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EXECUTIVE SUMMARY

This model "Watershed Action Plan (WAP)," Appendix A of the Report of Waste Discharge (ROWD), was prepared to meet Section J and L of the municipal NPDES Stormwater Permit - Order R9-2002-0001 and was revised in 2005 to integrate the separate responses of the Watershed Permittees to Clean-Up and Abatement Order 99-211 (issued December 28, 1999) and California Water Code Section 13225 Directive (issued March 2, 2001). This WAP is also discussed in Section 12.0 of the DAMP, and in commitments to watershed planning in Section 3.0 of the DAMP.

Within Orange County there are both jurisdictional and watershed-based efforts to improve water quality. The jurisdictional efforts are captured as part of the DAMP/LIP. The DAMP/WAP was created to capture the efforts that are undertaken to address priority constituents of concern in a specific watershed.

The purpose of this document is to present a planning framework for the Aliso Creek Watershed to:

- Identify the most significant water quality issues related to urban runoff sources that can be addressed at a multi-jurisdictional watershed-scale,
- Focus jurisdictional pollution prevention and source control programs on local constituents, of concern, to identify treatment control opportunities,
- Incorporate prior data from planning studies,
- Identify indicators to track progress, and
- Present an integrated plan of action for urban sources that results in meaningful water quality improvement in the Aliso Creek Watershed.
- Describe the numerous existing programs related to water quality and the activities conducted by the Watershed Permittees at the watershed scale.

The WAP comprises the following sections:

Section 1.0 describes the environmental setting of the watershed, discusses program coordination between the Watershed Permittees, and outlines the approach taken in plan development.

Section 2.0 provides an assessment of current water quality conditions and identifies issues and data gaps and constituents of concern. The constituent of concern identified for this watershed is pathogen indictor bacteria.

Section 3.0 provides information on the Directives issued for impaired segments of this watershed, and the development of existing total maximum daily load (TMDLs) and the schedule for future TMDLs.

Section 4.0 discusses pollution sources and provides an inventory of enhanced best management practices (BMPs) and restoration projects that have been implemented in the watershed.

Section 5.0 focuses on the recommendations for actions to be taken to address the water quality issues of the watershed and discusses the annual means of assessment of the program effectiveness.

1.0 INTRODUCTION

The designation of "Aliso Creek Watershed" refers to the hydrologic watershed that is defined by drainage and only minimally by jurisdictional boundaries. The Aliso Creek Watershed encompasses portions of the cities of Aliso Viejo, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, and Mission Viejo, and unincorporated areas within the County of Orange. More than a decade ago, the Watershed Permittees (the County of Orange, the cities of Aliso Viejo, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, and Mission Viejo, and the Orange County Flood Control District) recognized that Aliso Creek and the beach at the creek mouth were suffering from a variety of water quality problems and began an unprecedented program of collaboration to address these problems. It was realized early on that the management of water quality was more appropriately dealt with within the hydrologic boundaries of the watershed, rather than solely on the jurisdictional basis of political boundaries.

This Aliso Creek Watershed Action Plan (WAP) of the Drainage Area Management Plan (DAMP) has been developed to attain the following multiple objectives:

- To meet the requirements for a Watershed Urban Runoff Management Plan (WURMP) contained in the municipal National Pollutant Discharge Elimination System (NPDES) stormwater permit;
- To identify the most significant water quality issues and constituents of concern on a watershed scale and relate these to urban sources;
- To focus the pollution prevention and source controls implemented at a individual jurisdiction level on the identified constituents of concern and to identify any jurisdiction-specific treatment control opportunities;
- To identify the water quality issues that are most appropriately addressed through a multi-jurisdictional watershed-scale approach;
- To incorporate information obtained from prior planning studies;
- To present an integrated plan of action that results in meaningful water quality improvement in the Aliso Creek Watershed group at a watershed-scale that balances economic, social, and environmental constraints; and
- To identify indicators to track progress.

To achieve these objectives, the Aliso Creek Watershed Permittees will be building on the considerable work and studies that have been completed collaboratively over a multi-year period. These initiatives include:

- Since 1990, the Watershed Permittees have developed and implemented common water quality programs within their own jurisdictions in response to the requirements of the municipal NPDES stormwater permit.

- In February 2003, an updated version of the 2003 DAMP was provided to the San Diego Regional Water Quality Control Board (Regional Board), including Local Implementation Plans (**LIPs – 2003 DAMP Appendix A**). The LIPs are detailed plans that focus on specific areas required by the NPDES permits, including the legal authority to regulate pollutant discharges; public education; enhanced standards for new development/significant re-development; implementation of BMPs at municipal facilities, construction sites, and commercial and industrial facilities; and, water quality monitoring. The BMPs can, in most cases, be focused on targeted constituents of concern to be identified through the monitoring program.

- On December 28, 1999 the San Diego Regional Board issued a Clean-up and Abatement Order (CAO 99-211) to the County, Orange County Flood Control District, and the City of Laguna Niguel to address occurring bacteria indicators in the storm drain designated J03P02. The CAO recipients have implemented an extensive program of monitoring and BMPs in this sub-watershed and reported progress in twenty-one quarterly progress reports. The CAO was rescinded by the Regional Board on May 11, 2005.

- On March 2, 2001, the Regional Board issued a Water Code Section 13225 Directive (Directive) to the Watershed Permittees in response to the elevated levels of bacterial indicators detected in many areas of the Aliso Creek Watershed that were attributed to urban sources. The Directive required the Watershed Permittees to conduct extensive additional monitoring and to detect and eliminate the sources of the bacterial indicators. In response to the Directive, the Watershed Permittees collaborated to address this highly specific water quality problem. This collaboration included developing and implementing one of the most extensive bacterial monitoring programs attempted at a watershed-scale, and specific plans of action by each of the Watershed Permittees for addressing problem storm drains on a prioritized basis. The plans of action focus on many of the pollution prevention and source control approaches described in the LIPs, and include a number of collaborative actions between the Watershed Permittees, such as public education and treatment control BMP retrofits.

- Since 1997, a multi-jurisdictional effort has been taking place to develop solutions to the watershed-scale problems in Aliso Creek. The Corps of Engineers' watershed management study process and a Clean Water Act Section 205(j) water quality planning grant were two of the key components of this effort. The result of this effort has been the development of a Watershed Management Plan that identified problems, opportunities, and ultimately identified a series of water quality improvement recommendations. Many of these recommendations are being pursued, with the County or, in some cases, individual Watershed Permittees as lead agency.

The Aliso Creek Watershed Chapter borrows much of its organization, structure, and terminology from the 2003 DAMP of which it is an appendix, and also from the reports developed in response to the Directive:

Section 1.0 describes the watershed and environmental setting, the program management coordination between the Watershed Permittees and other stakeholders, and the approach taken to develop the plan.

Section 2.0 assesses the water quality information available and identifies the water quality issues and the constituents of concern.

Section 3.0 provides details on the existing Directives in the watershed and provides information on the schedule for future TMDLs.

Section 4.0 discusses the urban sources of pollution, the available treatments for pollution control, and an inventory of Enhanced BMPs and stream system restoration projects that have been implemented in the watershed that address specific pollutants of concern.

Section 5.0 focuses on the actions to be taken to address the water quality issues of the watershed and discusses the annual means of assessment of the program effectiveness.

The Aliso Creek WAP is intended as a living document, one capable of being modified as new information becomes available and problems are addressed. It identifies the current state of knowledge on the issues facing the Aliso Creek Watershed and also sets the stage for future activities intended to address water quality issues in various reaches of the Creek and its tributaries. Figures enclosed represent available information in the GIS mapping format and some additional inventory information as supplied by the Watershed Permittees. The plan of action contained in this WAP will be reviewed for effectiveness and applicability annually through the annual progress reporting process required by the municipal NPDES stormwater permit.

1.1 Watershed Setting

The Aliso Creek Watershed is located in southern Orange County, approximately 50 miles south of Los Angeles and 65 miles north of San Diego (**Figure 1**). Aliso Creek drains a long, narrow coastal canyon with headwaters in the Cleveland National Forest. The creek ultimately discharges into the Pacific Ocean at Aliso Beach. The approximately 36-square-mile watershed includes portions of the cities of Aliso Viejo, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, and Mission Viejo. **Figures 2** through **4** depict the breakdown of the watershed by Unified School District boundaries, city boundaries, water provider, and parks and open space, respectively.

Major transportation arteries through the watershed include the San Joaquin Hills Transportation Corridor and Interstate 5. **Figure 5** shows the major transportation routes within the watershed.

The Aliso Creek Watershed is largely developed, with the exception of the Cleveland National Forest in the upper watershed and the Aliso Wood Canyon Regional Park in the lower watershed. **Figure 6** shows the existing land use in the Aliso Creek Watershed and **Figure 7** shows the future planned land use.

