmental Quality, OAR Chapter 340, Division 55

3.2 *Reuse Permits*

Within LA County, the Los Angeles and Lahontan RWQCBs, along with the SWRCB, have issued water reclamation requirements (WRRs), or reuse permits, to the various entities producing and/or distributing recycled water that govern where and how the recycled water may be used. Unlike irrigation or industrial users which have a constant location and a predictable demand for water, firefighting is, by definition, a transient event as the location of fires, the amount of recycled water needed to fight the fire, and the source of the recycled water cannot be determined beforehand. Even facilities with fire suppression systems plumbed with recycled water would rarely, if ever, use the recycled water for this purpose.

During the extensive Crown fire near Palmdale, CA, in the summer of 2010, the LA County Fire Department requested permission to utilize the Sanitation Districts' recycled water storage reservoirs in the Antelope Valley as a source for aerial water drops on the fire. This did not happen as the Lahontan RWQCB required an Engineering Report detailing this use be submitted prior to approval. Fires, even wildfires, require

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2 Water reuse regulations for each state can be found on an interactive map on the WateReuse Association website at: *https://watereuse.org/advocacy/state-policy-and-regulations/*.

immediate response and cannot wait for individual regulatory approval at the time of the event. Therefore, it is strongly recommended that all the RWQCBs in the region (since it is entirely possible that recycled water may be transported over RWQCB boundaries) provide prior approval to the operators of all the tertiary treatment plants in LA County for the use of their recycled water supplies for firefighting whenever and wherever it is needed. The amount of recycled water and the location of its application can be reported by the recycled water producer to the RWQCB in the monitoring report for the month in which the event occurred.

4. RECYCLED WATER QUALITY AND SAFETY

As stated above, essentially all the recycled water produced in LA County is tertiary-treated. Every one of the agencies responsible for its production take numerous steps to ensure its consistently and reliably high quality for beneficial reuse. The following section examines recycled water quality from the 15 tertiary WRPs in LA County with respect to the recycled water quality standards contained in Title 22. **Appendices D through H** detail the efforts made by these recycled water producers to ensure that the effluent produced by their WRPs meets all the recycled water standards contained in Title 22 and the permits issued by the RWQCBs.

4.1 *Recycled Water Quality*

Title 22 requires that tertiary-treated recycled water meet both of the following numeric water quality criteria:

Section 60301.230 Disinfected Tertiary Recycled Water

(b) The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed…2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analysis have been completed and the number of total coliform bacteria does not exceed…23 per 100 milliliters in more than one sample in any 30 day period. No sample shall exceed…240 total coliform bacteria per 100 milliliters.

Section 60301.320 Filtered Wastewater

(a) Has been coagulated and passed through…a bed of filter media…

(2) …the turbidity of the filtered wastewater does not exceed…

(A) An average of 2 NTU within a 24-hour period;

(C) 10 NTU at any time.

In order to determine the level of compliance with the Title 22 numeric limits, recycled water quality in terms of total coliform bacteria and turbidity for all the tertiary treatment facilities in LA County was collected for the 10-year period of January 1, 2011 through December 31, 2020. Tabular summaries and graphical presentations of this data are included in **Appendix A**. The data for this time period indicates that tertiary-treated recycled water throughout LA County complies with the Title 22 limits nearly 100% of the time and any incidents of non-compliance are extremely rare, relatively minor in nature, very short in duration, and would not directly impact firefighting operations. The following sections discuss the Title 22 water quality standards, along with other health related issues, in detail.

4.1.1 Turbidity

Table 1 in **Appendix A** presents a summary of turbidity monitoring for the 10-year period of 2011-20. Over this time frame which encompassed 53,545 reported samples from the 15 WRPs, only 32 days had levels exceeding the daily average turbidity limit of 2 NTU, resulting in a ***99.94% compliance rate***. It is important to note that the daily average turbidity limit for tertiary-treated recycled water is 2 NTU, not 2.0, which means turbidity values up to 2.5 NTU are not considered exceedances of this limit, since the test for turbidity is generally accurate to at least one decimal place.

It should be noted that most of the instances of non-compliance were due to isolated and unusual circumstances, not issues with the treatment process itself. All three days of non-compliance at the Sanitation Districts' Long Beach and San Jose Creek East WRPs were the result of record high daily rainfall in the region (5.86 and 5.75 inches total for the week before at Long Beach and San Jose Creek WRPs, respectively) and the subsequent runoff on January 23-24, 2017. Seven of the 18 exceedences at the City of Los Angeles' Tillman WRP also occurred during this timeframe and were also the result of high rainfall runoff. Ten of the remaining 11 instances of turbidity exceedences at the Tillman WRP also occurred during storm episodes in March of both 2017 and 2018, while the final instance occurred in March 2019 following several days of heavy rain earlier in February. Three of the instances at the Sanitation Districts' Palmdale WRP were due to an operational change of the coagulant dosing location in June 2018 that was immediately rectified.

And finally, only two samples from any WRP in the County were reported as exceeding the overall maximum limit of 10 NTU at any time, which occurred at the Las Virgenes Municipal Water District's Tapia WRP on February 17-18, 2017 during 7 inches of rainfall in 24 hours (average turbidity did not exceed the daily limit on either day). Otherwise, the highest recorded daily average turbidity during this 10-year period was 7.80 NTU.

Of all the high turbidity instances during these storm episodes or the operational change, ***not one resulted in either elevated bacteria counts or exceedences***.

4.1.2 Bacteria

Disinfected tertiary-treated recycled water is deemed to be essentially "pathogen-free" by the DDW and has also been approved in Title 22 for such high human contact applications as food crop irrigation (Section 60304(a)(l)), full-body contact such as swimming (Section 60305(a)), and indirect, potable reuse through groundwater recharge (Section 60320). Total coliform bacteria are used as an "indicator" organism, because they exist in huge numbers in raw sewage and are millions of times more plentiful than "pathogenic," or disease-causing, bacteria. Reducing total coliform bacteria from the millions down to non-detectable levels ensures that pathogenic bacteria are completely eliminated. Of the 53,030 samples of tertiary effluent taken from the 15 WRPs during the 10-year period, only 9.4% tested positive for total coliform bacteria (see **Table 2** in **Appendix A**), with the vast majority of these positives being at or just above the detection level. Please note that a coliform detection is ***NOT*** the same as non-compliance, as tertiary-treated recycled water is meant to be "disinfected" to remove pathogens, not "sterilized" to remove all microorganisms.

As far as compliance with the three Title 22 numeric bacteria limits listed above, there were only a handful of incidents over this 10-year period at only three of the WRPs in which there were exceedances of these limits:

- The 7-day median of 2.2 organisms per 100 mL was exceeded 1) at the Burbank WRP during a 4-day incident in March 2012, a 3-day incident in November 2013, a 3-day incident in April 2014, one day in January 2015, and a 3-day incident in March 2018, 2) at the Tillman WRP during a 4-day incident in May 2011, a 6-day incident in June 2011, a 4-day incident in February 2015, a 5-day incident in June 2015 and a 2-day incident in June 2019, and 3) at the Tapia WRP for one day in March 2019, a 7-day incident in December 2019, a 6-day incident in January 2020, and one day in May 2020.
- The limit of 23 organisms per 100 mL in more than one sample in any 30-day period was exceeded 1) at the Burbank WRP once each in May 2014 and April 2018 and 2) at the Tillman WRP once each in May 2011, December 2017, May 2018, January 2020, and June 2020.
- The limit of no sample with greater than 240 organisms per 100 mL was exceeded at the Burbank WRP once in March 2018.

Despite these relatively limited (56) instances of non-compliance, the 15 WRPs in LA County were ***in compliance with the bacteriological standards 99.89% of the time*** during the subject 10-year period.

In addition to total coliform, which is required to be monitored as a condition of their respective reuse permits, many of the WRPs in LA County also monitor fecal coliform and *E. coli* bacteria, with the results summarized in **Tables 3 and 4** in **Appendix A**, respectively. The frequency of positive samples for fecal coliform (0.9%) was more than an order of magnitude lower than that for total coliform (9.4%) and the frequency of positive samples for *E. coli* was even lower still (0.2%).

These results, combined with those for enteric virus presented in **Section 4.1.3** below, indicate that even activities involving frequent high contact with recycled water (e.g., contact with wet grass, swimming, eating produce, etc.) do not pose a microbiological risk to humans. Therefore, the risk of contracting a disease through much less frequent contact with the same recycled water via firefighting would be negligible by comparison.

4.1.3 Enteric Virus

There are no regulatory or monitoring requirements for enteric virus pertaining to the direct non-potable use of recycled water, such as for firefighting. However, the Sanitation Districts have been using tertiary-treated recycled water for groundwater recharge for over half a century. This indirect potable reuse application does require virus monitoring, which the Sanitation Districts initiated in 1979 and continue to refine to this day. **Table 5** in **Appendix B** summarizes results of this on-going monitoring program.

Of the 1,538 samples and 430,348 gallons (1.6 million liters) of tertiary-treated recycled water analyzed over the past 40 years (through November 2020), only three samples indicated virus of possible wastewater origin, one of which was suspected to be due to laboratory contamination. To give these statistics some context, if one were to drink 2 liters of recycled water every day, that person would expect to ingest a single virus (an infectious dose generally requires exposure to numerous viruses) approximately once every 1,115 years.

4.1.4 Drinking Water Standards

In addition to virus monitoring, the Sanitation Districts are also required to meet State Drinking Water Standards for groundwater recharge with recycled water. Some of the other recycled water producers in LA County may also have similar permit requirements. **Tables 6 and 7** in **Appendix C** lists Primary (health-related) and Secondary (aesthetic) Maximum Contaminant Levels (MCLs) that must be met for drinking water, as well the 2020 recycled water quality for the four Sanitation Districts' WRPs that contribute recycled water for replenishment of the potable groundwater supply in the Central Basin aquifer for which these constituents must be analyzed. As can be seen in these tables, the levels of all the constituents with health significance are not only in compliance with their respective Primary MCLs but, in many cases, are orders of magnitude below the limits and/or are undetectable in the recycled water. This also applies to constituents which have Secondary MCLs related to aesthetic, and not health-related concerns.[3]

Monitoring of these constituents in tertiary-treated recycled water produced at the other Sanitation Districts WRPs, although done less frequently, has demonstrated the same level of compliance with the Primary and Secondary MCLs. While not necessarily required monitoring at the other WRPs in LA County, their tertiary-treated recycled water would most likely have very similar effluent characteristics in regard to meeting drinking water standards, given the similar level of treatment provided.

4.1.5 Research

Research was performed in Australia[4] in 2004 by the Water Services Association of Australia (WSAA) that investigated the safety of using recycled water, particularly their Class A (equivalent to California Title 22 tertiary-treated recycled water) for firefighting. Among the goals of this project were:

- Review available literature (national and international) on health risk assessment of firefighting from recycled water;

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3 The exception is only for the relatively new Secondary MCL for odor, which is not a health-related concern, but which was exceeded at all the subject WRPs. This constituent's effects are discussed more in **Section 5.3**.
4 *Health Risk Assessment of Fire Fighting from Recycled Water Mains Occasional Paper No. 11*, Deere, D., Davison, A., Teunis, P., Cunliffe, D., and Donlon, P., Water Services Association of Australia, November 2004.

- Review any health regulatory guidance (national and international) on the use of recycled water for firefighting;
- Carry out an estimate of exposure of firefighters to water during firefighting or fire testing for ingestion, dermal (skin, mucous membrane – e.g. eyes) and inhalation contact;
- Carry out a health risk assessment of firefighting with recycled water for gastrointestinal, dermal, and inhalation contact for both microbial aspects and chemical aspects; and
- Carry out a comparative risk assessment with other commonly used water sources for firefighting (e.g. household swimming pools, local storages, rivers, dams).

The following are the pertinent conclusions reached by this project:

- Many of the treatment processes applied during water recycling are specifically and primarily designed to remove and inactivate enteric pathogens. As a result, recycled water can be made safe from hazardous concentrations of enteric pathogens provided systems are appropriately designed in proportion to the microbial challenge presented and the systems are consistently operated as designed in practice. Overall, risks from enteric pathogens to firefighters using Australian Class A recycled water were found to be low enough that its use need not be opposed on health grounds.

- Chemicals were also found not to be of health concern to firefighters using appropriately treated recycled water. As with microorganisms, acute health risks from chemical hazards to firefighters using Australian Class A recycled water were likely to be low enough that its use should not be opposed on health grounds.

- In summary, the risks to firefighters using Class A recycled water are expected to be below observable levels and equivalent to, or lower than, risks from many other accepted activities including the fighting of fires with many alternative and accepted water sources. Therefore, ***firefighting with Australian Class A (and, by extension, California tertiary-treated) recycled water can be considered to represent an acceptable health risk***.

However, the Queensland (Australia) Fire and Rescue Service (QFRS) and the United Firefighters Union (UFU) still had some reservations about the WSAA's 2004 study and the possibility of health risks to firefighters if recycled water were to be used for firefighting. A Health Risk Assessment[5] by independent experts, reporting through a Steering Committee comprised of representatives from QFRS, UFU, the Department of Emergency Services, Queensland Health, Natural Resources, Mines and Water, and the Environmental Protection Agency was undertaken in 2007 in response to these concerns. The overall summary from the investigation is that Class A+ (equivalent to Class A previously studied and to California Title 22 tertiary) ***recycled water is considered safe for firefighting***, provided appropriate controls are implemented. Specifically, the Steering Committee found:

- Firefighters' exposure to chemicals in Class A+ recycled water would be more than 1,000 times lower than the safe levels set by the drinking water guideline.
- The expected risks were estimated to be comparable with other benchmarks for acceptable risk for drinking water adopted by the United States Environmental Protection Agency and World Health Organization.
- Current turnout gear laundering requirements (only launder if dirty) and equipment cleaning protocols (interior and exterior) are sufficient.

5 *Health risk analysis for firefighters using Class A+ recycled water for firefighting operations*, Steering Committee Report, Queensland Government Department of Emergency Services, November 2007.

Between these two studies, the Australian government published guidelines for the safe use of recycled water, including its use in firefighting.[6] In this document, they determined that exposure to recycled water while firefighting could result in the ingestion of 20 milliliters (mL) by firefighters per incident. By comparison, State Health officials in California, when looking at exposure to recycled water during swimming, estimated casual consumption to be 100 mL per incident. Also by comparison, the health effects, or lack thereof, of swimming in recycled water were calculated based on daily exposure over the course of a lifetime; exposure during firefighting is expected to be significantly less and even rare, as the opportunities for using recycled water for this purpose are extremely limited.

4.2 *Treatment Plant Operations*

In order to ensure the protection of public health, the tertiary-treated recycled water that is delivered for beneficial reuse or discharged into a local waterway must consistently meet the high levels for quality that are mandated in the various permits issued by the regulatory community. To achieve this level of consistency, all the WRPs within LA County must ensure their daily high level of performance through a variety of means, including the employment of highly trained operators, redundant equipment and power sources, process monitoring, protocols for handling emergency situations, etc. Such protocols for each of the recycled water producers in LA County are included in this document as **Appendices D through H**.

5. PRACTICAL USE CONSIDERATIONS

The DDW has determined that the use of disinfected tertiary recycled water for firefighting purposes is an approved application that is fully protective of public health, including that of the firefighters. Workers who come in contact with recycled water being used for any purpose must practice proper hygiene, along the lines of hand washing with soap and water prior to eating. No gloves, masks or protective clothing of any kind is required to be worn when working with tertiary-treated recycled water, regardless of its application. Firefighters, however, do employee the use of Personal Protective Equipment (PPE) due to the nature of their work, and would, thus, automatically have an additional layer of protection.

LACWRA recommends the following practices as a minimum standard of care with recycled water use for firefighting:

5.1 *Fire Engine Post-Fire Procedures*

Fire hydrants supplied with recycled water must be clearly identified by purple paint, signs, tags, stencils, and/or other such labeling. Therefore, firefighters who connect to a fire hydrant supplied with recycled water will be readily aware of the source water. Since fire engines could possibly use their on-board water tank at some future date to distribute drinking water during potential civil emergencies, this tank must, as an additional safety precaution and as a matter of practice, be flushed and disinfected following the use of recycled water for firefighting. The following procedure has been adopted and used by the City of Burbank Fire Department and was approved by the former State Health Department (now DDW) in a letter to the City dated June 20, 1996:

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6 *National Guidelines for Water Recycling: Managing Health and Environmental Risks*, Natural Resource Management Ministerial Council, Environment Protection and Heritage Council, Australian Health Ministers' Conference (2006): *https://www.waterquality.gov.au/sites/default/files/documents/water-recycling-guidelines-full-21.pdf*

- Fire personnel must not drink the recycled water.
- Drain all recycled water from pumper tanks.
- Rinse all fittings, hoses, and tank with potable (drinking) water.
- Fill tanks with potable water and add one gallon of unscented chlorine bleach (5-¼% sodium hypochlorite) from an unopened container for each 500 gallons of water.
- Hold for at least 30 minutes.
- Drain chlorinated tank (if draining to storm drain, dechlorinate first with 0.4 pound of sodium sulfite or 0.3 pound of sodium thiosulfate per 500 gallons).
- Refill pumper tank with potable water.
- If another fire emergency prevents the full disinfection time of 30 minutes, as a minimum requirement, the tank must be drained of all recycled water before connecting to a potable water hydrant.

It must be emphasized that these cleaning and disinfection procedures are not strictly recycled water requirements but must be followed whenever ***any nonpotable water source has been used by the pumper to fight a fire.*** Such other sources include, but are not limited to, swimming pools, natural or manmade waterways, ornamental lakes, and irrigation ponds or canals.

5.2 *Fire Engine Pumps*

There is not expected to be any issue with corrosion, fouling, or other adverse impacts on fire engine equipment from the use of recycled water, as it is virtually indistinguishable from drinking water and does not contain excessive amounts of salts or other minerals. Tertiary-treated recycled water produced throughout LA County has also been used for numerous industrial processes including cooling towers, carpet dyeing, metal finishing, vehicle washing, and concrete mixing, with no evidence of corrosion or fouling of equipment being reported during the many years of use at these facilities. According to Testing Engineers,[7] *"Microbes can create the chemical environment that may lead to corrosion of piping systems. This phenomenon occurs almost entirely in stagnant or slow moving water. The most common cases of corrosion where MIC* [microbially induced corrosion] *is involved are fire protection and piping systems in new construction, when stagnant water is present."* Furthermore, since the availability of recycled water for firefighting is much more limited than that of the standard fire water system, exposure of fire engine pumps and valves to recycled water will be extremely infrequent and limited, if it occurs at all.

5.3 *Firefighter Turn-out Coats*

Disinfected tertiary-treated recycled water is generally indistinguishable from tap water to the human senses as it leaves the treatment plant. Recycled water use for firefighting involves water that is constantly in use and being replaced in the distribution system so that the water is not allowed to stagnate and produce nuisance conditions. However, there is a chlorine residual in the recycled water as it leaves the treatment plant, which does impart a slight odor, as reflected in the

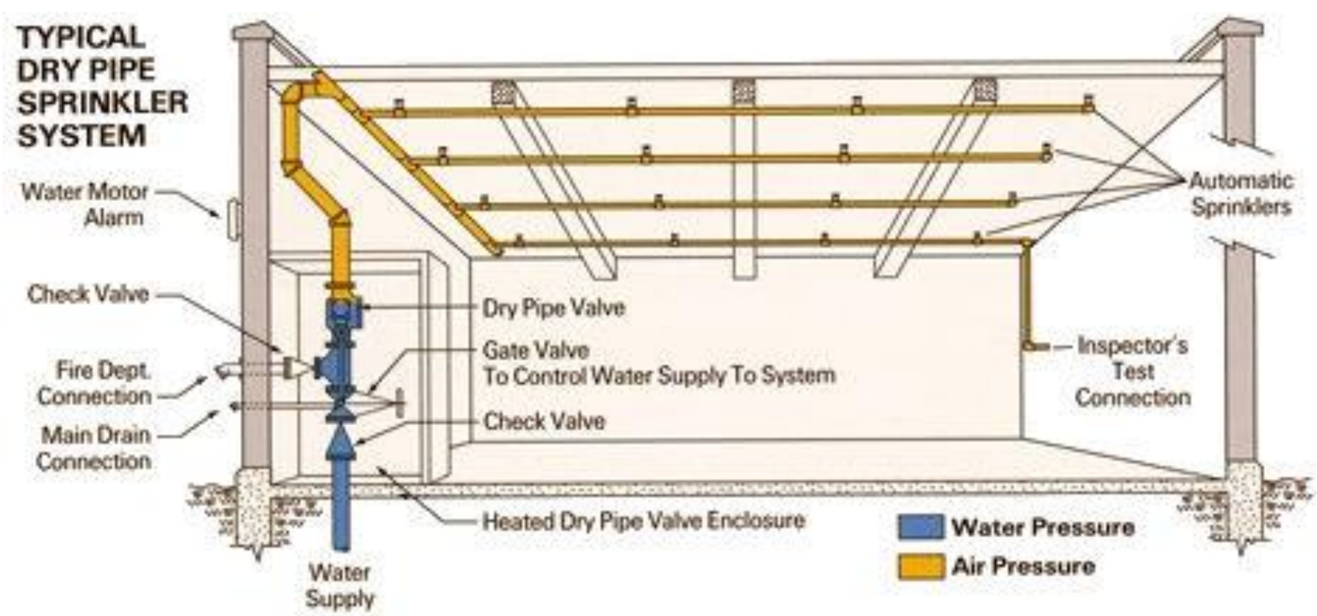
7 *http://www.testing-engineers.com/mic.html*

effluent data for contained in **Table 7** of **Appendix C**.[8] Nevertheless, recycled water is not expected to impart any more of an odor or other effect on firefighter equipment, such as turn-out coats, than the use of any other nonpotable water source (e.g., irrigation ponds, swimming pools) or than what would result from the various burning materials encountered during firefighting activities.

5.4 *Building Fire Sprinkler Systems*

Fire sprinkler systems in buildings proposed for use with recycled water are recommended to be of the "dry" variety (see **Figure 2**, below). Pipelines in the building supplying recycled water to the sprinkler heads should remain empty until fire sensors are activated and actuate an automatic valve outside the building that connects the recycled water supply system to the fire sprinkler system. Thus, the sprinkler system is only charged when it is needed, if ever. Following activation and operation of the recycled water fire sprinkler system, it should be drained and reset to the "dry" condition. By maintaining a "dry" recycled water fire sprinkler system, any problems with stagnant water or MIC of the piping system are avoided (photo, right), regardless of the water supply source.

Figure 2: Diagram of "Dry" Fire Sprinkler System



8 Sanitation Districts' Recycled Water 2019-20 Annual Averages vs. Secondary Drinking Water Standards

6. RECOMMENDATIONS

Based on the information contained in this document, LACWRA makes the following recommendations:

- Any and all Fire Departments within LA County that have the potential to access recycled water for firefighting should officially approve the use of tertiary-treated recycled water for all firefighting applications, based on the recycled water being adequately regulated by DDW for this use, being pathogen-free, being of a demonstrated consistent, high quality, being mandated for use by the State Legislature and, in nearly every case, meeting drinking water standards.
- These Fire Departments should adopt as a standard operating procedure the post-fire tank cleaning procedures outlined in this document, whenever ***any*** water is used that does not originate in a potable water fire system.
- A copy of this document should be made available to every fire station in areas accessible to recycled water.
- Building fire-suppression systems that are to be connected to a recycled water supply should be of the "dry" variety and not charged with recycled water until a fire is detected in the building. These fire systems would have to comply with the 2019 Fire Code (or latest version) requirements for flow and pressure.
- The Los Angeles, Lahontan, and Santa Ana RWQCBs should issue a blanket approval for the use of tertiary-treated recycled water for firefighting throughout the LA County area, regardless of where, when, and how much recycled water is required. During such emergencies, time is of the essence and there should be no requirement for report submittal or regulatory approval before recycled water can be used for this purpose. Following the conclusion of fire operations, the recycled water producer will supply to the appropriate RWQCB a report on the amount of recycled water used and the area on which it was applied.