Figure 1 Location Map
Aliso Creek Watershed

0 5 10 20 30 40 50 Miles

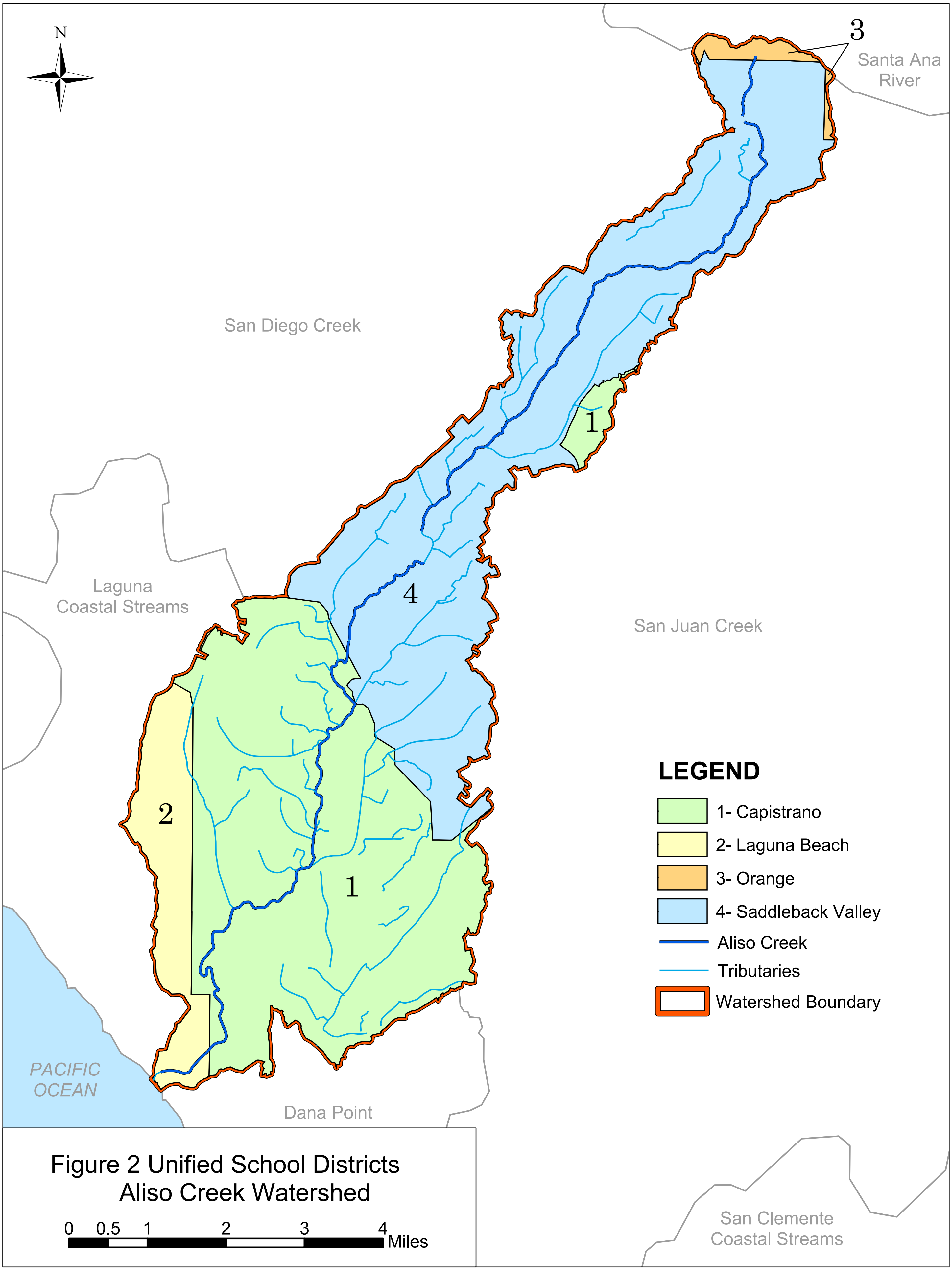

Figure 2 Unified School Districts
Aliso Creek Watershed

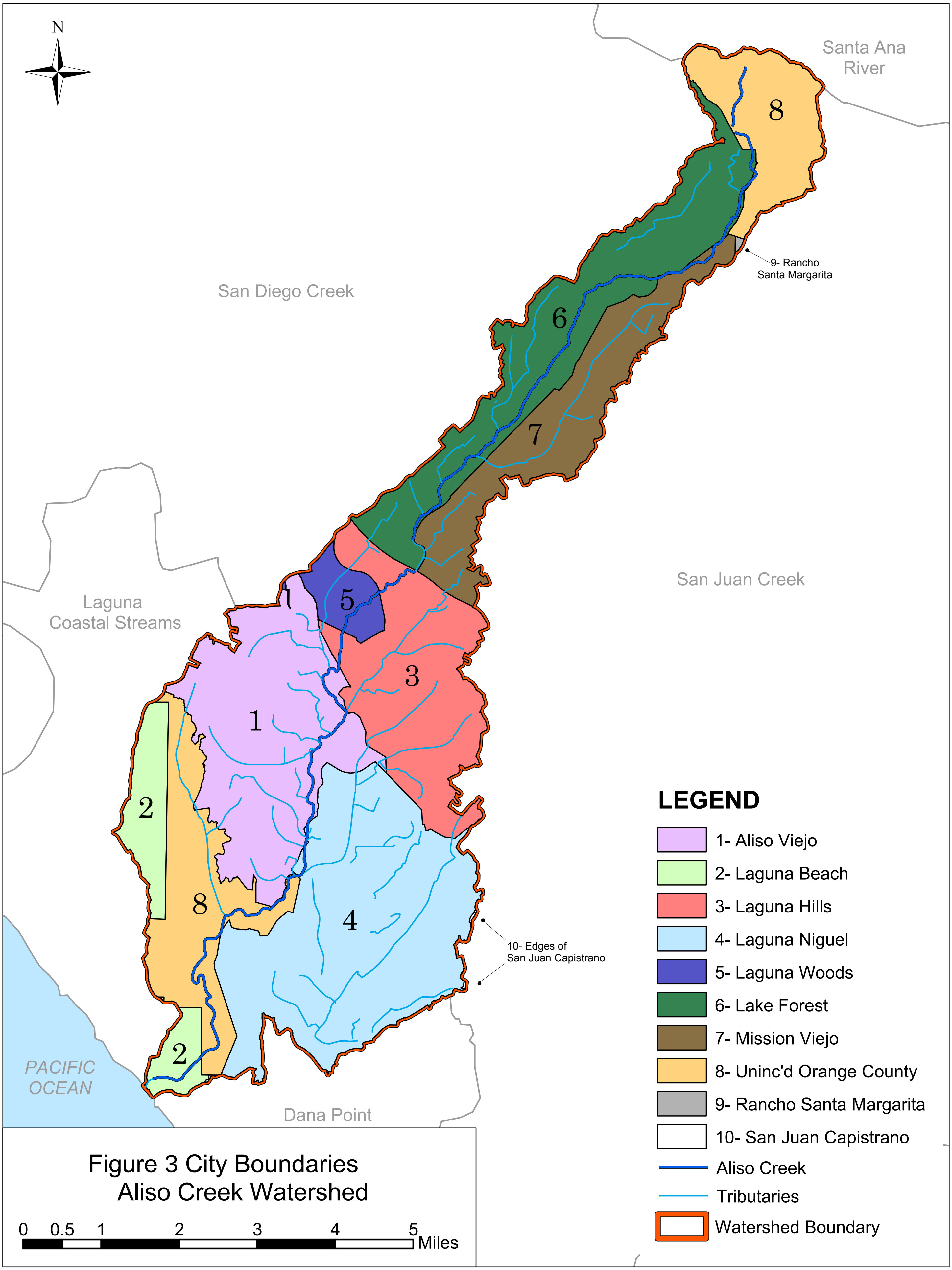

Figure 3 City Boundaries
Aliso Creek Watershed

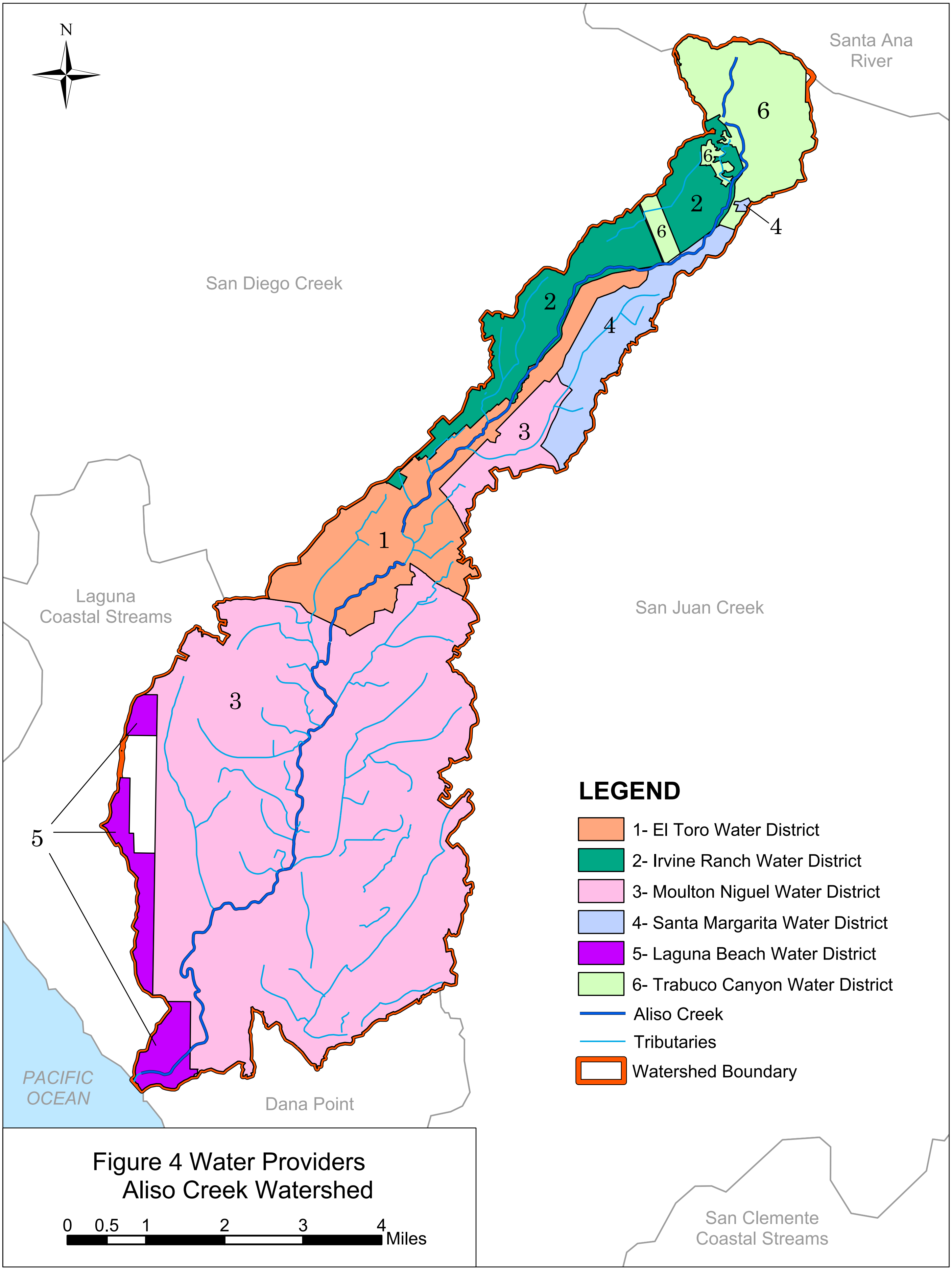

Figure 4 Water Providers
Aliso Creek Watershed

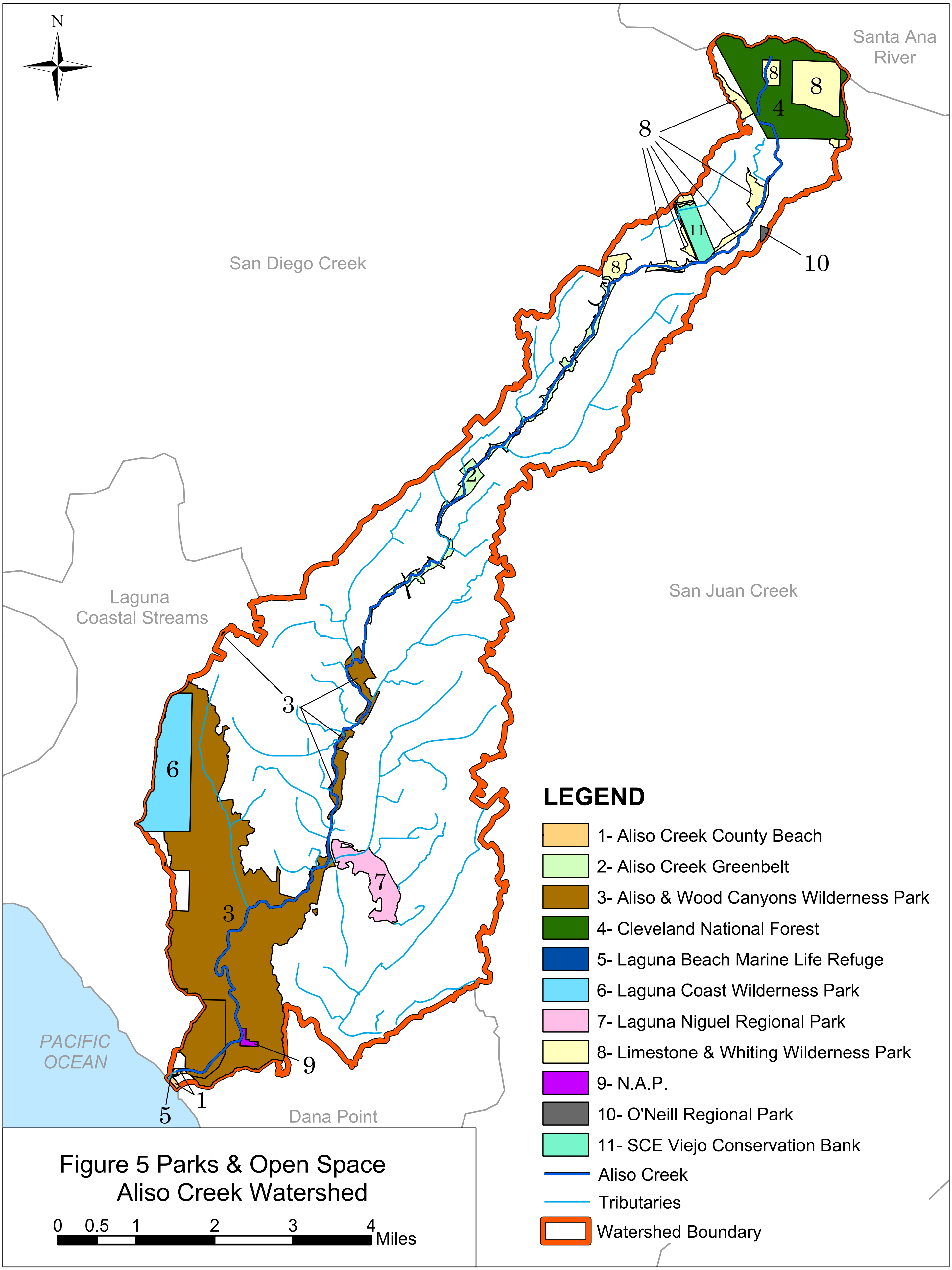

Figure 5 Parks & Open Space
Aliso Creek Watershed

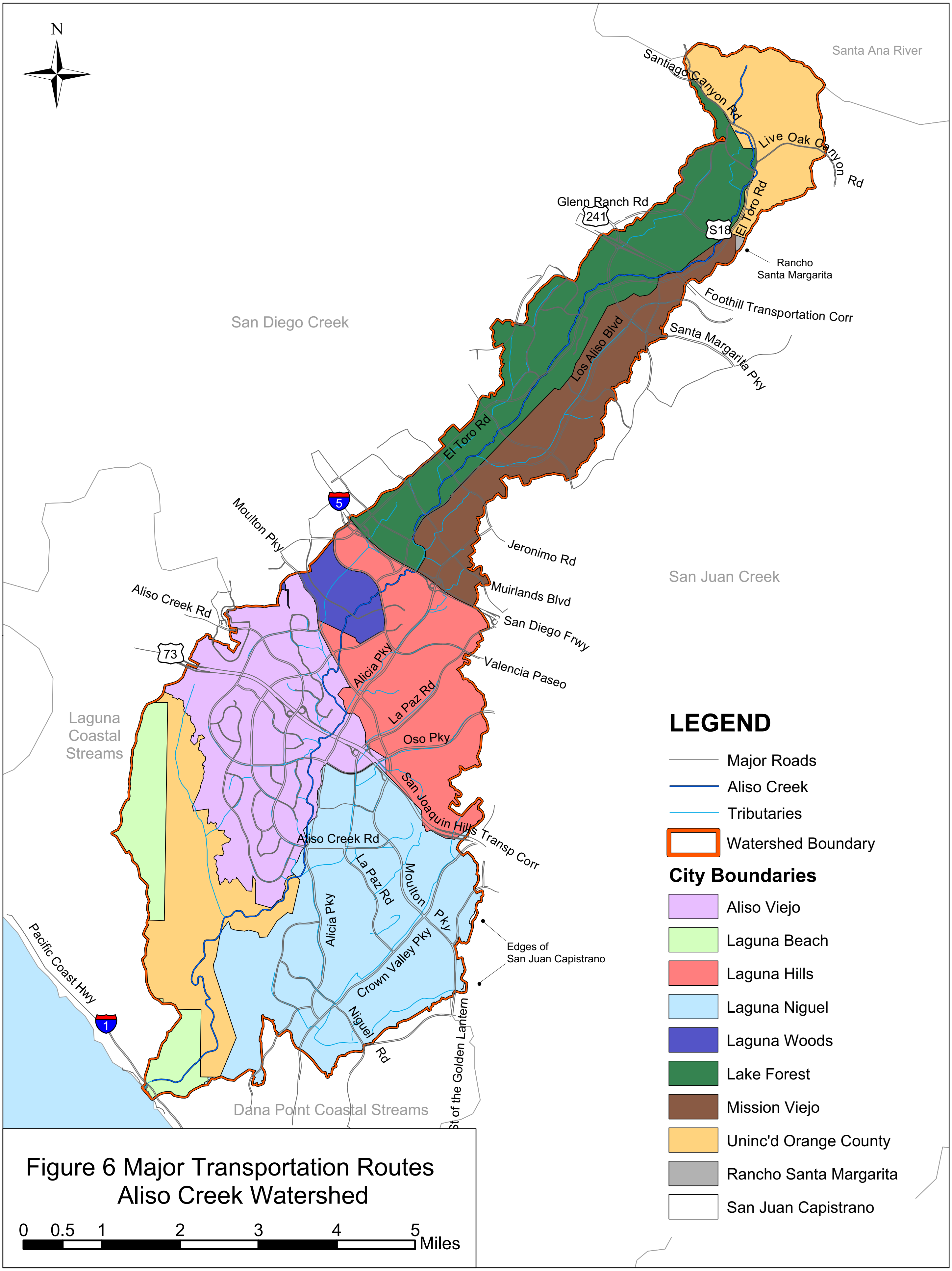

Figure 6 Major Transportation Routes Aliso Creek Watershed

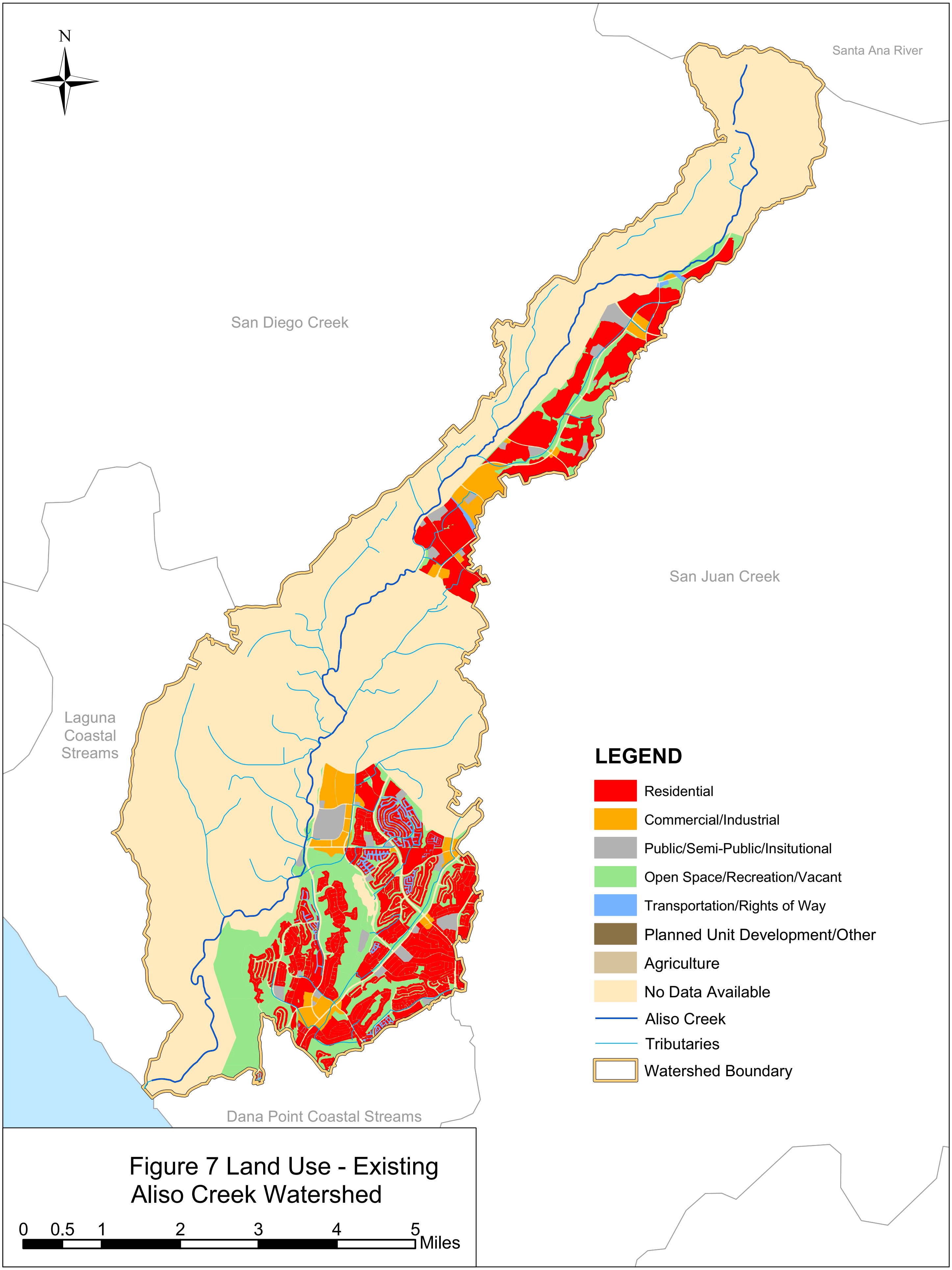

Figure 7 Land Use - Existing
Aliso Creek Watershed

Figure 8 Land Use - Future

1.2 Beneficial Uses

The Aliso Creek Watershed is within the jurisdiction of the San Diego Regional Board. The Regional Board has placed Aliso Creek under the Laguna subunit of the San Juan Hydrologic Basin (designated Hydrologic Sub Area 1.13). The Water Quality Control Plan (Basin Plan) also lists the English Canyon, Sulphur Creek, and Wood Canyon tributaries to Aliso Creek as receiving waters. The following existing beneficial uses are designated in the Basin Plan for Aliso Creek, Sulphur Creek, Wood Canyon, and English Canyon:

AGR – agricultural supply
REC1 – contact water recreation
REC2 – non-contact water recreation
WARM – warm freshwater habitat
WILD – wildlife habitat

The following designations apply to the mouth of Aliso Creek:

REC1 – contact water recreation
REC2 – non-contact water recreation
WILD – wildlife habitat
RARE – rare, threatened, or endangered species
MAR – marine habitat

Table 1 shows the beneficial uses associated with each waterbody.

Table 1: Designated Beneficial Uses – Aliso Creek

Inland Surface Water	AGR	REC-1	REC-2	WARM	WILD
Aliso Creek	●	○	●	●	●
English Canyon	●	○	●	●	●
Sulphur Creek	●	○	●	●	●
Wood Canyon	●	○	●	●	●
Aliso Creek Mouth	●	○	●	●	●

Existing - ● Potential - ○

Source: http://www.waterboards.ca.gov/sandiego/programs/basinplan.html

The following is a description of the relevant beneficial use designations:

Agricultural Supply (AGR) – Supports uses for farming, horticulture or ranching. Uses may include irrigation, stock watering, and support of vegetation for range grazing.

Contact Water Recreation (REC1) – Includes uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, white water activities, fishing, or use of natural hot springs.

Non-Contact Water Recreation (REC2) – Includes uses of water for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water would be reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beach combing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Warm Freshwater Habitat (WARM) – Supports warm water ecosystems that may preserve and enhance aquatic habitats, vegetation, fish, and wildlife, including invertebrates.

Wildlife Habitat (WILD) – Includes uses of water that support terrestrial ecosystems, including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

1.3 Constituents of Concern

As discussed in the Introduction, the focus of the WAP is to address the priority constituents of concern within the watershed. At the time of its preparation, it was assumed that the DAMP/WAP would ultimately evolve into a TMDL implementation plan and the anticipated development of the Beaches and Creeks Pathogen Indicator Bacteria TMDL established pathogen indicator bacteria as the priority constituent of concern in the watershed.

1.4 Watershed Program Management

Watershed management is the term used for the approach to water quality planning that places an emphasis on the watershed (the area draining into a river system, ocean or other body of water through a single outlet) as the planning area and looks to solutions to problems that cut across programs and jurisdictions. In Orange County, these efforts focus additional effort on the highest priority water quality constituents of concern in each watershed.

The approach taken to develop the DAMP/WAP establishes the jurisdictional DAMP/LIPs and the DAMP/WAPs as the principal policy and program documents for two separate, but nonetheless similar and highly interdependent, water quality planning processes targeting the control of pollutants in urban runoff (see **Section 3.0, 2007 DAMP**). In a number of watersheds these efforts are supportive of a third planning process that is focused on achieving broader objectives such as watershed habitat restoration and connectivity rather than specific water quality outcomes.

The Watershed Permittees coordinate the program management of the Aliso Creek Watershed through the program agreements and coordination meetings, which are described below.

1.4.1 NPDES Countywide Coordination

The Orange County Stormwater Program is underpinned by an Implementation Agreement between the County of Orange, the Orange County Flood Control District, and the 34 cities of Orange County. The Agreement provides a funding formula and budgeting process for shared countywide costs and monitoring costs by Regional Board area.

The Orange County Stormwater Program also has an extensive committee structure that is described in the DAMP (**2003 DAMP Section 2**) and in the LIPs of the Watershed Permittees (**2003 DAMP Appendix A-2)**. Each of the Watershed Permittees participates in the General Permittee meeting and, selectively, in the other oversight and technical committees.

1.4.2 NPDES Watershed Coordination

The Watershed Permittees also meet separately from the countywide program on a regular basis, typically quarterly, to coordinate activities in response to the Directive. As the intent of the Directive becomes integrated into both the LIP and the Aliso Creek WAP, these meetings are anticipated to continue in order to maintain coordination. The Watershed Permittees have developed a cost-sharing agreement for watershed monitoring costs to deal with those expenditures not covered by the countywide program.

1.4.3 Corps of Engineers Watershed Management Study

The County of Orange entered into an agreement with the Corps of Engineers in 1998 to conduct a Watershed Management Study focused on the broader goal of restoring watershed ecosystem integrity. Subsequently, the County entered into individual agreements with each of the Watershed Permittees as well as other agency stakeholders (such as water/sewer districts) to cost-share the multi-year study.

The Watershed Permittees, agency stakeholders, and others held meetings for more than five years in an effort to better define problems, opportunities, and roles and responsibilities within the study process and following its completion. During that time, a broad range of problems were identified, one of which is water quality. While the focus of the Corps of Engineers is on broader restoration issues, the focus of many of the members attending the meetings was on water quality improvement. The Watershed Permittees, in particular, participated from the outset in actively guiding the studies, evaluating the results, and providing direction to future efforts including securing grant funding under the Clean Water Act Section 205(j) for additional water quality studies. Participation in this group was voluntary, with numerous individuals donating their time and efforts toward the goal of improving water quality.

An important component of the study management process was participation from the public, many of whom regularly attended meetings in an effort to provide input into the direction of study and addressing of problems. While the meetings were announced in a variety of media, continued public participation was also ensured through maintenance of an e-mail list/address list through which many of the participants were contacted on a systematic basis.

The meetings included presentations on a wide variety of issues related to improvement of the entire watershed ecosystem. Subjects included the effects of development on various watershed attributes, ecosystem damage and restoration, water quality assessment and improvement, flood damage reduction, coastal issues, alternative development and selection, the development of the Watershed Management Plan, prioritization and inclusion of alternatives in the Plan, and the progress of the Corps of Engineers study process. Feedback from the participants actively guided the direction of future study efforts and provided valuable input into the issues related to each and every potential outcome. In addition, the presenters were often educated by the public on issues that may not have been anticipated by the technical team.

1.5 Governance

1.5.1 Watershed Chapter Committee

The Tier I/Cost Share Partners Stakeholder Group operates as the WAP Committee. This group includes representatives of the seven cities located within the watershed, representatives from the County of Orange, as well as representatives of interested agencies in the watershed. This group met four times in 2004-05.

1.5.2 Stakeholder Group

The Tier II/Public Stakeholders group provides for wider public participation and is comprised of representatives from the County, cities in the watershed, water districts, wastewater authorities, major landowners, and representatives of several environmental NGOs. The Tier II Group met four times in 2004-05.

1.6 Watershed Action Plan Development

Based upon the annual watershed assessment (discussed in Section 5.0), the Watershed Permittees and other participating jurisdictions will work together to address the priority water quality issues identified through the watershed planning processes. It is anticipated that water quality issues that are determined to be specific to a jurisdiction would be referred to that jurisdiction and thereafter be addressed as a jurisdictional program initiative through the LIP. Alternatively, the issue may originate from multiple jurisdictions within the watershed. In this instance, the problem would be addressed as a watershed cooperative effort.

Updates to this program will be the subject of annual reporting each November, which will include a water quality assessment and revisions to the listed water quality improvement initiatives.

2.0 WATER QUALITY ASSESSMENT

Urban discharges include surface runoff from residential, commercial, and industrial areas. Pollution sources that are not considered as part of the urban watershed planning responsibilities are atmospheric deposition and agricultural runoff.

The NPDES permit includes the requirement to monitor and assess the water quality associated with urban runoff. Within the Aliso Creek Watershed there have been several major initiatives to monitor and assess the water quality:

- The NPDES Monitoring Program began in 1990 and is anticipated to continue into the foreseeable future.
- The Clean Water Act Section 205(j) Water Quality Planning study began in 1998 and continued through October 2000.
- The bacteria monitoring program in response to the Directive began in April 2001 and is ongoing at present. It is the intention of the Watershed Permittees to integrate a revised Directive monitoring process within the program framework of the NPDES Monitoring Program.

Additionally, historical water quality-related data has been collected under various efforts and by other agencies and districts.

2.1 Water Quality Status

Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop a list of water quality limited segments—waters that do not meet water quality standards, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that state or local jurisdictions establish priority rankings for water quality impairment on the list and develop action plans, referred to as TMDLs, to improve water quality.

The SWRCB and the Regional Board staff have evaluated each addition, deletion, and change to section 303(d) based on all the data and information available for each water body and pollutant. These recommendations are based upon "all existing and readily available data and information" (40 CFR 130.7(b)(5)). In developing the recommendations, the SWRCB staff used the recommendations and analysis of the Regional Board as the basis of its analysis.

A new listing policy was used to develop the 2006 draft 303(d) list. Based on that policy, some data, for purposes of developing the section 303(d) list, are sufficient by themselves to demonstrate non-attainment of standards. Examples of these listing factors are (1) numeric data exceeding numeric water quality objectives, maximum contaminant levels, or California/National Toxics Rule water quality criteria and (2) use of numeric evaluation values focused on protection of consumption of aquatic species. Other data types require that multiple lines of evidence be used for listing and de-listing. The listing factors that require multiple lines of evidence are (1) toxicity, (2) health advisories, (3) nuisance, (4) beach postings, (5) adverse biological response, and (6) degradation of aquatic life populations or communities. Each of these lines of evidence generally need evidence of the presence of the pollutant(s) that cause or contribute to the adverse condition.

The 2002 303(d) list of impaired waters – approved by the State Water Resources Control Board – that could potentially be affected by activities occurring within the Aliso Creek Watershed is presented in **Table 2**. It should be noted that this list is updated every 3 years and will be replaced within this Watershed Action Plan.

Nineteen miles of Aliso Creek are listed as impaired for bacteria indicators, phosphorus, and toxicity on the 2002 303(d) list. In addition, an area of about 0.29 acre of the Aliso Creek mouth is listed as impaired for bacteria indicators as is the Pacific Ocean shoreline at the mouth of Aliso Creek. The listings were based on the following information:

> *Bacteria indicators* - Cumulative analyses of sampling data collected from 1998 to 1999 along the entire reach of Aliso Creek and in several tributaries indicated elevated enterococci concentrations. Subsequently, most of the hydrologic sub-area (HSA 1.13) was determined to be impaired for enterococci, including the tributaries of Aliso Hills Channel, English Canyon Creek, Dairy Fork Creek, Sulphur Creek, and Wood Canyon Creek. The sampling data also indicated concentrations of fecal coliform that exceeded the Basin Plan objective. These findings resulted in inclusion of the entire reach of Aliso Creek being listed as impaired due to fecal coliform.
>
> *Phosphorus* - Sampling data collected between 1997 and 2000 near the mouth of Aliso Creek (ACJ01) and further upstream at Country Club Road and at Pacific Park Drive/Oso Parkway showed phosphorus concentrations that exceeded the Basin Plan objective; this finding resulted in listing of Aliso Creek as impaired for phosphate in the lower four miles.
>
> *Toxicity* - Five stations, from the headwaters to the mouth of Aliso Creek, were sampled in 1998 and 1999, and all showed toxicity for one or both of the storm event samplings, thereby placing the entire reach on the list as impaired due to toxicity.

Table 2: 2002 303(d) List and TMDL Priority Schedule – Aliso Creek Watershed

Type	Name	Hydro Unit	Pollutant/Stressor	Source	Priority	Estimated Size Affected
R	Aliso Creek	1.13	Bacteria Indicators	Urban Runoff/Storm Sewers Unknown point source Nonpoint/Point Source	Medium	19 Miles
			Phosphorus Impairment located at lower 4 miles	Urban Runoff/Storm Sewers Unknown point source Nonpoint/Point Source	Low	19 Miles
			Toxicity	Urban Runoff/Storm Sewers Unknown point source Nonpoint/Point Source	Low	19 Miles
E	Aliso Creek (mouth)	1.13	Bacteria Indicators	Nonpoint/Point Source	Medium	0.29 Acres
C	Pacific Ocean Shoreline, Aliso HSA	1.13	Bacteria Indicators Impairment located at Aliso Beach	Nonpoint/Point Source	Medium	0.65 Miles

(Note: R – Rivers; E – Estuary; C – Coastal Shoreline/Beaches)

2.2 Summary of Monitoring Activities

The major monitoring programs in the Aliso Creek watershed are described below.

2.2.1 NPDES Monitoring and Assessment Program

NPDES permits are issued for a five-year term and are issued on an area-wide basis. The first municipal NPDES Stormwater Permit was for the period 1990-1996; the Second Term Permit covered 1996-2002; and the Third Term Permit covers 2002-2007. Each of the permits has required the development and implementation of a monitoring program to support an effective County-wide urban stormwater management program.

First Term Permit

The monitoring program for the First Term consisted of four elements. These elements were Field Screening, Channel Monitoring, Harbor/Bay Monitoring, and Sediment Sampling.

- Field screening was performed to detect the presence of illegal discharges or illicit connections. Physical and chemical analyses were conducted in the field. The annual evaluation of each station included two dry-weather samplings and one storm sampling. Field screening monitoring stations within the Aliso Creek Watershed were:

    1) Aliso Creek Channel at Aliso Creek Road
    2) Aliso Creek Channel at Pacific Coast Highway
    3) Sulphur Creek Channel at Laguna Niguel Regional Park
    4) Narco Channel at Laguna Niguel Regional Park
    5) English Canyon Channel at Los Alisos Boulevard

- Channel monitoring focused on specific watercourses with beneficial uses identified in the Basin Plan. Stations were monitored monthly and/or during storms. Samples were collected using automatic samplers. Samples were analyzed for pH, electrical conductivity, turbidity, nutrients, total suspended solids, volatile suspended solids, and total recoverable metals. Aliso Creek in Aliso/Wood Canyon was the station located in the Aliso Creek Watershed.

- Harbor/Bay sites were monitored semiannually and during storms. The monitoring included sampling for nutrients in the water column and trace metals and organics in the sediment. No Harbor/Bay Monitoring was directly associated with the Aliso Creek Watershed.

- Sediment sampling was conducted semiannually from designated channels and several bays and harbors. Samples were evaluated for metals, pesticides, herbicides, PCBs, and PAHs.

Second Term Permit

The First Term Permit monitoring program was continued into the second permit term. However, in 1999 the 99-04 Monitoring Plan was developed and implemented. This plan revised the geographic focus of the monitoring effort by designating "warm spots" (where constituents are substantially above system-wide averages) and "Critical Aquatic Resources" or CARs.

The monitoring objective for the Warm Spot segment of the program was to detect changes in the levels of the identified constituents over the long term. The CARs were prioritized and additional monitoring stations selected to gather data at those sites. A total of seven monitoring stations were established. In the Aliso Creek Watershed, the established station was located at Aliso Creek in Laguna/Wood Canyon Wilderness Park.

Third Term Permit

This current permit period is the most comprehensive monitoring effort to date. It extends the monitoring program to a broader range of locations and to a wider array of methods for measuring impacts. Investigation of the effects of stormwater plumes on the nearshore marine environment has been added to the program. Inland, the monitoring program includes bioassessment of creeks, along with more consistent use of toxicity testing. The bioassessment, toxicity testing, and measurement of chemical parameters are referred to as the "triad" approach. The Wet Weather Monitoring Program and the Dry Weather Monitoring Program supercede the 99-04 Monitoring Plan.

The four elements of the Wet Weather Monitoring Program are:

Urban Stream Bioassessment Monitoring – includes 12 sites plus three reference sites. Five sites are located in the Aliso Creek watershed, one is located in Wood Canyon, one is located on English Creek, and three are located on Aliso Creek.

Long-Term Mass Loading Monitoring – includes measurements of key pollutants at 6 sites. Monitoring sites include the sites designated in the 99-04 monitoring program plus additional sites. A total of 6 stations were selected across Orange County. Aliso Creek in Aliso/Wood Canyon is the only station in the Aliso Creek Watershed for this program element.

Coastal Storm Drains Monitoring – based on a suite of bacterial indicators. There are 36 sites, including the mouth of Aliso Creek.

Ambient Coastal Receiving Waters Monitoring – uses a measure of runoff plume characteristics. Stations include the mouth of Aliso Creek and three sites in nearby Dana Point Harbor. Testing will be done semi-annually and during two storms per year.

The Dry Weather Monitoring Program is focused on detection of illicit discharges and illegal storm drain connections. **Figure 9** shows the subwatersheds and the monitoring locations within the Aliso Creek Watershed.

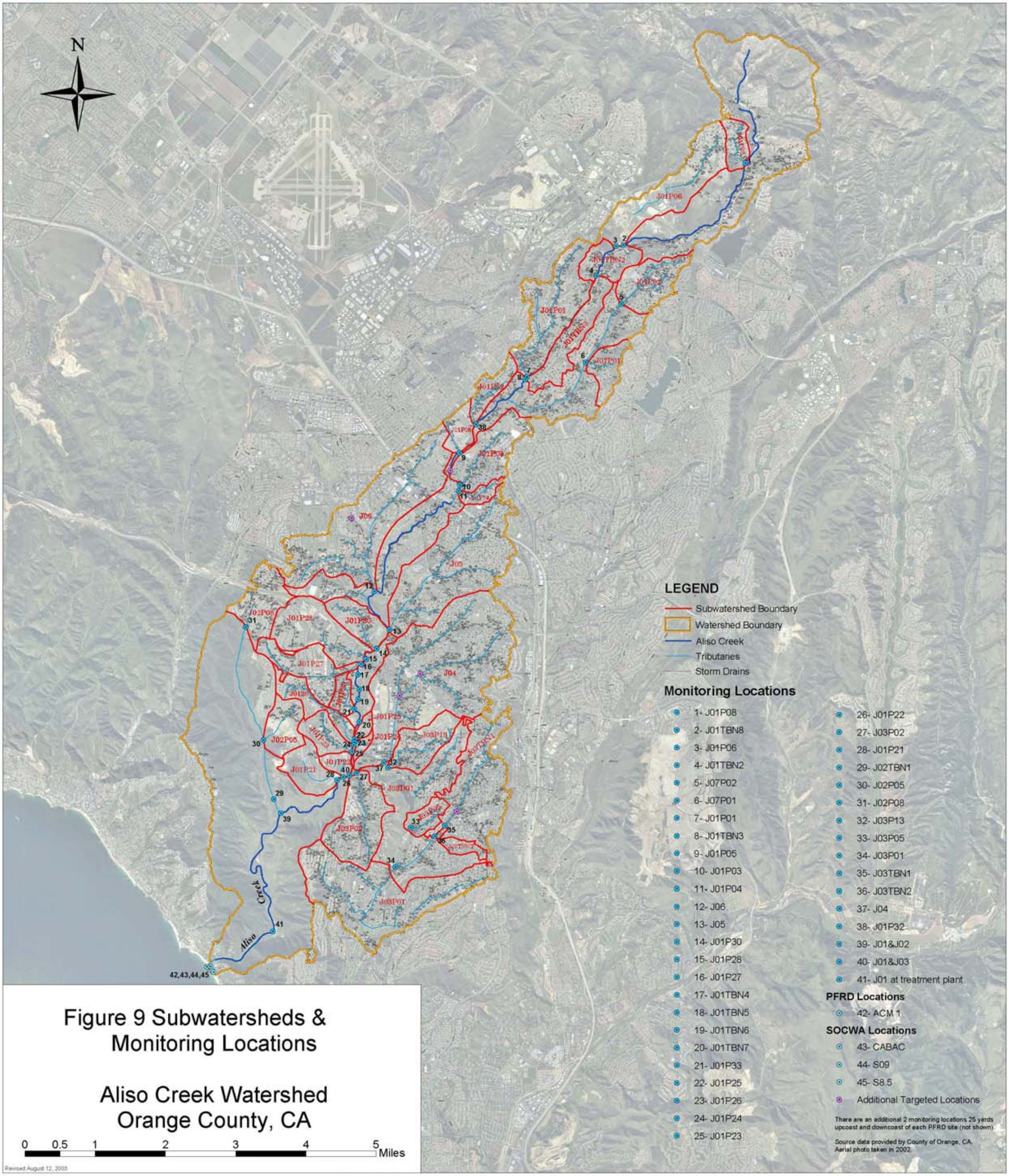

Figure 9 Subwatersheds & Monitoring Locations

Aliso Creek Watershed
Orange County, CA

Pipes currently monitored as dry weather monitoring locations within the Aliso Creek Watershed include:

1) J01P26
2) J01P27
3) J01P28
4) J01P33
5) J02P05
6) J01P01
7) J01P02
8) J01P05
9) J01P08
10) J04P04
11) J03P01
12) J04@J03
13) J01@Laguna Beach
14) J01@ASVM
15) J01P03
16) J01P04
17) J07P02

This list will be modified over time.