APPENDIX A

Recycled Water Turbidity, Total Coliform, Fecal Coliform and *E. Coli*

Table 1: Effluent Turbidity Compliance

WRP	Number of Samples	Exceedences		Percent Compliance	Maximum Daily Average NTU
		No.	%		
Long Beach	3,642	1	0.03%	99.97%	4.80
Los Coyotes	3,640	1	0.03%	99.97%	2.95
Pomona	3,639	0	0%	100%	2.00
San Jose Creek East	3,645	3	0.08%	99.92%	7.80
San Jose Creek West	3,637	1	0.03%	99.97%	7.80
Whittier Narrows	3,551	0	0%	100%	1.90
Valencia	3,640	0	0%	100%	1.90
Saugus	3,648	0	0%	100%	1.50
Palmdale	3,307	5	0.15%	99.85%	5.50
Lancaster	3,079	0	0%	100%	2.50
Burbank	3,651	0	0%	100%	1.94
Tillman	3,648	18	0.49%	99.51%	5.29
LA-Glendale	3,653	0	0%	100%	1.66
Tapia	3,607	3	0.08%	99.92%	6.93
West Basin	3,558	0	0%	100%	2.49
TOTALS	**53,545**	**32**	**0.06%**	**99.94%**	**7.80**

Table 2: Effluent Total Coliform Compliance

WRP	Number of Samples	Positives		Percent Non-detect	Maximum Number
		No.	%		
Long Beach	3,645	673	18.5%	81.5%	51
Los Coyotes	3,647	150	4.1%	95.9%	49
Pomona	3,633	582	16.0%	84.0%	68
San Jose Creek East	3,648	328	9.0%	91.0%	7
San Jose Creek West	3,650	264	7.2%	92.8%	42
Whittier Narrows	3,510	24	0.7%	99.3%	27
Valencia	3,648	38	1.0%	99.0%	61
Saugus	3,648	306	8.4%	91.6%	59
Palmdale	3,304	76	2.3%	97.7%	10
Lancaster	3,069	249	8.1%	91.9%	65
Burbank	3,142	280	8.9%	91.1%	540
Tillman	3,642	766	21.0%	79.0%	200
LA-Glendale	3,649	146	4.0%	96.0%	80
Tapia	3,648	1,119	30.7%	69.3%	23
West Basin	3,547	1	0.03%	99.97%	2
TOTALS	**53,030**	**5,002**	**9.4%**	**90.6%**	**540**

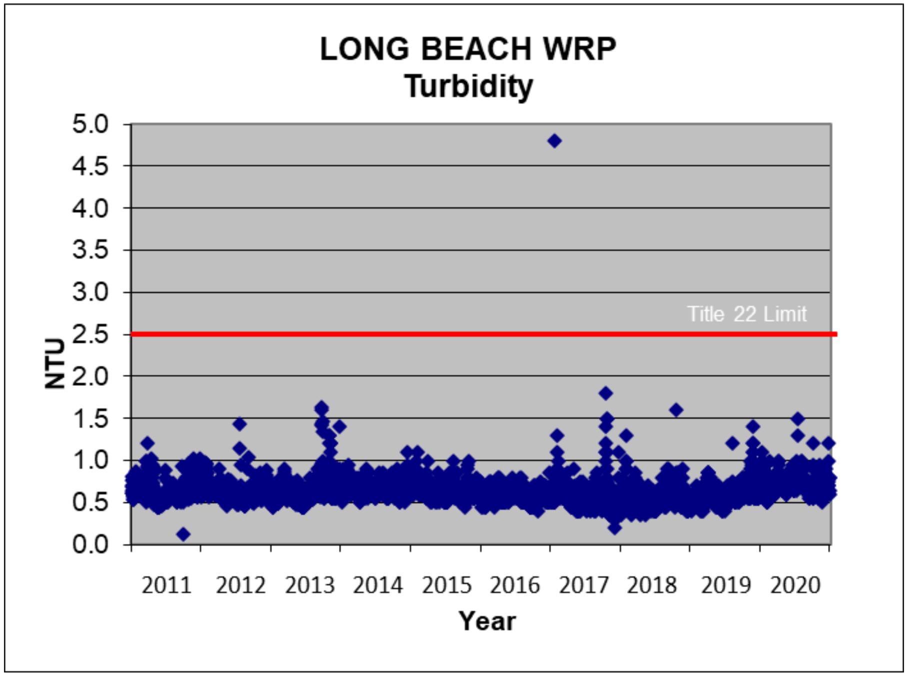
Table 3: Effluent Fecal Coliform Monitoring

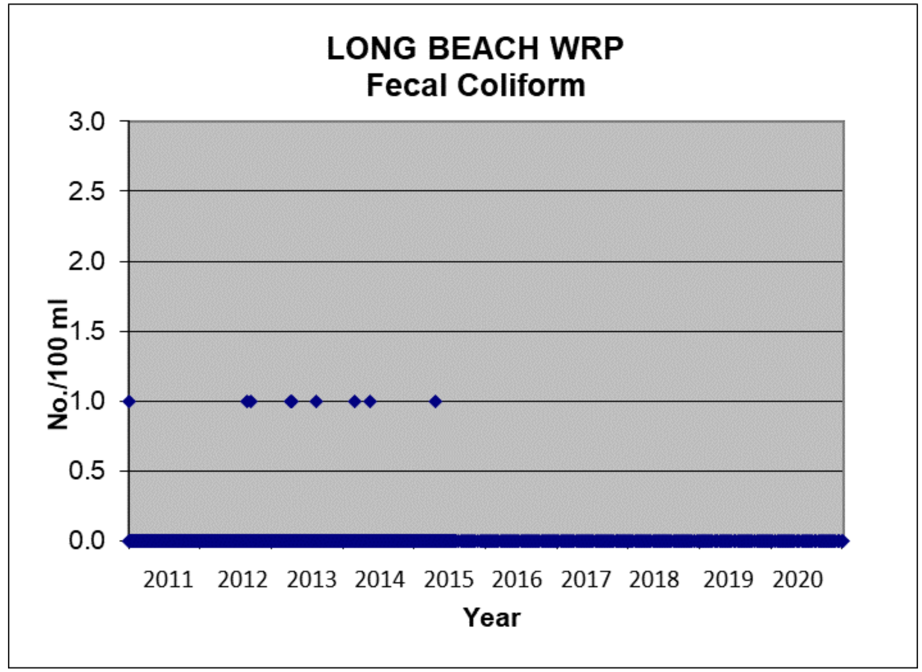
WRP	Number of Samples	Positives		Percent Non-detect	Maximum Number
		No.	%		
Long Beach	1,954	9	0.5%	99.5%	1
Los Coyotes	1,955	9	0.5%	99.5%	1
Pomona	521	9	1.7%	98.3%	3
San Jose Creek East	1,903	12	0.6%	99.4%	3
San Jose Creek West	1,903	8	0.4%	99.6%	1
Whittier Narrows	3,508	2	0.1%	99.9%	1
Valencia	525	0	0%	100%	<1
Saugus	415	1	0.2%	99.8%	<1
Palmdale	N/A				
Lancaster	N/A				
Burbank	2,147	30	1.4%	98.6%	94
Tillman	2,312	61	2.6%	97.4%	6
LA-Glendale	2,311	5	0.2%	99.8%	3
Tapia	3,648	63	1.7%	98.3%	16
West Basin	485	1	0.2%	99.8%	2
TOTALS	23,587	210	0.9%	99.1%	94

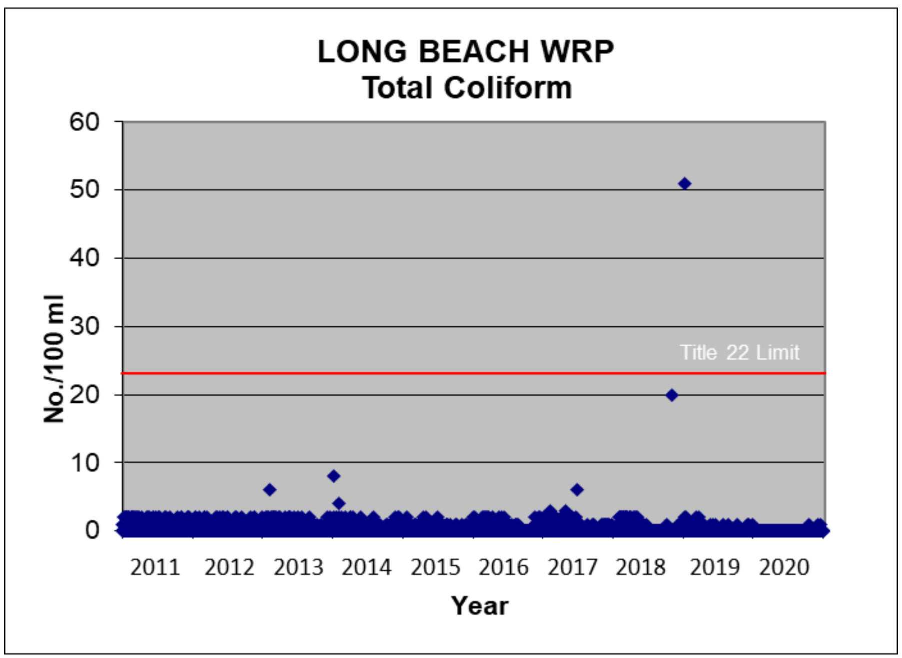
Table 4: Effluent E. coli Monitoring

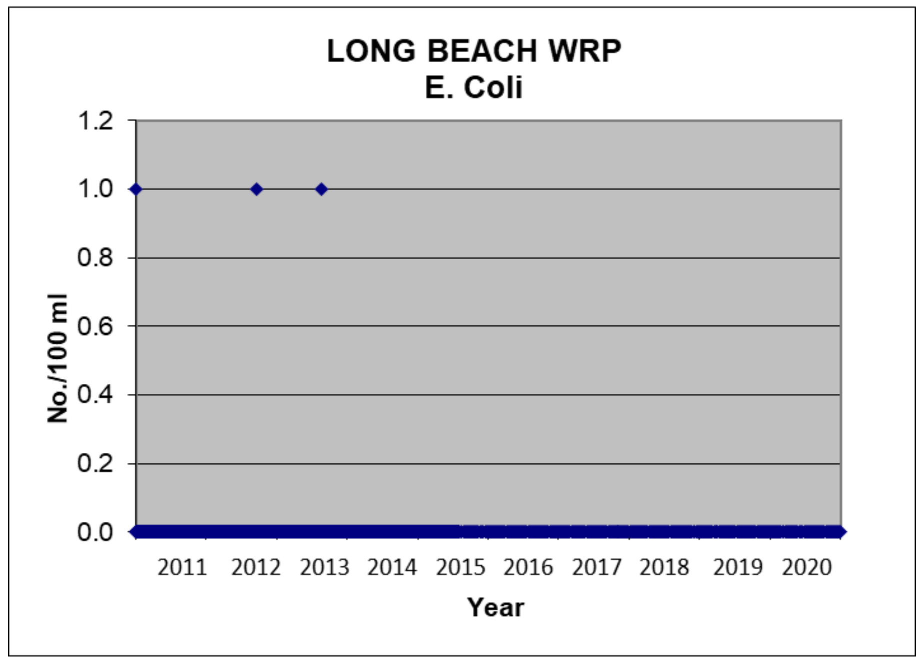
WRP	Number of Samples	Positives		Percent Non-detect	Maximum Detected
		No.	%		
Long Beach	1,953	3	0.2%	99.8%	1
Los Coyotes	1,955	0	0%	100%	<1
Pomona	521	5	1.0%	99.0%	1
San Jose Creek East	1,902	4	0.2%	99.8%	3.6
San Jose Creek West	1,903	2	0.1%	99.9%	1
Whittier Narrows	3,497	3	0.1%	99.9%	7.5
Valencia	523	0	0%	100%	<1
Saugus	413	0	0%	100%	<1
Palmdale	N/A				
Lancaster	N/A				
Burbank	2,635	10	0.4%	99.6%	54
Tillman	1,685	3	0.2%	99.8%	1
LA-Glendale	1,672	1	0.1%	99.9%	3
Tapia	1,163	14	1.2%	98.8%	<1.1
West Basin	N/A				
TOTALS	**19,822**	**45**	**0.2%**	**99.8%**	**54**

Long Beach Water Reclamation Plant









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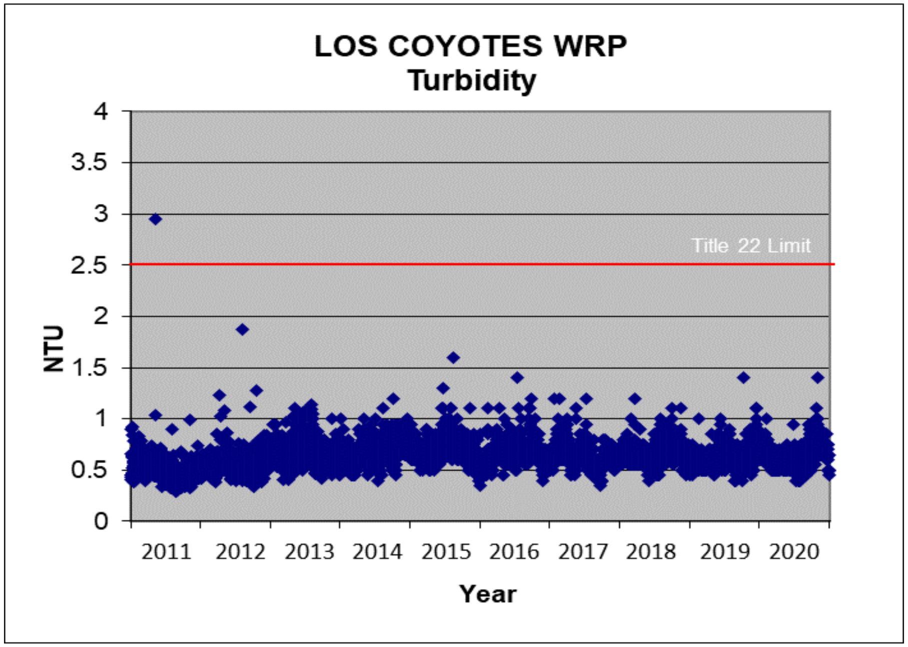