2.2.2 Bacteria Monitoring Program: CAO 99-211

On December 28, 1999 the Regional Board issued a Cleanup and Abatement Order (CAO 99-211) due to preliminary 205(j) Study findings of elevated fecal coliform levels at a particular storm drain (J03P02). CAO 99-211 required Orange County, the Orange County Flood Control District, and the City of Laguna Niguel to develop a workplan with a time schedule to cleanup the waste discharge from the J03P02 storm drain outfall into the Sulphur Creek tributary of Aliso Creek; abate the effects of the discharged waste; implement a weekly monitoring program; and, to submit quarterly progress reports. This order was rescinded by the Regional Board on May 11, 2005.

2.2.3 Bacteria Monitoring Program: Directive

On March 2, 2001, the San Diego Regional Board issued a directive pursuant to California Water Code Section 13225 ("Directive") to the Principal Permittee and the cities within the Aliso Creek Watershed ("Watershed Permittees") for an investigation of urban runoff in the watershed. The

Directive found that the Watershed Permittees may be discharging waste with high bacteria levels from municipal storm drain outfalls into Aliso Creek and its tributaries. To meet requirements of the Directive, the Watershed Permittees implemented a watershed-wide regional bacteriological monitoring program in April of 2001.

A revised regional monitoring program that more efficiently allocates efforts to source identification and reduction was approved in October 2005 and began implementation in June 2006. The revised program focuses monitoring efforts on “status sites” and “trends sites” in the lower watershed and on a “BMP evaluation sites” at high-priority drains throughout the watershed.

The monitoring of status and trend sites addresses two questions:

1. Are conditions in receiving waters protective of beneficial uses? (status)
2. Are conditions in receiving waters getting better or worse over time? (trends)

Status and trends monitoring takes place at five core stations in the lower portion of the watershed, which past studies indicate is the area of highest recreation use and related concern about potential human health impacts. Despite some variability among them, the stations as a group provide a picture of conditions in the lower portion of the Creek. These five stations will be monitored during August and September, at a frequency of 10 samples per month. This period represents the most conservative sampling period because it captures the annual peak of bacteria levels in the watershed and the time of year that body contact recreation is most likely.

The BMP evaluation monitoring focuses on answering three questions:

1. Have bacteria loads from the high-priority drains decreased?
2. Are BMPs having their intended effects on concentrations in and/or loads from the drains?
3. Have impacts from high-priority drains on the receiving waters decreased?

Data from the BMP evaluation sites will also be compared to the results of the status and trends monitoring in the lower sections of Aliso Creek. This will help to assess whether a reduction in loads at the high-priority drains is associated with improving conditions in the lower Creek.

The revised program also contains important adaptive components that will ensure the monitoring program maintains its focus on key management questions, responds appropriately to monitoring findings, initiates new activities only when they are supported by the monitoring data, and reduces monitoring effort when it no longer provides useful information. Data and results of the revised monitoring program will be submitted on an annual basis on November 15th of each year.

2.2.4 205(j) Water Quality Study

The Aliso Creek 205(j) study was an effort led by the County of Orange to collect information throughout the Aliso Creek Watershed on a wide range of water quality parameters. The initial water quality investigation included chemical, physical, bacteriological, and toxicity sampling.

Results of the initial water quality investigation indicated that elevated bacteria and aquatic toxicity were the most critical water quality issues in the watershed. Elevated bacteria were viewed by a Watershed Technical Advisory Committee as requiring immediate attention. Further focused studies were undertaken to collect bacteriological data to determine those subwatersheds that should undergo more focused source identification efforts based on potential sources of the elevated bacteria levels. Efforts undertaken in this study also included an aquatic life assessment, water temperature profiling, and recreational use analysis. As a result of the water quality findings, several recommendations were made in the Corps study and Watershed Management Plan and have and are being pursued by the Watershed Permittees within the watershed (see later sections of this document).

2.2.5 Pre-NPDES Monitoring Program

Prior to the start of the NPDES Monitoring Program in 1991, a monitoring station was operated along Aliso Creek, a quarter mile upstream of the Pacific Coast Highway. The monitored constituents included nutrients, total lead, copper, zinc, cadmium, and chromium. Monitoring was also performed for dissolved oxygen, which was a concern because of the sand blocking that develops at the mouth of the creeks due to currents and tidal action. When dissolved oxygen concentrations dropped below a critical level, the sand berm was breached to allow circulation.

2.2.6 Orange County Health Care Agency

Over the past 40 years, the Health Care Agency (also known as Environmental Health) and local sanitation agencies (Orange County Sanitation District and South Orange County Wastewater Authority) have been testing the coastal waters in Orange County for bacteria that indicate possible presence of human disease-causing organisms. Samples are collected weekly at approximately 150 ocean, bay, and drainage locations throughout coastal Orange County. Within the Aliso Creek Watershed, there are sample locations at the mouth of Aliso Creek and on Aliso Beach (**Figure 9**).

2.2.7 Stream Gage Information

While the collection of data at the stream gages is not precisely a water quality monitoring program, it does provide valuable information in the overall knowledge of the flow history in the watershed and is therefore discussed throughout this section.

Data consisting of periodic discharge measurements (instantaneous discharge in cubic feet per second) has been measured at one site on Aliso Creek from 1932 to the present. This information indicated peak discharges for each water year and the average daily baseflow over the period of record. Historically (pre-urbanization), Aliso Creek was an ephemeral creek. However, the Aliso Creek Watershed has yielded a steady increase in baseflow over the period of record. This is believed to be due to irrigation throughout the watershed increasing the water available to infiltrate into subsurface and emerge as baseflow in the creek. This baseflow currently supports vegetation and wildlife in a discontinuous riparian corridor from the headwaters to the ocean.

A second stream gage was installed in 2001 at the bridge to the treatment plant in Aliso/Wood Canyon Regional Park to allow further flow assessments in response to the 13225 Directive.

2.3 Water Quality Monitoring Data Assessment

2.3.1 Findings of the NPDES Monitoring Program

While the priority constituent of concern in the Aliso Creek Watershed is pathogen indicator bacteria, the water quality issue of greatest public concern (see **FY2002-03 Unified Report**) is pollution of beaches. Consequently, this discussion primarily considers, based upon the findings from analyses of the Wet Weather Monitoring Program - Coastal Storm Drain Outfall data, the impact of the Creek on coastal waters. These analyses, which were undertaken to identify on a regional basis the most potentially problematic outfalls, comprised:

1. Comparing indicator levels at each drain to the State's Ocean Water–Contact Sports Standards (also referred to as "AB411" standards);
2. Ranking drains based upon the proportion of total possible exceedances of the AB411 standards;
3. Plotting indicator levels in the receiving water vs. those in the drain; and
4. Ranking drains in terms of the slope of the linear regression of receiving indicator levels vs. those in the drain.

More detailed discussion of these analyses and the analyses of data from the other monitoring program elements (Bioassessment, Mass Emissions, etc.) are presented in the **2004-2005 Unified Report Section C-11).** A summary of findings is depicted in tables and figures attached to this WAP **(Attachment 1, Water Quality Monitoring Data)**.

Attachment 1a shows the proportion of all samples exceeding AB411 standards in the receiving water upstream and downstream of coastal drains for the entire year and for the AB411 season. The exceedances were predominantly for Enterococcus and Monitoring Site ACM1 did not rank in the top 5 (10% or higher rate of exceedance) in either comparison.

Exceedances of AB411 standards in the receiving waters were usually associated with elevated concentrations of indicator organisms in the outfall itself. **Attachment 1b** provides a graphic illustration of this relationship. Linear regression provides additional insight by quantifying the strength of the outfall/receiving water relationship (measured by the statistical significance – 'p' value - of the regression slope). **Attachment 1b** shows that site ACM1 ranks highest in terms of its influence on receiving water quality.

Based upon these analyses, a number of overall patterns in the overall bacteria output of the watershed are evident:

- The proportion of exceedances is generally lower in the AB411 season than in the entire year, implying that exceedance rates are highest in the rainy season; and
- Regressions are generally less strongly significant in the AB411 season than in the entire year, implying that the relationship between drains and nearby receiving waters is tighter (i.e. a more influential determinant) in the rainy season.

2.3.2 Results of Bacteria Monitoring Program: CAO 99-211

Quarterly progress reports were submitted to the Regional Board from May 2000 to April 2005 by the County, Orange County Flood Control District and the City of Laguna Niguel describing the results of the weekly sampling program and efforts to identify causes of elevated bacterial water quality in the storm drain identified as J03P02 in the Kite Hill area.

Extensive investigations over the term of the CAO identified no broken or leaking sanitary sewer lines in the vicinity of J03P02 and no human pathogens in the discharge. Instead, source investigations conducted pursuant to the CAO identified the predominant source of fecal bacteria as avian, with additional inputs from rabbits, dogs, and manure used as fertilizer. Source investigations conducted in 2000 indicate the following sources probably contribute to the levels of bacteria in the J03P02 system: organic soil amendments, turfgrass areas, wildlife, domestic pets, accumulated organic debris in the surface and subsurface storm drain system, and street sweeping debris. Regrowth of bacteria within the storm drain system was also identified as a potential contributor to the problem.

To address the elevated bacterial levels, the City of Laguna Niguel constructed the Wetland Capture and Treatment Network (WetCAT), a system of three constructed wetlands and an inlet/piping system that captures and treats virtually all low-flow and first-flush runoff from the entire J03P02 watershed. This system has been effective at reducing bacterial levels.

2.3.3 Results of the Aliso Creek Water Code 13225 Directive Monitoring Program

Over the FY2004-05 reporting period, bacteriological concentration levels followed the expected seasonal pattern of increasing during the dry weather seasons (spring and summer) and decreasing during the wet weather seasons (fall and winter). Bacteria levels in the winter (16th quarter), Spring (17th quarter) and Summer (18th quarter) seasons indicated a decrease from levels from the same season of the previous year. This decrease is expected as the Watershed Permittees continue activities to abate bacteria or eliminate sources. **Attachment 1c** summarizes, by quarter, the geomean concentrations of fecal coliform in the stormdrains measured in the Directive Monitoring Program.

The quarterly geomean concentrations of fecal coliform are plotted for each site in **Attachment 1d.** The graphs are positioned according to the relative position of the stormdrain in the watershed (i.e. J01P08 is the furthest upstream sampled drain). From these graphs it appears that the stormdrains can be placed in one or more categories. These categories include:

- Stormdrains which show little impact on receiving water (e.g. J01TBN3, J01P05, J01P04, J05, J01TBN4, J01P33, J01P30 [last 2 years], J01P26, J01P25, J01P24, J01P22, J01P21, J03P05, J03P13, and J03P02 [except summers of 2003 and 2004]).
- Stormdrains which appear to have a significant impact on their respective receiving waters (e.g. J01P08, J01P01, J01P03, J01P28, J03TBN2, J03P01, J04, J02TBN1, and J02P05).
- Stormdrains in which the fecal coliform concentration in the discharge is consistently lower than their respective receiving water concentration (J01P24, J01P21).

It should be noted that the assignments of the stormdrains to the categories above were based solely on visual observations of the data patterns in the graphs. The impact of a drain on its respective receiving water is a function of many factors including:

- Concentration of bacteria in the stormdrain discharge
- Concentration of bacteria in the receiving water upstream of the discharge
- Discharge rate of the stormdrain
- Volume of the receiving water relative to the discharge rate of the stormdrain (assimilative capacity)

For example, J01P08 and J01P28 show very high concentrations of fecal coliform in their respective discharges. The estimated discharge rate of J01P28 is approximately twice that of J01P08. The graphs of the fecal coliform quarterly geomean appear to show that the impact of J01P08 on the Creek is much greater than the impact of J01P28. The difference in the magnitudes of impact can be explained by second and fourth factors. The concentration of fecal coliform in the Creek is much lower upstream of J01P08 than upstream of J01P28. J01P08 is near the top of the watershed and J01P28 is in the lower third of the watershed. The volume of water in the Creek upstream of J01P08 is much lower than that upstream of J01P28. Hence the assimilative capacity of the Creek is much lower at J01P08 than at J01P28.

Within the watershed, the monitoring is starting to provide a basis for stormdrain prioritization, specifically, that there are clearly:

- Stormdrains which show little impact on receiving water;
- Stormdrains which appear to have a significant impact on their respective receiving waters; and
- Stormdrains in which the fecal coliform concentration in the discharge is consistently lower than their respective receiving water concentration.

2.3.4 Conclusions of the 205(j) Water Quality Study

The water quality analysis of data collected and analyzed as part of the 205(j) study led to the following conclusions:

- Nutrient concentrations in Aliso Creek are low to moderate compared with similar regions in Orange County. Basin Plan objectives were generally met for N:P ratios and for ammonia.

- Orthophosphates were not analyzed during this study, but total phosphate levels indicate that orthophosphate may exceed Basin Plan objectives.

- The samples collected had low to moderate turbidity levels that generally met the Basin Plan objectives.

- Total recoverable metals were sampled and were shown to be below the California Toxics Rule. The presence of high water hardness suppresses the potential toxic effects of trace metals by limiting the effective bio-availability of the metals.

- The percentage of sodium is within the guideline of 60 percent specified in the Basin Plan for inland surface waters.

- Elevated levels of total dissolved solids, sulfate, iron, and manganese were noted throughout the watershed and may be partly attributable to high saltwater concentrations in the groundwater and/or related to soil types/geologic formations.

- Analysis of dissolved oxygen, pH, and electrical conductivity showed that these parameters generally stayed within the objectives outlined in the Basin Plan.

- Aquatic toxicity was noted in the watershed. Possible sources include trace metals, polynuclear aromatic hydrocarbons, pesticides, herbicides, PCBs, and ammonia. Based on other studies performed in Orange County, it is suspected that organophosphate pesticides may be a significant component of aquatic toxicity in the Aliso Creek storm samples.

- Bacteriological studies show that elevated bacteria occur throughout this watershed. Samples in the watershed showed fecal coliform and *E. coli* levels exceeding 4,000 MPN/100 ml. Important management activities to decrease bacteria include (a) reduction of excess irrigation runoff, (b) additional research-level source investigations, and (c) creek restoration initiatives. This study leads to the conclusion that more investigation efforts are needed to understand the impacts of bacteria to human health within the watershed, as well as the sources of bacteria within the basin.

3.0 TMDLS IN THE WATERSHED

3.1 Directives

On March 2, 2001, the San Diego Regional Board issued a directive pursuant to California Water Code Section 13225 ("Directive") to the Principal Permittee and the cities within the Aliso Creek Watershed ("Watershed Permittees") for an investigation of urban runoff in the watershed. The Directive found that the Watershed Permittees may be discharging waste with high bacteria levels from municipal storm drain outfalls into Aliso Creek and its tributaries. To meet requirements of the Directive, the Watershed Permittees implemented a watershed-wide regional bacteriological monitoring program in April of 2001.

3.2 TMDLs

Section 303(d) of the Clean Water Act requires that each state identify waters that are not meeting the water quality standards for their applicable beneficial uses. This process involves requesting and compiling readily available data and comparing these data to the appropriate water quality objectives (WQOs). The waterbody-pollutant combinations exceeding WQOs at predefined frequencies, which are specified in the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List, are placed on the 303(d) list of impaired waters. Section 303(d) also requires states to establish a priority ranking for waterbody-pollutant combinations on the 303(d) list and to subsequently establish TMDLs for each.
The goal of the TMDL process is to attain water quality standards and protect the beneficial uses of water bodies. It is defined as "the sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) and requires that the capacity of the water body to assimilate pollutant loadings (the loading capacity) is not exceeded.

The TMDL process begins with the development of a technical analysis which includes the following seven components: (1) a Problem Statement describing which WQOs are not being attained and which beneficial uses are impaired; (2) identification of Numeric Targets which will result in attainment of the WQOs and protection of beneficial uses; (3) a Source Analysis to identify all of the point and nonpoint sources of the impairing pollutant in the watershed and to estimate the current pollutant loading for each source; (4) a Linkage Analysis to calculate the Loading Capacity of the waterbodies for the pollutant; i.e., the maximum amount of the pollutant that may be discharged to the waterbodies without causing exceedances of WQOs and impairment of beneficial uses; (5) a Margin of Safety to account for uncertainties in the analyses; (6) the division and Allocation of the TMDL among each of the contributing sources in the watersheds, wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint and background sources; and (7) a description of how Seasonal Variation and Critical Conditions are accounted for in the TMDL determination. The write-up of the above components is generally referred to as the technical TMDL analysis.

In addition to a technical TMDL analysis, the state is required to incorporate the TMDLs and their appropriate implementation measures into the State Water Quality Management Plan (40 CFR 130.6(c)(1), 130.7), such as the San Diego Regional Water Quality Control Plan (Basin Plan). After a TMDL is adopted as an amendment to the Basin Plan (amendments are initially developed by the Regional Board staff, then approved by the Regional Board, State Water Resources Control Board, and State Office of Administrative Law), it is submitted to EPA and reviewed. Approval from EPA is the last step in the TMDL process.

3.2.1 TMDLs for Indicator Bacteria

TMDLs for pathogen indicator bacteria have been developed to address 17 of the 38 bacteria-impaired waterbodies in the San Diego Region identified on the 2002 Clean Water Act Section 303(d) List of Water Quality Limited Segments. This regulatory initiative is referred to as the Project I – Beaches and Creeks in the San Diego region. The impaired beaches and creeks are located within or hydraulically downstream of five watersheds in Orange County (including Aliso Creek) and seven watersheds in San Diego County. The TMDL documentation (draft Technical Report, December 9, 2005) notes that because bacteria loading within urbanized areas generally originates from urban runoff discharged from municipal storm drains, the primary mechanism for TMDL attainment will be increased regulation of the Watershed Permittees. It is anticipated that TMDL provisions will be incorporated into the Fourth Term Permits in 2007.

4.0 BMP INVENTORY

In developing a plan to address water quality within the Aliso Creek Watershed, it is important to (1) understand the sources of pollution within the watershed and (2) know the Enhanced BMPs and creek system restoration projects that have been implemented (or proposed to be implemented) within the watershed to deal with the watershed constituents of concern. This section provides the available information for these areas.

4.1 Watershed Pollution Sources

Pollution sources in the Aliso Creek watershed include urban runoff, open space runoff, groundwater, permitted discharges, atmospheric deposition, agriculture, and wildlife. Because the mandate of the Orange County Stormwater Program is to address urban runoff, this WAP and planning effort will focus mainly on the urban sources although it is inherently recognized that in many cases, such as sediment control, the Watershed Permittees have taken on a broader role as responsible stakeholders even though the urban contribution is limited.

The urban sources in the watershed include runoff generated during storm events and non-storm related runoff from municipal facilities, residential, commercial, and industrial areas and parks.

4.2 Enhanced BMPs

The DAMP/LIP and DAMP/WAP planning processes essentially result in *Baseline BMPs* and *Enhanced BMPs,* respectively. *Baseline BMPs* are based upon the model programs identified in the DAMP and are implemented on a countywide basis to contribute to the control of all pollutants. *Enhanced BMPs* generally target watershed priority constituents of concern (currently pathogen indicator bacteria). The DAMP/WAP planning process also incorporates actions to comply with California Water Code (CWC) directives and abatement orders. Progress on DAMP/WAP implementation has been reported in the FY2003-04 and FY2004-05 Annual Progress Reports.

Examples of Enhanced BMP implementation efforts in the watershed targeting pathogen indicator bacteria include:

- Provision of pet waste disposal bags in parks and on trails (LN-L3f);
- Installation of municipal facility drain inlet debris screens (OC-L3a);
- Installation of drain inlet debris screens (LH-L3b, LN-L3b, MV-L4b);
- Installation of drain inlet filters (LF-L3a, MV-L3a);
- Installation of bactericidal in-line storm drain filters (MV-L3c);
- Installation of a hydro-dynamic separator (LF-L3a);
- Installation of a stormwater treatment vault (MV-L4b);
- Operation of a UV disinfection water treatment system on drain JO1P28 (OC-L3b);
- Installation of stormdrain sand filter (LF-L3c);
- Creation of wetland habitat within detention basins (AV-L3g);
- Landscape irrigation control (LN-L3e);

- Operation of a constructed wetland treatment system (Wet CAT) in drain JO3PO2 (LN-L2c). The Wet CAT system consists of three constructed multipurpose wetlands designed to capture and treat low-flow urban runoff from a suburban residential neighborhood. The wetlands were constructed in 2001-03 in response to the Clean-up and Abatement Order issued to the City of Laguna Niguel and the County of Orange in December 1999;
- Implementation of a trash enclosure retrofit program (MV-L3e);
- Implementation of bio-retention devices (MV-L3f), and
- Hosting Fats, Oils and Greases (FOG) seminars (LF-L3f).

4.3 Restoration Projects

The term "Restoration" is applied to projects and planning efforts that contribute to the re-establishment of a more natural watershed hydrologic regime and which are focused on achieving broader objectives such as watershed habitat restoration and connectivity rather than specific water quality outcomes (**Table 3**).

The US Army Corps of Engineers watershed planning studies, which incorporated many of the water quality recommendations of the 205(j) water quality study, form the basis of much of the multi-jurisdictional project implementation efforts in the watershed. While the ecosystem restoration plans are not directed primarily at water quality improvement, but at larger-scale ecosystem improvement, they would be expected to have a positive impact on water temperature, turbidity, and oxygen content and potentially on bacteria reduction through the creation of vegetative buffering from urban landscaping.

4.3.1 U.S. Army Corps of Engineers Watershed Planning Studies

The Army Corps of Engineers has completed a comprehensive study of the creek and its watershed in order to develop a management plan that will accomplish stream stability, habitat restoration, flood and embankment protection, and improved water quality. $45m in Section 219 funds is being sought to support the Aliso Creek Water Quality SUPER project.

Table 3: Components of the Aliso Creek Watershed Management Plan

Measure	Component		Description
Ecosystem Restoration Alternatives			
Aliso Creek Mainstem Ecosystem Restoration	1A	Lower Aliso Creek Stabilization Plan	Construct riffle structures; regrade side slopes riparian; vegetation
	1B	Middle Aliso Creek Stabilization Plan	Construct riffle structures; floodplain modifications; riparian vegetation
	1C	Floodplain and Riparian Habitat	Floodplain and riparian habitat upstream of ACWHEP

Measure	Component		Description
	1D	Off-channel Aquatic Habitat and Riparian Restoration	Off-channel fish spawning and riparian habitat in abandoned horseshoe bend below Wood Canyon confluence
Sulphur Creek Ecosystem Restoration	2A	Sulphur Creek along Crown Valley Parkway from treatment plant to community center access road	Modify flow control structure and small basins at upstream and downstream end to restore natural hydrologic regime; re-establish riparian vegetation
	2B	Sulphur Creek upstream of La Paz Road long Crown Valley Parkway between La Plata Drive and Moulton Parkway	Remove concrete V-ditch and non-native species; restore riparian habitat
Wood Canyon Ecosystem Restoration	3A	Restoration of upstream-most detention basin	Modify basin to retain water longer; reduce downstream erosion and revegetation
	3B	Tributary from northeast side canyon (current gabion structure)	Remove gabion structure, bioengineer slope with grading and revegetation
	3C	Localized stream restoration	Replacement of washed-out road crossings; removal of pipe in stream; placement of invert stabilizers, placement of water diversion bars
English Canyon Ecosystem Restoration	-	Restoration of English Canyon immediately upstream of Aliso confluence	Remove exotic vegetation; remove riprap and regrade streambanks; restore native riparian; excavate and create emergent marsh just stream of confluence
Pacific Park Basin Ecosystem Restoration	-	Wetland/Riparian habitat restoration	Removal of exotic vegetation; limited excavation and regarding of basin; covering riprap with soil and vegetation; restore native riparian vegetation
Water Quality Improvement Projects			
BMPs	-	Best Management Practices	Review and development of BMPs for Orange County and associated cities
Water Quality Wetlands	7A	Dairy Fork	Wetlands to reduce nutrients and bacteria in low-flows
	7B	English Canyon	Wetlands to reduce nutrients and bacteria in low-flows

Measure	Component		Description
Streambank Erosion Control			
SOCWA Treatment Plant Bridge		SCTP Invert Stabilization	Stream stabilization at the SOCWA Treatment Plant Bridge
English Canyon Erosion Control Sites	9A	Limited bank protection	Limited bank protection between Los Alisos Boulevard and Trabuco Road
	9B	Spot fixes	Repair scour holes below Via Noveno, Vista del Lago, and Entidad; protect short section of streambank
Floodproofing Plans			
Floodproofing	-	Floodproofing/Relocation of Aliso Creek Inn	Floodproofing, relocation, and removal alternatives for the Aliso Creek Inn
Comprehensive Plans			
Watershed Education	-	Watershed Education Plan Nonpoint Source Public Awareness	Education plan for K-12 to teach watershed stewardship; public education on residential and/or commercial practices that affect the watershed
Water Quality Monitoring Plan	-	Water Quality Monitoring Plan	Monitor effectiveness of education program and BMPs
Watershed-Wide Exotic Species Eradication	-	Watershed-wide removal of exotic species	Removal of Arundo donax and several other non-native species

The Aliso Creek Watershed Management Study is currently under evaluation for possible Corps funding for feasibility studies for the Mainstem Restoration. The Aliso Creek Mainstem Ecosystem Restoration, which is the most expensive of all the recommended actions, is currently in the phase of preparation of a Project Management Plan.

A number of projects recommended in the Watershed Management Study have been pursued by the Watershed Permittees as presented in **Table 4** and discussed below. Several elements of the Sulphur Creek and Wood Canyon Ecosystem Restoration efforts have been implemented or are undergoing final design.