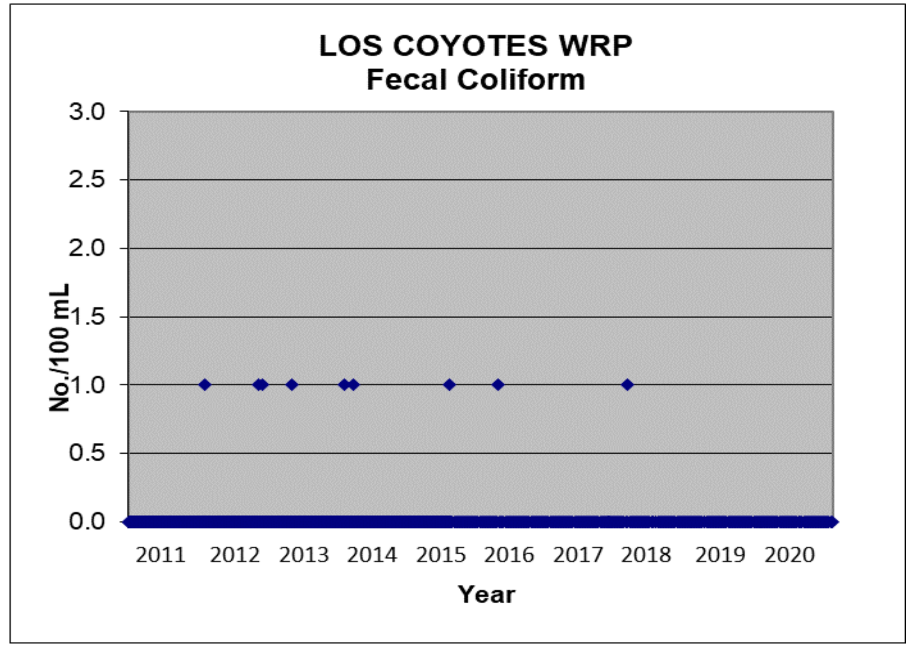

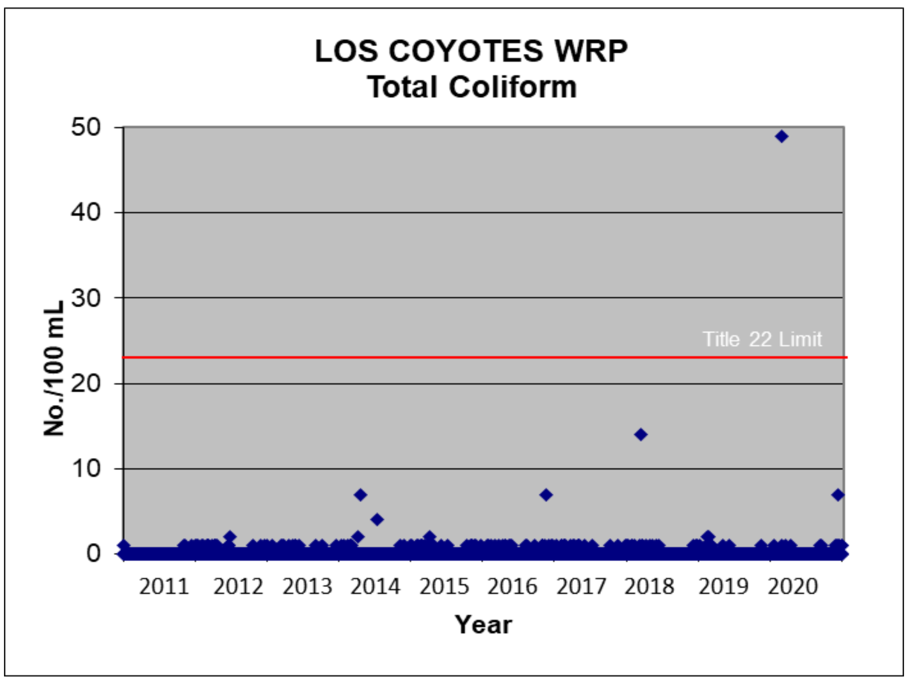

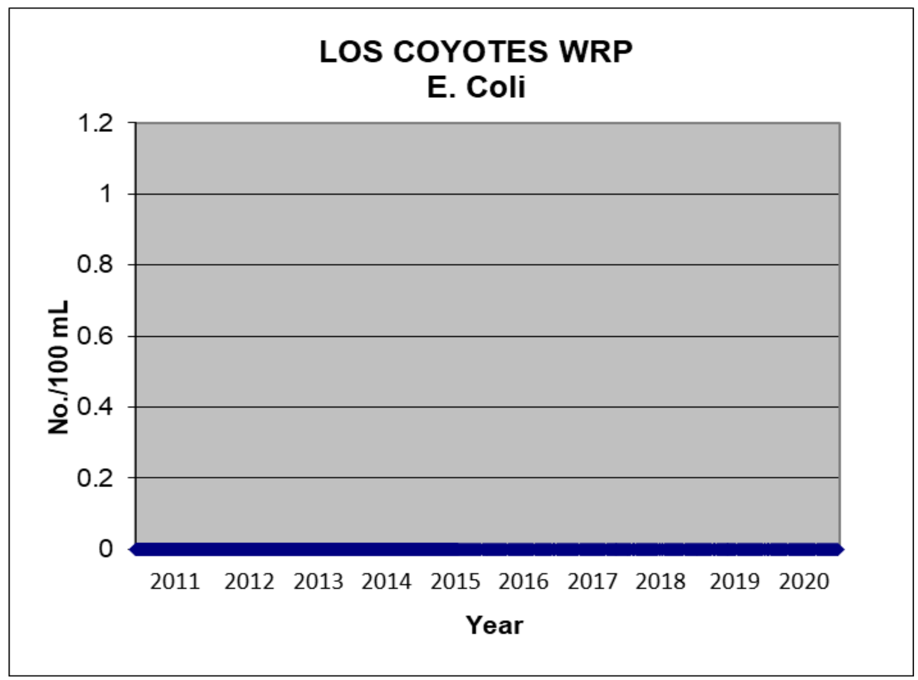

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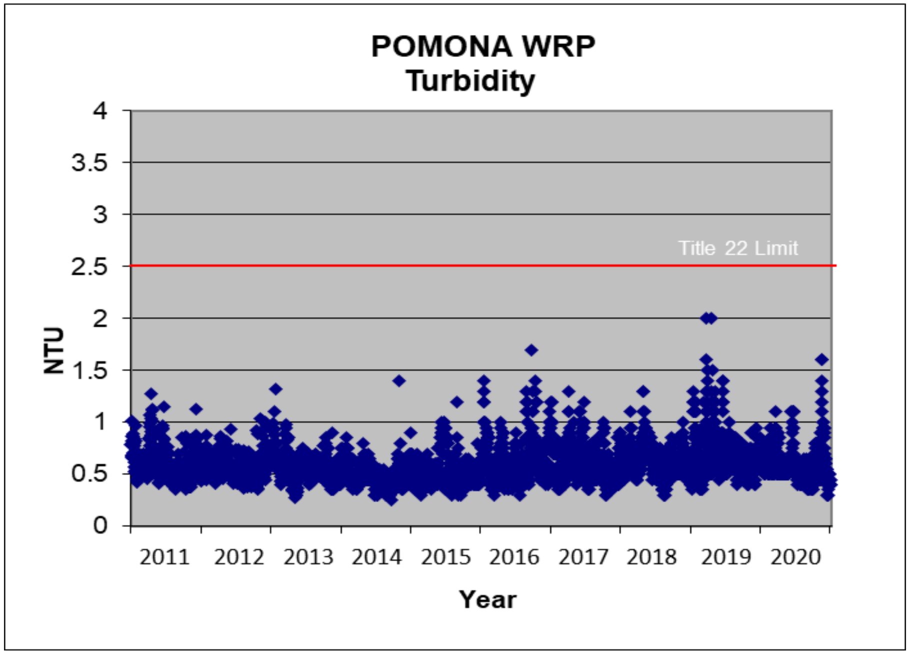
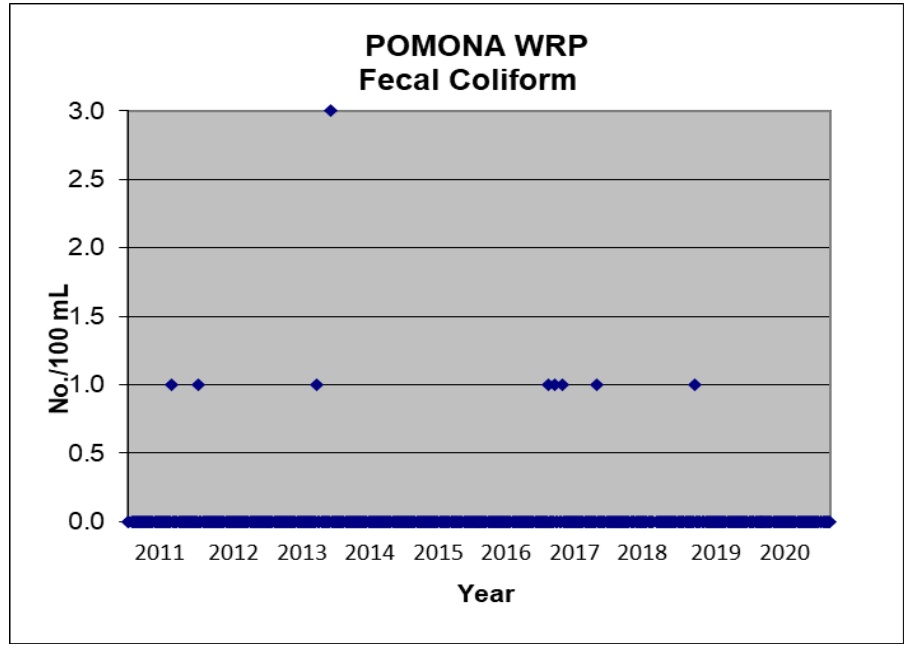
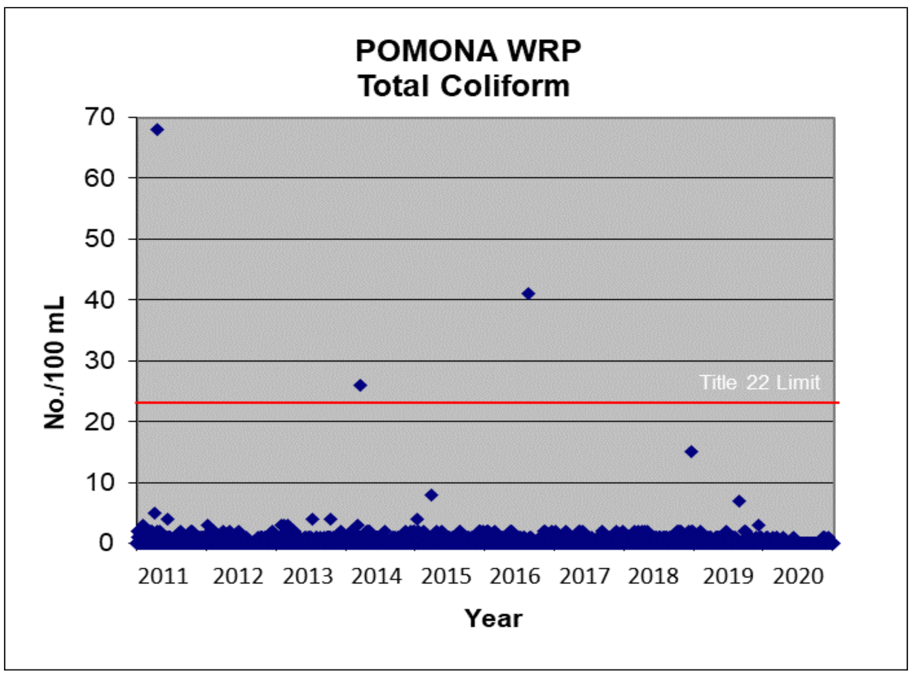
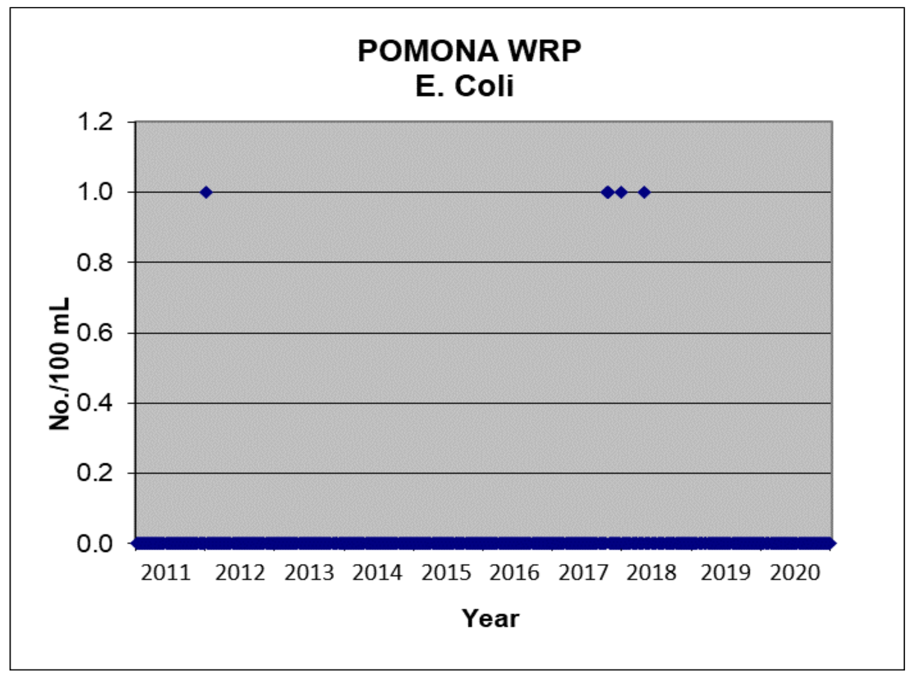
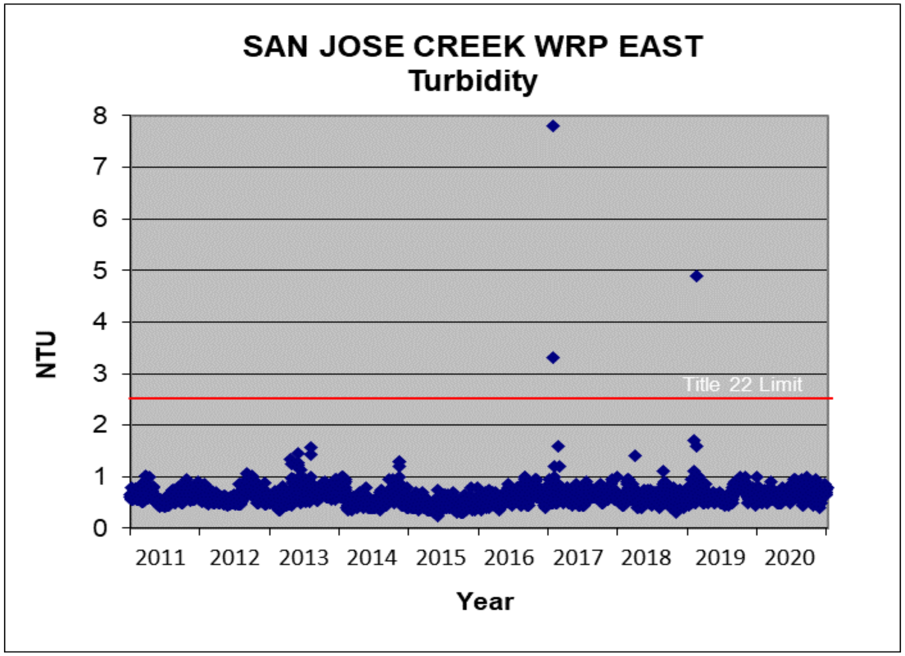