Table 4: Restoration/Retrofitting Projects in the Aliso Creek Watershed

Project	City/Sub-Watershed	Status	Performance Measures
La Paz Park on-site wetlands	Laguna Niguel	Constructed 01-02	Habitat

Project	City/Sub-Watershed	Status	Performance Measures
Sulphur Creek Park enhancement	Laguna Niguel	Constructed 02	Habitat
Sulphur Creation @ Crown Valley Pk	Laguna Niguel	Constructed 02	Habitat
J03P01 restoration @ Crown Valley Pk	Laguna Niguel/J03P01	Constructed 02	Habitat
East Wetland @ J03P02	Laguna Niguel/J03P02	Constructed 02	Habitat, Water Quality
Munger Storm Drain Filter	J01P01	Under Construction	Bacteria
Laguna Hills Wetlands	Laguna Hills/J01P04	Construction Complete	Bacteria
Aliso Viejo Wetlands	Aliso Viejo/J02P08	Conceptual	Bacteria
ACHWEP	County of Orange/J01	Constructed	Habitat

Sulphur Creek Rehabilitation within the Laguna Niguel Regional Park

The County of Orange completed a creek rehabilitation project along 3,000 feet of Sulphur Creek within the Laguna Niguel Regional Park. The project included (1) the removal of a low-flow concrete liner that carried water from Sulphur Creek reservoir downstream through the Regional Park and replacement with a more natural channel constructed of gravel, buried riprap, and boulders; (2) regrading of the site; and (3) revegetation of the corridor with native riparian species. The project was completed in 1998 and has satisfied the performance criteria for the project established during the planning and design phase.

Middle Sulphur Creek within the City of Laguna Niguel

The City of Laguna Niguel is conducting restoration projects anticipated to have a positive effect on water quality in Sulphur Creek, Aliso Creek's largest single tributary, identified for improvement in previous studies. A joint effort with the Corps of Engineers, using funds available under Section 206 of the Continuing Authorities Program (CAP), began in 2001, with an expected completion date of November 2005. Performance criteria include habitat expansion and quality improvement. The restored stream should be more effective at bacteria removal and may reduce phosphorus and toxicity loads. As the first Section 206 project completed by USACE in Southern California, it will be a demonstration project of interagency cooperation for restoration of beneficial use.

Upper Sulphur Creek within the City of Laguna Niguel

The Upper Sulphur Creek ecosystem restoration was awarded State of California funding through Proposition 13, and implementation began in 2004. The project includes a stream restoration component along 7,200 linear feet of Upper Sulphur Creek. The restored stream, which includes replacement of concrete v-ditch with natural soft-bottom vegetated channel, should be more effective at bacteria removal and low flow attenuation and may reduce phosphorus and toxicity loads. The project demonstrates strategies for multi-agency funding and Homeowners Association cooperation, potentially applicable to other Aliso watershed sites. Performance criteria include habitat expansion and quality and water quality parameters.

Wood Canyon

Restoration efforts in Wood Canyon would also be funded under Section 206 of the Corps of Engineers' CAP. This restoration is undergoing final design, but has no funding available at this time. Performance criteria include habitat quality and water quality parameters.

Narco Channel Aquatic Ecosystem Restoration

The City of Laguna Niguel is implementing a stream restoration project along 400' feet of the Narco Channel tributary to Sulphur Creek. The restored stream, which includes replacement of a dirt trapezoid with more natural soft-bottom vegetated channel, should be more effective at bacteria removal. The project demonstrates strategies for outfall restoration and interagency cooperation, potentially applicable to other Aliso watershed sites. Performance measures include habitat and water quality.

English Canyon within the City of Mission Viejo

A preliminary restoration plan has been developed by the Army Corps of Engineers to restore and enhance the degraded riparian and aquatic habitat along 3.11 km of English Creek, to reestablish conditions characteristic of natural riparian watersheds and stream channels. Performance criteria include enhancement of biological community structure, diversity and quality; reestablishment of stream flow and beneficial hydrology to a portion of the creek; and provision of riparian and costal sage scrub habitat for listed, threatened and endangered species.

4.4 Estimating Load Reductions of Existing BMPs

Understanding the load reduction of implemented BMPs is important in assessing whether or not those BMPs are improving the quality of the receiving waters. Guidelines available through the DAMP (**DAMP Appendix E-1**, BMP Effectiveness and Applicability for Orange County) as well as California Stormwater Quality Association (CASQA) (CASQA BMP Handbook) associate wide ranges of estimates for the reduction in pollutants with various types of BMPs. Because the pollutant reductions are highly variable, actual monitoring data is often collected to assess the load reduction of the existing BMPs (see discussion of BMP evaluations in **Section 4.5**).

4.5 Recommendations for BMPs in the Watershed

New candidate BMPs can be prevention or removal oriented and can be considered either for updating baseline BMPs or for incorporation as Enhanced BMPs. New BMPs are generally identified from one or more of the following:

- A review of technical literature (such as the ASCE/EPA database);
- A review of existing control programs;
- Demonstration or research projects;
- Input from consulting firms and municipalities already involved in new BMP implementation; or
- Other sources.

Consistent with DAMP Section 3.0, the process for BMP selection and implementation at the watershed scale involves consideration of a candidate BMP with respect to:

- The Watershed Permittees' needs, goals, and objectives
- Consistency with federal and state programs
- Economies from streamlined analysis and implementation procedures
- Opportunities for flexibility in the development of management alternatives
- Decision-making based on environmental and local considerations
- Effective Capital Improvement Program planning and budgeting

The Watershed Permittees, together with the Permittees County-wide, have coordinated with one another to complete a BMP effectiveness study. In addition, there are several other studies underway or completed that are testing the efficacy and cost-effectiveness of various water quality improvement measures. It is anticipated that these studies will result in proposed modifications to the list of recommended BMPs and other measures contained in the 2003 DAMP and later incorporated into the Watershed Permittees LIPs.

Studies directed at all jurisdictions within the watershed that are currently underway or have been completed include the following:

- BMP Effectiveness Study/Orange County
- Trash and Debris BMP Evaluation
- Erosion Control BMP Effectiveness Evaluation
- Septic System Assessment on Stormwater Quality Evaluation
- Portable Toilet Oversight Program Evaluation
- Fats, Oils, and Grease (FOG) Program for Restaurants Evaluation
- Bacterial "Warm Spot" Elimination for City Storm Drains Evaluation

In addition to these countywide studies, a number of the Watershed Permittees are undertaking direct investigation of BMP effectiveness within their own jurisdictions at the sub-watershed level (**Table 5**). BMP effectiveness evaluations are generally directed toward High-Priority sub-watersheds as determined by each Permittee based on the results of the monitoring under the Aliso Creek 13225 Directive.

Table 5: Watershed BMP Short-Term Effectiveness Studies

Measure	Site	Performance Measures
City of Laguna Hills		
Catch Basin Inserts	Sub-watersheds J04P02, J04P03, J04P04	Trash, Organics, TSS
Laguna Hills Wetlands	Sub-watershed J01P04 Alicia & Moulton	Bacteria, Nutrients, TSS
City of Laguna Niguel		
Catch Basin Grate Screens	Sub-watershed J04/J03P01*	Trash, Nutrients
Catch Basin Insert Retrofits	Sub-watershed J04/J03P01*	Trash, Nutrients, Bacteria
Street Sweeping Frequency	Sub-watershed J04/J03P05*	Trash, Nutrients
Treatment Wetlands	Sub-watershed J03P02	Bacteria, Nutrients, TSS
Stream Restoration	J03TBN1*	Bacteria, Nutrients, TSS, Flow
Stream Restoration	Sub-watershed area in upper J03*	Habitat, Bacteria, Nutrients
Irrigation Control	Sub-watershed J03P05*	Nutrients, Flow Rate Reduction

** Indicates projects in High-Priority Sub-watersheds as determined by individual Watershed Permittees during two-Year Aliso Creek 13225 Directive monitoring program.*

5.0 PLAN IMPLEMENTATION AND ASSESSMENT

5.1 Plan Implementation

Plan Implementation Strategy Tables have been developed for the Aliso Creek Watershed that identifies the specific actions that are being undertaken to improve urban water quality within the watershed. These strategy tables are specific to the constituent of concern for the watershed and include information on past progress as well as the scheduled tasks to support this action. On an annual basis these tables will be updated to identify the progress made in that year as well as the schedule for the subsequent year. The Aliso Creek Watershed Strategy Tables are included as **Exhibit 2** to this WAP.

5.2 Plan Assessment

Effectiveness Assessment is the process that managers use to evaluate whether their programs are resulting in desired outcomes, and whether these outcomes are being achieved efficiently and cost-effectively (CASQA, 2003). A principle objective of the Watershed Action Plan is to present an integrated plan of action that will result in meaningful water quality improvements in the Newport Bay Watershed while balancing economic, social and environmental constraints. This plan of action is laid out in the strategy tables which are referenced in Section 5.1 and included herein as **Exhibit 2**. The program effectiveness assessment strategy requires the identification and thereafter annual consideration of measures that indicate whether progress is being made toward attainment of this objective and the other program objectives discussed in **Section 1.0**.

Assessment measures that are pertinent to the WAP are related to the confirmation of progress on the actions identified in the strategy table. The assessment of progress is integrated in the strategy tables through the annual update to the tables that require documentation on the progress that has been made on that specific action. Reasonable progress on these action items indicates that the Watershed Action Plan is effective.

6.0 REFERENCES

CASQA (California Stormwater Quality Association). January 2003. California Stormwater BMP Handbook.

National Research Co. 2003. Managing Troubled Waters. National Academy Press.

Table 6: Abbreviations/Definitions (Nomenclature)

Abbreviation	Definition
BMP	Best Management Practice
CASQA	California Stormwater Quality Association
CAP	Continuing Authorities Program
CARs	Critical Aquatic Resources
CIAs	Common Interest Areas
CTR	California Toxics Rule
DAMP	Drainage Area Management Plan
FOG	Fats, Oils, Grease
ID/IC	Illegal Discharge/Illicit Connection
LIP	Local Implementation Plan
NPDES	National Pollutant Discharge Elimination System
OCHCA	Orange County Health Care Agency
OCSD	Orange County Sanitation District
RDMD	Resources & Development management Department
ROWD	Report of Waste Discharge
RWQCB	Regional Water Quality Control Board
SWRCB	State Water Resources Control Board
TMDL	Total Maximum Daily Load
USACE, ACOE	United States Army Corps of Engineers
USEPA / EPA	United States Environmental Protection Agency
WAP	Watershed Action Plan
WLA / LA	Waste Load Allocation / Load Allocation
WMP	Watershed Management Plan
WQO	Water Quality Objective
WURMP	Watershed Urban Runoff Management Plan

EXHIBIT 1

ALISO CREEK 13225 DIRECTIVE REVISED MONITORING PROGRAM DESIGN

ALISO CREEK 13225 DIRECTIVE

REVISED MONITORING PROGRAM DESIGN – INTEGRATION WITH NPDES PROGRAM

Submitted to:
San Diego Regional Water Quality Control Board

December 2004

Prepared By:

County of Orange
Orange County Flood Control District
City of Aliso Viejo
City of Laguna Beach
City of Laguna Hills
City of Laguna Niguel
City of Laguna Woods
City of Lake Forest
City of Mission Viejo

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Appendices

1.0 INTRODUCTION AND OVERVIEW

This document describes a revised monitoring program for bacteria in the Aliso Creek watershed that integrates monitoring previously required under the California Water Code Section 13225 Directive (from the San Diego Regional Water Quality Control Board dated March 2, 2001) into the ongoing NPDES permit monitoring program conducted by the County of Orange (County), the Orange County Flood Control District, and the cities of Aliso Viejo, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, and Mission Viejo (Permittees). The revised and refocused monitoring program will thus represent a special focus within the larger National Pollutant Discharge Elimination System (NPDES) water quality monitoring program being conducted throughout the southern portion of the County. This in turn will achieve efficiencies of scale by integrating the Aliso Creek watershed monitoring efforts into the current NPDES monitoring activities in this watershed.

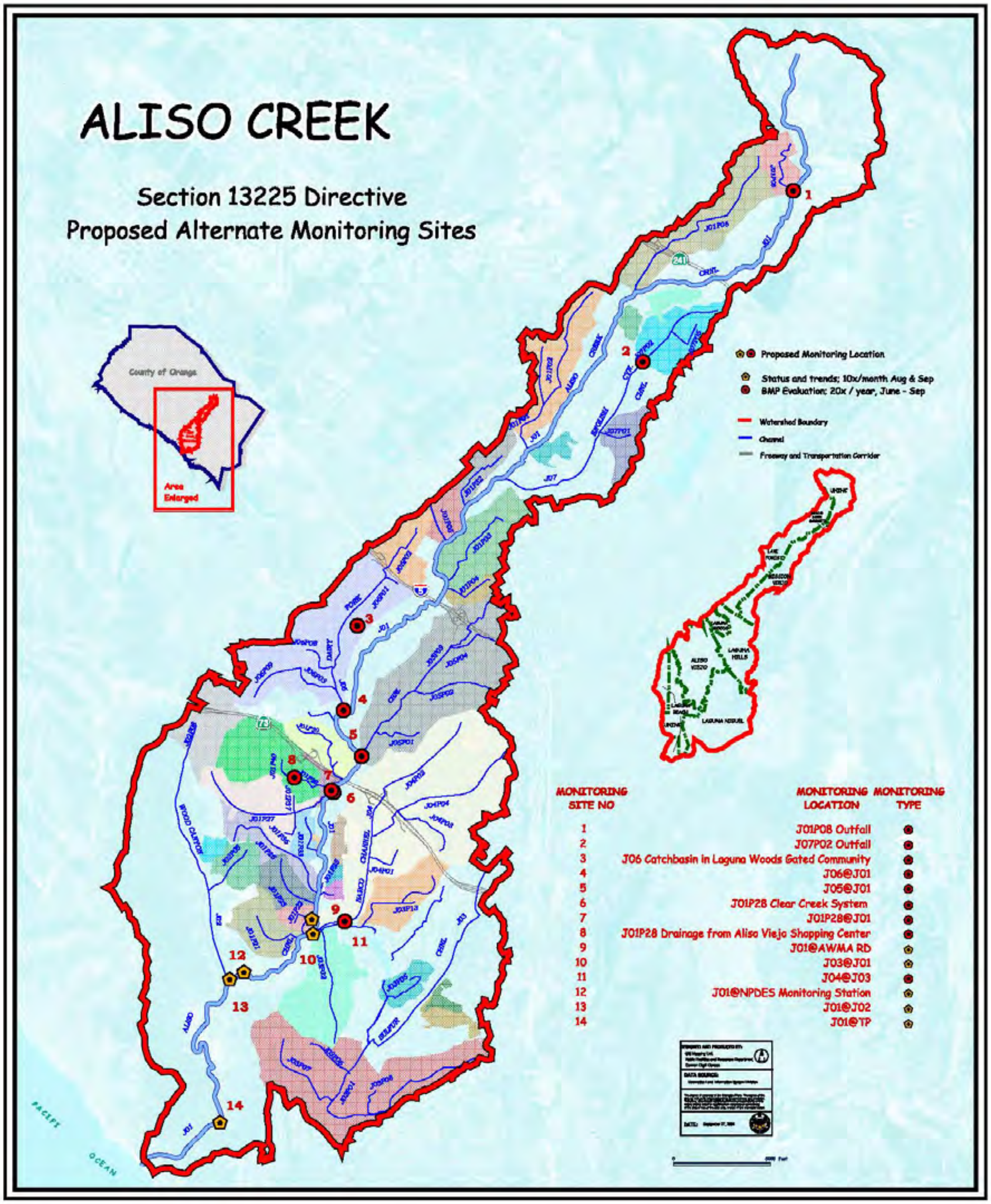
The proposed revisions, based on several years of monitoring data, build on improved knowledge about overall patterns of bacteria in the watershed as well as more localized responses to specific Best Management Practices (BMPs). The proposed program (**Figure 1**) focuses monitoring efforts on a group of status and trends sites near the bottom of the watershed and a second set of BMP evaluation sites at high-priority drains throughout the watershed. Monitoring will occur at a higher frequency than at present, but only during the two-month period in late summer when bacteria levels are highest. Analyses of the available monitoring data show that this design will sufficiently track compliance with REC1 standards in the area of highest recreational use in the lower watershed and document the effectiveness of BMPs implemented at the high-priority drains.

The revised program presented below contains important adaptive components that will ensure the monitoring program maintains its focus on key management questions, responds appropriately to monitoring findings, initiates new activities only when they are supported by the monitoring data, and reduces monitoring effort when it no longer provides useful information.

The prioritization process that resulted in selection of the high-priority drains in the Aliso Creek watershed is consistent with the basic intent of the prioritization process being used in both the San Diego and Santa Ana Regions to select dry weather reconnaissance sites for follow-up source identification efforts. In addition, the use of specific triggers that would lead to changes in the monitoring design and/or additional studies is a fundamental feature of the current NPDES monitoring programs in both Regional Board areas of Orange County.

Figure 1. Location of the revised monitoring locations

Includes five status and trends sites and nine BMP evaluation sites.



2.0 FUTURE MONITORING OBJECTIVES

The revised program design will focus on bacterial contamination and will:

- Document trends in water quality at high-priority locations
- Evaluate BMPs implemented to improve water quality
- Support source identification efforts.

These program objectives provide the underpinning for the specific monitoring questions presented in the following sections.

Monitoring at the revised sites and times will continue to rely on the indicators currently used, specifically:

- Total and fecal coliforms (all sampled sites and times)
- Enterococcus (all sampled sites and times)
- Total chlorine (drains only, once / month)
- pH (drains only, once / month)
- Temperature (drain and downstream station, all sampled times)
- Estimated flow (drains, all times).

In addition, the sampling design will retain the structure of monitoring:

- The pipe discharge at each site
- Ambient bacteria concentrations 25 feet upstream of the discharge point
- Ambient bacteria 25 feet downstream of the discharge point.

This will maintain consistency with past data in the watershed and agrees with the recommendations developed by the Stormwater Monitoring Coalition's (SMC) model stormwater monitoring program project. Monitoring the suite of three bacterial indicators along with flow also conforms to the recommendations of the SMC model stormwater monitoring reports, available on the Southern California Coastal Waters Research Project (SCCWRP) website.

3.0 PROPOSED REVISIONS

The following subsections describe proposed revisions to status and trends monitoring, BMP evaluation monitoring, and source identification efforts. **Figure 1** summarizes all station locations and sampling frequencies for both status and trends and BMP evaluation portions of the program (see **Appendix A** for additional detail).

3.1 Status and Trends Monitoring

Status and trends monitoring focuses on answering two questions:

1. Are conditions in receiving waters protective of beneficial uses? (status)
2. Are conditions in receiving waters getting better or worse over time? (trends)

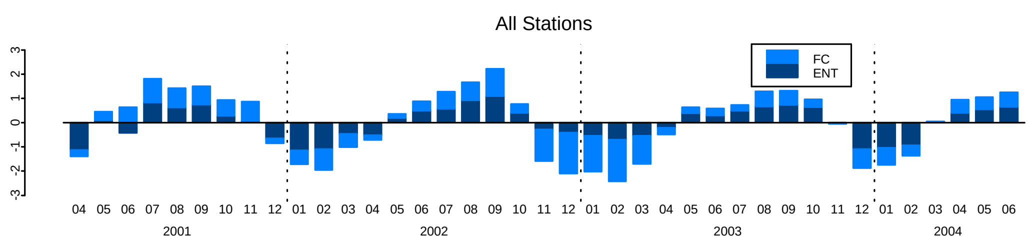
Status and trends monitoring will take place at five core stations in the lower portion of the watershed (**Figure 1**), which past studies indicate is the area of highest recreation use and related concern about potential human health impacts (see **Appendix A.1** for further background and justification). Despite some variability among them, the stations as a group provide a picture of conditions in the lower portion of the Creek.

These five stations will be monitored during August and September, at a frequency of 10 samples per month. This period represents the most conservative sampling period because it:

- Captures the annual peak of bacteria levels in the watershed (**Figure 2**)
- Is the time of year that body contact recreation is most likely.

Figure 2. Overall seasonal pattern of bacteria levels in the Aliso Creek watershed, summarized over all stations.

Data represent monthly means of levels in discharges from all drains over the 2001 – 2004 period. The darker portion of each vertical bar indicates Enterococcus and the lighter blue portion fecal coliform.



The monitoring frequency was selected with the goal of detecting an 80% drop in fecal coliform levels over a ten-year period. This sampling frequency is based on analyses of the ability to detect change for various levels of sampling effort (**Appendix B.1**). These analyses show this sampling frequency has the ability to both assess compliance with the REC1 objective in the most critical period of the year as well as to track trends over time.

Once the REC1 objective has been met in the lower sections of the Creek, then further monitoring effort could be focused on a second tier of sites along the higher sections of the Creek with a lower level of human health risk. Alternatively, if additional monitoring data show that conditions in the lower Creek can be adequately described by a smaller number of stations, then some of this monitoring effort could be reallocated to a second-tier site elsewhere in the watershed. (See **Section 5.0** and **Appendix C** for additional detail on the decision framework.)

Finally, while this program does not explicitly attempt to connect with the developing bacteria TMDL for the San Diego Region, one of the long-term status and trends sites does correspond with the "critical point" at the bottom of the watershed defined in the proposed TMDL.

3.2 BMP Evaluation

BMP evaluation monitoring focuses on answering three questions:

1. Have bacteria loads from the high-priority drains decreased?
2. Are BMPs having their intended effects on concentrations in and/or loads from the drains?
3. Have impacts from high-priority drains on the receiving waters decreased?

3.2.1 Sampling frequency

BMP evaluation monitoring will take place at nine sites in the six high-priority drainage areas in the watershed (**Figure 1**). These are the areas where the most concentrated efforts to implement BMPs have occurred and which are therefore the highest priority for evaluation monitoring. Additional background on site selection can be found in **Appendix A.2**.

The BMP evaluation sites will be monitored during the June – September period, with a total of 20 samples collected at each site each year during this period. Analyses of historical data (see **Appendix B.2**) suggest that, with minor exceptions, this would be adequate to detect an average 50% reduction in loads and an average 30% reduction in impact on downstream receiving water at each site over a ten-year period.

3.2.2 BMP effectiveness

Analyses of historical data from the watershed (see **Appendix B.3** for more detail) also show that, with the data available now, changes in water quality at some drains are detectable, although the association with BMP implementation is not always clear.

Figure 3, for example, shows the two drains with the largest observed decrease in loads (based on dry season values).

- In the J01P25 drainage, the City of Laguna Niguel has been implementing its Local Implementation Plan (LIP) (also sometimes referred to in this document as the JURMP Action Plan) and has also installed a CDS unit to remove trash and sediment.
- In the J01P28 drainage, the City of Aliso Viejo has been implementing its LIP, fixed a significant pipe leak in early 2002, and then in mid-2002 began a greater intensity of inspection, education, and BMP implementation. A Clear Creek treatment system was installed at the J01P28 outfall and began operation in mid-2003.

Conversely, **Figure 4** shows two drains with increased loads, neither of which was targeted for more intense effort above the LIP.

– In the J01P06 drainage a manufacturing plant and a new nursery may have increased runoff. **Figure 4** shows that, since mid-2003, flow (CFS) in J01P06 has been consistently above the system-wide mean.
– In the J06 drainage, there is no readily available explanation for the pattern seen.

Figure 5 summarizes the cumulative monitoring data to show there is not always a consistent relationship between the degree of visible improvement in discharge loads and the relative intensity of BMP implementation in each drain's drainage area.

The monitored drains in the watershed fall into three categories in terms of trends in discharge loads (**Figure 5**; see **Appendix B.3** for more detail):

1. Those with visible improvement in loading(11 drains)
2. Those with no apparent loading trends (18 drains)
3. Those that are visibly worse in loading(7 drains).

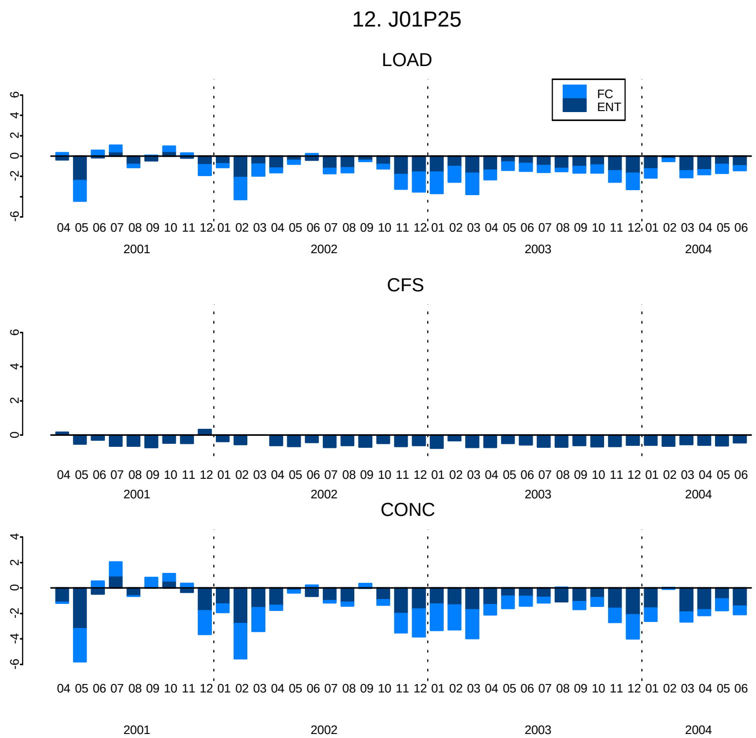
The lack of a consistent relationship between the intensity of BMP implementation in a drainage area and the size or direction of trends in loads from the discharge suggests that additional monitoring will be required to:

- Validate trends in category #1 drains and determine their relationship to BMPs
- Resolve trends in category #2 drains
- Determine if improvements appear in category #3 drains with more intensive BMP implementation.

Data from the BMP evaluation sites will also be compared to the results of the status and trends monitoring in the lower sections of Aliso Creek. This will help to assess whether a reduction in loads at the high-priority drains is associated with improving conditions in the lower Creek. **Table 1** presents a framework for conducting this comparison. As questions about BMP effectiveness at the high-priority drains are resolved over time, monitoring effort would be shifted to the next level of priority drains. See **Section 5.0** and **Appendix C** for additional detail on the decision framework.

Figure 3. Two drains showing largest decrease in discharge loads. All parameters calculated as deviations (either plus or minus) from long-term system mean. The dark portion of each vertical bar indicates Enterococcus and the blue portion fecal coliform. "Load" is bacterial load in the pipe discharge; "CFS" the measure of flow (cubic feet/second) in the discharge; "CONC" the concentration in the discharge.

Basic JURMP Action Plan; CDS unit



Basic JURMP Action Plan; fixed pipe leak early 2002; began major focus on inspection, education, and BMP implementation mid-2002; Clear Creek treatment system operational mid-2003

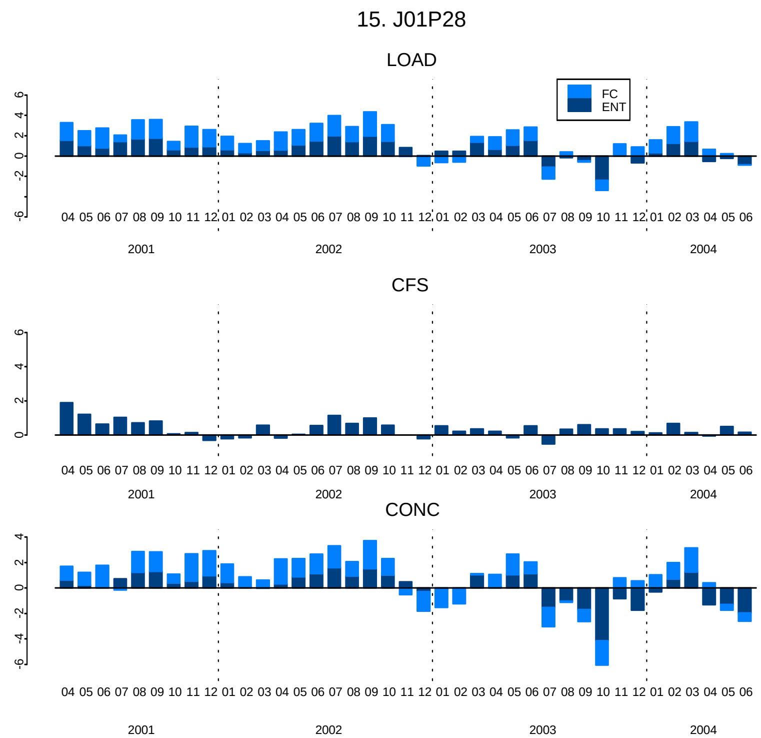
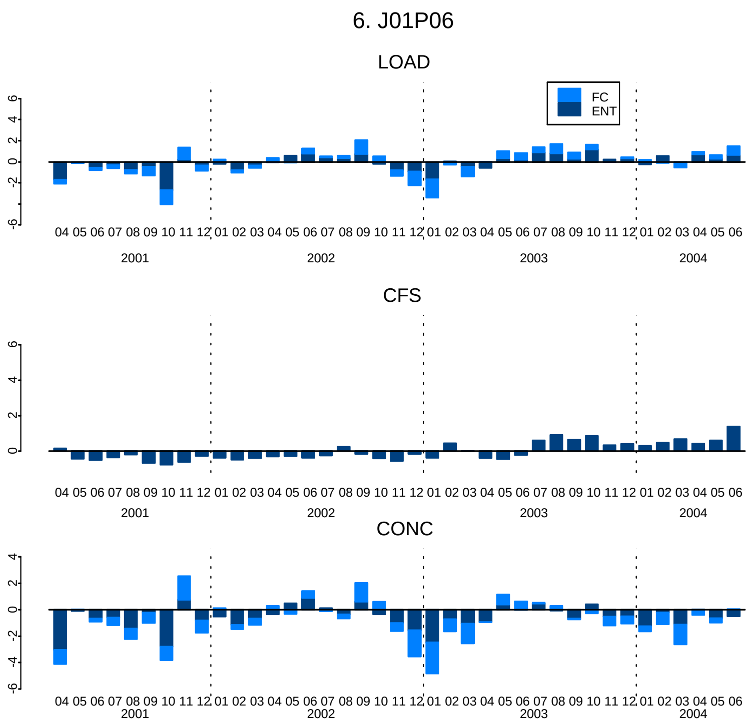


Figure 4. The two drains showing the largest increase in discharge loads. All parameters as in Figure 3.

Basic JURMP Action Plan



Basic JURMP Action Plan

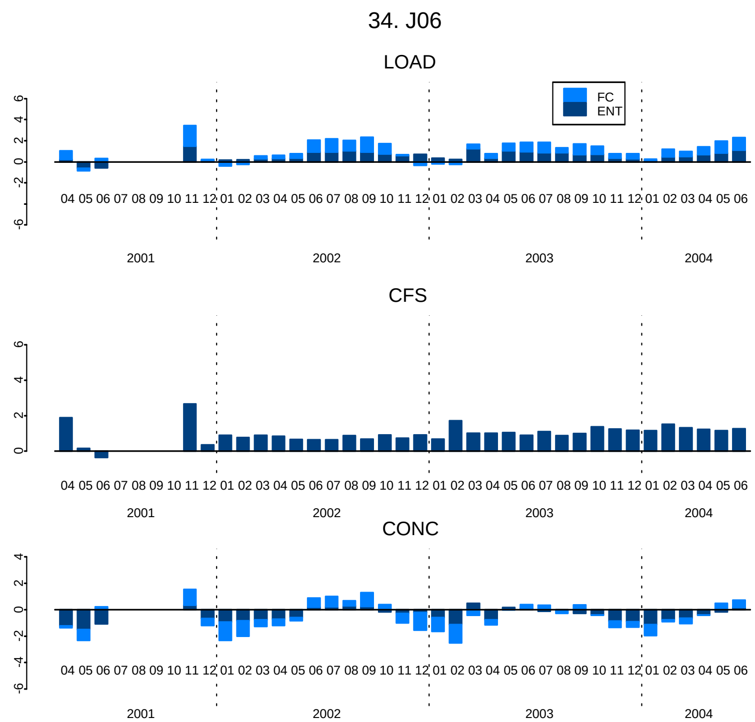


Figure 5. Map legend indicates four categories of BMP implementation and three categories of trend in loads. See Table B-2 for more detail on BMP efforts. Unshaded drainage areas did not contain discharge pipes meeting program criteria and were not monitored.

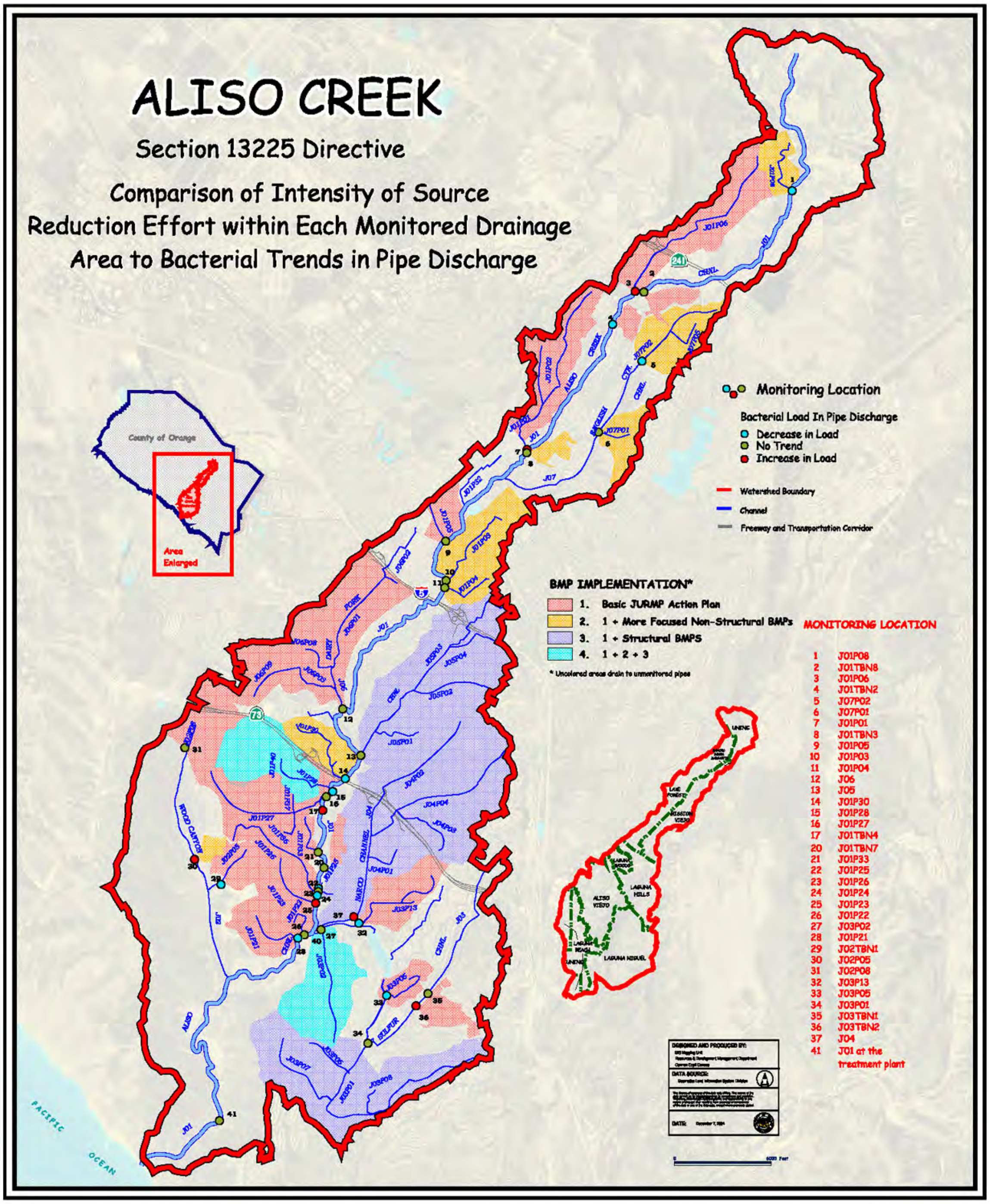


Table 1. Potential monitoring outcomes and their implications

"Conceptual model" refers to the set of mechanistic assumptions about how BMPs will affect bacterial levels and loads.

Trend at S&T stations	BMPs work and are widely implemented	BMPs work but are not widely implemented	BMPs don't work
Trend downward	are seeing the effects of BMPs	Are seeing the effects of BMPs; confirm with loads modeling other factors are involved; develop new conceptual model	other factors are involved; develop new conceptual model
No trend (variable)	other sources likely; develop new conceptual model	BMPs not widely enough implemented to reduce the problem	problem remains as originally envisioned
Trend upward	other sources likely; develop new conceptual model	other sources likely; develop new conceptual model	other sources likely; develop new conceptual model

3.3 Source Identification

The revised bacteria monitoring program will also support ongoing source reduction efforts in the watershed. One aspect of such efforts is the Permittees' NPDES dry weather reconnaissance monitoring program, which has several random and targeted sites in the Aliso Creek watershed (**Table 2**). As the targeted sites are resolved and replaced with new sites over the course of the Third-Term Permit, this rotating set of sites will provide coverage of the MS4 system and trigger upstream source identification efforts at those sites with pollutant levels that are substantially above the regional background.

Table 2. Random and Targeted Dry Weather Sites in the Aliso Creek Watershed

City	Random sites	Targeted sites
Aliso Viejo	J01P27 J01P28	J01P26 J01P33 J02P05
Laguna Beach	None	No high-priority sites in the Aliso Creek watershed
Laguna Hills		J04P04
Laguna Niguel	J03P01	J03TBN J04@J03
Laguna Woods	Moulton & Calle Cortez J01@Alisos Blvd.	J06P01 inside Leisure World gate
Lake Forest	J01P01 J01P05	J01P08
Mission Viejo	J07P02	J01P03

Additional targeted source identification studies may be called for in response to findings that bacteria levels in the high-priority drains and/or in the Creek itself are either increasing or not decreasing as expected (see **Section 5.0**). Such adaptive source identification efforts will have clearly defined terminology, methods, and endpoints, in line with the SMC's recommendations in its model stormwater monitoring program description.

4.0 SPECIAL STUDIES

There are a number of special studies that could be carried out to:

- Reassess monitoring results
- Evaluate BMP effectiveness
- Investigate bacterial dieoff / proliferation processes in the drains themselves
- Evaluate and then apply improved microbial source tracking (MST) methods to better identify sources of pollution.

The structure and timing of these and other potential special studies will largely be based on monitoring results, as well as on the progress and results of outside studies.

Monitoring results will be reassessed when they do not correspond to past patterns and/or to expectations of how bacteria levels should change in response to BMPs.

Targeted studies of BMP effectiveness in the Aliso Creek watershed should be conducted when monitoring data are not sufficient to confirm their effectiveness and/or when it is determined that available data from studies carried out elsewhere are not applicable to the Aliso Creek watershed.

Bacterial dieoff/proliferation processes should be investigated when SCCWRP and the SMC, both of which include Regional Board representatives, agree that there is enough evidence to warrant a scientific study. Any such study should be undertaken in progressive stages (e.g., literature review, pilot study, field assessment).

Microbial source tracking methods should be field tested in the Aliso Creek watershed only when SCCWRP and the SMC agree that the available methods have been developed to the point they are likely to provide definitive and quantitative information about sources of bacterial contamination in the watershed.

5.0 DECISION POINTS

The revised program includes a decision framework that will guide the interpretation of monitoring information and its application to decision making (**Figure 6**). Such clearly defined decision points will ensure that:

- Monitoring results are used in management decisions in a timely way
- The monitoring design is adjusted as needed to incorporate improved scientific knowledge and to remain responsive to management concerns
- Monitoring does not continue past the point at which it provides relevant and useful information.

Bacteria monitoring in the Aliso Creek watershed occurs in a wider context that also includes BMP implementation, active source identification efforts, and the development of improved microbial source tracking methods. Thus, there are a number of triggers that could suggest changes to the monitoring plan, adjustments to BMP design and implementation, and/or revisions to management policies about bacteria levels in Aliso Creek.

Figure 6 outlines an overall decision framework that combines monitoring of both status and trends and BMP effectiveness with the results of source identification efforts to provide specific guidance for the interpretation and application of monitoring results. The triggers and endpoints for each of the actions in the decision framework are designed to be as explicit as possible. If improvements to knowledge stemming from monitoring results and/or research alter the specifics any trigger or endpoint, then the trigger or endpoint will be redefined.

5.1 Objective for the Lower Creek

This framework reflects the management priority placed on human health issues in the Creek, that is, the risk of illness due to body contact recreation "where the ingestion of water is reasonably possible." In accord with the approach adopted by the Beach Water Quality Work Group and the SMC's model stormwater monitoring project, the revised Aliso Creek bacteria monitoring program focuses monitoring for human health initially in the lower sections of Aliso Creek where surveys of recreational activity have shown higher-risk use to be concentrated. Thus, the immediate objective, or endpoint, identified for this status and trends monitoring at the five stations in the lower Creek is the Basin Plan REC1 objective. Once the REC1 objective has been met in the lower Creek, the status and trends monitoring in the lower Creek can be reevaluated and converted to a core, long-term health monitoring program. In addition, once the REC1 objective is met in the lower Creek, the upstream BMP evaluation monitoring effort at the six high-priority drains can be reallocated to a second tier of sites along the Creek with a lower level of human health risk.

5.2 Objective for the High-Priority Drains

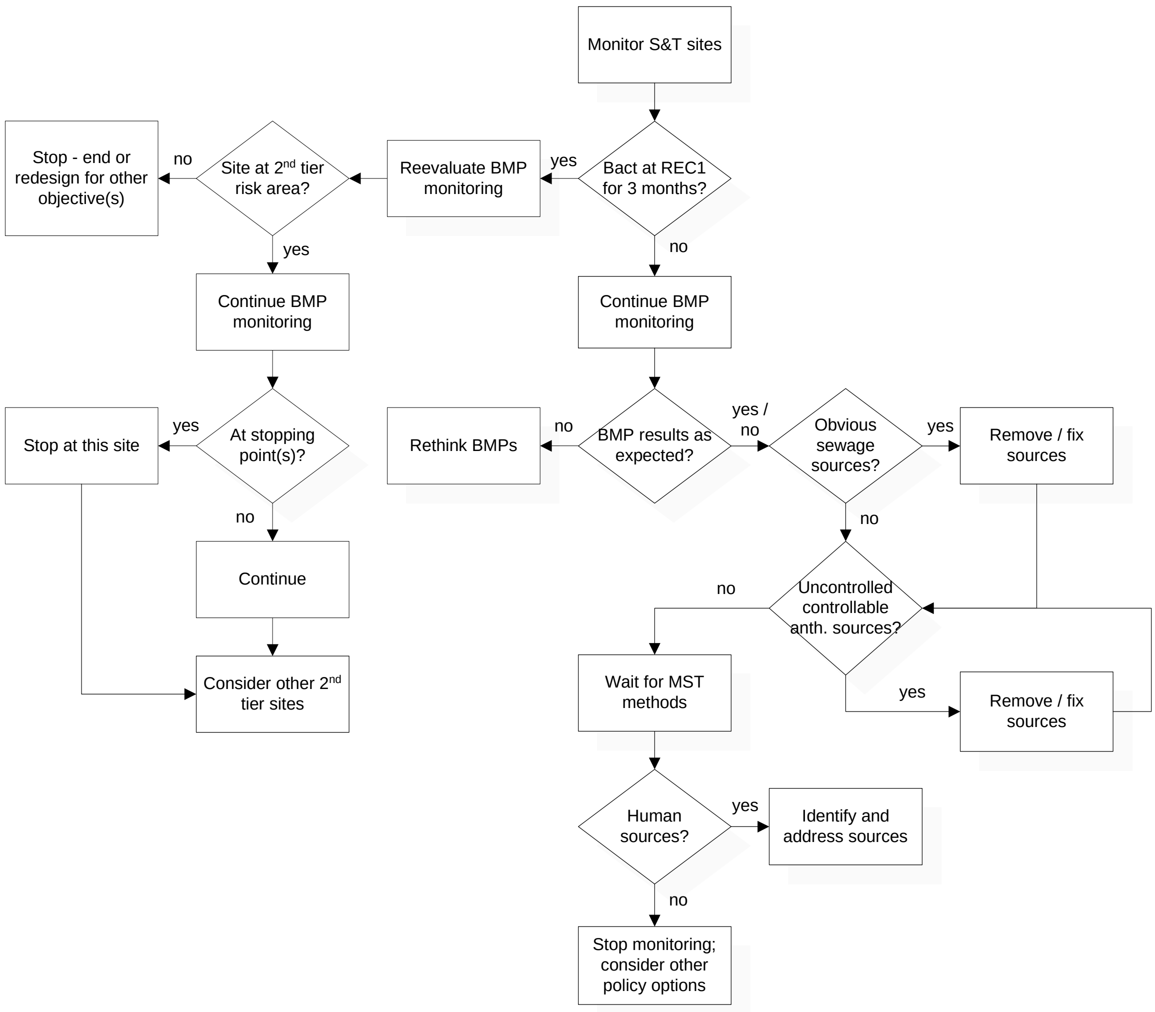
Efforts to improve water quality in order to meet the REC1 objective in the lower sections of Aliso Creek are concentrated on the specific upstream discharges to the Creek, where a range of source identification, enforcement, and pollution prevention activities are planned and/or underway. Monitoring of the effectiveness of these BMP efforts is currently concentrated on stations associated with the six high-priority drains throughout the Aliso Creek watershed. The immediate objective for this monitoring is to assess whether these activities have contributed to an improvement of conditions in the lower sections of the Creek. A parallel objective is to provide site-specific feedback about whether these efforts are working as expected. Explicit endpoints for this BMP evaluation monitoring are associated with the completion of a series of source identification efforts:

- Identify obvious sources of human sewage
- Identify uncontrolled controllable anthropogenic sources
- Apply microbial source tracking methods when available
- Address additional controllable anthropogenic sources identified by microbial source tracking.

These source identification efforts will follow explicit protocols being reviewed and organized by the SMC's model stormwater monitoring program. Once remaining sources have been determined to be uncontrollable and/or non-urban in nature, then the monitoring described here will have provided as much useful information as it can. At that point, if conditions in high-risk areas of the Creek have still not met the REC1 objective, then whether to implement structural BMPs and other treatment options would be a policy decision based on a number of factors, including the nature of the sources, the amount of recreation actually occurring in different portions of the creek, BMP effectiveness, and the cost and feasibility of implementation.

Figure 6. Decision Framework for Aliso Creek Watershed Bacteria Monitoring

(S&T refers to Status and Trends.)



6.0 SUMMARY

The revised bacteria monitoring program for the Aliso Creek watershed focuses on three core objectives:

- Documenting trends in water quality
- Evaluating BMPs implemented to improve water quality
- Supporting source identification efforts.

The new program takes advantage of knowledge gained during the past three years of monitoring to reduce the number of sampling locations, identify a core set of status and trends monitoring stations that will provide information on the condition of the Creek as a whole, and make changes to sampling frequency. In addition, the revised program targets monitoring at those locations in individual drainage areas where changes due to management efforts are most likely to occur. Finally, the dry weather reconnaissance component of the Permittees' NPDES monitoring program provides targeted support for source identification efforts across the watershed.

These monitoring and source identification efforts have also been placed in the overall context of a decision framework that identifies alternative actions and decisions in response to a range of monitoring findings. This decision framework reflects the adaptive nature of the monitoring program and its intent to respond appropriately to new information as it becomes available.

In addition to these monitoring efforts, certain special studies may provide opportunities to substantially improve the efficiency of monitoring, the utility of BMPS, and/or the ability to identify sources of pollution. As these studies are conducted, their results will be used to further refine the monitoring program and the cities' source identification and source reduction efforts.

APPENDIX A: JUSTIFICATION FOR MONITORING LOCATIONS

Table A-1 summarizes all station locations and monitoring frequencies for the revised program (note that there are a few minor exceptions to the general pattern of discharge, up-, and downstream sampling).

A.1 Status and Trends Station Locations

The proposed revisions to the locations of status and trends monitoring stations are intended to focus effort on the areas of highest recreational use and attendant concern about potential human health impacts. This approach is in accord with that recently adopted by the Beach Water Quality Work Group (made up of representatives from county health departments, the State Water Resources Control Board, SCCWRP, and Heal the Bay), as well as by the SMC's model stormwater monitoring program project. Past surveys of recreational use in the Aliso Creek watershed (summarized in the program's 3rd quarterly report; Figure 2.20: Recreational Sites and Activities, Table 2.7: Activities Within Recreation Facilities in Aliso Creek Watershed) show that the majority of recreational use "where the ingestion of water is reasonably possible" (Basin Plan definition of REC1 beneficial use) occurs in the lower part of the Creek. (This is the most current information available that is not purely anecdotal.) This is an important criterion because ingestion has been demonstrated as the principle route by which contaminated waters cause illness.

Thus, the status and trends monitoring stations listed in **Table A-1** include five core monitoring stations along the lower sections of Aliso Creek. The available data show that the stations in the lower creek are dissimilar, with a progression of increasing indicator values in the downstream direction. The behavior of individual stations is so variable that it would be risky to extrapolate from one station to the entire lower Creek. Thus, the stations, as a group, provide a picture of conditions in the lower portion of the Creek. More detailed site location information is presented in **Table A-1**.

A.2 BMP Evaluation Station Locations

BMP evaluations will be based on data from stations associated with the six high-priority drains listed in **Table A-1**. A review of the structure of the drainage system in each city, along with the geographic distribution of their source reduction and/or pollution prevention efforts, led to the identification of two additional monitoring sites in Aliso Viejo (drainage to J01P28) and one in Laguna Woods (drainage to J06). These sites are intended to improve the monitoring program's ability to distinguish the effectiveness of source reduction efforts within those cities. In the remaining cities, source reduction efforts are distributed throughout the subwatershed and/or are concentrated in the lower portion of the subwatershed. In these cases, the monitoring site at the discharge point to Aliso Creek is adequate for assessing the overall results of BMPs in the subwatershed.

The BMP evaluation sites are intended to fulfill two purposes. The first is to document the relative effectiveness of source reduction efforts in the high-priority subwatersheds.

Given that similar source reduction efforts are being implemented throughout the Aliso Creek watershed, the second purpose is to produce information to help guide decision making about source reduction efforts at other locations. As questions about BMP effectiveness at the high-priority drains are resolved over time, monitoring effort would be shifted to the next level of priority drains.

In addition to existing source reduction efforts throughout each drainage area, additional structural BMPs are being implemented and/or planned, including the Munger Creek Filtration Basin on J01P01, a treatment wetland in the J01P04 drainage, a Clear Creek treatment system at the J01P28 outfall, and treatment wetlands in the J03P02 drainage. As these projects are implemented, additional monitoring sites to assess each project's effectiveness may be required, as are currently in place for the Clear Creek system.

Table A-1. Sampling sites in the revised monitoring program. Map ID refers to station numbers on Figure 1.

Type of site & Map ID	Drainage	City	Site location	Sampling location(s)	Frequency	Comments
Status and trends #9	Creek	Laguna Niguel	Creek at AWMA Rd. bridge	1 station in Creek	10 / mon Aug & Sep	Core trend monitoring station on the Creek
Status and trends #10	Creek	County	Sulphur Creek (J03) at Aliso Creek (J01)	Sulphur Creek 25' up / down	10 / mon Aug & Sep	Core trend monitoring station on the Creek
Status and trends #12	Creek	County	Aliso Creek (J01) in Aliso Wood Canyon Park	At NPDES mass emission station	10 / mon Aug & Sep	Core trend monitoring station on the Creek
Status and trends #13	Creek	County	Wood Canyon Channel (J02) at Aliso Creek (J01)	25' up / down	10 / mon Aug & Sep	Core trend monitoring station on the Creek Wood Canyon Channel discharge not readily accessible
Status and trends #14	Creek	County	Aliso Creek (J01) at SOCWA treatment plant	1 station in Creek	10 / mon Aug & Sep	Core trend monitoring station on the Creek
BMP evaluation #1	J01P08	Lake Forest	J01P08 outfall at Aliso Creek (J01)	Drain 25' up / down	20 total Jun – Sep	Drains a residential area. Outreach is distributed in the drainage area and includes informational letters and other public education. Advanced irrigation controls planned for 2005.
BMP evaluation #2	J07P02	Mission Viejo	J07P02 outfall at Aliso Creek (J01)	Drain 25' down	20 total Jun – Sep	No upstream location Evaluate effectiveness of follow-up intensive reconnaissance investigations. Evaluate effectiveness of performing inspections and follow-up enforcement of all high-priority commercial and industrial facilities.