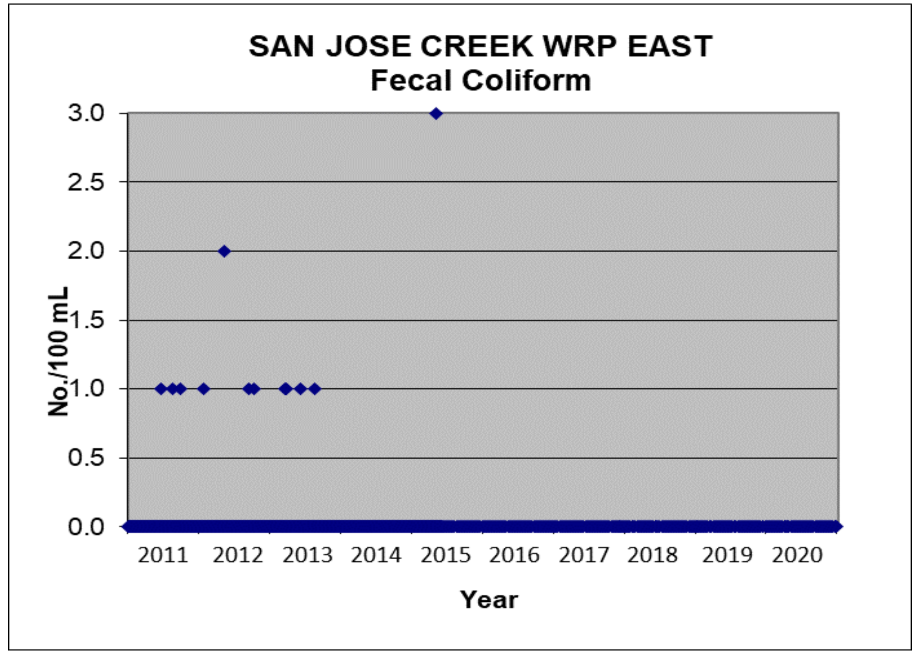


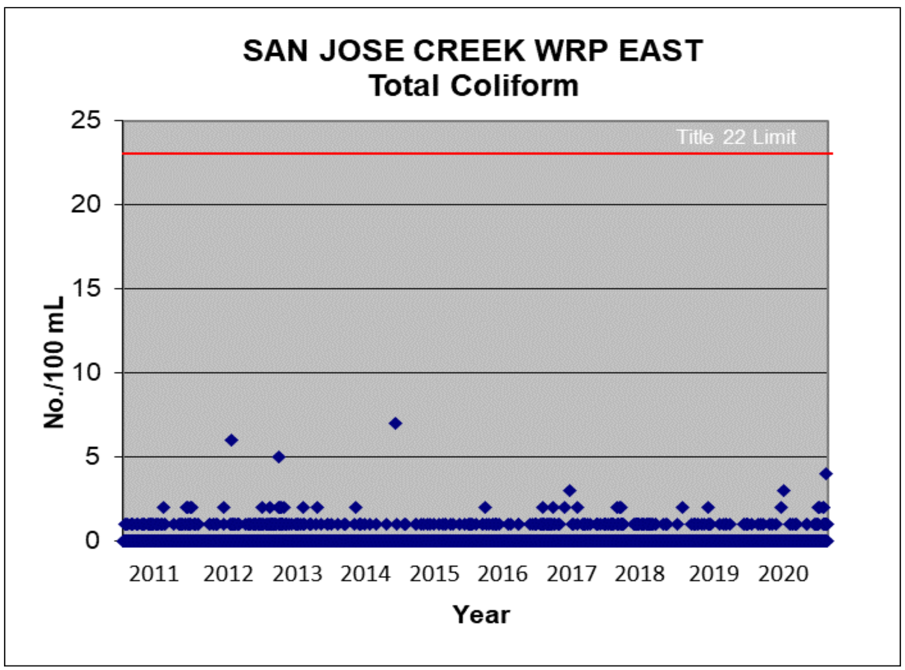


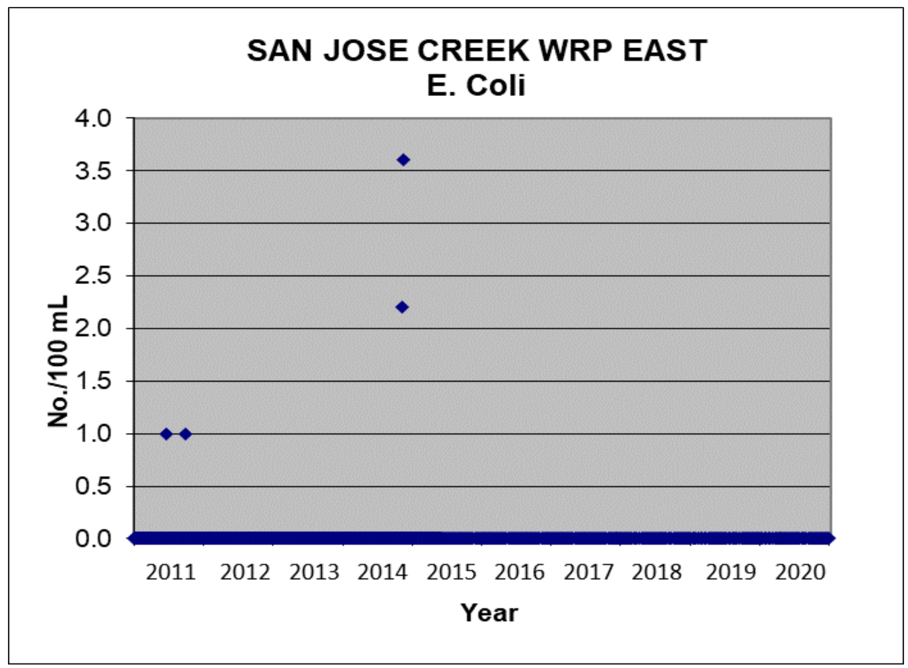


San Jose Creek East Water Reclamation Plant

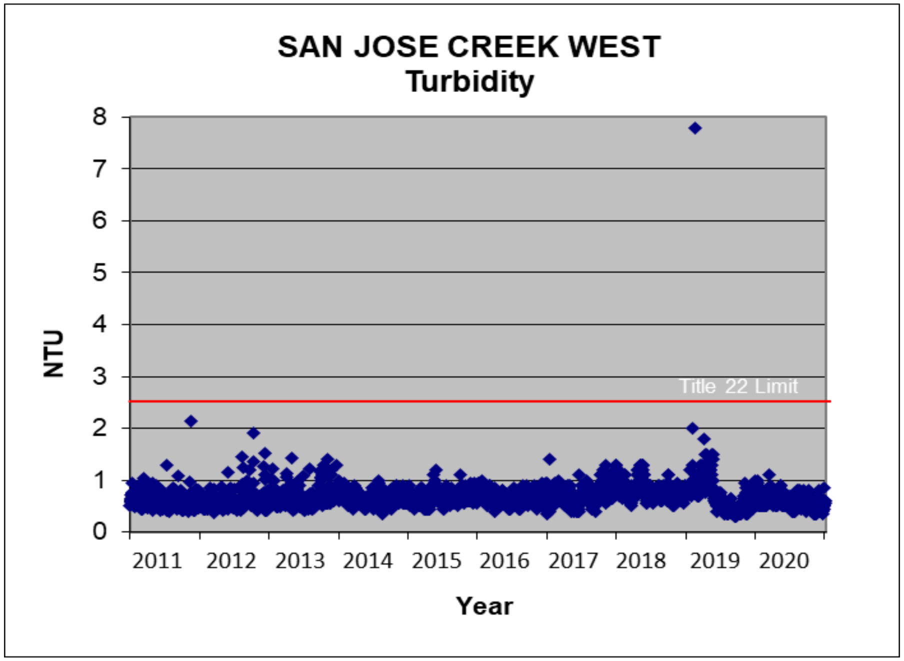


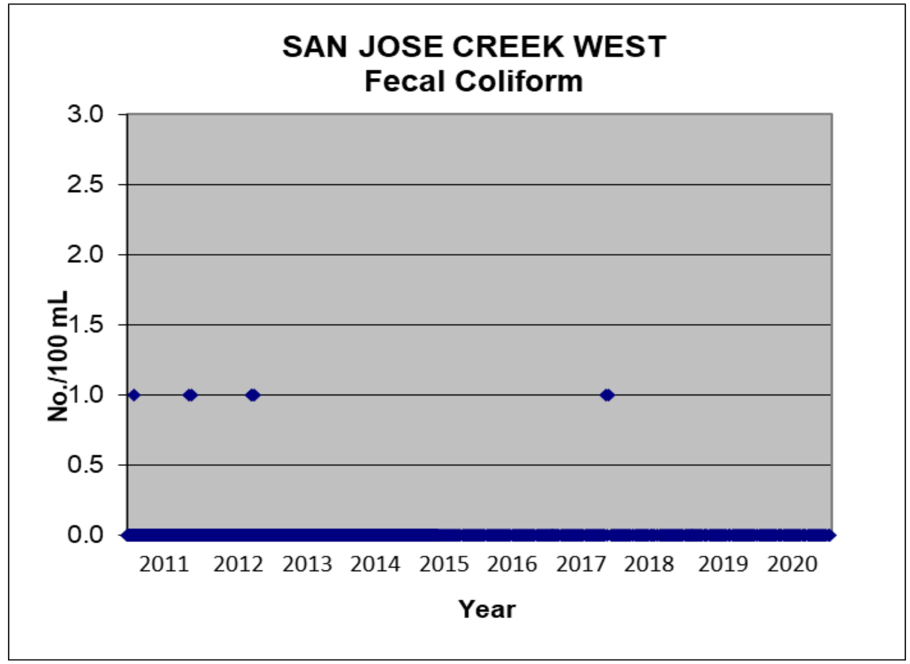


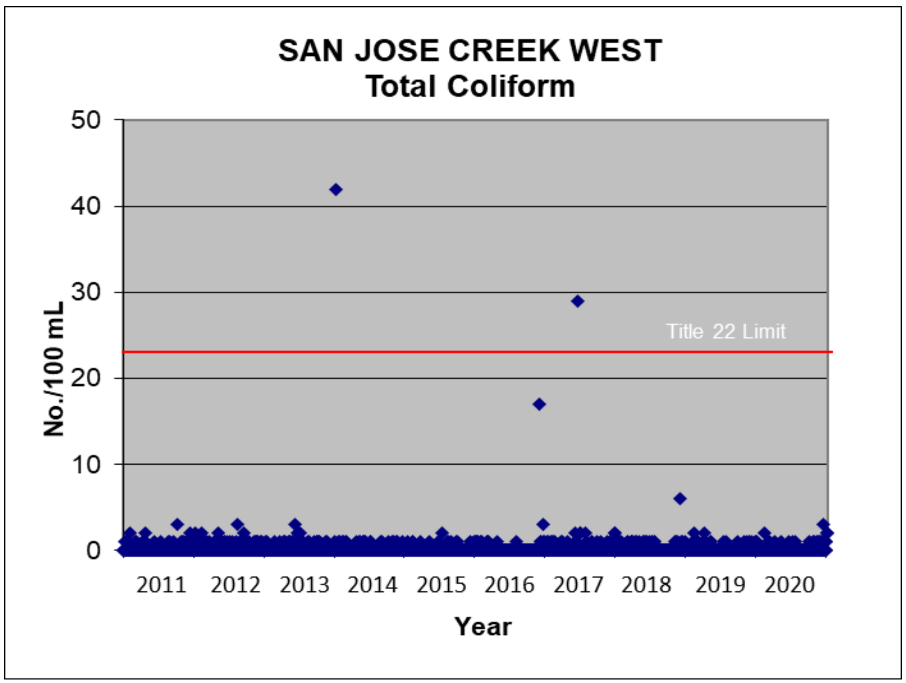


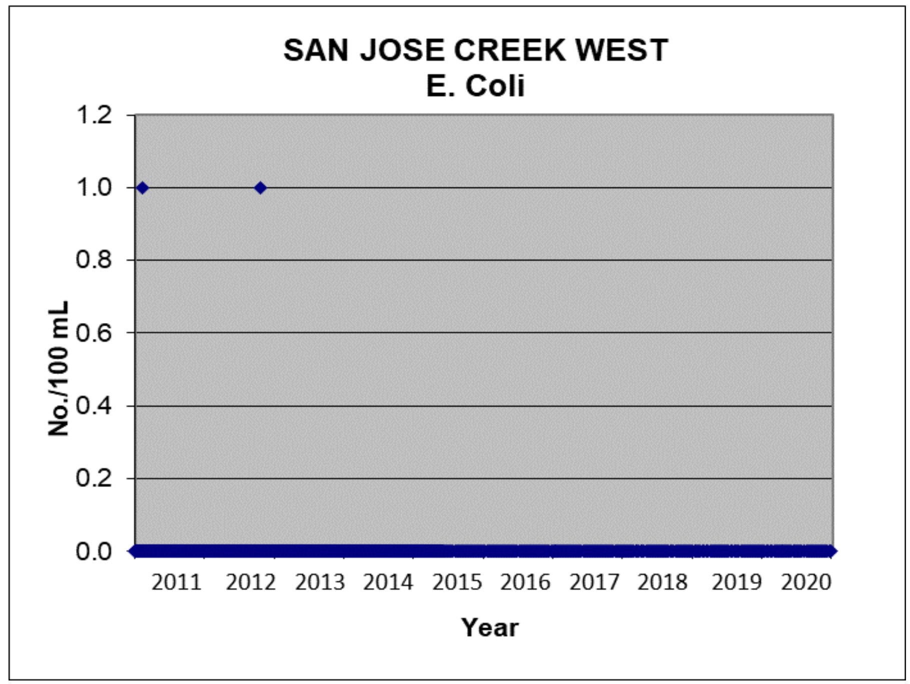


San Jose Creek West Water Reclamation Plant

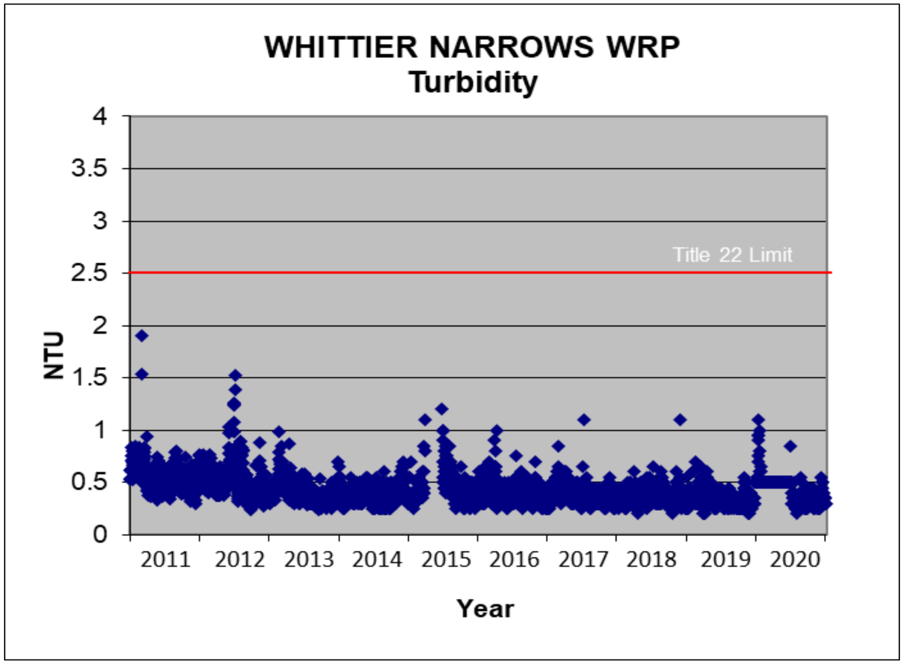


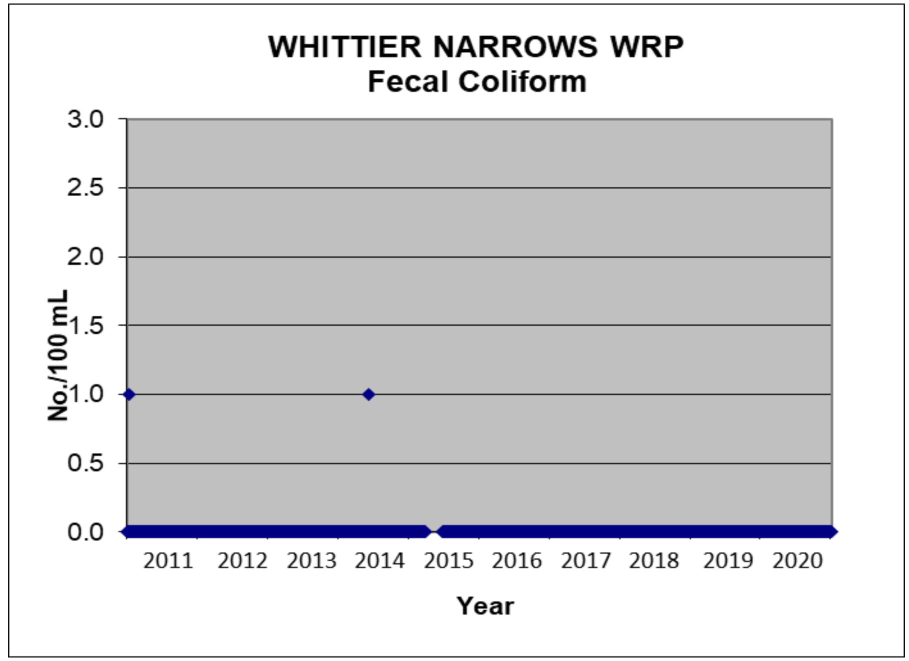


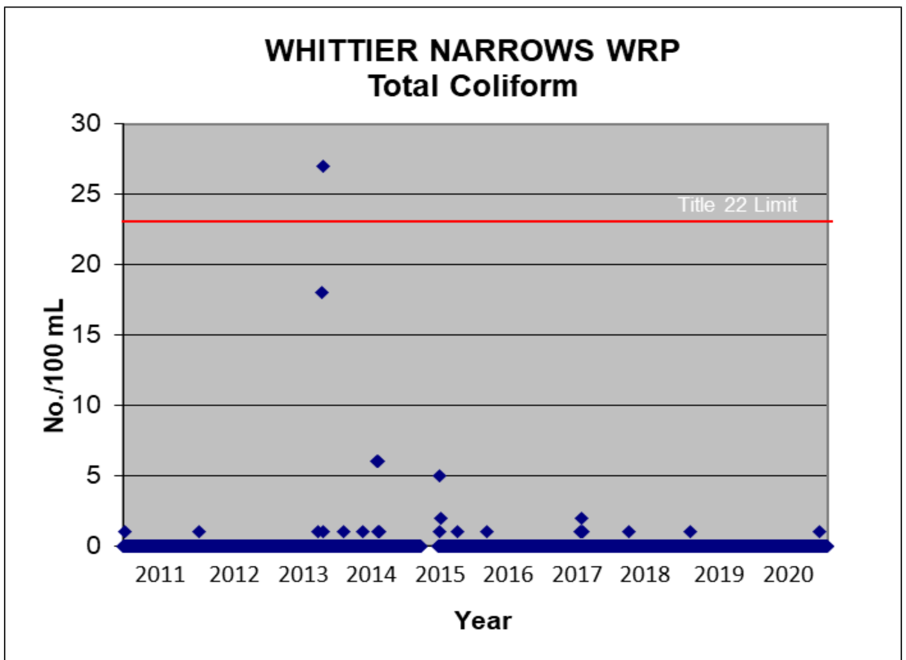


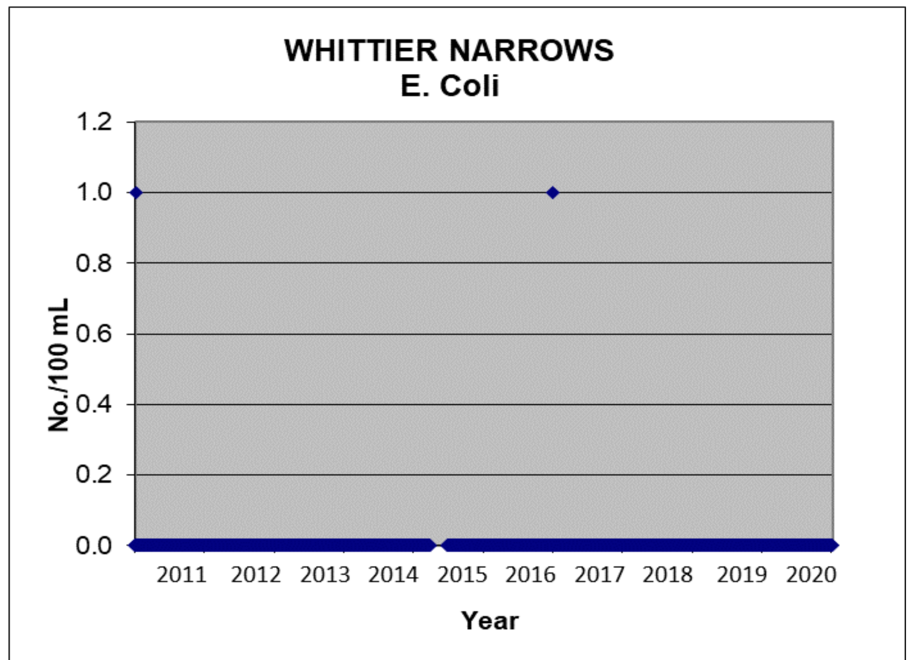


Whittier Narrows Water Reclamation Plant

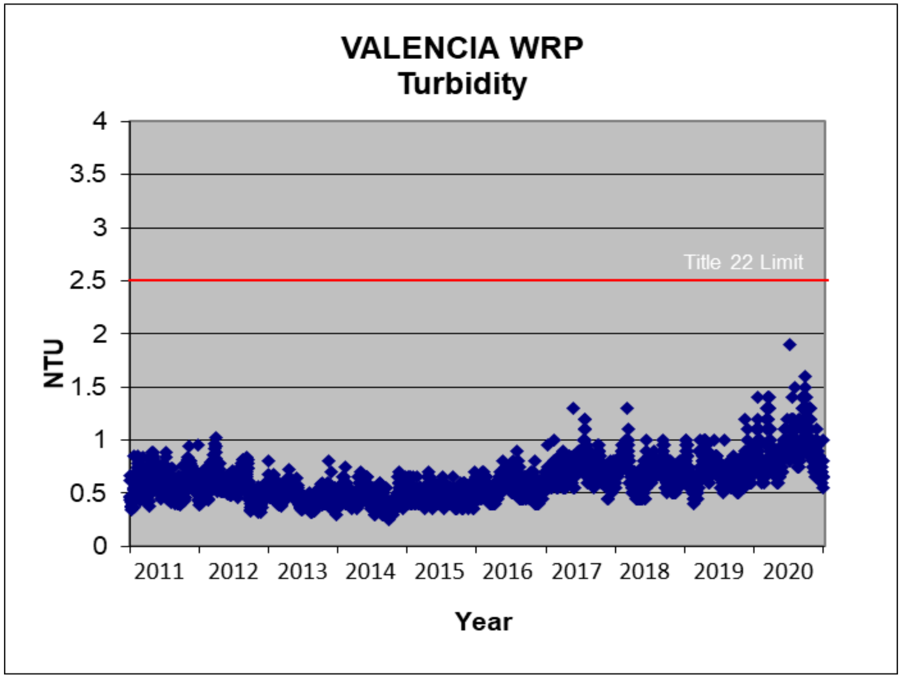


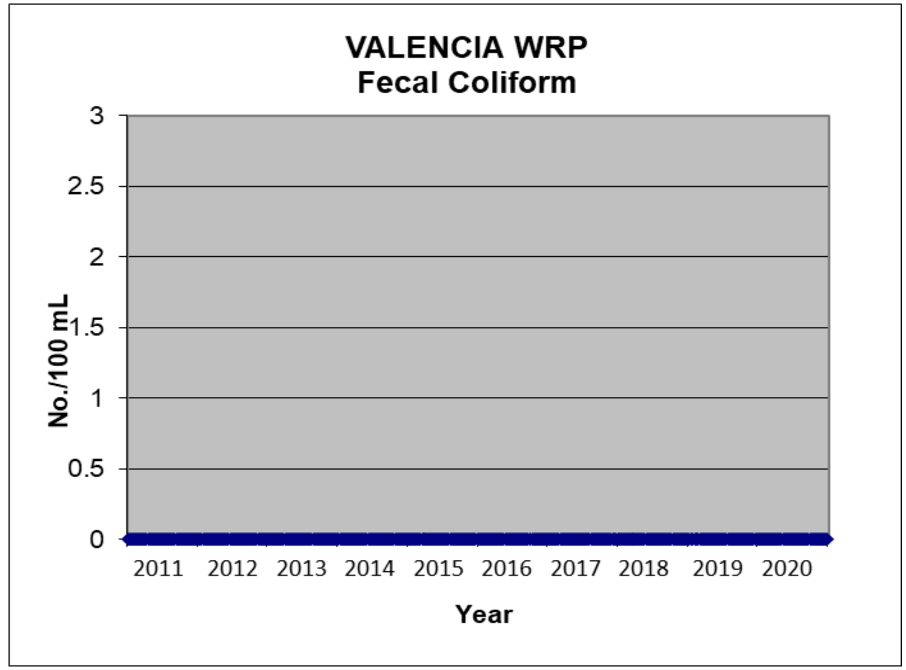


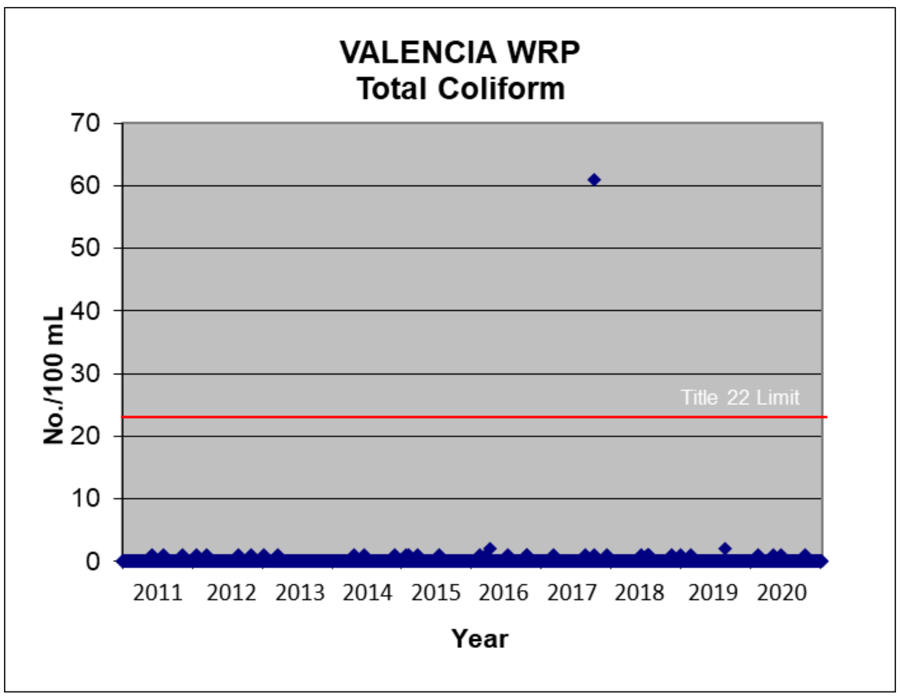




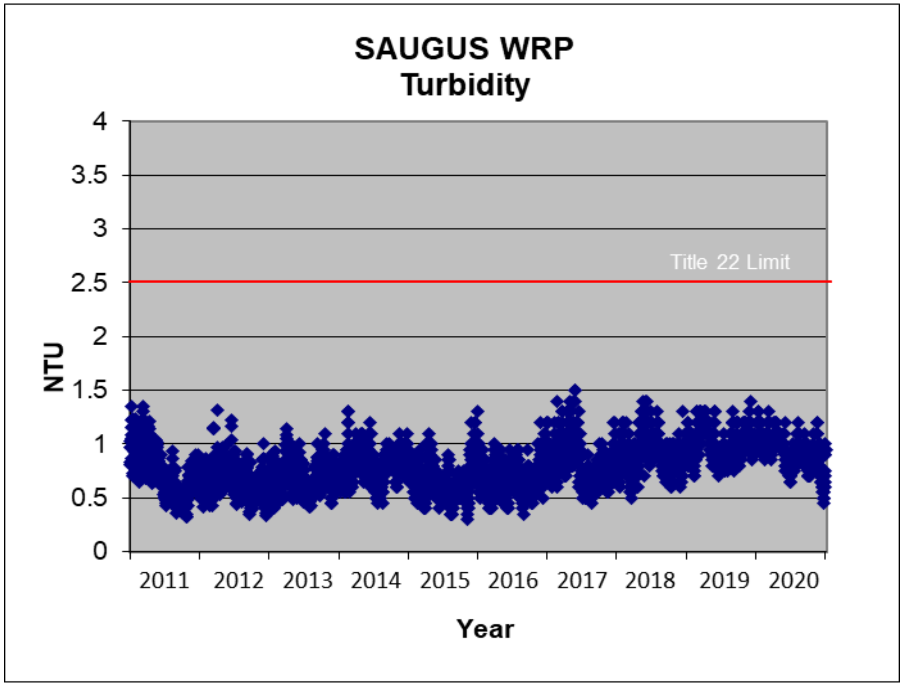
Valencia Water Reclamation Plant

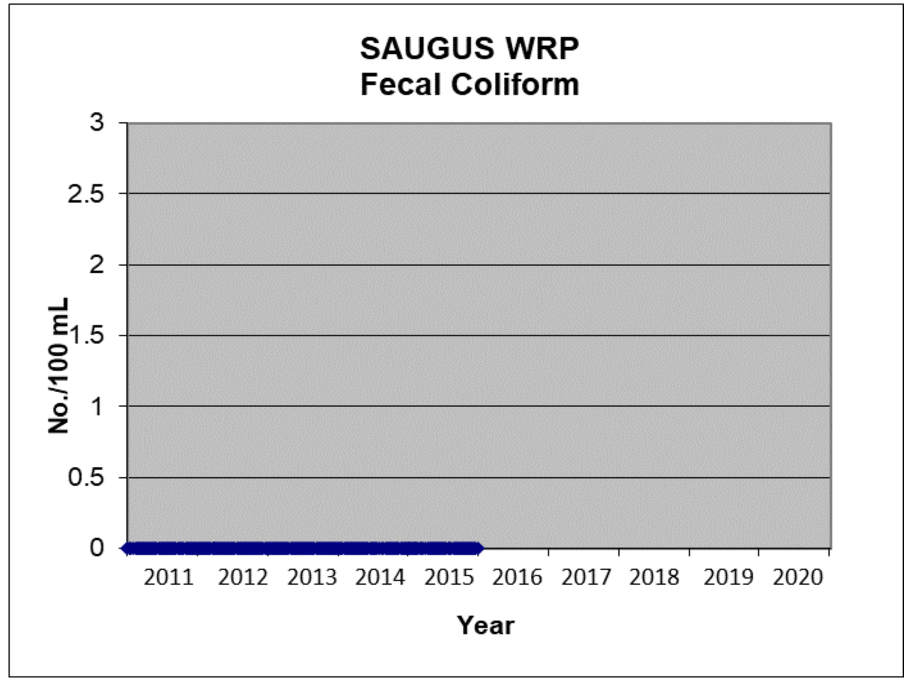


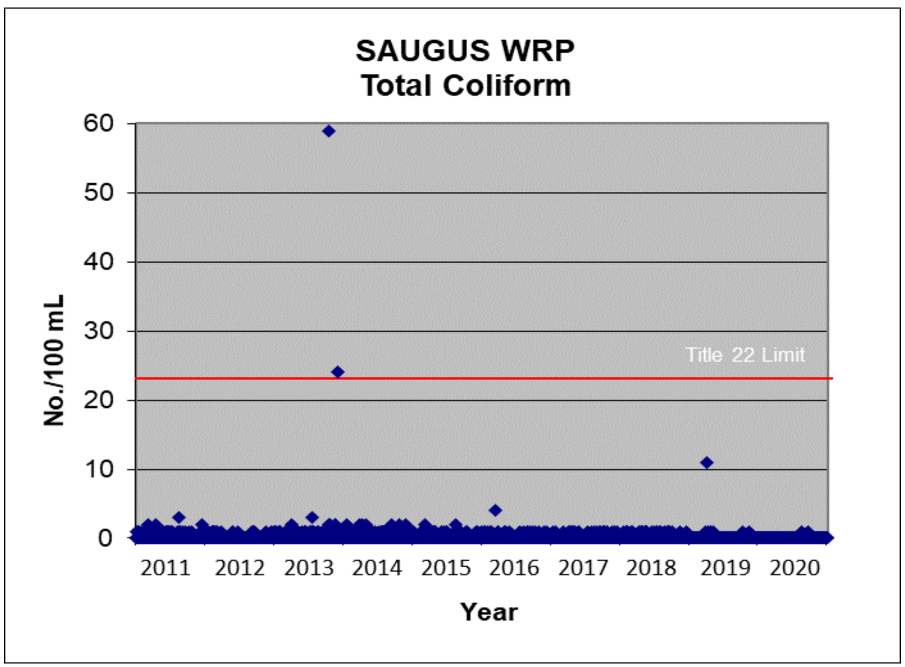


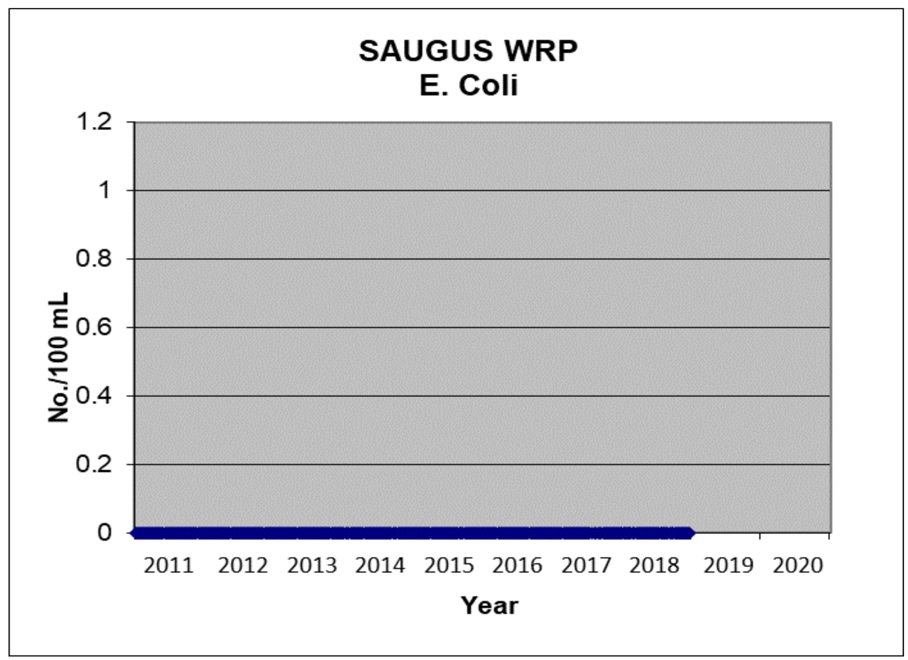


Saugus Water Reclamation Plant

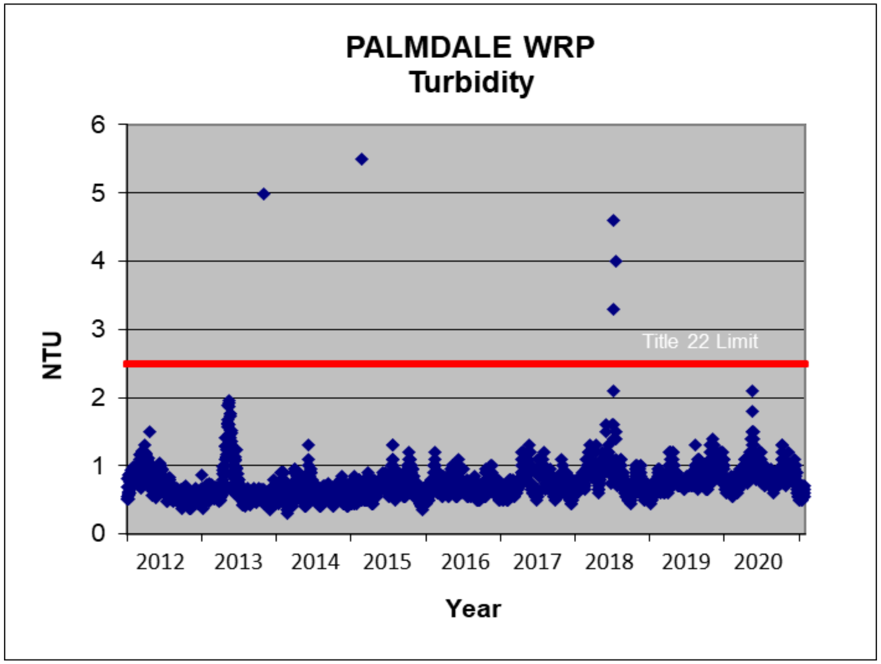


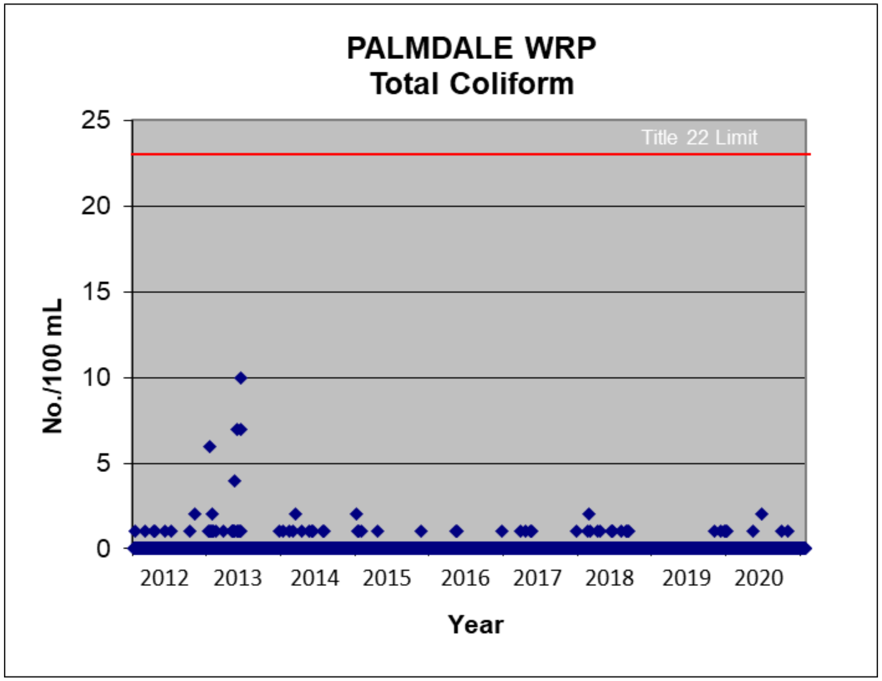




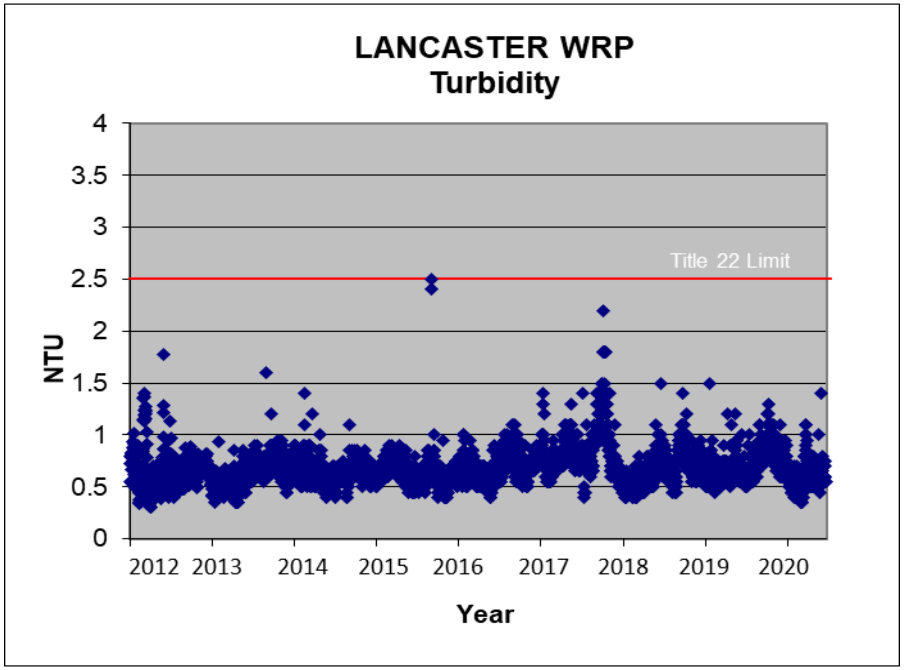


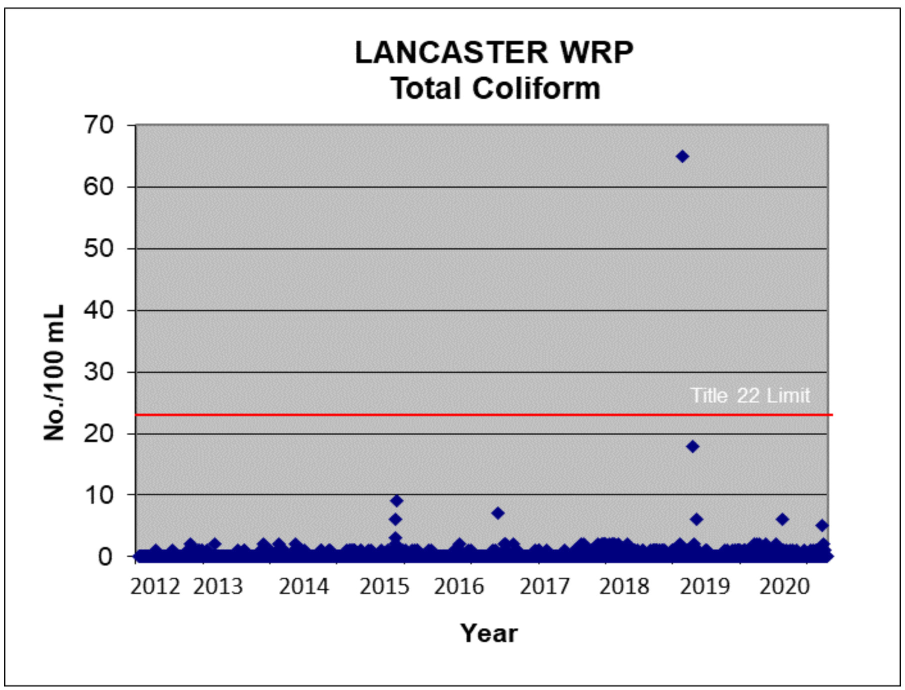
Palmdale Water Reclamation Plant



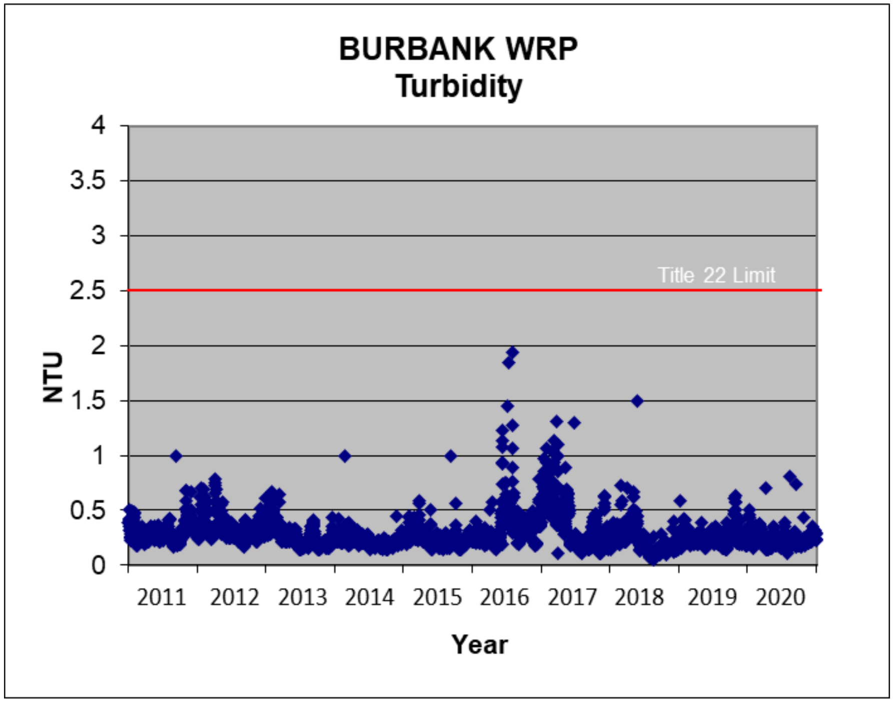


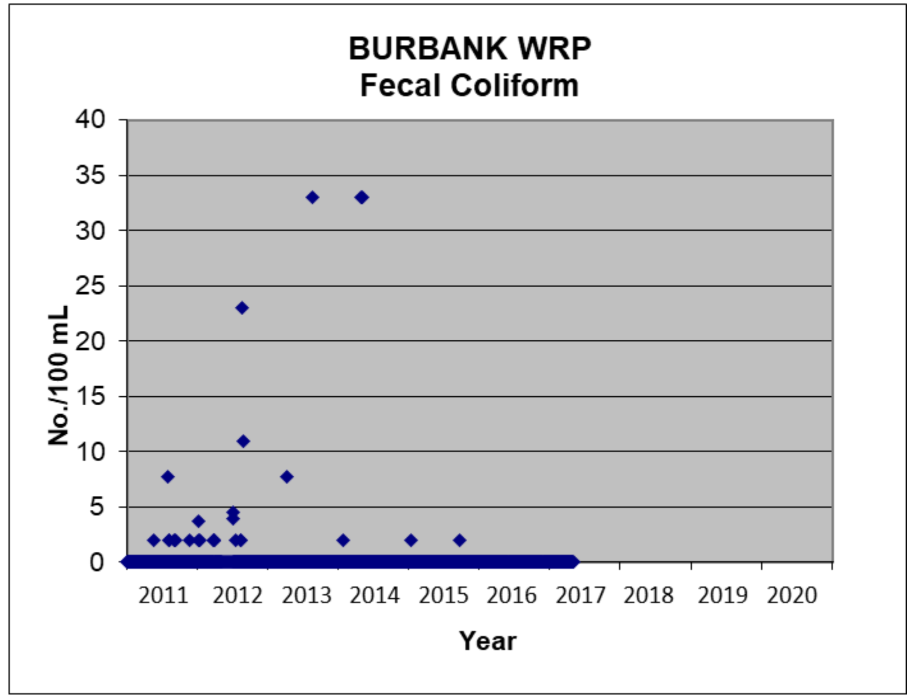
Lancaster Water Reclamation Plant

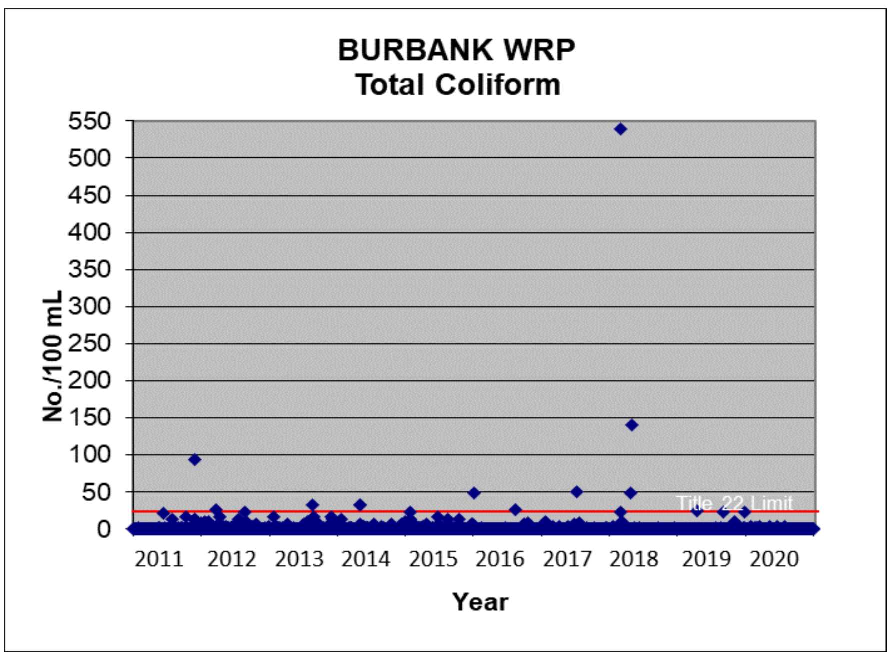


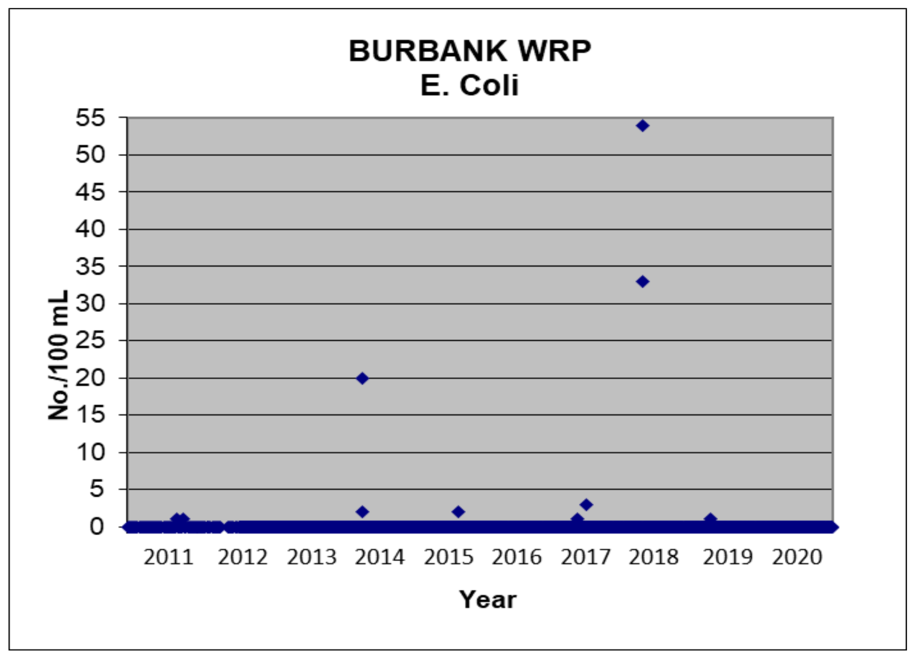


Burbank Water Reclamation Plant

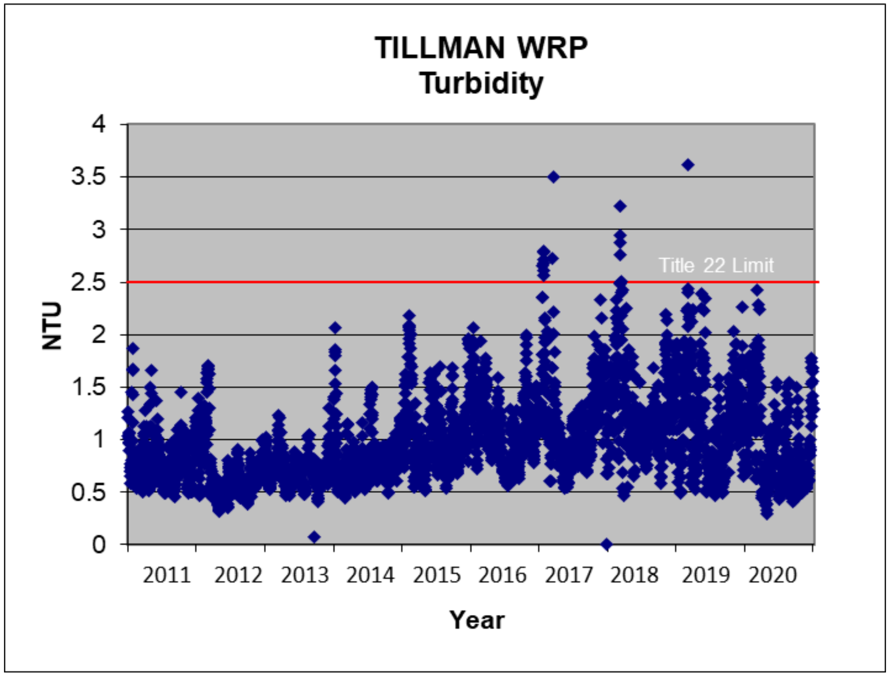


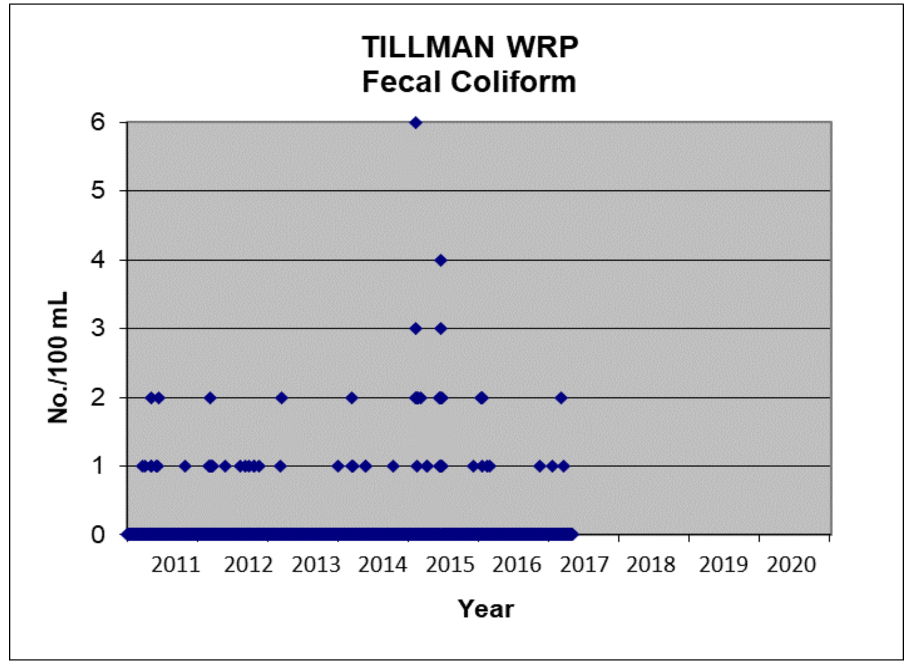


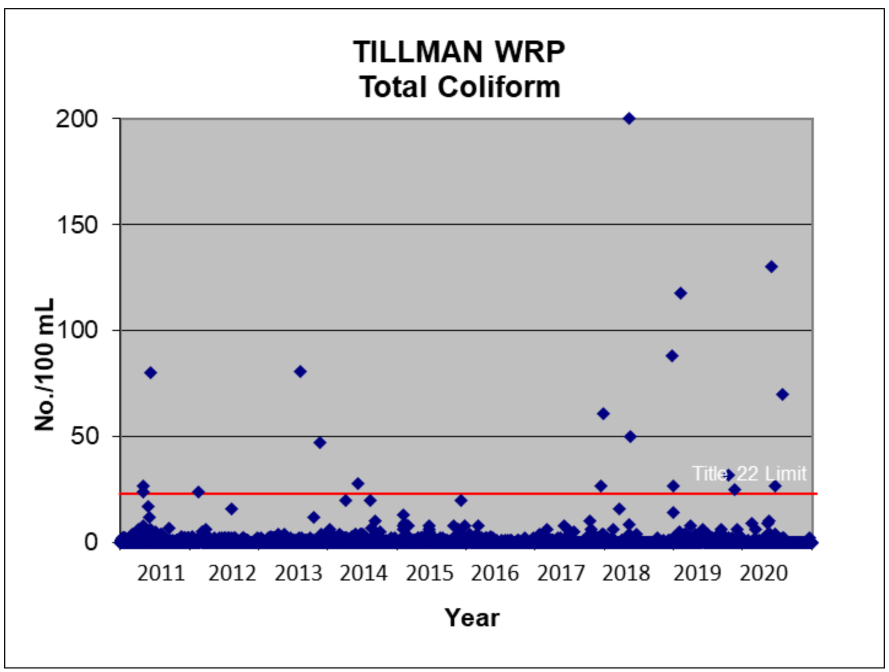


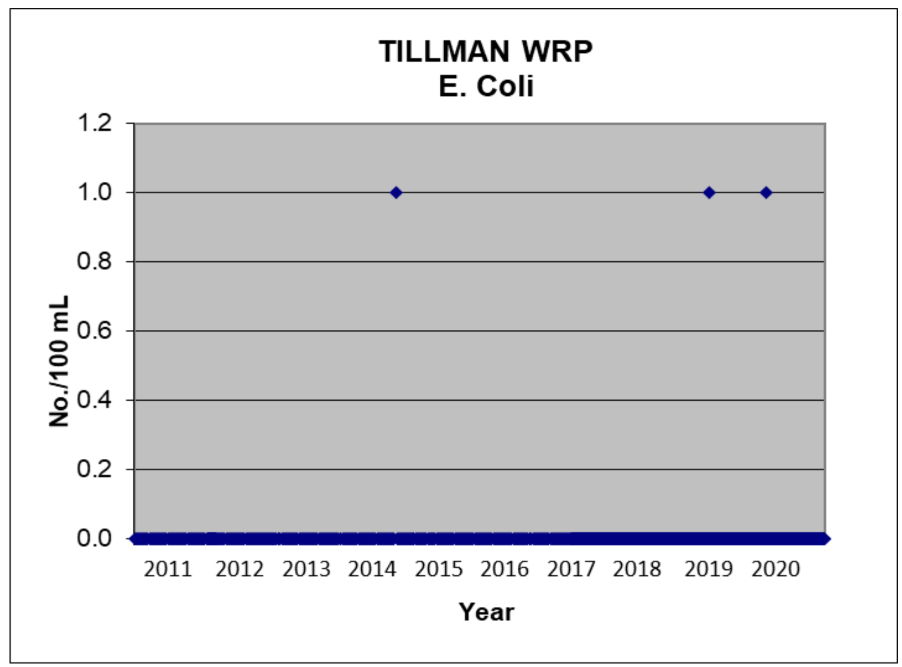


Donald C. Tillman Water Reclamation Plant

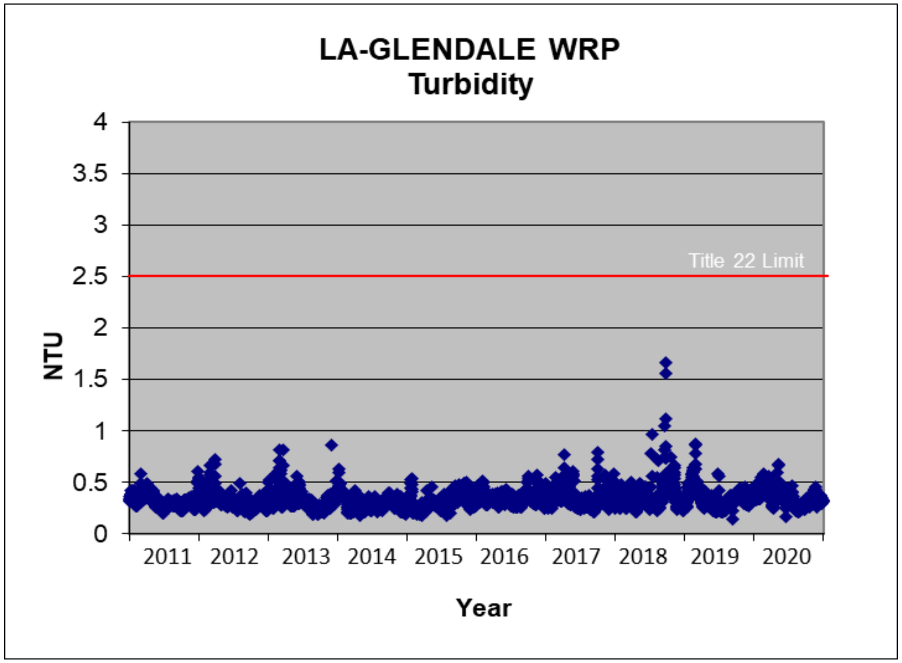


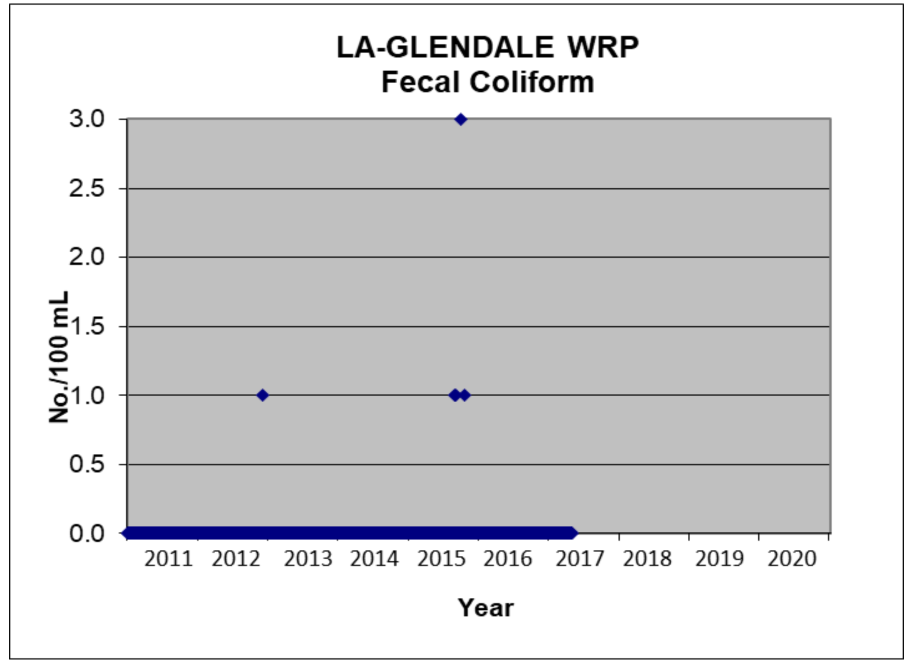


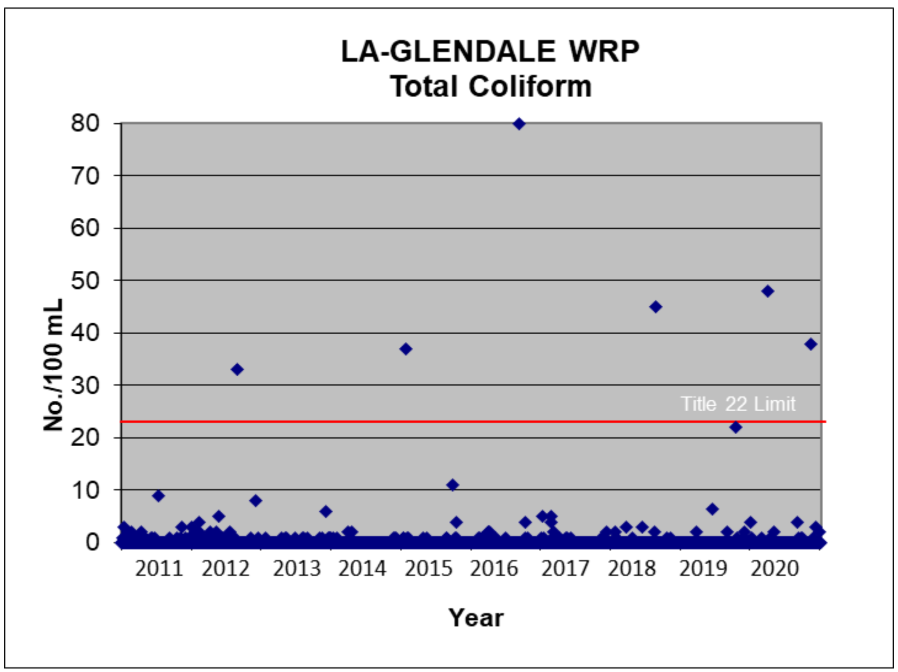


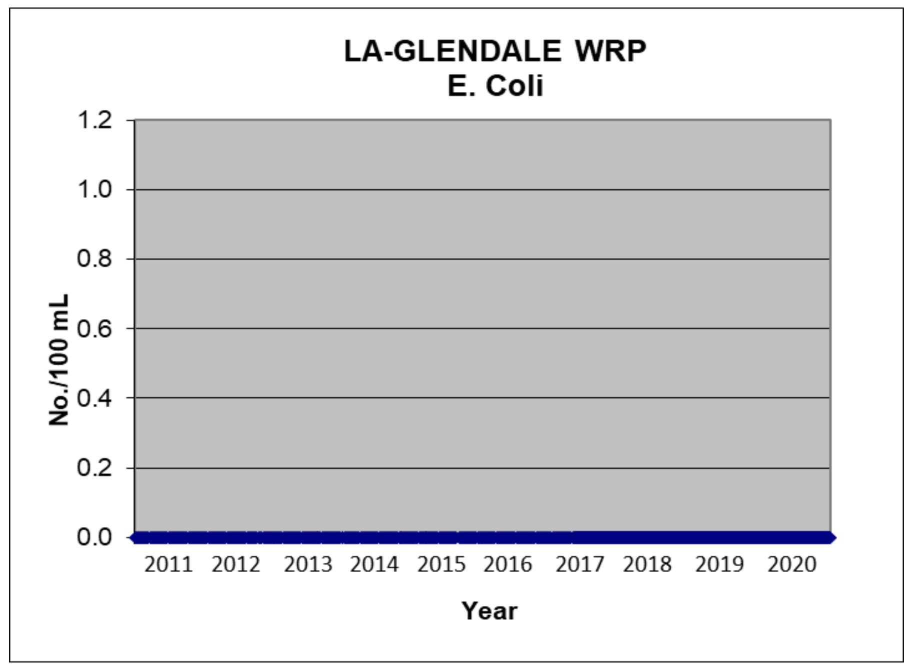


L.A.-Glendale Water Reclamation Plant

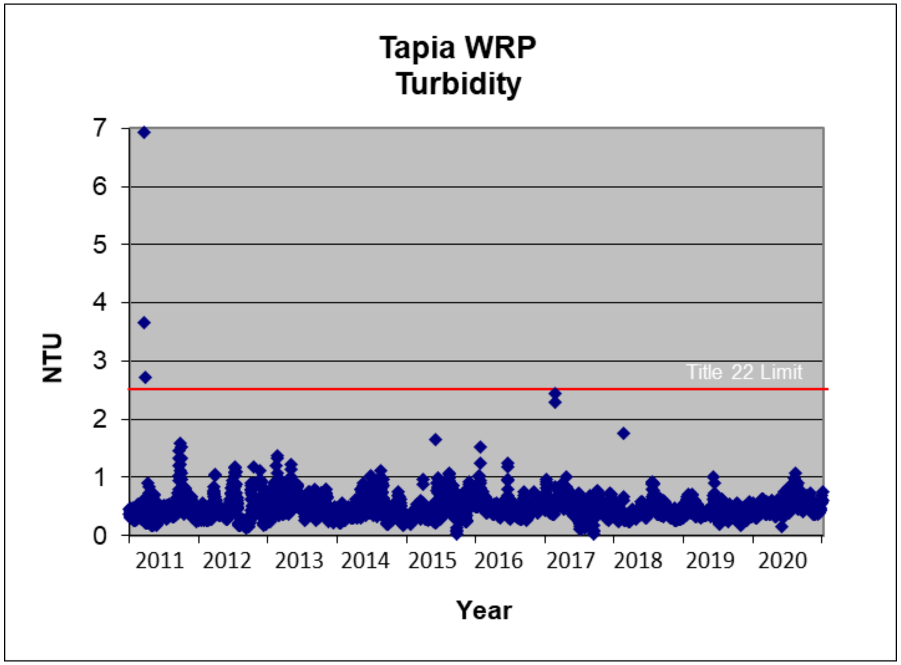


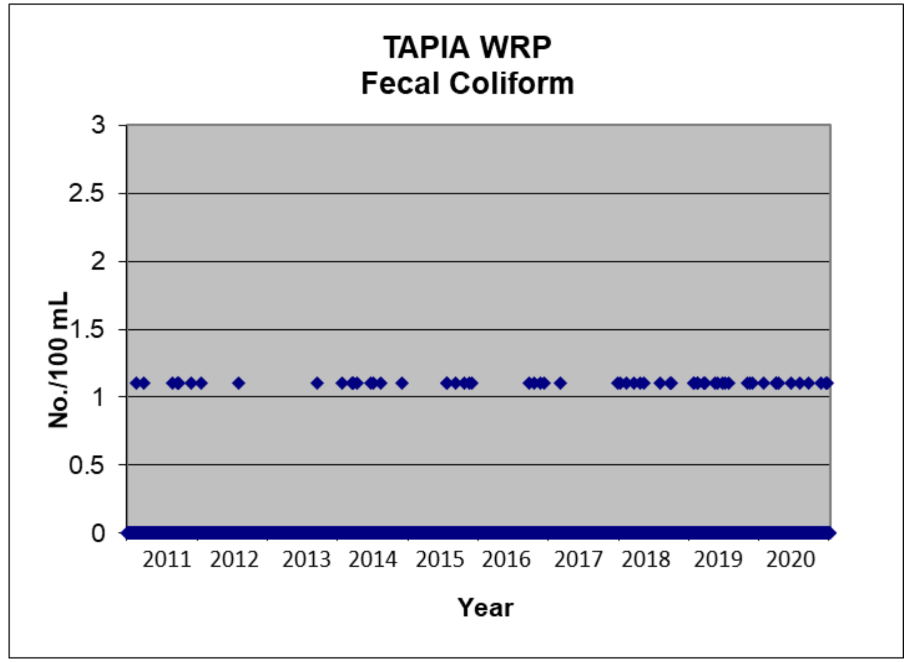


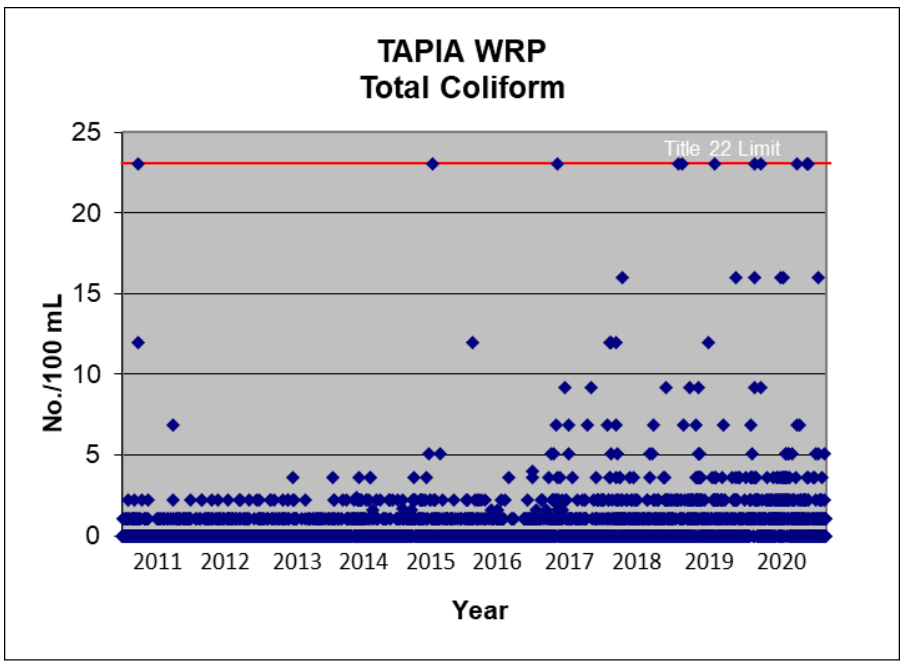


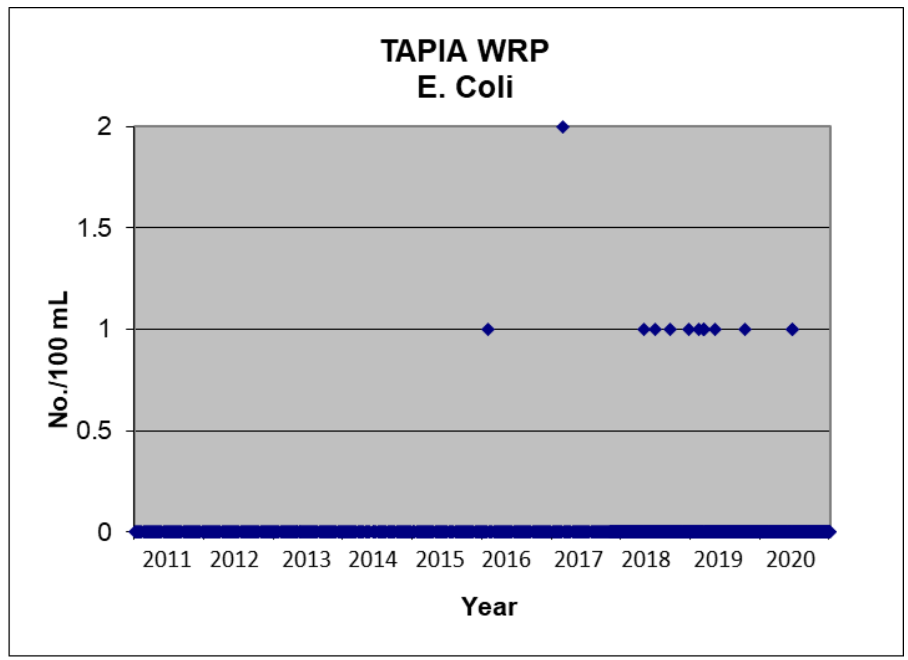


Tapia Water Reclamation Plant

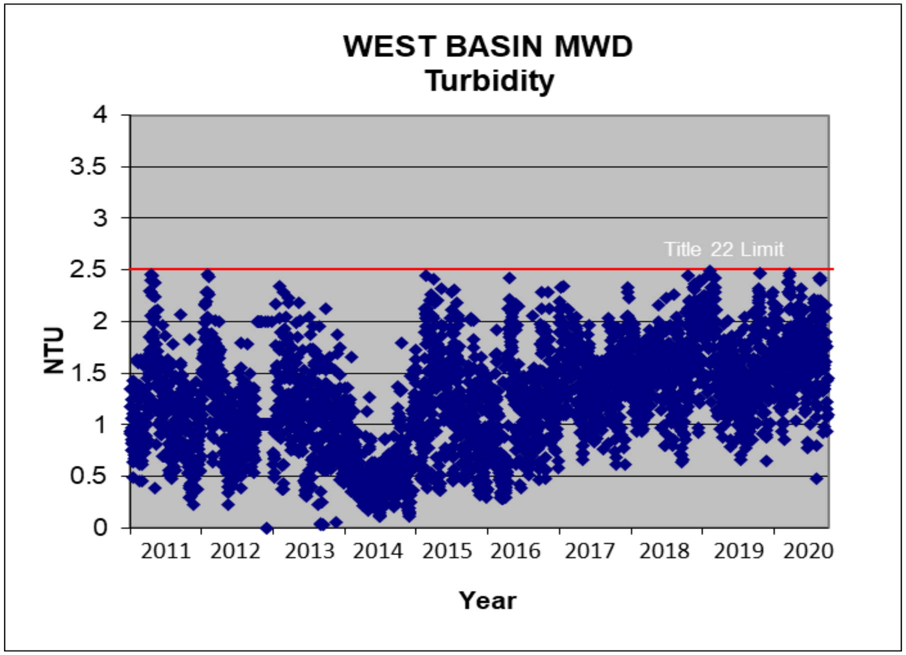


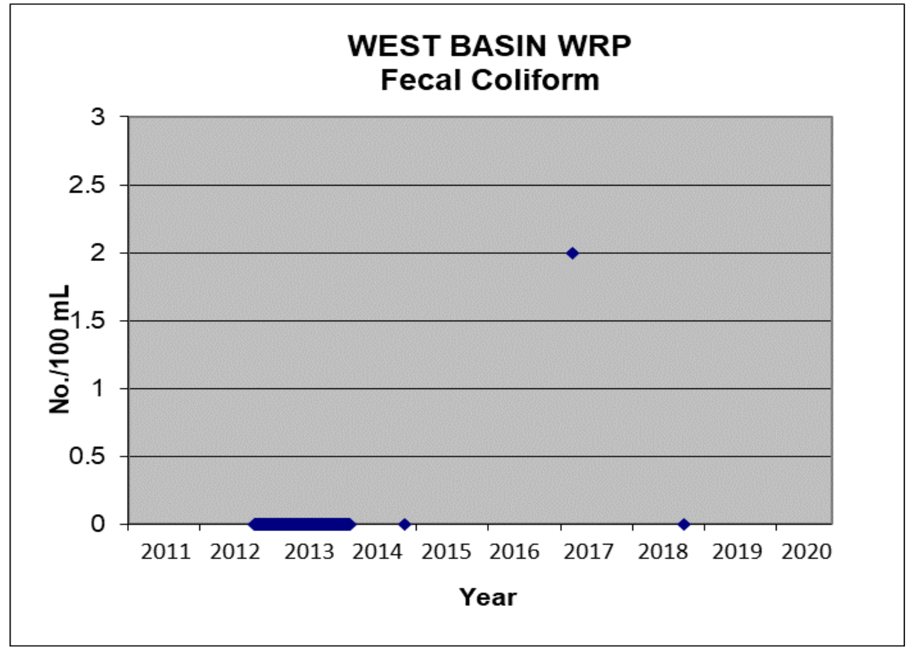


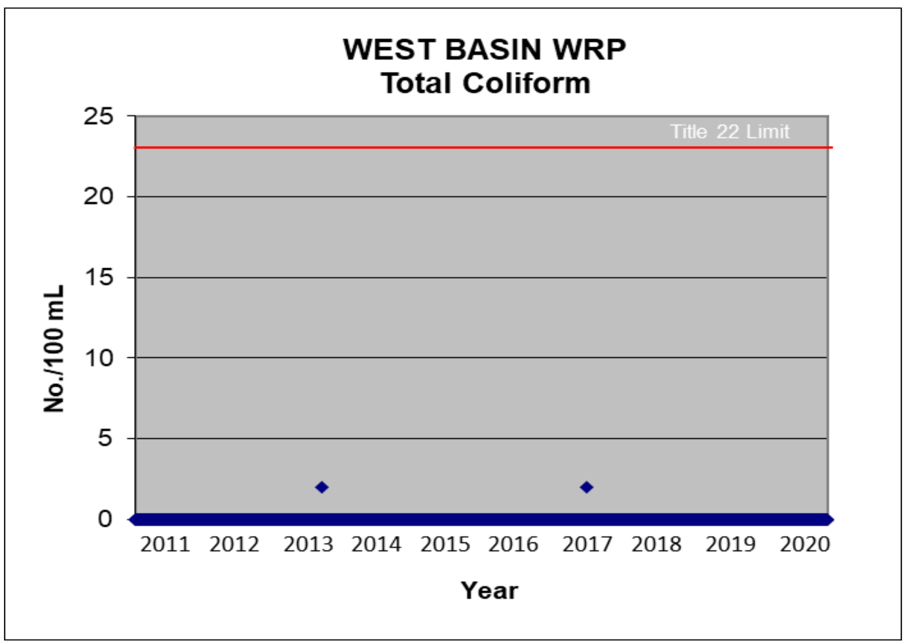




Edward Little (West Basin) Water Recycling Facility







APPENDIX B

Sanitation Districts Recycled Water Virus Monitoring

Table 5: Sanitation Districts' Recycled Water Virus Monitoring Summary

WRP	Sample Date Range	No. of Samples	No. of Detects	Total Sample Volume (gallons)
Long Beach	Jun. 1982 – Apr. 2010	178	1 *	45,658
Los Coyotes	Jun. 1982 – Apr. 2010	168	0	44,481
Pomona	Jan. 1979 – Nov. 2020	278	0	82,607
San Jose Creek East	Jan. 1979 – Nov. 2020	295	0	83,436
San Jose Creek West	Jan. 1994 – Nov. 2020	126	0	35,960
Whittier Narrows	Jan. 1979 – Nov. 2020	277	0	78,028
Valencia	Oct. 1984 – Oct. 2009	143	1	38,828