Table A-1. (continued)

Type of site & Map ID	Drainage	City	Site location	Sampling location(s)	Frequency	Comments
BMP evaluation #3	J06	Laguna Woods	J06input Inside gated community	To be determined	20 total Jun – Sep	Monitor effectiveness of source reduction efforts inside community.
BMP evaluation #4	J06	Laguna Woods	J06 at Aliso Creek (J01)	Drain 25' up / down	20 total Jun – Sep	Conducting increased inspections and education, especially at construction sites.
BMP evaluation #5	J05	Laguna Hills	J05 outfall at Aliso Creek (J01)	Drain 25' up / down	20 total Jun – Sep	Drains a residential area and a 10 acre wetland near the bottom of the drainage area. Wetland is intended to improve water quality.
BMP evaluation #7	J01P28	Aliso Viejo	J01P28 at Aliso Creek (J01)	Drain 25' up / down	20 total Jun – Sep	High-priority drain
BMP evaluation #6	J01P28	Aliso Viejo	Clear Creek system	Basin, discharge	20 total Jun – Sep	Clear Creek system treating water in drain just before discharge to Creek
BMP evaluation #8	J01P28	Aliso Viejo	Shopping center at Aliso Creek Rd. and Enterprise	Discharge from shopping center	20 total Jun – Sep	Inspection, education, and enforcement efforts concentrated at shopping center in upper portion of drainage
BMP evaluation #11	J04	Laguna Niguel	J04 at J03, at Aliso Creek Rd.	Drain	20 total Jun – Sep	Drains equestrian/agricultural area in upper part of drainage (Laguna Hills) that has been fitted with catch basin filters to remove bacteria. Outreach to residents with horses and farm animals. Catch basin retrofits in commercial areas in lower part of drainage (Laguna Niguel).

APPENDIX B: ANALYSIS OF HISTORICAL DATA

The past three years of monitoring data in the Aliso Creek watershed were analyzed to:

- Select an appropriate sampling period within the year
- Select a sampling frequency adequate to detect expected trends
- Confirm that effects of BMPs are observable in the watershed.

B.1 Status and Trends Sampling Period and Frequency

The current sampling frequency is weekly throughout the year, which has resulted in greater understanding of patterns of variability in the Creek. The past monitoring data has been examined to determine whether this frequency should be adjusted. Such adjustments are intended to better optimize the monitoring program's ability to determine if indicator levels in receiving waters are meeting appropriate water quality objectives (Question 1 (Section 3.1): Are conditions in receiving waters protective of beneficial uses?), as well as to quantify the amount of change in indicator values over time (Question 2 (Section 3.1): Are conditions in receiving waters getting better or worse over time?). The proposed new sampling frequency is:

> 10 samples per month, collected in August and September at each of the five core status and trends monitoring stations.

This would provide the ability to assess compliance with the REC1 objective in the most critical period of the year, as well as to track trends over time, with the goal of detecting an 80% reduction in fecal coliform levels over a ten-year period. An 80% decrease would represent a drop from the highest levels currently observed to near the REC1 level. The following paragraphs provide the technical rationale for this recommendation. They describe how:

- Sampling frequencies are based on examination of the historical data and on statistical power analyses
- Historical data show that peak bacterial levels occur in late summer and early fall, corresponding to the period of greatest recreational use, suggesting that this is the best period for conducting comparisons to the REC1 standard
- The ideal months for tracking trends during the peak period, however, differ from site to site
- The needed frequency for assessing compliance with the REC1 standard is 5 samples per month (30-day period), while the preferred frequency for assessing trends in a reasonable time frame is 10 samples per month
- The sampling frequency that meets both needs is 10 samples per month, in August and September.

The revised monitoring frequency is based on an examination of patterns in the Aliso Creek bacterial monitoring datasets as well as on statistical power analyses on these data. Statistical power analysis is a standard tool in study design, in which estimates of variability in target indicators are used to determine the level of sampling effort needed to detect different amounts of change in those indicators. Power analyses will be repeated at intervals, as additional data accumulate, to confirm that sampling frequencies are adequate or to provide the basis for any needed midcourse corrections to the sampling design.

The REC1 standard (related to Question 1) for fecal coliforms is a geometric mean of 200/100 ml for five samples taken over a 30-day period. In addition, not more than 10% of the samples taken over this period can exceed 400/100ml. **Figures B-1** and **B-2** show that the downstream stations are above the REC1 standard most of the time by both criteria. Since this is the portion of the Creek where the incidence of human contact recreation is highest, these data provide the basis for targeting sampling at a key subset of months rather than throughout the entire year.

The highest fecal coliform counts consistently occur in the summer and fall, with the peak usually in the fall. Since these are the warmer months where human contact recreation in the Creek is most likely, it will be most beneficial to reduce the fecal coliform levels during this period and monitoring should accordingly also focus on this period. **Figures B-1** and **B-2** indicate that two thirty day sampling periods in the late summer / early fall period should be sufficient to determine whether the creek locations meet the REC 1 standard during the most relevant and critical part of the year. When levels drop closer to the standard, further power tests should be performed to determine if additional precision could be achieved with an increased number of samples per 30-day period.

The situation for tracking trends (Question 2) is different, however. Because the fecal coliform levels vary considerably among the months in lower Aliso Creek, it would statistically be most efficient to stratify the trend analyses by month, with separate trend analyses for each month. Lumping months that normally have highly divergent fecal coliform counts would increase the within-year variability and make it more difficult to detect trends over time. Power tests (Fryer and Nicholson, 1993) were performed to estimate the number of years and number of samples within a 30-day period that might be required to detect different percentages of decrease in fecal coliform counts (**Figure B-3**). Power tests were performed only at stations and for months for which more than one year was sampled because the power tests require an estimate of between-year variability.

Figure B-3, with plots for each station organized in order of increasing geomean, shows that the ideal months to sample differ from station to station. For example, the highest power for a given sampling effort occurs in August for the SOCWA treatment plant site (**Figure B-3.d.**) but in June for the Aliso Wood Canyon Park Site (**Figure B-3.c.**).

Because it would be logistically inefficient to sample each station at a different time, some tradeoffs are always required in applying power analysis results to real-world situations. In this case, a sampling frequency of 10 samples per month, collected in August and September at each of the five stations would provide the ability to assess compliance with the REC1 objective in the most critical period of the year, as well as to track trends over time, with the goal of detecting an 80% reduction in fecal coliform levels over a ten-year period. An 80% decrease would represent a drop from the highest levels currently observed to near the REC1 level.

B.2 BMP Evaluation Sampling Frequency

As for the status and trends monitoring, statistical power analyses were used to determine an appropriate sampling frequency for the BMP evaluation stations and the revised monitoring frequency of 20 samples per year at each high-priority drain station, collected in the June – September period, is based on these analyses.

Figure B-4 shows that bacterial levels in the high-priority drains, as well as at the upstream and downstream stations associated with each, are typically highest in the June – September period and lower throughout the rest of the year. Power analyses therefore focused on this period in order to reduce the within-year variability. Power analyses were performed for two measures, the load from each drain (**Figure B-5**) and the impact of each drain (**Figure B-6**) measured as the difference between the downstream and upstream stations. It will not be feasible to track loads at station J06 (**Figure B-5**) nor to track impacts at station J01P08 (**Figure B-6**). With the exception of these parameters at these stations, however, the power analysis suggests that a sampling frequency of 20 samples, collected in the June – September period, would be adequate to detect an average 50% reduction in loads and an average 30% reduction in impact over a ten year period.

B.3 Analysis of BMP Effects

Our past experience with the inherent variability in bacteria levels (both in discharges and in receiving waters), along with the statistical power analysis results, show that it may well take many years to reliably detect substantial trends in measures of loads and impact at individual sites. We therefore investigated other, system-wide analysis approaches which proved able, in some instances, to describe the results of BMP implementation on a shorter time frame.

The first analysis approach is based on a method commonly used by oceanographers and climate scientists. It involves calculating the overall system-wide mean of key parameters (e.g., loads, flow) and then examining the deviations over time from the system mean at each site. This approach was informative in providing more insight into both the unique behavior of each site as well as responses to BMPs. **Table B-1** lists all stations in alphabetic order, along with their ranks on a number of key variables, including degree of year-to-year decrease in loads (based on dry season data only) compared against the system-wide average. **Figure B-7** provides the graphical results for each station, all in terms of deviation from the overall system average. **Table B-2** provides more detailed information on the specifics of BMPs implemented in each drainage area.

Figures 5 and **B-7**, along with **Table B-2**, show that some discharges demonstrate patterns of decreasing loads that can be related to BMP implementation. However, these data also show that not all drains with a pattern of decreasing loads can be correlated with more intensive BMP implementation, and vice versa.

This analysis approach was not able to clearly show the results of all BMP efforts throughout the watershed. However, it was successful in describing overall patterns and often revealing BMP effects where efforts have been most intensive.

The second analysis approach focused on testing the assumption that reducing discharge loads from individual pipes will reduce the impact of these discharges on the creek receiving water below the discharge. This assumption was tested by performing regressions of impact (downstream minus upstream concentrations) against discharge load for each pipe for both Enterococcus and fecal coliform.

These regressions (**Figures B-8** and **B-9**) show that reduced loads are correlated with reduced impacts at only a subset of the pipes and that results for Enterococcus and fecal coliform differ at the same pipe. Thus, while the first analysis demonstrated that reductions in loads are detectable at some locations, these reductions do not necessarily always result in reductions in impacts in the receiving water. This is largely because the size of impact is strongly influenced by the amount of water in the Creek. Thus, the same load will produce a larger impact if it enters the Creek where flows are low and a smaller impact if it enters the Creek where flow are higher.

Table B-1. Historical monitoring stations, listed in alphabetic order.

"Map ID" refers to station identification on Figure 5. "Input Conc" refers to bacteria concentration in the discharge. Each station is ranked from highest to lowest, compared to all other stations, on several key variables, e.g., a "Load Rank" of 5 indicates the 5th highest load overall. "Decrease Rank" is based on year-to-year decrease in loads (or concentration where loads not available) during the dry season. Some data is missing for some stations.

Alpha Order	Station	Map ID	Load Rank	Input Conc Rank	Decrease Rank	Flow (cfs) Rank
1	CTPJ01	41		35	25	
2	J01P01	7	8	21	28	9
3	J01P03	10	5	13	19	8
4	J01P04	11	26	20	32	24
5	J01P05	9	22	17	23	23
6	J01P06	3	19	30	36	11
7	J01P08	1	7	2	9	16
8	J01P21	28	33	36	4	33
9	J01P22	26	17	18	17	19
10	J01P23	25	13	5	33	15
11	J01P24	24	30	31	5	21
12	J01P25	22	28	32	1	20
13	J01P26	23	16	16	29	17
14	J01P27	16	3	1	22	7
15	J01P28	15	11	27	2	5
16	J01P30	14	14	4	13	18
17	J01P33	21	25	10	15	28
18	J01TBN2	4	29	12	7	31
19	J01TBN3	8	27	24	12	29
20	J01TBN4	17	24	19	34	22
21	J01TBN7	20	31	23	26	32
22	J01TBN8	2	32	33	27	25
23	J02P05	30	4	6	31	6
24	J02P08	31	1	7	30	2
25	J02TBN1	29	12	8	3	14
26	J03P01	34		26	24	
27	J03P02	27	2	22	18	1
28	J03P05	33	6	11	8	10
29	J03P13	32	15	28	14	12
30	J03TBN1	35	21	3	21	30
31	J03TBN2	36	20	15	20	27
32	J04	37		25	16	
33	J05	13	18	34	11	3
34	J06	12	10	29	35	4
35	J07P01	6	23	9	6	26
36	J07P02	5	9	14	10	13

Table B-2. BMP implementation details in each drainage area.

BMP Category is as in Figure 5, where #1 is basic JURMP Action Plan (inspections, education, enforcement, and promotion of best practices); #2 is #1 + more focused non-structural BMP efforts, # is #1 + structural BMPs, and #4 is all of the above. Loads trends: A is clear decrease; B is clear increase; C is no apparent trend.

Drainage	BMP Category	Loads Trend	BMP Details
CTPJ01	NA	B	
J01P01	1	C	
J01P03	2	B	Catch basin inserts
J01P04	2	B	Catch basin inserts
J01P05	1	B	
J01P06	1	C	
J01P08	2	A	Source ID reconnaissance, focused education programs for likely sources
J01P21	1	A	
J01P22	1	B	
J01P23	1	C	
J01P24	3	A	Partial implementation of catch basis retrofits, trash screens, and filters
J01P25	3	A	CDS unit
J01P26	1	B	
J01P27	1	B	
J01P28	4	A	Sampling, monitoring, and intensive surveillance programs, intensive public education program, strict enforcement of BMPS for commercial facilities, installation of Clear Creek treatment system
J01P30	2	A	Sampling, monitoring, and intensive surveillance programs
J01P33	1	B	
J01TBN2	1	A	
J01TBN3	2	B	Catch basin inserts
J01TBN4	1	C	
J01TBN7	1	B	
J01TBN8	1	B	
J02P05	2	C	Sampling and monitoring program, intensive education program for homeowners and landscapers re urban runoff
J02P08	1	B	
J02TBN1	1	A	
J03P01	3	B	Stream restoration for short reach
J03P02	4	B	Intensive surveillance and source ID, education and enforcement, installation of catch basin inserts, temporary dry weather diversion and installation of Clear Creek system (Note: site was upstream of diversion and CCS and thus unaffected by these treatments), installation of WETCAT treatment wetlands
J03P05	1	A	
J03P13	1	A	
J03TBN1	1	C	
J03TBN2	1	B	
J04	3	C	Surveillance program commercial strip mall, strict BMP enforcement for commercial facilitites, partial implementation of catch basis retrofits, trash screens, and filters
J05	3	B	Aliso Hills Channel treatment wetlands
J06	1	B	
J07P01	2	B	Catch basin inserts
J07P02	2	A	Catch basin inserts

Figure B-1. Fecal coliform measurements at and upstream/downstream of discharge points in lower Aliso Creek. The data points are 5-sample moving geometric averages. The data values used in an average are the sample for the date and the four previous samples. The horizontal dashed line represents the Basin Plan REC1 objective for fecal coliforms (geomean not higher than 200/100 ml). The point symbols indicate the year of sampling, with the symbol equal to the last digit of the year (e.g., 1 for 2001, 2 for 2002).

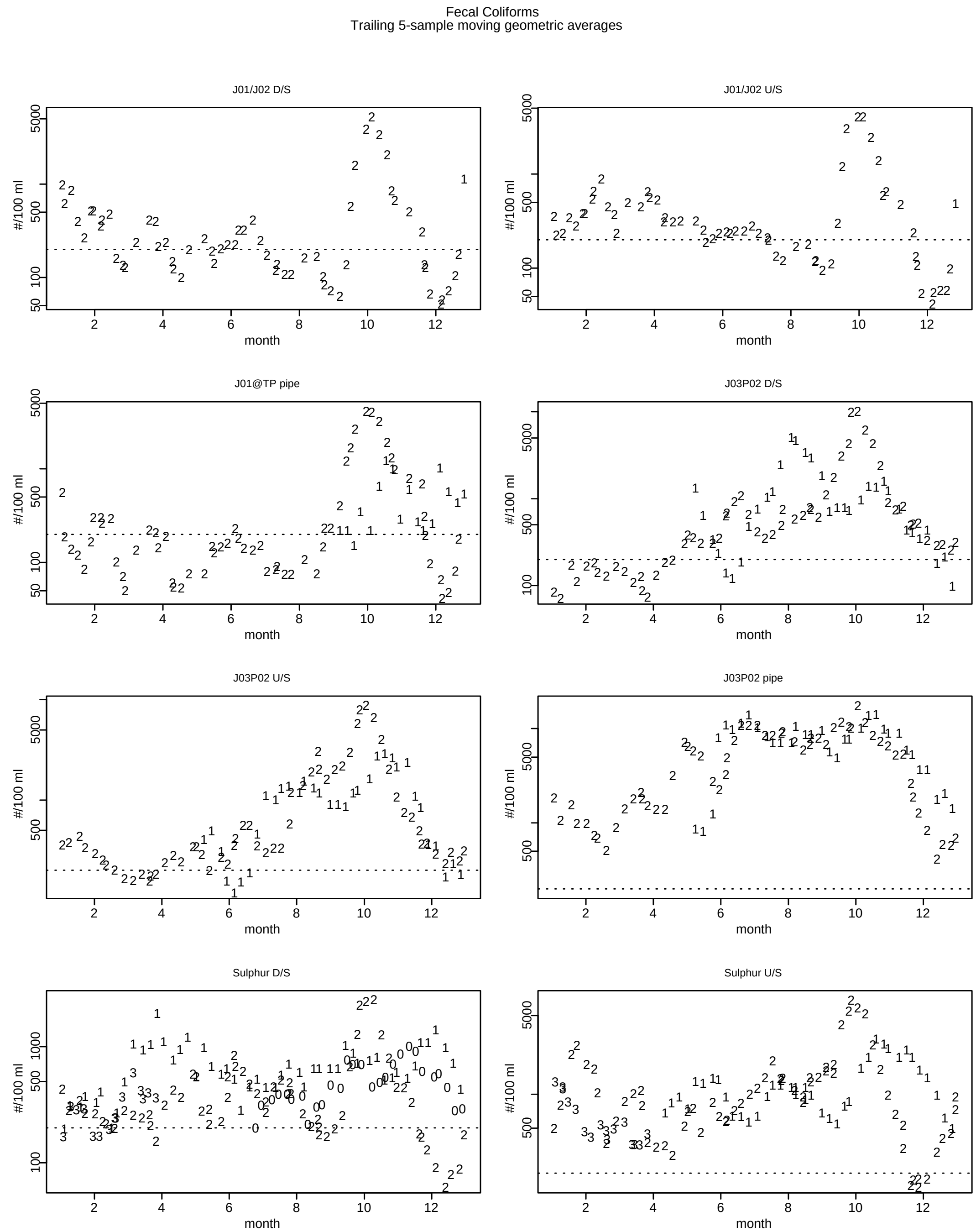


Figure B-2. Fecal coliform measurements at and upstream/downstream of discharge points in lower Aliso Creek. The data points are the percent of fecal coliform samples above 400/100 ml in the five most recent samples. The horizontal dashed line represents the Basin Plan REC1 objective for fecal coliforms (no more than 10% above 400/100 ml). The point symbols indicate the year of sampling, with the symbol equal to the last digit of the year (e.g., 1 for 2001, 2 for 2002).

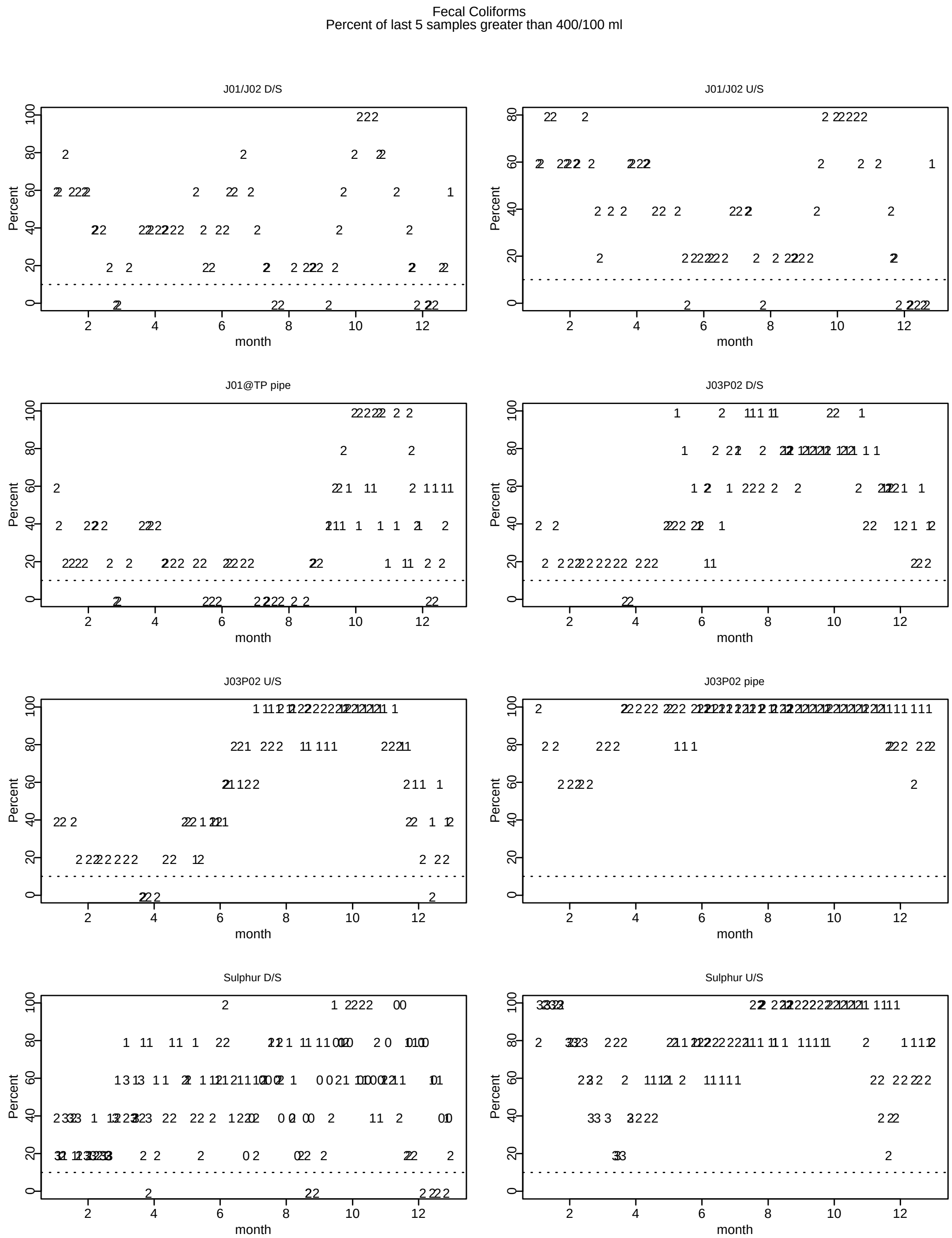


Figure B-3a. Power analysis of a trend monitoring design at the AWMA ROAD Bridge, station Sulphur Creek upstream. The y-axis shows the amount of change detectable, the x-axis the years of sampling, and the different curves the number of samples in a given 30-day period (5, 10, 20, 40) needed for 80% power.

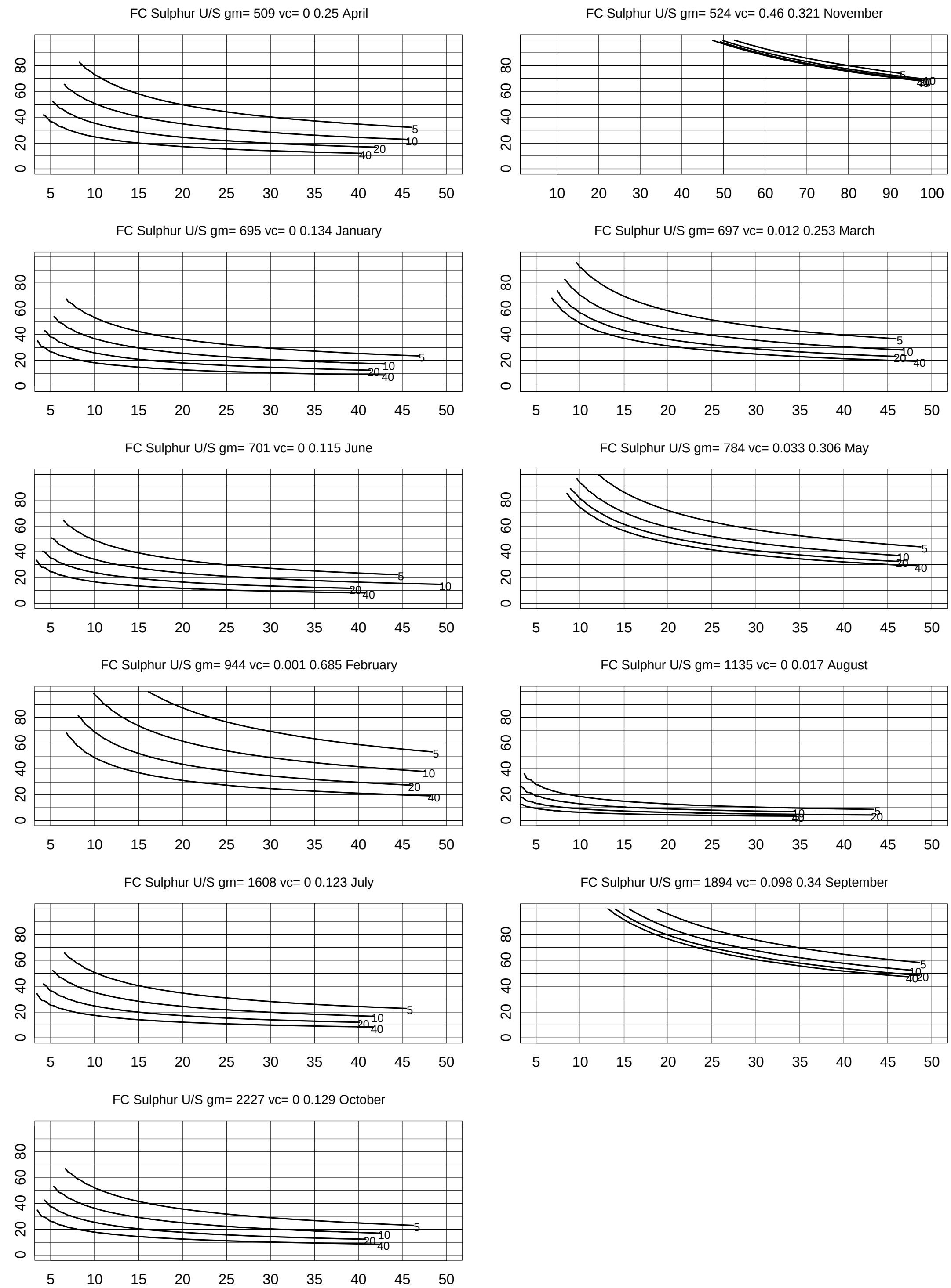


Figure B-3b. Power analysis of a trend monitoring design at the confluence of Aliso and Sulphur Creeks, station J03P02 downstream. The y-axis shows the amount of change detectable, the x-axis the years of sampling, and the different curves the number of samples in a given 30-day period (5, 10, 20, 40) needed for 80% power.