Saugus	Mar. 1995 – Oct. 2009	73	1	21,350
TOTALS		**1,538**	**3**	**430,348**

* Virus detection is suspected to be the result of laboratory contamination.

APPENDIX C

Sanitation Districts Recycled Water Compliance with Drinking Water Standards

Table 6: Sanitation Districts' Recycled Water 2019-20 Annual Averages vs. Primary Drinking Water Standards

Constituent	Units	SJC-E	SJC-W	WN	POM	Primary MCL
Aluminum	µg/L	3.03	3.33	45.1	35.4	1,000
Antimony	µg/L	0.56	0.30	0.088	0.25	6
Arsenic	µg/L	0.650	0.688	ND	0.295	10
Asbestos	MFL	ND	ND	ND	ND	7
Barium	µg/L	72.6	38.7	34.3	37.2	1,000
Beryllium	µg/L	ND	ND	ND	ND	4
Cadmium	µg/L	ND	ND	ND	ND	5
Chromium (total)	µg/L	0.79	0.85	0.87	1.0	50
Cyanide	Mg/L	ND	ND	ND	ND	0.15
Fluoride	mg/L	0.384	0.555	0.584	0.247	2
Mercury	µg/L	0.0030	0.0023	0.0014	0.0027	2
Nickel	µg/L	2.35	1.78	6.59	1.57	100
Nitrate + Nitrite (as nitrogen)	mg/L	6.57	6.38	6.81	6.48	10
Nitrite (as nitrogen)	mg/L	0.0079	0.16	0.13	0.11	1
Selenium	µg/L	ND	ND	ND	ND	50
Thallium	µg/L	ND	ND	ND	ND	2
Gross alpha radioactivity	pCi/L	2.05	0.60	1.75	1.56	15
Radium 226 + 228	pCi/L	0.11	0.19	0.12	ND	5
Strontium-90	pCi/L	0.232	0.157	0.102	ND	8
Tritium	pCi/L	ND	ND	ND	ND	20,000
Uranium	pCi/L	0.414	1.23	1.37	0.425	20
1,1-dichloroethane	µg/L	ND	ND	ND	ND	5
1,1-dichloroethene	µg/L	ND	ND	ND	ND	6
1,1,1-trichlorethane	µg/L	ND	ND	ND	ND	200
1,1,2-trichloro-1,2,2-trifluoroethane	µg/L	ND	ND	ND	ND	1200
1,1,2-trichlorethane	µg/L	ND	ND	ND	ND	5
1,1,2,2-tetrachlorethane	µg/L	ND	ND	ND	ND	1
1,2-dibromo-3-chloropropane	µg/L	ND	ND	ND	ND	0.2
1,2-dibromoethane	µg/L	ND	ND	ND	ND	0.05
1,2-dichloroethane	µg/L	ND	ND	ND	ND	0.5
1,2-dichloropropane	µg/L	ND	ND	ND	ND	5
1,2,3-trichloropropane	µg/L	0.0085	0.0018	ND	ND	0.005
1,2,4-trichlorobenzene	µg/L	ND	ND	ND	ND	5
1,3-dichloropropene	µg/L	ND	ND	ND	ND	0.5
2,3,7,8-TCDD	µg/L	ND	ND	ND	ND	0.00003
2,4-D	µg/L	ND	ND	ND	ND	70
2,4,5-TP (silvex)	µg/L	ND	ND	ND	ND	50
Alachlor (Lasso)	µg/L	ND	ND	ND	ND	2
Atrazine	µg/L	ND	ND	ND	ND	1
Bentazon	µg/L	ND	ND	ND	ND	18
Benzene	µg/L	ND	ND	ND	ND	1
Benzo(a)pyrene	µg/L	ND	ND	ND	ND	0.2
bis(2-ethylhexyl) phthalate	µg/L	ND	ND	ND	ND	4
Bromate	µg/L	ND	ND	ND	ND	10
Carbofuran	µg/L	ND	ND	ND	ND	18

Carbon tetrachloride	µg/L	ND	ND	ND	ND	0.5
Chlorite	µg/L	ND	ND	ND	ND	1000
Chlorobenzene	µg/L	ND	ND	ND	ND	70
cis-1,2-dichlorethene	µg/L	ND	ND	ND	ND	6
Dalapon	µg/L	0.40	0.13	ND	0.17	200
Di(2-ethylhexyl)adipate	µg/L	ND	ND	ND	ND	400
Dinoseb	ND	ND	ND	ND	ND	7
Diquat	µg/L	ND	ND	ND	ND	20
Endothall	µg/L	ND	ND	ND	ND	100
Endrin	µg/L	ND	ND	ND	ND	2
Ethylbenzene	µg/L	ND	ND	ND	ND	300
gamma-BHC (lindane)	µg/L	ND	ND	ND	ND	0.2
Glyphosate	µg/L	3.3	ND	ND	ND	700
Haloacetic acids (HAA5)	µg/L	58	26	6.7	29	60
Heptachlor	µg/L	ND	ND	ND	ND	0.01
Heptachlor epoxide	µg/L	ND	ND	ND	ND	0.01
Hexachlorobenzene	µg/L	ND	ND	ND	ND	1
Hexachlorocyclopentadiene	µg/L	ND	ND	ND	ND	50
Methoxychlor	µg/L	ND	ND	ND	ND	30
Methylene chloride	µg/L	ND	ND	ND	ND	5
Molinate	µg/L	ND	ND	ND	ND	20
o-dichlorobenzene	µg/L	ND	ND	ND	ND	600
Oxamyl	µg/L	ND	ND	ND	ND	50
p-dichlorobenzene	µg/L	ND	ND	ND	ND	5
Pentachlorophenol	µg/L	ND	ND	ND	ND	1
Perchlorate	µg/L	0.39	0.5	0.3	0.37	6
Picloram	µg/L	ND	ND	ND	ND	500
Polychlorinated biphenyls (PCBs)	µg/L	ND	ND	ND	ND	0.5
Simazine	µg/L	ND	ND	ND	ND	4
Styrene	µg/L	ND	ND	ND	ND	100
Technical chlordane	µg/L	ND	ND	ND	ND	0.1
Tert-butyl methyl ether (MTBE)	µg/L	ND	ND	ND	ND	13
Tetrachloroethene	µg/L	ND	ND	ND	ND	5
Thiobencarb	µg/L	ND	ND	ND	ND	70
Toluene	µg/L	ND	ND	0.087	0.09	150
Total trihalomethanes	ug/L	69.2	41	14.6	41.6	80
Toxaphene	µg/L	ND	ND	ND	ND	3
trans-1,2-dichlorethene	µg/L	ND	ND	ND	ND	10
Trichloroethene	µg/L	ND	ND	ND	ND	5
Trichlorofluoromethane	µg/L	ND	ND	ND	ND	150
Vinyl chloride	µg/L	ND	ND	ND	ND	0.5
Xylenes	µg/L	ND	ND	ND	ND	1,750

ND = not detected
SJC-E = San Jose Creek WRP, East
SJC-W = San Jose Creek WRP, West
MCL = Maximum Contaminant Level
WN = Whittier Narrows WR
POM = Pomona WRP

Table 7: Sanitation Districts' Recycled Water 2019-20 Annual Averages vs. Secondary Drinking Water Standards

Constituent	Units	SJC-E	SJC-W	WN	POM	Secondary MCL
Aluminum	µg/L	3.03	3.33	45.1	35.4	200
Color	CU	8	14	13	12	15
Copper	µg/L	4.31	5.49	3.22	5.70	1,000
Iron	µg/L	36	45	35.3	33.5	300
Manganese	µg/L	10.5	6.67	3.84	6.35	50
Odor	T.O.N	29	21	67	120	3
Silver	µg/L	ND	ND	ND	ND	100
Surfactant (MBAS)	mg/L	0.0066	0.0066	0.0042	0.0098	0.5
Tert-butyl methyl ether (MTBE)	µg/L	ND	ND	ND	ND	5
Thiobencarb	µg/L	ND	ND	ND	ND	1
Zinc	µg/L	55.5	55.7	54.3	69.4	5,000

ND = not detected
SJC-E = San Jose Creek WRP, East
SJC-W = San Jose Creek WRP, West
MCL = Maximum Contaminant Level
WN = Whittier Narrows WR
POM = Pomona WRP

APPENDIX D

Sanitation Districts of Los Angeles County

The Sanitation Districts operate 11 wastewater treatment facilities, 10 of which are classified as WRPs. All but the smallest of these WRPs (in La Cañada-Flintridge) are tertiary treatment plants, meaning wastewater that has undergone primary sedimentation and secondary biological oxidation and clarification, is then subjected to tertiary coagulation, inert-media filtration and chemical disinfection (note: the last treatment stage is similar to that which takes place in a drinking water treatment plant). The objective of the tertiary treatment process is to remove suspended solids and particulate matter in order to enhance the inactivation of bacteria and virus through the addition of disinfectants. As mentioned previously, the quality of water at that treatment level has been approved by the DDW for all direct reuse applications contained in their Title 22 Water Recycling Criteria, including structural and non-structural firefighting.