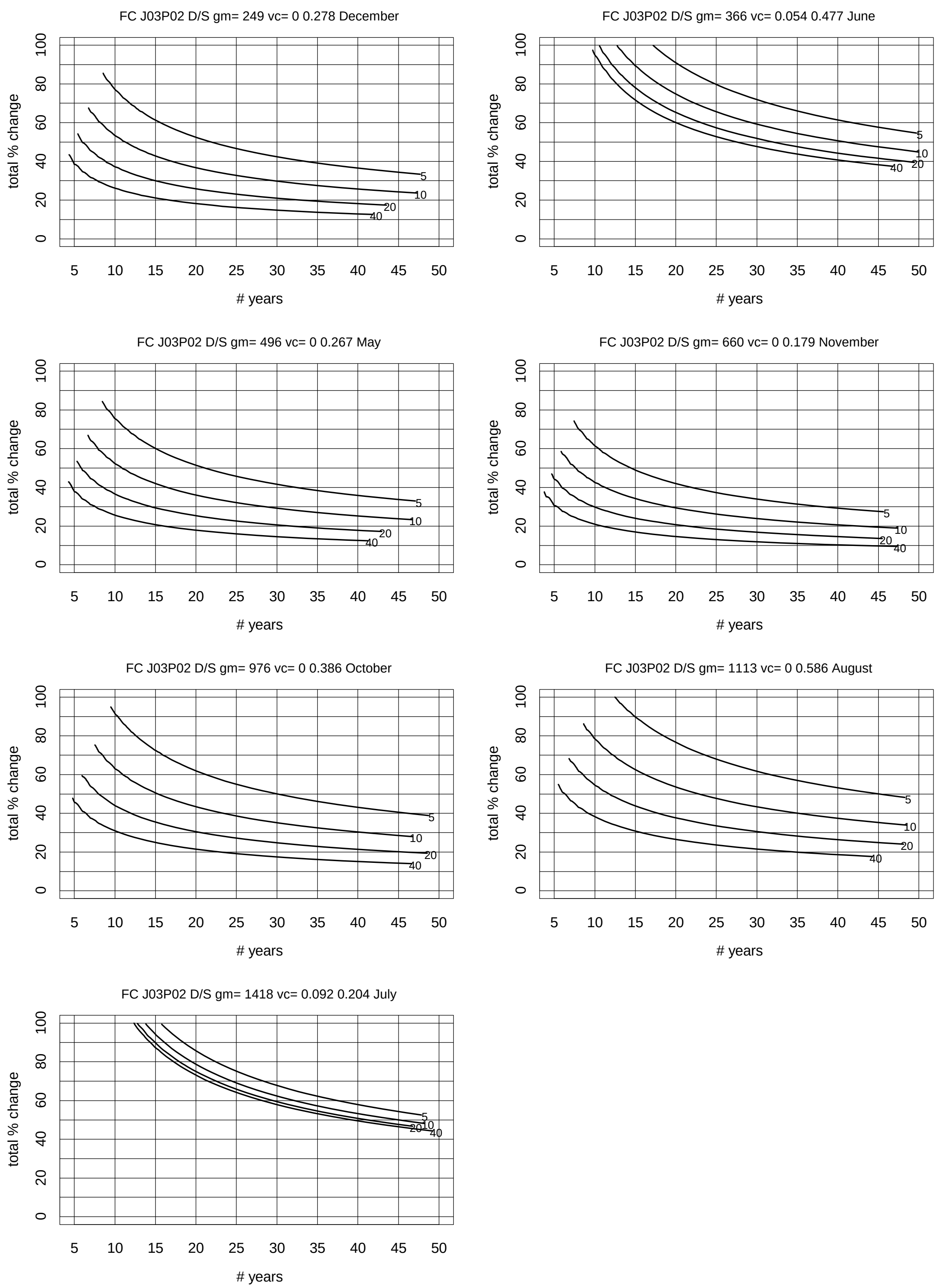


Figure B-3c. Power analysis of a trend monitoring design atAliso Wood Canyon Park, station Sulphur Creek downstream. The y-axis shows the amount of change detectable, the x-axis the years of sampling, and the different curves the number of samples in a given 30-day period (5, 10, 20, 40) needed for 80% power.

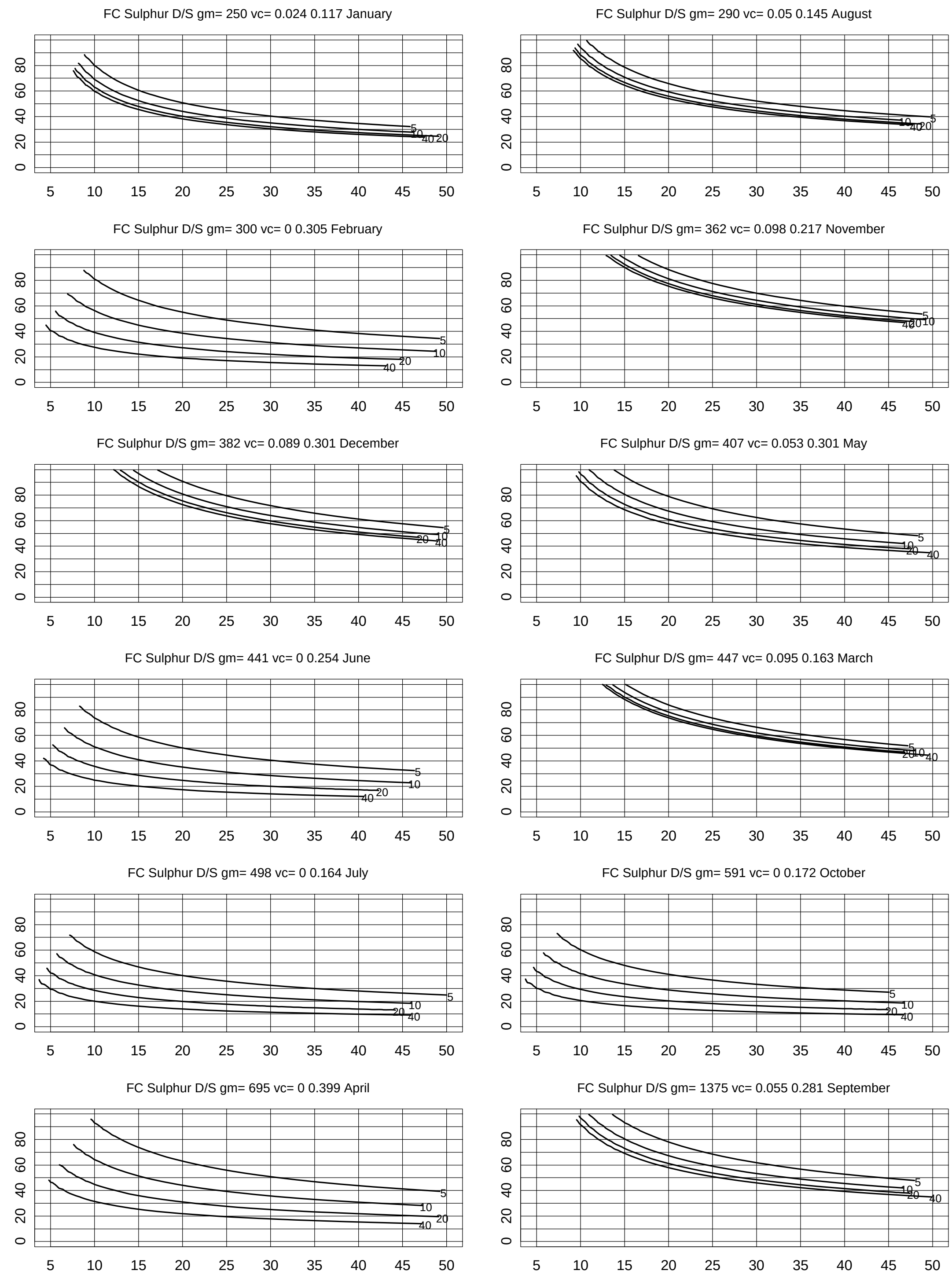


Figure B-3d. Power analysis of a trend monitoring design at the SOCWA treatment plant, station J01@TP. The y-axis shows the amount of change detectable, the x-axis the years of sampling, and the different curves the number of samples in a given 30-day period (5, 10, 20, 40) needed for 80% power.

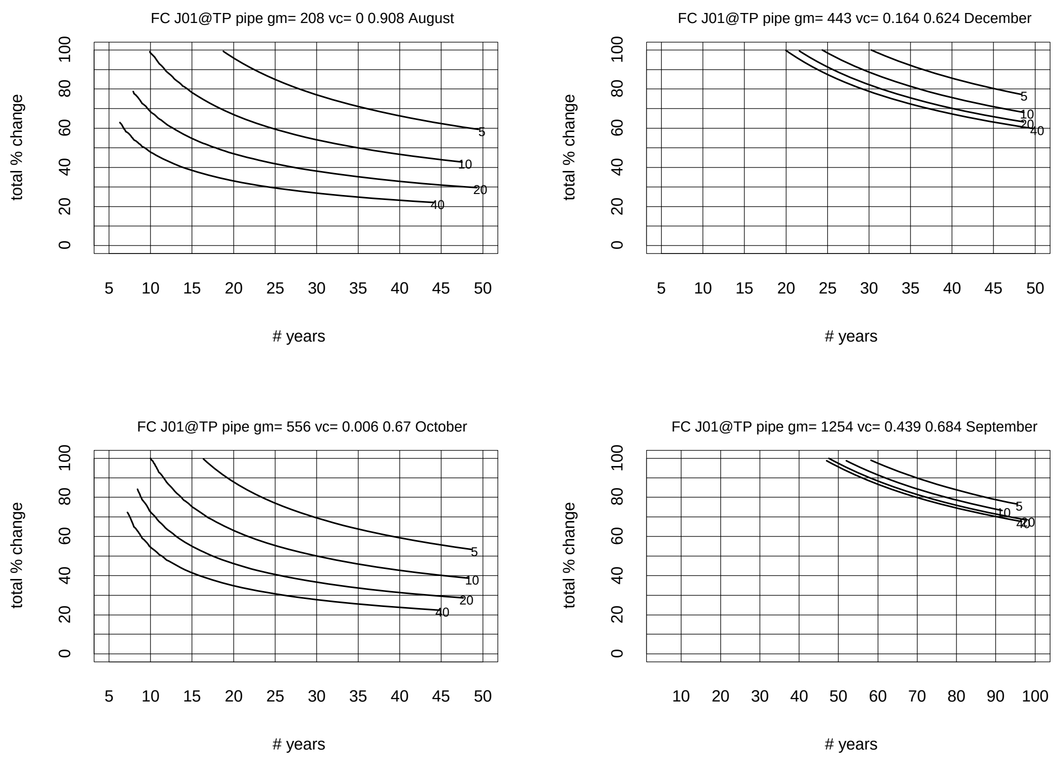


Figure B-4. Fecal coliform levels at the high-priority drains in the Aliso Creek watershed. The dashed line represents the Basin Plan REC1 objective for fecal coliforms (geomean not higher than 200/100 ml).

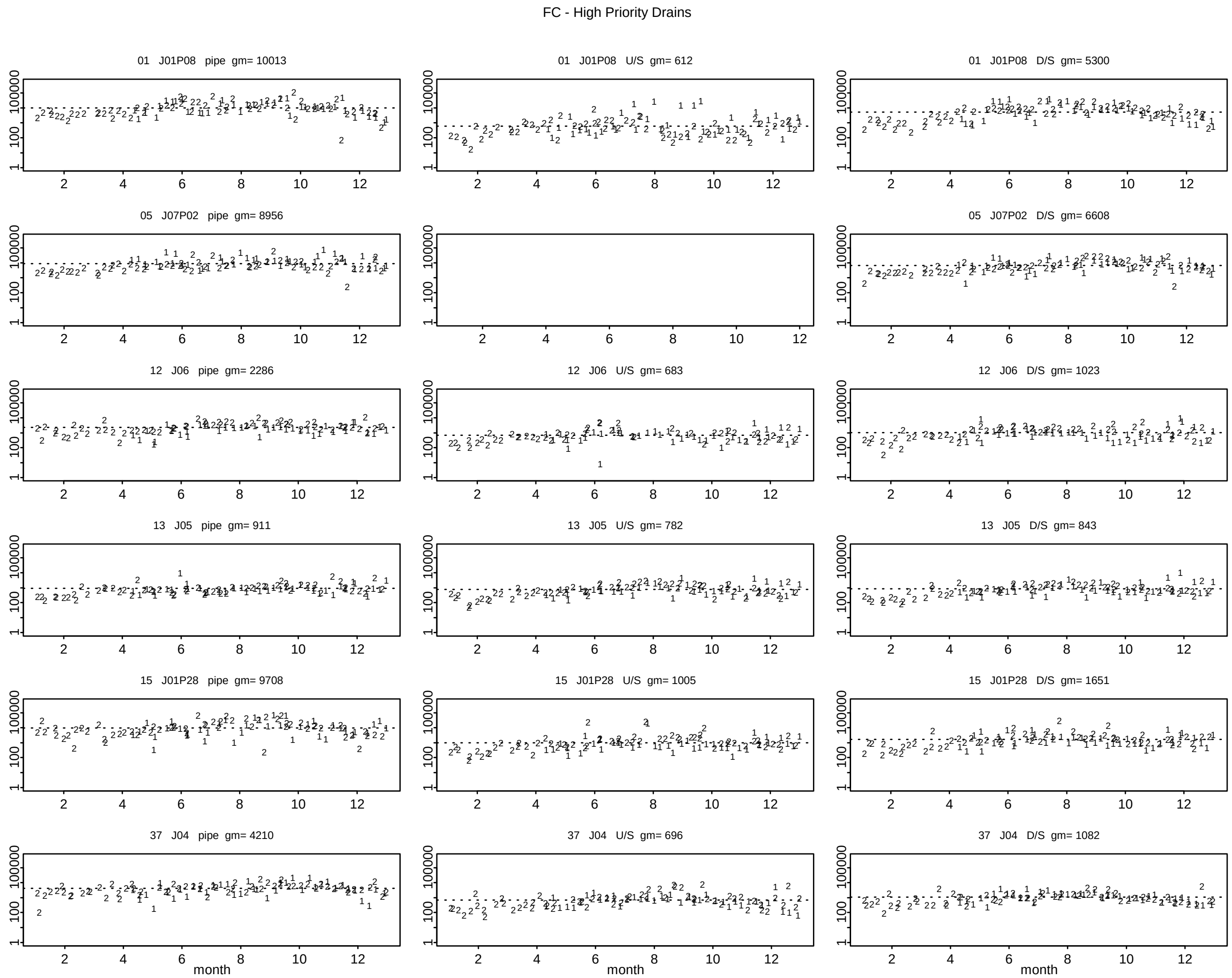


Figure B-5a. Power analysis of a trend monitoring design for fecal coliform loads at the high-priority drains in the Aliso Creek watershed. The y-axis shows the amount of change detectable, the x-axis the number of years sampling, and the different curves the number of samples in per year (5, 10, 20, 40) needed for 80% power. No results are shown for station J04 because the flow was not measured in 2002. Power estimates are based on data from months June – September.

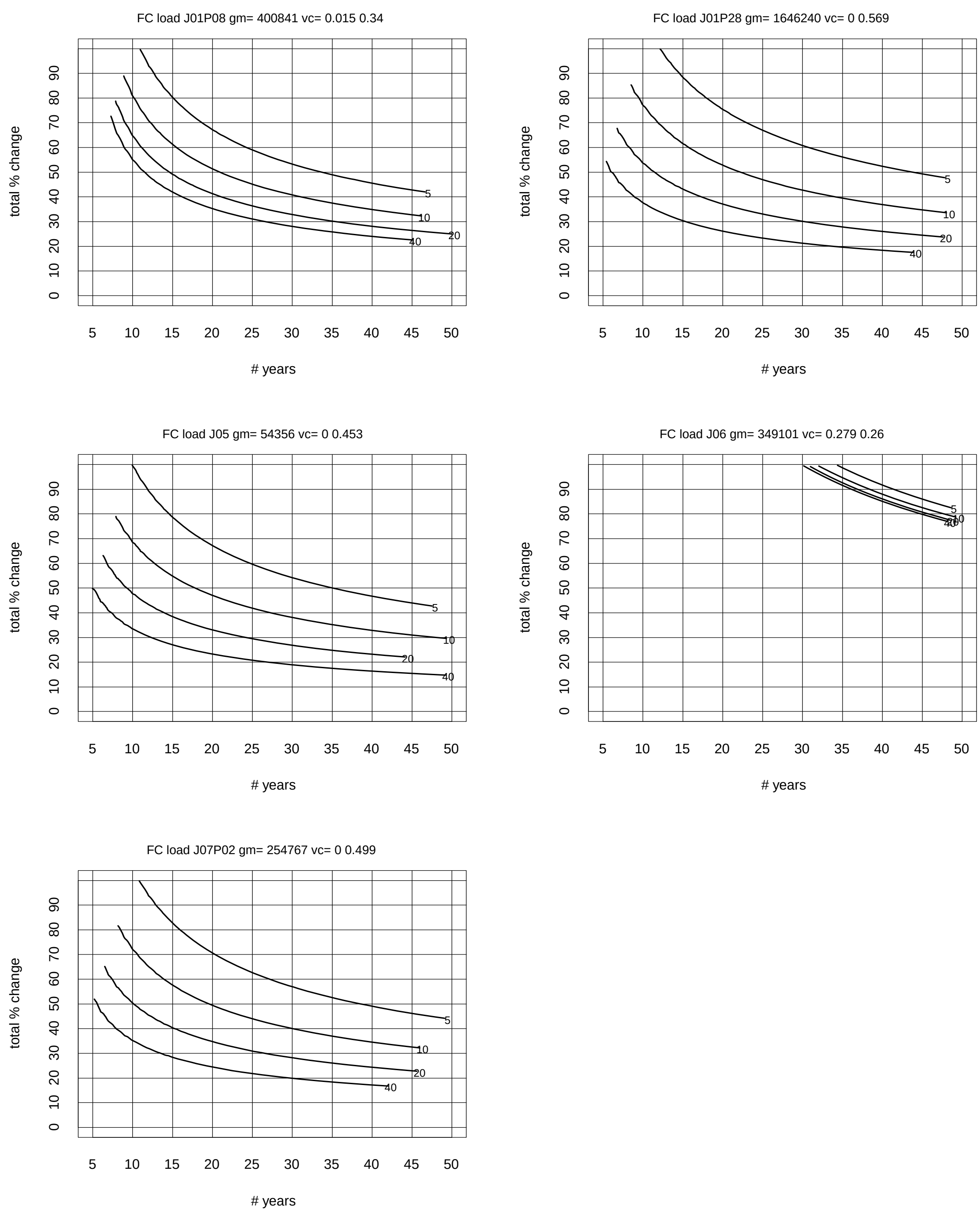


Figure B-5b. Power analysis of a trend monitoring design for fecal coliform loads at the remaining drains in the Aliso Creek watershed. The y-axis shows the amount of change detectable, the x-axis the number of years sampling, and the different curves the number of samples in per year (5, 10, 20, 40) needed for 80% power. Power estimates are based on data from months June – September.

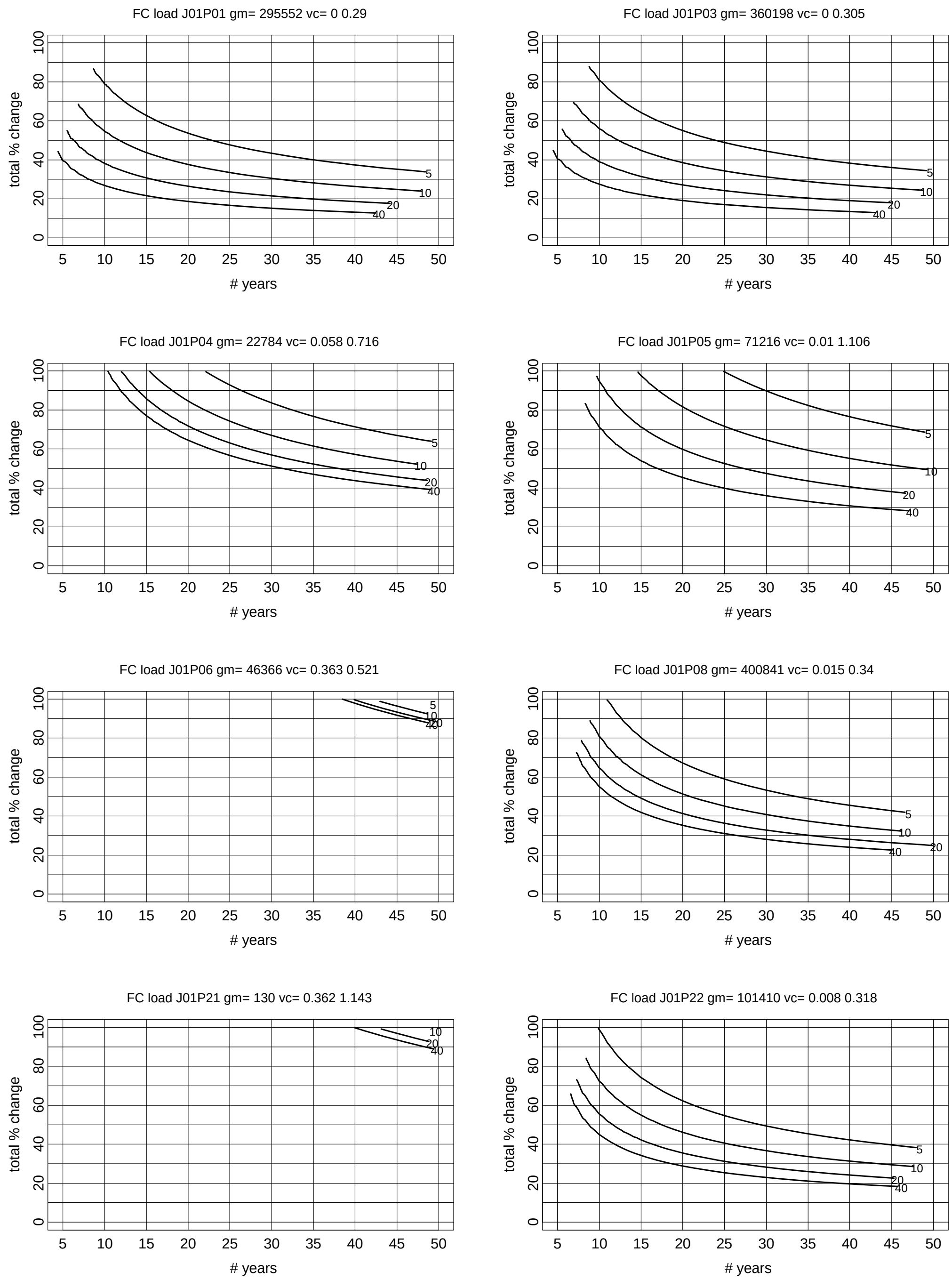
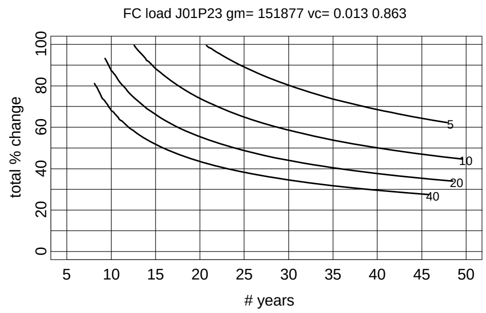
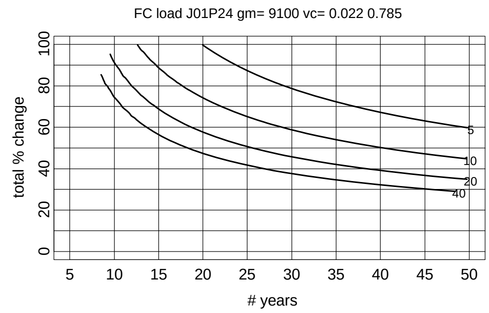
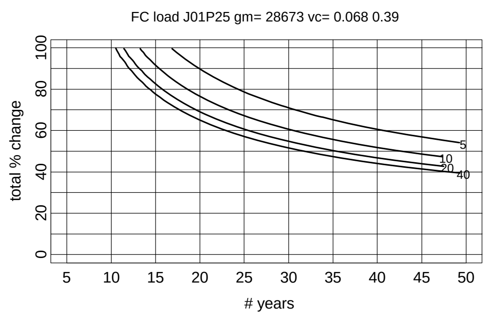
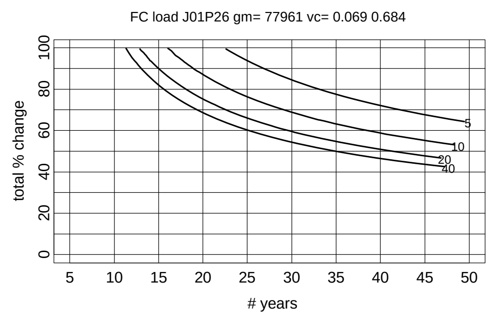


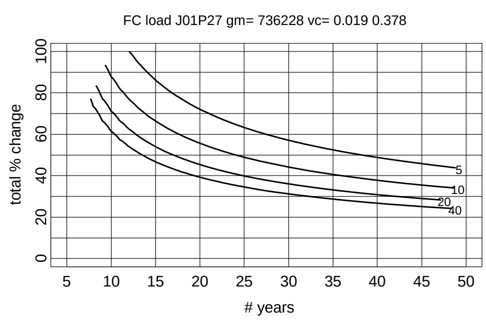
Figure B-5b (continued). Power analysis of a trend monitoring design for fecal coliform loads at the remaining drains in the Aliso Creek watershed.