Five of the plants (San Jose Creek [East and West], Whittier Narrows, Pomona, Los Coyotes, and Long Beach) are in the eastern portion of the Metropolitan Los Angeles County and are known as the Joint Outfall System (JOS). Two other WRPs (Valencia and Saugus) serve the City of Santa Clarita. The final two WRPs serve the cities of Lancaster and Palmdale and have been upgraded to full tertiary treatment. While all nine WRPs consist of the same basic treatment train they do have significant differences. Their design capacities range from 6.5 million gallons per day (MGD) at the Saugus WRP to 62.5 MGD at the San Jose Creek WRP East. The plants also differ in the number and sizes of the various process tanks, the type of aeration system (conventional, step-feed, and/or nitrification/denitrification), aeration tank operation (serpentine vs. parallel), type of filter (pressure vs. gravity), filter media (dual media anthracite coal/sand vs. mono media anthracite vs. cloth), type of disinfectant (sodium hypochlorite or UV light), dosages of coagulants and disinfectants, tributary wastewater quality, and plant operational parameters. Yet despite these myriad differences, all the WRPs consistently produce high quality effluent that consistently meets every federal and state health-related drinking water standard, which allows the recycled water to be used for all applications contained in Title 22.

The Sanitation Districts have made a commitment to produce recycled water from all its WRPs that is adequately disinfected and meets all effluent water quality requirements set by the RWQCB and DDW for all reuse applications and for surface water discharges. To this end, numerous measures have been employed by the Sanitation Districts:

- ***Highly qualified and experienced plant operators:*** All the Sanitation Districts' tertiary treatment plants are staffed with State certified operators, each plant under the direction of a Plant Supervisor. Each of the Plant Supervisors are certified at the highest level of Grade V, with all having several decades worth of experience in wastewater treatment plant operations. The Plant Supervisors report to two Plant Superintendents and two Assistant Plant Superintendents, all of whom are certified at Grade V, and who can lend their considerable operational experience during non-standard operating situations or emergencies. It is this extensive experience that allows for all the Sanitation Districts' tertiary treatment facilities to maintain a consistently high effluent quality during normal operation and for rapid, appropriate, and effective responses to extraordinary or emergency situations that may threaten effluent quality.
- ***Real-time monitoring of critical parameters:*** Continuous real-time monitoring of influent pH alerts the plant operators to changes in the pH of the raw wastewater that could possibly be caused by an incompatible industrial waste entering the plant. Continuous real-time monitoring of secondary, filter, and final effluent turbidity warns the operators of an upset of the activated sludge process well in advance of noncompliant effluent leaving the plant. Issues such as these that are identified early can be corrected much more readily than if the conditions are allowed to degrade to the alarm point, at which time effluent discharge or recycled water violations could be more likely.
- ***Computerized Distributed Control System (DCS):*** The Sanitation Districts have installed state-of-the-art DCS at all its WRPs through which all the critical plant parameters can be monitored and

nearly all of the process equipment can be operated. Furthermore, the DCS computers at the plants not staffed 24-hours a day are linked to the DCS computers at the nearest WRP that has a full-time staff of operators, allowing for a certain degree of remote operations. One of the greatest advantages of the DCS is the fact that it gives the Plant Supervisor and his/her operators the ability to view long-term trends, such as rising turbidity or decreasing oxygen levels, and institute early corrective actions prior to reaching alarm conditions. Treatment facilities that are not staffed during the swing and graveyard shifts also have the advantage of operator oversight of these trends from a remote location. During an alarm condition, process changes can be made immediately to the remote facility (such as an increase in chlorine dosage) prior to an operator's arrival at that facility, saving precious time during an emergency. Even more process oversight is provided, as the Plant Superintendent can access the DCS of the various treatment plants that are his responsibility.

- ***Comprehensive Alarm System:*** A comprehensive alarm system immediately notifies the plant operators of any failure of process equipment or if any critical water quality parameter has exceeded its predetermined set-point. Plants that are not staffed 24-hours a day are equipped with call-out alarms that notify the nearest staffed WRP or, in some cases, the Plant Supervisor at home (with response times ranging from 30-60 minutes). These warning systems allow for the early detection of a problem so that the cause can be investigated, possible corrective actions evaluated, and remedial action taken before recycled water quality is adversely affected. Sets of procedures for addressing alarm conditions, notifying supervisors, and taking corrective actions have been developed for each individual WRP, although the specific actions must be determined after analyzing the alarm condition. In addition to alarms for equipment failure, there are also turbidity alarms for secondary, filter, and final effluent that are set at various levels and with different delay periods depending on the operational needs of each of the plants. Each turbidity alarm allows for potential effluent quality problems to be identified at several critical points in the overall treatment process so that recycled water quality is not degraded. Plant operators use secondary effluent as a gauge of water quality and can institute process changes (e.g., step-feed locations, dissolved oxygen concentrations, polymer addition) to resolve turbidity problems in the secondary treatment process before such problems even reach the filters.

- ***Back-up Power Supplies:*** All the Sanitation Districts' WRPs have preferred electrical service from Southern California Edison (SCE), some from multiple electrical system grids, to ensure a continuous power supply. In addition, all these WRPs have had emergency diesel generators permanently installed which allow for the plants to remain in full operation even during an extended power interruption or a catastrophic event.

- ***Preventive maintenance:*** All critical equipment, even that which is not in everyday use, undergoes regular service by a full complement of Sanitation Districts' electrical, instrumentation, and mechanical technicians.

- ***Emergency procedures:*** Incidents that can affect normal treatment plant operation are discharges of incompatible industrial wastes, power failure, process equipment failure, excessive rainfall runoff, earthquake, fire, etc. Most incidents that adversely impact the wastewater treatment process are minor, transitory, and/or cause little or no degradation of effluent quality.

- ***Procedures to Divert Off-Spec Effluent:*** It is the Sanitation Districts' policy to take any and all necessary actions to prevent and/or avoid discharging effluent that would violate any permit provisions. These provisions consist of waste discharge requirements (WDRs) and/or WRRs that are contained in the various river discharge and reuse permits issued by the RWQCB. However, if remedial actions taken by the operators cannot prevent the degradation of effluent quality below the reuse standards, then the plant operators are required to take actions that will minimize the adverse effects on human health and environmental quality. Certain conditions that are monitored real-time, that cannot be adequately rectified and that could even ***potentially*** result in an effluent violation would initiate an immediate shutdown of all deliveries of recycled water to direct, nonpotable recycled water distribution systems. Specifically, these conditions are color in the effluent, a filter bypass, or a severe, consistent increase in filter effluent turbidity (as evaluated at the time by the plant operators and supervisors). The recycled water pump stations are not restarted unless the plant effluent meets all the requirements for reuse (e.g., turbidity levels, adequate disinfection).

- ***Coagulation:*** All the Sanitation Districts' tertiary WRPs are equipped with the means to dose secondary wastewater with chemical coagulants upstream of the effluent filters. The addition of alum (aluminum sulfate in a 50% solution) and/or cationic polymer aids the filtration process by coagulating suspended solids for increased removal in the filters or the final clarifiers, respectively, and is usually done in response to increases in secondary, filter, and/or final effluent turbidity. Both the alum and cationic polymer coagulant systems at all the WRPs have the same routine preventive maintenance schedule to ensure proper operation whenever the respective coagulant is needed. Secondary effluent is normally dosed with alum as it is directly applied to the filters, without an intermediate flocculation tank. During a plant upset that results in increased turbidity and additional solids going to the effluent filters, the alum dosage to the secondary effluent can be increased. If necessary, the cationic polymer system can also be activated, resulting in an increase in solids removal in the final clarifiers and a decreased load on the effluent filters. Cationic polymer is most effective in reducing bacterial floc-related turbidity resulting from poor settling, solids carryover, or solids washout.

- ***Filtration:*** In order to enhance the disinfection process by the removal of particulate matter that may shield bacteria and virus from the disinfectant, the Sanitation Districts' WRPs have been equipped with inert media filters that operate below the maximum flow rate set by DDW. In order to eliminate clogging and loss of filtration capacity, the filters are periodically backwashed to remove organic material that has accumulated in the filter media, with a backwash interval of between 10 and 48 hours. Most of the WRPs have at least two triggers to initiate a backwash cycle, in order to prevent filter bypasses. The WRPs that do not are either staffed 24-hours a day or backwash the filters prior to the end of the workday.

- ***Disinfection:*** Disinfection of effluent leaving the Sanitation Districts' tertiary WRPs is accomplished by either sodium hypochlorite or UV light disinfection, followed by the addition of a chlorine residual for the recycled water distribution system. For the plants still using chlorine, the process of "sequential chlorination" has been developed to first dose the recycled water with free chlorine and then chloramines, a process that has been demonstrated to be more effective at inactivating virus than simple chlorination alone. All the WRPs are being operated so that there is a minimum of 3 mg/L of chlorine residual leaving the chlorine contact tanks (which have been covered to prevent sunlight from degrading the chlorine and promoting algal growth). Alarms are set for both low "IN" and "OUT" chlorine residuals to maintain this minimum residual, with additional alarms on the amount of chemical storage to ensure that enough disinfectant is on hand.

Emergency Procedures to Maintain Plant Operational Status

The following is a standard initial response to a plant alarm that is applicable at all the WRPs:

- Determine the cause and location of the alarm condition. Certain treatment plant buildings (e.g., Influent Pump Building, Electrical Building, and the chlorine and sulfur dioxide Storage Buildings) may have exterior flashing red lights that are individually actuated along with horns or other audible alarms when an alarm condition occurs in that particular building. All other alarms are indicated by the horns or other audible alarms only and are displayed on the DCS screens. Therefore, if the lights on the previously mentioned buildings are not lit, the operator must check the alarm annunciators on the local control panels and the panels in the Control Building.

- The alarm is silenced by pushing the appropriate "ACKNOWLEDGE" button. Depending on the nature of the alarm sounding and the severity of the situation, the operator is to contact the Plant Supervisor, the Plant Superintendent, or the Assistant Plant Superintendent either at work, at home, or by mobile phone.

- If applicable, place standby equipment into operation.
- Determine the cause of the failure and correct it if possible. If the procedure required to correct the alarm condition is too extensive to be handled by the personnel on hand, the Plant Supervisor or Plant Superintendent must be notified so that the additional personnel required to correct the malfunction can be contacted or supplied.

Specific responses to incidents that may result in discharge violations must be evaluated considering the specific conditions of the event. The appropriate actions that will avoid and/or prevent the degradation of the final effluent would then be taken.

Storm Flow Procedures

Of all the potential incidents that could adversely affect effluent quality, storm flow is not only the most likely to occur but can be anticipated and prepared for ahead of time using weather forecasts (unlike events such as earthquakes and fire which are very rare and completely unpredictable). The official rainy season is from November 1 to April 1. The primary objectives during storm flows are to prevent sewer overflows and to try to minimize negative effects on plant performance after the storm flow subsides. To this end, the Sanitation Districts' WRPs have hydraulic capacities that are approximately double their design capacities, allowing for much greater short-term (peak) plant flows.

If storm flow is not too heavy, off-specification effluent from the Whittier Narrows and Pomona WRPs can be returned to the sewer and off-specification water from San Jose Creek WRP (East or West) can be discharged to the lined portion of the San Gabriel River via the San Jose Creek Outfall, thus avoiding river discharge upstream of the spreading grounds. However, during heavy storm flows, final effluent must be discharged to the local waterways, as storage is neither possible nor available. During these periods, the effluent discharge is greatly diluted by several orders of magnitude in the vast amount of rainfall runoff, and public contact with the rivers is virtually nonexistent, due to the hazardous swift-water conditions that prevail. Heavy storm runoff can also result in river flow containing off-specification recycled water going directly to the ocean if the spreading grounds have been filled to capacity (as often happens during heavy storms). Also, during such events, irrigation demand (which makes up the vast majority of recycled water users) is at a minimum, so an operator shut-down of the recycled water delivery pumps due to a degradation of water quality below reuse standards generally does not cause any serious consequences for the landscape customers. Industrial users are normally equipped with a backup potable water supply for such situations.

Procedures for advance preparation, operation during storm flow conditions, and operation after storm flows are given below.

Advance Preparation for Storm Flows: Since storm flows depend upon the amount, intensity, and location of rainfall and the degree of soil saturation, it is not certain that the plant will experience abnormally high peak flows when it rains. However, preparation is essential. The operator must stay aware of the weather forecast and call the Weather Service if significant rainfall is predicted.

All equipment is prepared and maintained for maximum loading or output. If minor repairs are required to put critical equipment back into service and there is sufficient time to complete them, the repairs are made. Besides these general guidelines, the following tasks are completed before the arrival of storm flows.

- Backwash all filters.
- Mix a batch of cationic polymer.
- Open one additional step feed gate for each aeration unit, normally the next gate downstream from those already in use if the plant is in step-feed operation (if instructed to do so).

Operation During Storm Flow Conditions: The primary consideration during storm flows is to prevent an overflow in the sewerage system. A secondary consideration is to maintain adequate treatment to meet discharge requirements. The operator must pay specific attention to the amount of plant flow, to operation of the filters, and to maintaining adequate disinfection. If any violations occur, or if there is the possibility of having a violation, plant operators are instructed to immediately notify the Plant Supervisor. Specific operating procedures are given below for the various systems.

- Influent Pumping: Make sure the operable pumps are in automatic and set for the appropriate sequence. If necessary, sequence additional pumps.
- Primary Sedimentation: Make sure enough primary tanks are in service and check the wastewater level in the primary influent channel.
- Aeration System and Activated Sludge Process:
  1) Make sure there are enough step feed gates open to handle the plant flow. If more gates are needed, open the next gate(s) located downstream.
  2) As the plant flow increases above normal, increase the return sludge flow to maintain the normal ratio between return sludge and plant flows.
  3) Increase the air flow to the aeration tanks as required to maintain an acceptable dissolved oxygen level (a higher dissolved oxygen level is required to compensate for the reduced detention time; however, storm flows are weaker in organic matter).
- Effluent Filters:
  1) If it appears that plant flow will be extremely high, put every operable effluent filter into service and open the effluent valves 100 percent when needed.
  2) If the secondary effluent turbidity reaches a predetermined level on the strip chart or DCS (varies from plant to plant), start up the Cationic Polymer Feeding System and inject polymer at the aeration tanks' outlet gates. Use only enough polymer to bring the secondary effluent turbidity down to an acceptable level.
  3) When plant flows approach hydraulic capacity, keep a close watch on the chart or DCS indicating the water depth at the emergency bypass structure. A high-water alarm will sound prior to a partial filter bypass.
- Disinfection:
  1) Always maintain adequate disinfection.
  2) If there is a partial filter bypass, increase "IN" chlorine residual to 50% above the current set point to compensate for a loss of contact time.

Post Storm Flow Procedures:

- Check the condition of plant grounds, roads, and structures for settling, cracks, and leakage. Damage and/or defects are reported to Plant Supervisor.
- Check all electrical vaults and pull-boxes for water accumulation and use a siphon to drain them. Findings are reported to Plant Supervisor.

Power Failure

Although power outages are relatively rare events, they have occurred in the past. For example, the Northridge earthquake of 1994 damaged the SCE transformer serving the Valencia WRP and, on August 10, 1996, a nine-state blackout occurred that affected almost all the Sanitation Districts' treatment facilities. The loss of electrical power to the WRPs for an extended period can have serious, adverse impacts on plant operation and subsequent effluent quality. For the JOS, the smaller Pomona and Whittier Narrows WRPs have the capability to bypass all their influent wastewater around the plant downstream to the Sanitation Districts'

Joint Water Pollution Control Plant (JWPCP) in Carson for treatment. The Los Coyotes WRP can bypass all but peak influent flow to JWPCP. The San Jose Creek (East and West) and Long Beach WRPs do not have this option because there is insufficient downstream sewer capacity to handle all the additional influent flow from the plant. Some of the flow can be diverted back to the sewer, and during low flow conditions, all the flow. For the Santa Clarita system, some of the Saugus WRP flow can be bypassed to the Valencia WRP. However, there is no ability to bypass flow from the Valencia WRP since there is no other downstream treatment facility available. It must be noted that the aforementioned diversions and bypasses back into the sewer can be severely or even completely limited due to excess flow in the sewers during heavy storm events.

Once raw sewage enters the treatment plants, it flows by gravity through almost all of the treatment processes, eliminating the need for pumping. However, the wastewater does have to be pumped into the treatment plant, and electrical power is required for the backwash pumps, the chlorination equipment, the sludge handling equipment and, most important, the process air compressors (PACs) serving the secondary biological treatment process. All the WRPs have been equipped with backup generators to enable the plants to continue operation until full power has been restored. During plant power outages, delivery of recycled water, whether it meets the water reclamation requirements or not, can be manually interrupted. The pump stations are not restarted following restoration of plant power unless the recycled water meets the water reclamation requirements (e.g., turbidity, adequate disinfection). Effluent that does not meet the water reclamation requirements is returned to the sewer, if possible, or discharged to the river.

The following are general procedures that are followed by the operators at each WRP in the event of power loss to the entire plant, or to individual pieces of equipment.

Entire Plant: In the event of power failure to the entire plant, the following procedures are followed:

- Call SCE to inform them of the power failure and to find out how long the interruption of service will last. Only power failure phones can be used.
- Plant Supervisor, Plant Superintendent, and/or the Assistant Plant Superintendent are notified.
- Shut off the breakers located in the breaker box adjacent to the PAC Building (only if applicable for a particular plant). If these breakers are not shut off, a power surge during resumption of service may damage the instruments.
- If SCE says that the power interruption will last more than 10 minutes, start the emergency generator. (Note: San Jose Creek WRP has individual, interconnected substations serving the East and West sides. Each substation has enough capacity to serve both sides of the plant if a power interruption affects the other.) If the Standby Generator will not start after many repeated attempts, notify the Plant Supervisor, Superintendent, or Assistant Superintendent that the Standby Generator will not start. Ask for instructions on how to proceed.
- As soon as power is restored, do the following:
  1) Reset the Control Building breaker if it has been tripped.
  2) Turn on the breakers at the appropriate Control Panel.
  3) Check the influent pumps for proper operation.
  4) Make sure that one of the instrument air compressors is running.
  5) If the plant is using SCE's power, start the PACs.
  6) Take the appropriate steps to restart the Chlorination and Dechlorination Systems (these vary from plant to plant based on different equipment and disinfectants in use).

- After the vital plant systems have been put into operation, the operator conducts plant rounds and performs the following:

1) Check every pump and motor.

2) Make sure all samplers and turbidity meters are turned on.

3) Check all electrical panels and make sure all breakers are in proper positions.

Individual Equipment: In the event of power failure to any individual piece of equipment in the plant, the following procedure is followed:

- Notify the Plant Supervisor.
- If appropriate, throw the circuit breaker to the faulty piece of equipment to the "OFF" position. This is not always done, as newer types of equipment (e.g., PACs, variable speed drives) have built-in diagnostics, and turning power off will reset the card and prevent the diagnostic function from being performed. Such equipment is readily distinguishable from equipment that is not equipped with diagnostics.
- Notify the Sanitation Districts' electricians of the malfunction.
- Under no circumstances should any of the plant operators attempt to repair an electrical failure within the plant unless the repair only consists of resetting the breaker and pushing the "RESET" buttons.
- The operator informs the arriving electrician of any events which could possibly have led to the failure.

Earthquake

During an earthquake, the primary concern of an operator should be to protect him or herself from injury. Once the quake has subsided, there are certain procedures which are followed. These consist of checking the plant for damages and restarting equipment where necessary. The following actions are taken:

- Account for all personnel.
- All structures, buildings, tanks, galleries, etc., are checked for cracks or any other type of structural damage.
- Check all machinery for damage or realignment which could have occurred during the quake. Especially check the mountings of all heavy machinery (e.g., PACs, influent pumps, return sludge pumps, etc.) for cracks and broken bolts which could allow the equipment to shift or break loose during normal operation.
- After the equipment and structures have been visibly checked and appear to be undamaged, restart any equipment which was shut down due to the quake.
- The chlorination and dechlorination facilities should be checked very closely for any leaks which could have occurred during the quake, since such leaks are potentially very dangerous.
- Check all plant piping for leaks and damage.
- Contact the Plant Superintendent within 15 minutes for a status report.

Following completion of these emergency procedures, the plant operators can then evaluate water quality to determine if the recycled water meets reuse requirements (e.g., turbidity levels, adequate disinfection). Off-specification effluent is either returned to the sewer, if possible, or discharged into the river (away from the unlined portion or the spreading grounds, if possible). Recycled water deliveries are not to resume until the effluent quality meets the water reclamation requirements.

Fire

In the event of fire, the operator on duty assesses the severity and type (e.g., electrical, chemical, etc.) of fire. The local fire department is then notified immediately. Firefighting equipment, good for any type of fire, has been provided throughout the WRPs for use in extinguishing fires, if possible, or preventing the spread of fires. In the event a fire cannot be extinguished by plant personnel, the following general procedures are then followed to prevent further spread of the fire and damage to the equipment.

- Notify the Fire Department at 911 and the Plant Supervisor as soon as possible.
- Remove any combustible material from the vicinity of the fire.
- If the fire is electrical in nature, shut off the appropriate circuit breaker.
- Hose down nearby structures.
- Remove any equipment which can be moved from the area.

Following completion of these emergency procedures, the plant operators can then evaluate water quality to determine if the recycled water meets reuse requirements (e.g., turbidity levels, adequate disinfection). Off-specification effluent is either returned to the sewer, if possible, or discharged into the river. Recycled water deliveries are not to resume until the effluent quality meets the water reclamation requirements.

APPENDIX E

City of Los Angeles Bureau of Sanitation

The City of Los Angeles Bureau of Sanitation (LA Sanitation) operates four wastewater treatment facilities, three of which are classified as WRPs. Two of these three WRPs, Donald C. Tillman WRP (Tillman) and Los Angeles-Glendale WRP (LAG), are in the northern and north-eastern portions of the City of Los Angeles, respectively, serving the communities in the San Fernando Valley as well as accepting wastewater from the cities of Burbank, Glendale, and La Cañada-Flintridge. They are tertiary treatment plants, meaning wastewater that has undergone primary sedimentation and secondary biological oxidation, and is then subjected to coagulation and inert media filtration, followed by chemical disinfection. The objective of the tertiary treatment process is to remove suspended solids and particulate matter in order to enhance the inactivation of bacteria and virus. The quality of water at that treatment level has been approved by the DDW for all direct reuse applications contained in their Title 22 Water Recycling Criteria, including structural and non-structural firefighting.

While these WRPs consist of the same basic treatment train they do have significant differences. Their design capacities range from 20 MGD at LAG to 80 MGD at Tillman. The plants also differ in the number and sizes of the various process tanks, filter media (cloth filtration vs. dual media anthracite coal/sand), type of disinfectant (sodium hypochlorite and ammonium hydroxide to form monochloramine), dosages of coagulants and disinfectants, tributary wastewater quality, and plant operational parameters. Yet despite these differences both WRPs consistently produce high quality effluent that meets nearly every federal and state drinking water standard, which allows for the use of the recycled water for all Title 22 reuse applications.

The third WRP, Terminal Island, is in the southern most portion of the City of Los Angeles and treats its effluent to an advanced level beyond tertiary. Its recycled water production is used for industrial processes and for seawater intrusion barrier injection. Due to its advanced treatment train and much higher water quality, it is not included in this study.

LA Sanitation has made a commitment to produce recycled water from Tillman and LAG that is adequately disinfected and meets all effluent water quality requirements set by the Los Angeles RWQCB and the DDW for all reuse applications and for surface water discharges. To this end, numerous measures have been employed by LA Sanitation:

- ***Highly qualified and experienced plant operators:*** Both Tillman and LAG are staffed with State certified operators, each plant under the direction of a Plant Supervisor. Each of the Plant Supervisors are certified at least at Grade IV, with all having several decades' worth of experience in wastewater treatment plant operations. The Plant Supervisors report to the Operations Manager, who is Grade V certified, and who can lend their considerable operational experience during non-standard operating situations or emergencies. It is this extensive experience that allows for all LA Sanitation's tertiary treatment facilities at the Title 22 level to maintain a consistently high effluent quality during normal operation and for rapid, appropriate and effective responses to extraordinary or emergency situations that may threaten effluent quality.
- ***Real-time monitoring of critical parameters:*** Continuous real-time monitoring of influent pH alerts the plant operators to changes in the pH of the raw wastewater that could possibly be caused by an incompatible industrial waste entering the plant. Continuous real-time monitoring of secondary, filter, and final effluent turbidity warns the operators of an upset of the activated sludge process well in advance of noncompliant effluent leaving the plant. Issues such as these that are identified early can be corrected much more readily than if the conditions are allowed to degrade to the alarm point, at which time discharge violations could be more likely.
- ***Computerized Distributed Control System (DCS):*** LA Sanitation has converted Tillman and LAG to the state-of-the-art DCS through which all the critical plant parameters can be monitored and nearly

all of the process equipment can be operated. Tillman and LAG are staffed with a minimum of one Grade III plant operator 24-hours of the day. Tillman staffs two plant operators on duty 24-hours of the day, while LAG staffs one plant operator on duty during the night shifts. One of the greatest advantages of the DCS is the fact that it gives the Plant Supervisor and his/her operators the ability to view long-term trends, such as rising turbidity or decreasing oxygen levels, and institute early corrective actions prior to reaching alarm conditions.

- ***Comprehensive alarm system:*** A comprehensive alarm system immediately notifies the plant operators of any failure of process equipment or if any critical water quality parameter has exceeded its predetermined set-point. These warning systems allow for the early detection of a problem so that the cause can be investigated, possible corrective actions evaluated, and remedial action taken before recycled water quality is adversely affected. Sets of procedures for addressing alarm conditions, notifying supervisors, and taking corrective actions have been developed for both Tillman and LAG, although the specific actions must be determined after analyzing the alarm condition. In addition to alarms for equipment failure, there are also turbidity alarms for secondary, filter, and final effluent that are set at various levels and with different delay periods depending on the operational needs of the two plants. Each turbidity alarm allows for potential effluent quality problems to be identified at several critical points in the overall treatment process so that recycled water quality is not degraded. Plant operators use secondary effluent as a gauge of water quality and can institute process changes to resolve turbidity problems in the secondary treatment process before such problems even reach the filters.

- ***Back-up power supplies:*** Tillman and LAG both receive preferred electrical service from the City of Los Angeles Department of Water and Power (LADWP), and both WRP's have two redundant sources of power from LADWP. Tillman is currently in the process of modifying circuitry which would allow operators to use the Emergency Generator to power enough equipment to bring sewage from the sewers and into the onsite wet-weather storage basins should conditions warrant it. In the unlikely event that both LADWP power sources fail at LAG, an onsite power generator starts automatically. Plant operations while functioning on generator power is limited to the use of only one process air compressor when normally there are two compressors online. This limitation could reduce total plant flow by 25%. In addition, the recycled water pump station is not available when the plant is operating on generator power. In such situations, no recycled water will be available to customers.

- ***Preventive maintenance:*** All critical equipment, even that which is not in everyday use, undergoes regular service by a full complement of LA Sanitation's electrical, instrumentation, and mechanical technicians.

- ***Emergency procedures:*** Incidents that can affect normal treatment plant operation are discharges of incompatible industrial wastes, power failure, process equipment failure, excessive rainfall runoff, earthquake, fire, etc. Most incidents that adversely impact the wastewater treatment process are minor, transitory, and/or cause little or no degradation of effluent quality.

- ***Procedures to divert off-spec effluent:*** It is the policy of LA Sanitation to take any and all necessary actions to prevent and/or avoid discharging effluent that would violate any permit provisions. These provisions consist of WDRs or WRRs that are contained in the various river discharge and reuse permits issued by the RWQCB. However, if remedial actions taken by the operators cannot prevent the degradation of effluent quality below the reuse standards, then the plant operators are required to take actions that will minimize the adverse effects on human health and environmental quality. Certain conditions that are monitored real-time, that cannot be adequately rectified and that could even potentially result in an effluent violation would initiate an immediate shutdown of all deliveries of recycled water to direct, non-potable recycled water distribution systems. Specifically, these conditions are color in the effluent, inadequate disinfection, a filter bypass, or a severe, consistent increase in filter effluent turbidity (as evaluated at the time by the plant operators and supervisors). The recycled water pump stations are not restarted unless the plant effluent meets all of the requirements for reuse (e.g., turbidity, adequate disinfection).

- ***Coagulation:*** Tillman and LAG are equipped with the means to continuously dose secondary treated wastewater with cationic polymer upstream of the effluent filters. The addition of cationic polymer aids the filtration process by coagulating suspended solids for increased removal in the filters. The cationic polymer coagulant systems at Tillman and LAG have the same routine preventive maintenance schedule to ensure proper operation. Cationic polymer is also continuously dosed to the returned activated sludge for aerator foam control. This also helps to improve sludge settling characteristics in the final clarifiers.
- ***Filtration:*** In order to enhance the disinfection process by the removal of particulate matter that may shield bacteria and virus from the disinfectant, LA Sanitation's WRPs have been equipped with filters that periodically backwash to remove organic material that has accumulated in the filter media. For Tillman, the backwash interval is between 20-60 minutes. For LAG, the backwash interval is between 12-48 hours. The difference in backwash time at each plant relates to the strength of the biological loading. The difference in backwash frequency between Tillman and LAG relates to the different filtration systems in place at each plant. Tillman utilizes a cloth media filter system, whereas LAG utilizes a dual media anthracite coal/sand filtration system. Both of these systems satisfy discharge permit requirements.
- ***Disinfection:*** Disinfection of filtered effluent at Tillman and LAG is accomplished with the addition of sodium hypochlorite and ammonium hydroxide to form monochloramine. The resulting total chlorine residual concentration of the chlorine contact tank effluent is typically 4-6 mg/L. Effluent sampling for total and fecal coliform is conducted daily. Recycled water pumping is temporarily halted whenever the chlorine residual concentration is below 3 mg/L. Alarms are set for both low "IN" and "OUT" chlorine residuals to maintain this minimum residual, with additional alarms on the amount of chemical storage to ensure that enough disinfectant is on hand. Both Tillman and LAG use a 12.5% sodium hypochlorite solution and a 19% ammonium hydroxide solution to form chloramines for disinfection.

Emergency Procedures to Maintain Plant Operational Status

The following is a standard initial response to a plant alarm that is applicable at Tillman and LAG:

All alarms are visually displayed, audibly announced and remotely acknowledged from the DCS in the Main Control Room at both Tillman and LAG. In addition, a remote DCS Control Station is located in the Sludge Pump Room at LAG. Major equipment failures generally require local acknowledgement as well.

Tillman is staffed with a minimum of two operators at all times. One operator is continuously stationed in the Control Room. The second operator performs all the routine and emergency field duties The Control Room operator will notify the field operator of an alarm condition by two-way radio and a field inspection of the condition will be conducted. The field operator would acknowledge and silence local alarms at various Local Control Panels as required.

LAG is staffed with only one operator during nights, weekends, and holidays. The sole operator will generally spend 40-50% of each shift in the field. The DCS is equipped with a dial-out alarm system which notifies the operator of specific alarms and their location by pager. Alarm conditions generally will require a field inspection and acknowledgement.

- Depending on the nature of the alarm and the severity of the situation, the operator would make necessary operational adjustments to maintain plant processes including placing standby equipment into operation as required. The operator would then contact the Plant Supervisor or the Operations Manager for advisement, consultation, and/or on-site assistance.
- The Operator would always attempt to determine the cause of the failure and correct it if possible. If the procedure required to correct the alarm condition is too extensive to be handled by the personnel

on hand, the Plant Supervisor or Operations Manager must be notified so that the additional personnel required to correct the malfunction can be contacted or supplied.

Specific responses to incidents that may result in discharge violations must be evaluated considering the specific conditions of the event. The appropriate actions that will avoid and/or prevent the degradation of the final effluent would then be taken.

Storm Flow Procedures

Of all the potential incidents that could adversely affect effluent quality, storm flow is not only the most likely to occur but can be anticipated and prepared for ahead of time using weather forecasts (unlike events such as earthquakes and fire which are very rare and completely unpredictable). The primary objectives during storm flows are to prevent sewer overflows and to try to minimize negative effects on plant performance after the storm flow subsides.

In the case of Tillman, the plant treats approximately 36 MGD, but has a plant capacity of 80 MGD as well as a storage basin that can accept an additional 18.2 MG of water. In the event of a large storm, both the additional treatment capacity of approximately 40 MGD as well as the 18.2 MG of storage can be utilized to provide hydraulic conveyance relief. LAG maintains two standby primary clarifiers with a total capacity of 240,000 gallons which can be utilized for emergency storage at the discretion of LA Sanitation's Storm Commander. In all cases, after the storm passes and conveyance is normalized, the water that was temporarily stored will be released to the primary sewer system whereby it will be treated at the Hyperion Treatment Plant (Hyperion) downstream. Beyond these scenarios, there are no differences in operation for Tillman and LAG between wet weather events and normal dry conditions.

Advance Preparation for Storm Flows: The City of Los Angeles is unique in the fact that one large treatment plant handles the majority of the wastewater generated in the City as well as the contracted agencies that discharge into the conveyance system. The two upstream plants, Tillman and LAG, provide hydraulic relief under normal operating conditions. Because of this, operating conditions under storm flow are identical to normal dry weather operating conditions. Aside from periodic cleaning of the wet-weather storage basins at Tillman there are no advanced preparations that need to take place at either Tillman or LAG.

Operation During Storm Flow Conditions: The primary concerns during storm flows are to prevent sanitary sewer overflows (SSOs) from the wastewater conveyance system and treat wastewater to effluent discharge standards. Because of the concern regarding SSOs, Tillman is equipped with a wet-weather storage basin that is capable of temporarily storing 18.2 MG of influent water for a 24-hour period. This provides hydraulic relief within the conveyance system downstream of Tillman and is helpful in prevention of SSOs. In addition to this storage capacity, Tillman operates at 36 MGD of the 80 MGD capacity. In the case of heavy rainfall, Tillman can utilize the additional approximately 40 MG as storage. In both cases, after the storm passes and conveyance is normalized, the water that was temporarily stored will be released to the sewer system whereby it will be treated at the downstream Hyperion plant. Beyond these scenarios, there are no differences in operation for Tillman and LAG between wet weather events and normal dry conditions.

Power Failure

In the rare event of a power failure at either Tillman or LAG, wastewater can be diverted to Hyperion downstream via the Primary Sewer System if emergency electrical systems do not operate properly. Wastewater that has yet to pass through the chlorine contact tanks will remain in the plant until the treatment process can resume. At no time during a power outage will any water that does not meet Title 22 standards be released to the recycled water system.

Both Tillman and LAG have redundant power sources from LADWP, as both WRPs are considered critical pieces of infrastructure to the City of Los Angeles and the region. Loss of power in any event is extremely rare. However, in the unlikely event of power failure to the entire plant, the following procedures are followed.

Tillman: An existing standby generator at Tillman has been modified to provide limited hydraulic relief for the collection system. Influent wastewater would be pumped into the plant for on-site storage in the wet weather storage basins. All other flows that would normally enter Tillman would be diverted through the primary sewer system to Hyperion.

LAG:

- The LAG Standby Generator will start automatically.
- The operator immediately inspects and adjusts the sodium bisulfite gravity flow dechlorination system.
- The operator notifies the Plant Supervisor and/or the Operations Manager and the plant electrician.
- After the Standby Generator circuit breaker closes, power will be restored to plant equipment.
- Restart the de-chlorination system equipment followed by the plant PAC.
- Restart the remainder of the plant process equipment sequentially in accordance with Standard Operating Procedures.
- Once the plant is back online, the operator reviews the equipment restart checklist to ensure that no equipment system or controller has been overlooked.
- The operator conducts plant rounds and prepares for the next power outage that will occur after LADWP is restored and the generator automatically shuts down.
- Upon the restoration of power, the following steps are performed:
  1) Control Panel breakers are turned on by authorized personnel in their respective and appropriate sequences.
  2) All vital plant processes are checked to ensure that the plant is 100% operational.
  3) All chlorination, dechlorination, and dosing systems are checked to ensure that they are operational to effluent discharge standards.
  4) All water contained in the wet-weather storage basins is released to the primary sewers when conveyance capacity is available.

Individual Equipment: In the event of power failure to any individual piece of equipment in the plant, the following procedure is followed for both Tillman and LAG.

- Start standby equipment to maintain normal plant process control.
- Notify the Plant Supervisor and plant electrician of the failure.
- The operator informs the arriving electrician of any events which could possibly have led to the failure.

Earthquake

During an earthquake, the primary concern of an operator should be to protect him or herself from injury. Once the quake has subsided, there are certain procedures which are followed. These consist of checking the plant for damages and restarting equipment where necessary. The following actions are to be taken:

Tillman:

- Building evacuation occurs and role is taken to account for all personnel. The On-call Supervisor is contacted immediately in the event of any evacuation.
- The operator on duty will assess the plant status as much as possible from the Control Room if it is safe to do so. This will not take place if potentially unsafe working conditions occur.
- The operator will wait until additional personnel arrive before entering process structures that indicate possible structural damage.
- All structures, buildings, tanks, galleries, etc., are checked for cracks or any other type of structural damage. High sump level alarms would indicate leakage from process piping or process tanks.
- Check all machinery for damage or realignment which could have occurred during the quake. Especially check the mountings of all heavy machinery (e.g., PACs, influent pumps, return sludge pumps, etc.) for cracks and broken bolts which could allow the equipment to shift or break loose during normal operation.
- After the equipment and structures have been visibly checked and appear to be undamaged, restart any equipment which was shut down due to the quake.
- The chlorination and dechlorination facilities should be checked very closely for any leaks which could have occurred during the quake, since such leaks are potentially very dangerous.
- Check all plant piping for leaks and damage.
- Contact the Operations Manager to provide a status report.
- Upon completion of plant inspection, a report of injury/loss/damages is generated for the Industrial Safety & Compliance Division.

LAG:

- Building evacuation occurs and role is taken to account for all personnel. The On-call Supervisor is contacted immediately in the event of any evacuation.
- The operator on duty will assess the plant status as much as possible from the Control Room if it is safe to do so. This will not take place if potentially unsafe working conditions occur.
- The operator will wait until additional personnel arrive before entering process structures that indicate possible structural damage.
- A strong earthquake will likely cause the PAC to fail on high vibration. If this occurs, secure influent pumping, bypass the filters, and secure the disinfection system, if possible, until the PAC can be restarted.
- All structures, buildings, tanks, galleries, etc., are checked for cracks or any other type of structural damage. High sump level alarms would indicate leakage from process piping or process tanks.
- Check all machinery for damage or realignment which could have occurred during the quake. Especially check the mountings of all heavy machinery (e.g., process air compressors, influent pumps, return sludge pumps, etc.) for cracks and broken bolts which could allow the equipment to shift or break loose during normal operation.
- After the equipment and structures have been visibly checked and appear to be undamaged, restart any equipment which was shut down due to the quake.
- The chlorination and dechlorination facilities should be checked very closely for any leaks which could have occurred during the quake, since such leaks are potentially very dangerous.
- Check all plant piping for leaks and damage.

- Contact the Operations Manager to provide a status report.
- Upon completion of plant inspection, a report of injury/loss/damages is generated for the Industrial Safety & Compliance Division.

Following completion of these emergency procedures, the operators at either plant can then evaluate water quality to determine if the recycled water meets reuse requirements (e.g., turbidity levels, adequate disinfection). Off specification effluent is either returned to the sewer. Recycled water deliveries are not to resume until the effluent quality meets water reclamation requirements.

Fire

In the event of fire, the operator on duty assesses the severity and type (e.g., electrical, chemical, etc.) of fire. The City of Los Angeles Fire Department (LAFD) is then notified immediately. Firefighting equipment, good for any type of fire, has been provided throughout the plant for use in extinguishing fires, if possible, or preventing the spread of fires. In the event a fire cannot be extinguished by plant personnel, the following general procedures are then followed to prevent further spread of the fire and damage to the equipment.

- LAFD is notified through 911 and the On-call Supervisor is contacted immediately.
- Evacuation of the area associated with the fire.
- Where safe conditions occur, combustible material is moved away from the vicinity of the fire.
- If the fire is electrical in nature, shut off the appropriate circuit breaker.
- If directed by LAFD, assist in needs to extinguish fire. Removal of equipment from area will be at the direction of LAFD.
- Upon completion of plant inspection, a report of injury/loss/damages is generated for the Industrial Safety & Compliance Division.

Following completion of these emergency procedures, the operators at either plant can then evaluate water quality to determine if the recycled water meets reuse requirements (e.g., turbidity levels, adequate disinfection). Off specification effluent is returned to the primary sewer system to be treated at Hyperion. Recycled water deliveries are not to resume until the effluent quality meets the water reclamation requirements.

APPENDIX F

West Basin Municipal Water District

West Basin Municipal Water District (West Basin) operates the Edward C. Little Water Recycling Facility (ECLWRF) which treats secondary effluent from the City of Los Angeles Sanitation Department's Hyperion Treatment Plant. Although the facility has the capacity to produce four different grades of recycled water to meet the needs of customers, the discussion following will focus on recycled water meeting Title 22 standards which is distributed to several hundred customers via West Basin's recycled water distribution system throughout the South Bay. The tertiary Title 22 process consists of coagulation, flocculation, and sedimentation in a high rate clarifier followed by mono-media filtration, and disinfection. Ferric chloride and polymer are used in the high rate clarifier to help settle the suspended solids in the water. Disinfection is accomplished by adding sodium hypochlorite to achieve a minimum CT (chlorine dose multiplied by contact time) of 450 mg-min/L.

West Basin is committed to producing recycled water that is adequately disinfected and meets all effluent water quality requirements set by the RWQCB and DDW. Numerous measures have been employed by West Basin to try to accomplish this:

- ECLWRF is staffed with 17 State certified operators and is manned 24 hours a day, seven days a week. A Grade V operator supervises the operations staff.
- Continuous real-time monitoring of influent and effluent turbidity, effluent chlorine residual, and filter effluent pH help to ensure compliance with permit requirements.
- All the critical plant parameters can be monitored and nearly all of the process equipment at the ECLWRF can be operated through its DCS.
- All critical equipment is regularly serviced by the maintenance staff.
- There is 10 MG of recycled water storage at ECLWRF for use during short-term, planned outages.
- Procedures are in place to divert and/or stop non-compliant water from being pumped into the distribution system.

APPENDIX G

City of Burbank

In order to maintain a recycled water supply of desired quality on a reliable basis, features such as alarms and backup power supplies are incorporated into the system. These alarms signal that the treated effluent quality is out of the desired range and alert the operators to take corrective action.

Burbank WRP is equipped with turbidimeters to measure the plant effluent turbidity on a continuous basis. Turbidity alarms warn the operators in the event the treated effluent is not of desirable quality. The alarm is located at the effluent point of the chlorine contact tank and sounds in the control building. This building is manned from 5:00 am to 5:00 pm. During unmanned hours, the alarm system will automatically dial a series operator's phone numbers and eventually the Burbank Police Department until someone responds to the alarm.

Power supply is provided by two separate independent power lines. Power is supplied to the plant continuously by one of the lines and the second line is used as a backup. A diesel generator supplies back-up power to the disinfection and tertiary filter bypass valve to the City of Los Angeles Hyperion system.

Recycled water is stored in seven reservoirs in order to maintain a continuous supply. Supplemental potable water supply provisions with adequate air gaps to prevent cross connection and back flow with the recycled water are located at Pump Station 1 and a tank above De-Bell Golf Course, as well as the Stough Canyon tank.

To bolster the reliability of the treatment plant, redundant units have been installed for the tertiary filter pumps and blowers, aeration system blowers, and sodium hypochlorite chemical dosing pumps.

APPENDIX H

Las Virgenes Municipal Water District

- The Tapia WRP (Tapia) applies state-of-the-art technology to transform wastewater into high quality recycled water that is used to irrigate public and commercial landscaping such as golf courses, school grounds, highway medians and parks. Tapia has a capacity to process up to 16 MGD, but currently averages about 9.5 MGD. Wastewater drains into the wastewater (sewer) collection system, traveling through a series of collection pipes in the LVMWD service area, mainly by gravity, to the Tapia plant.

- Wastewater entering Tapia is 99% water and 1% solids and inert materials. The first step is to remove the inert materials. Larger items, like rags and paper, are removed by passing the waste stream through a vertical slatted bar screen. Finer materials (egg shells and coffee grinds) are removed in a "grit chamber." Here, the flow is slowed, and air is injected to keep small, organic particles suspended while the heavier, inert materials fall to the bottom. The items removed from the wastewater to this point go to a landfill.

- The wastewater is then pumped to the primary sedimentation tanks. Primary treatment is a separation process using gravity, where the solids in the wastewater can settle to the bottom of the tank. Oil and grease, which are lighter than water, float to the surface. Large paddles skim the water surface and the bottom of the tanks to remove these materials, which are then pumped to the Rancho Las Virgenes Composting Facility.

- Secondary treatment is a biological process utilizing aeration tanks. As in nature, microorganisms remove contaminants and clean the water as they feed, grow, and multiply. Oxygen is added by injecting air into the tanks, which helps speed the process. The partially treated wastewater then flows to the secondary sedimentation tanks, where the microorganisms can settle out. They are then collected and returned to the aeration tanks, to work on another batch of wastewater. Meanwhile, the liquid portion goes on to the next step, tertiary treatment.

- Tertiary treatment is a filtration process designed to remove any remaining extremely small particles. Chemicals are added to "flocculate", or clump the particles together, making them easier to filter out. The water is then disinfected with chlorine. After a sufficient amount of "contact time", the chlorine is then "neutralized".

- Tapia is staffed with nine operators that are certified by the State of California in wastewater treatment. Operator certifications range from Grade I to Grade V. All operators report to the Chief Water Reclamation Plant Operator who holds a Grade V certificate with many years of experience. Tapia is staffed 9 hours per day, seven days per week.

- Tapia employs numerous automated controls that assure that the quality of recycled water is in conformance with the required parameters. Tapia is monitored and controlled via a robust Supervisory Control and Data Acquisition (SCADA) system. This system monitors key parameters in the treatment train such as dissolved oxygen, turbidity, and disinfection chemical levels, as well as monitoring process status. It has the capability to start and stop processes based upon real-time monitoring data. This is important, because the SCADA system can perform important tasks such as backwashing filters and starting and stopping motors as needed. The SCADA system can also automatically re-route water back into the plant for additional treatment if it does not meet effluent standards. When the SCADA system senses a problem at the facility, it sends out an alarm. If there is no staff at the facility, it calls standby personnel at their home to address any issues. Any issue can be addresses remotely via a laptop, or by responding physically. Standby personnel are required to respond at the facility within 45 minutes of being called to rectify any issues.

- Tapia has three diesel emergency generators that can provide power to all of the processes in case of an interruption in SCE’s service.

- LVMWD also has a full maintenance staff consisting of seven Electrical and Instrumentation Technicians and seven Maintenance Mechanics who provide preventive maintenance as well as repairs to the facility to assure that all treatment systems are in operation.

- An on-site, state-certified water quality laboratory conducts testing to assure that all potable and recycled water served by LVMWD meets stringent state and federal health standards.