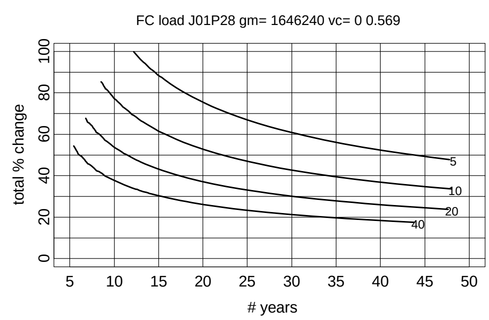


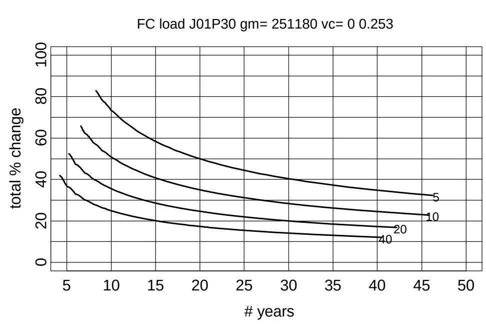












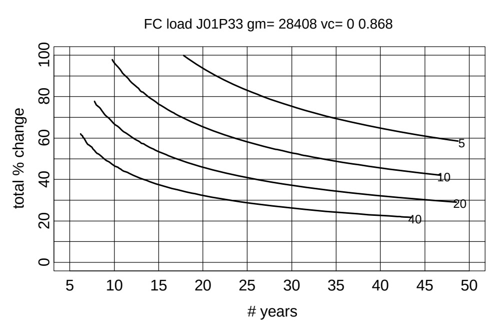


Figure B-5b (continued). Power analysis of a trend monitoring design for fecal coliform loads at the remaining drains in the Aliso Creek watershed.

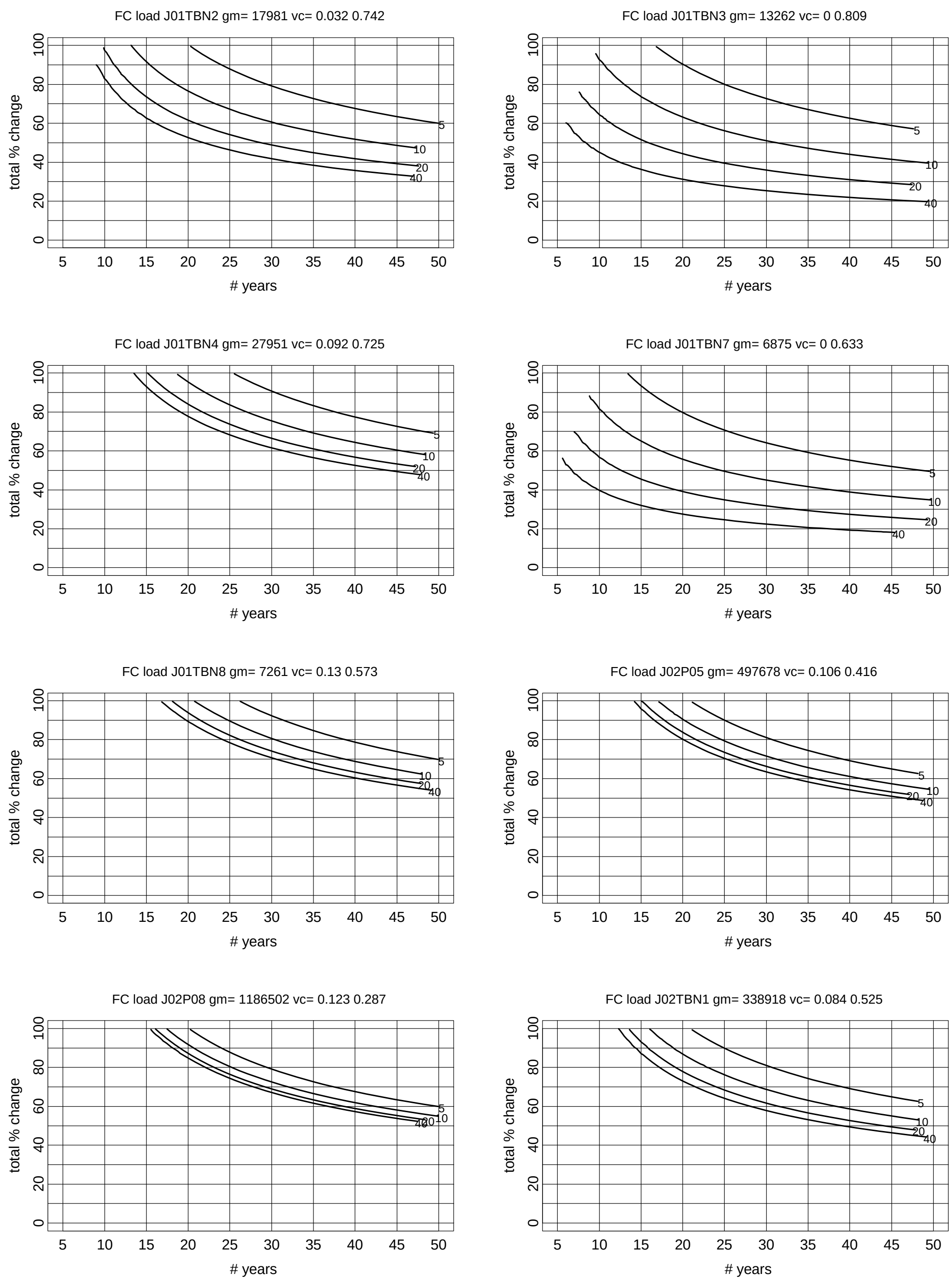


Figure B-5b (continued). Power analysis of a trend monitoring design for fecal coliform loads at the remaining drains in the Aliso Creek watershed.

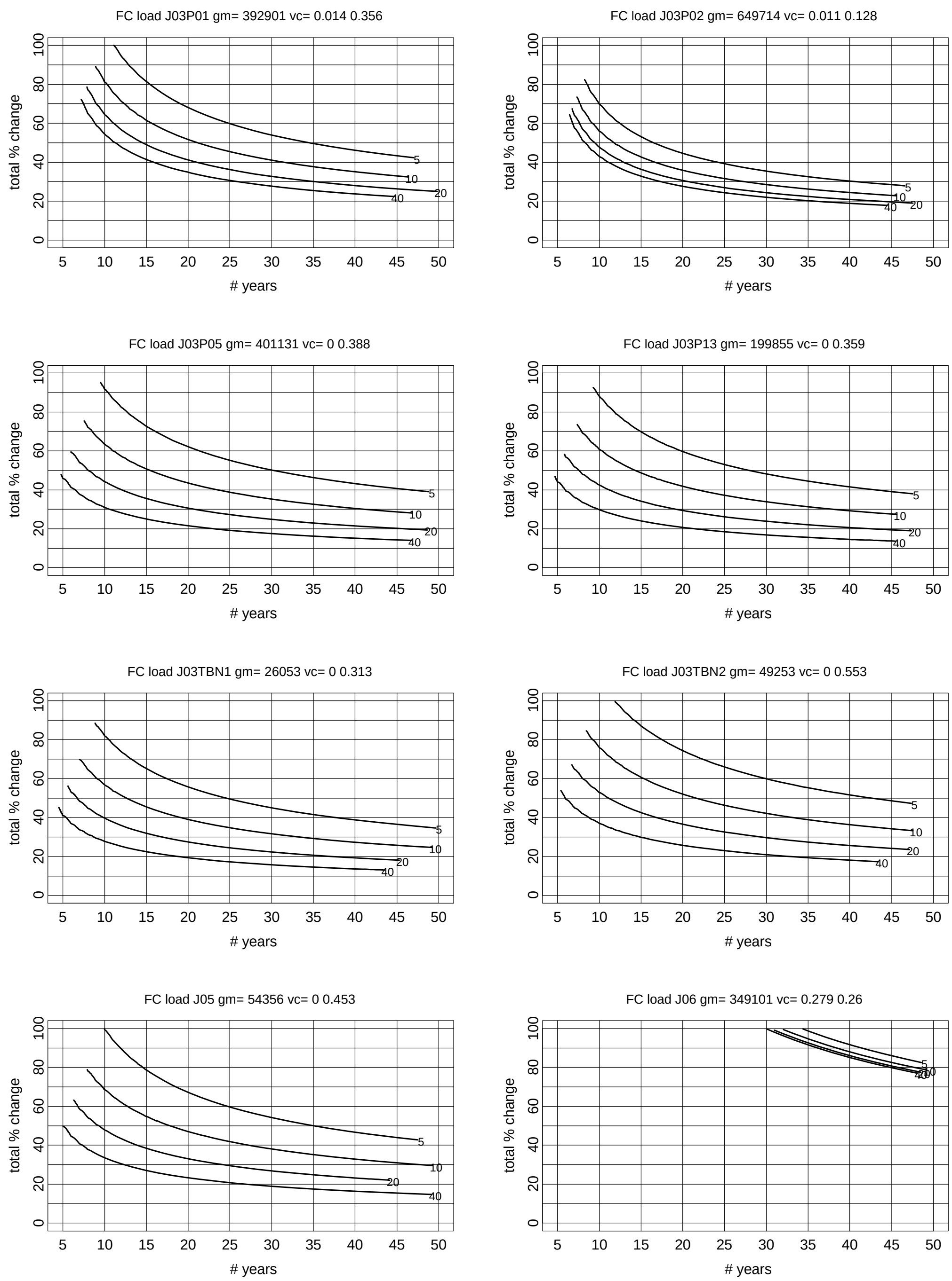
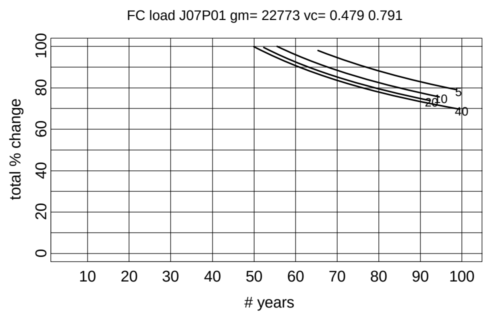


Figure B-5b (continued). Power analysis of a trend monitoring design for fecal coliform loads at the remaining drains in the Aliso Creek watershed.



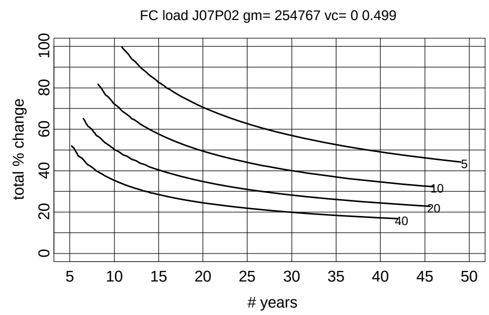


Figure B-6a. Power analysis of a trend monitoring design for fecal coliform impact at the high-priority drains in the Aliso Creek watershed. The y-axis shows the amount of change detectable, the x-axis the number of years sampling, and the different curves the number of samples in per year (5, 10, 20, 40) needed for 80% power. Power estimates are based on data from months June – September.

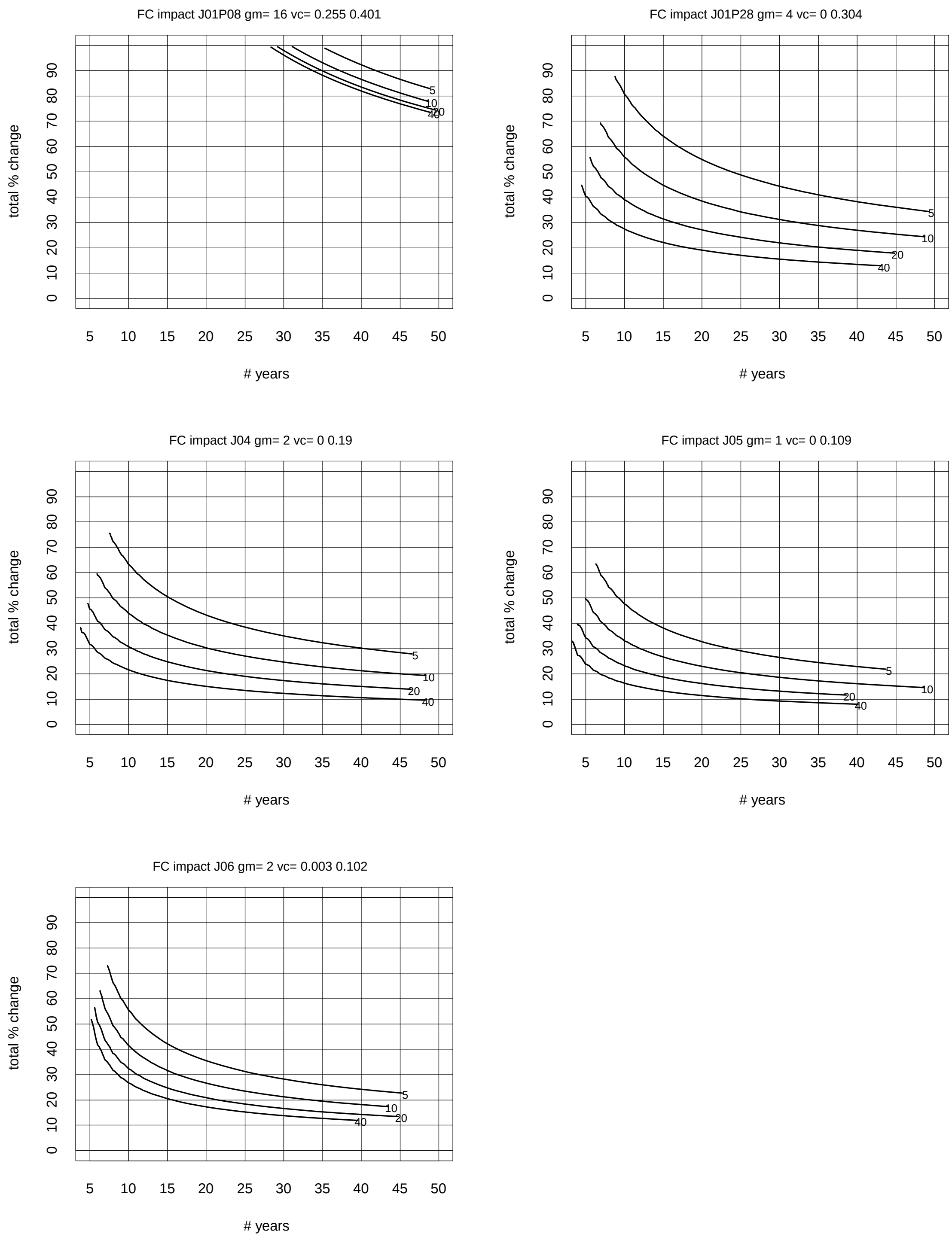


Figure B-6b. Power analysis of a trend monitoring design for fecal coliform impact at the remaining drains in the Aliso Creek watershed. The y-axis shows the amount of change detectable, the x-axis the number of years sampling, and the different curves the number of samples in per year (5, 10, 20, 40) needed for 80% power. Power estimates are based on data from months June – September.

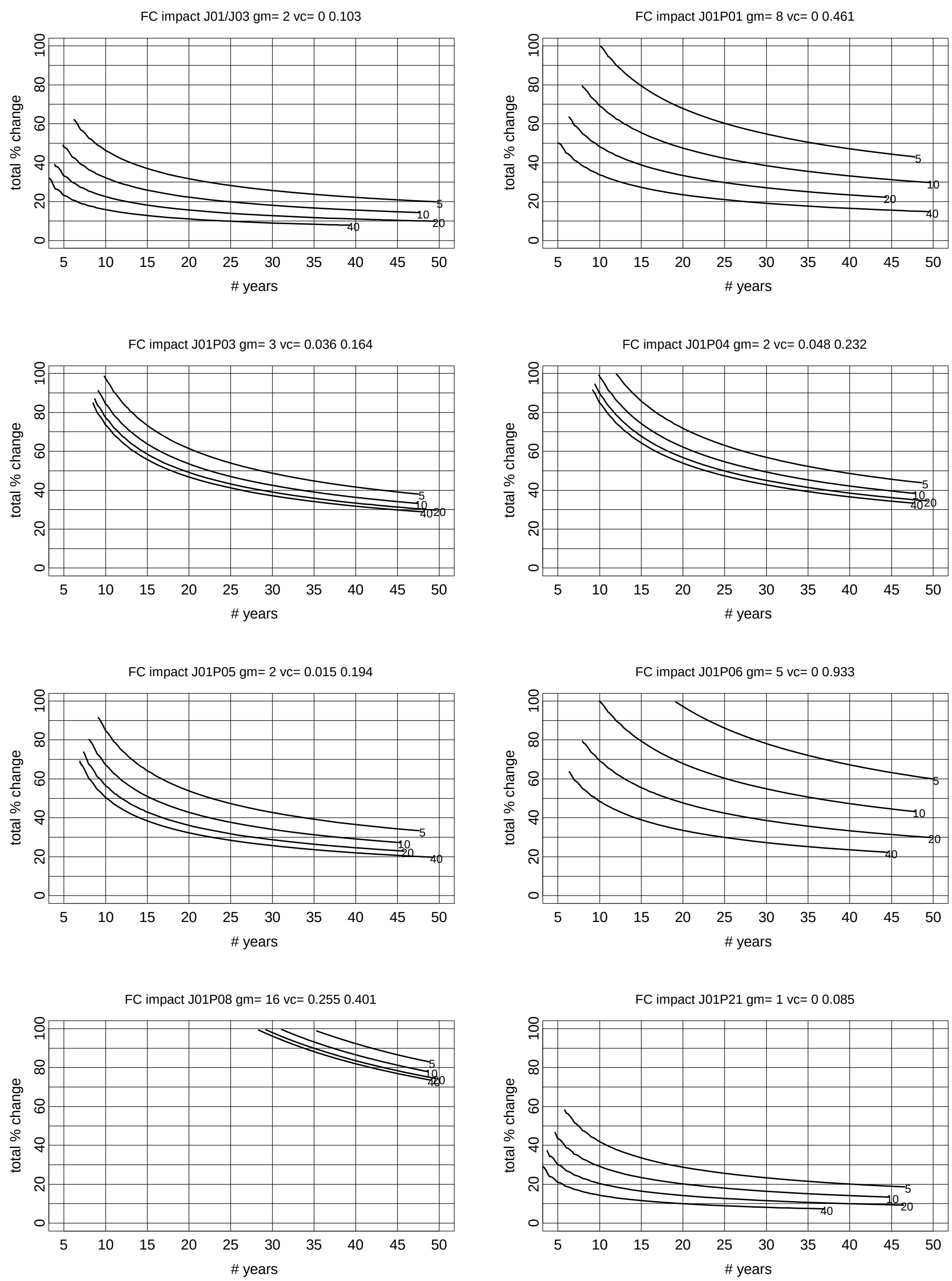


Figure B-6b (continued). Power analysis of a trend monitoring design for fecal coliform impact at the remaining drains in the Aliso Creek watershed.

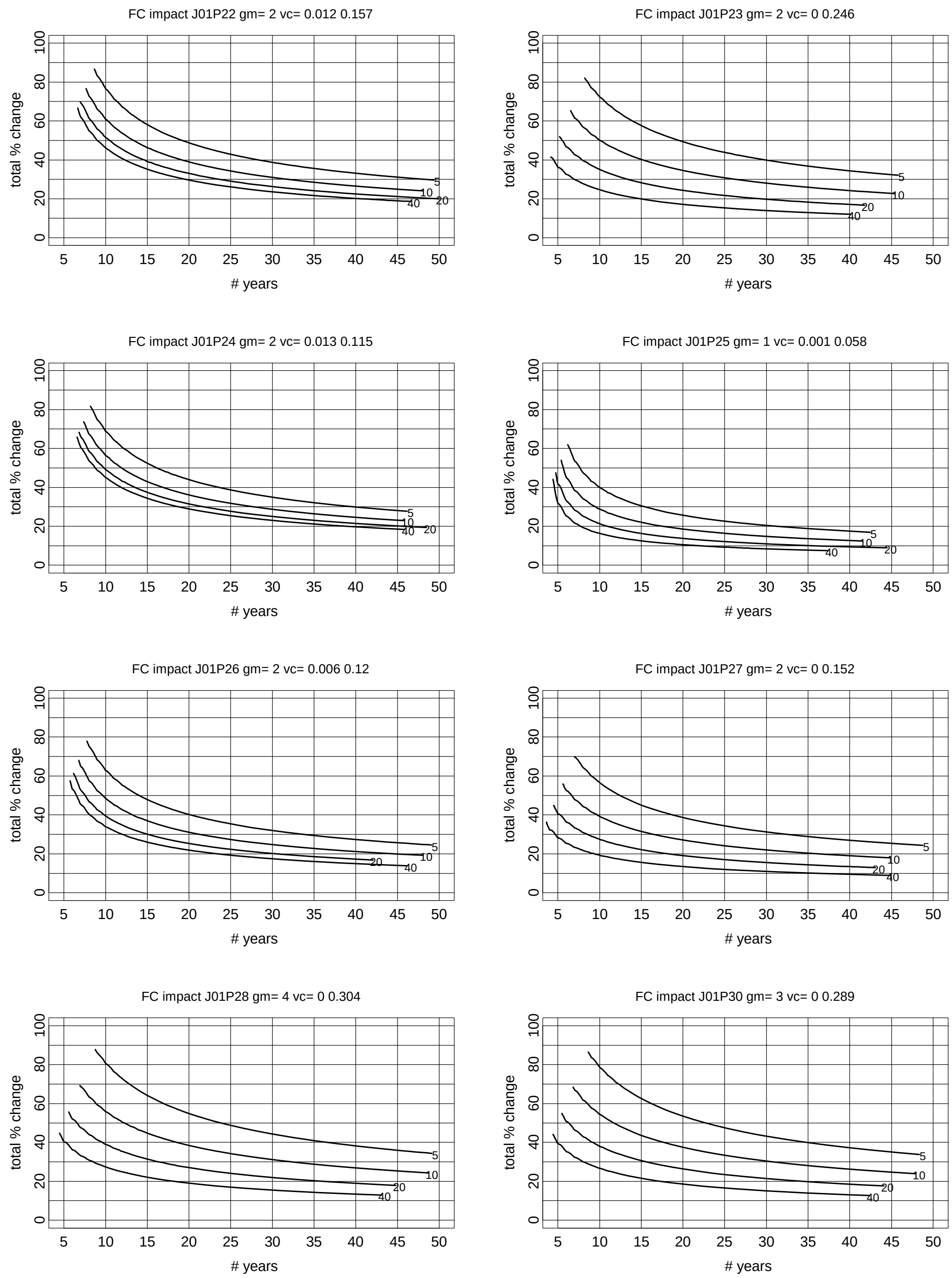
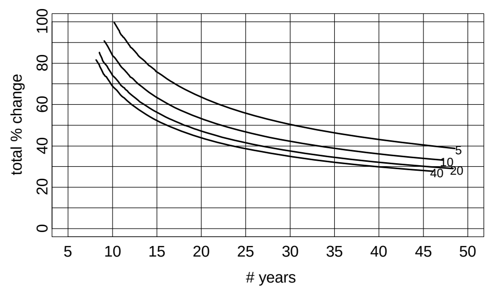
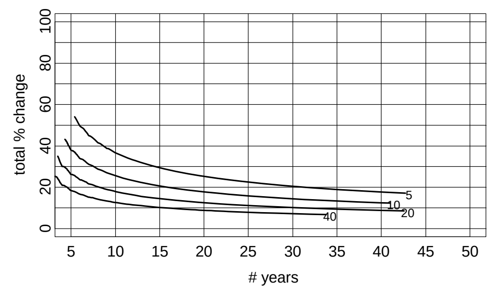


Figure B-6b (continued). Power analysis of a trend monitoring design for fecal coliform impact at the remaining drains in the Aliso Creek watershed.

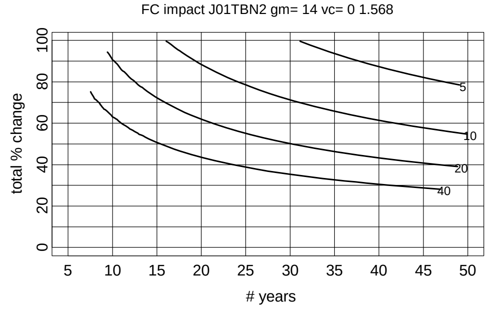
FC impact J01P32 gm= 2 vc= 0.03 0.219



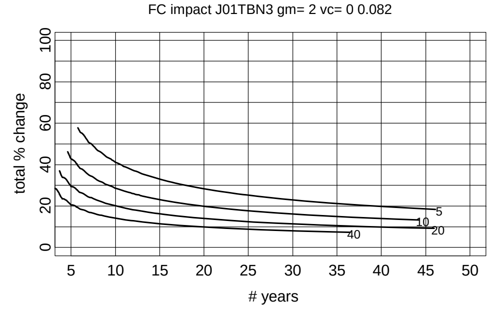
FC impact J01P33 gm= 2 vc= 0 0.065



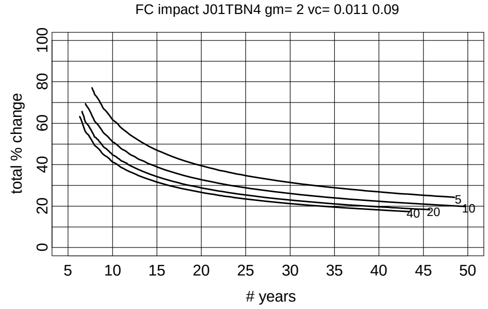
FC impact J01TBN2 gm= 14 vc= 0 1.568



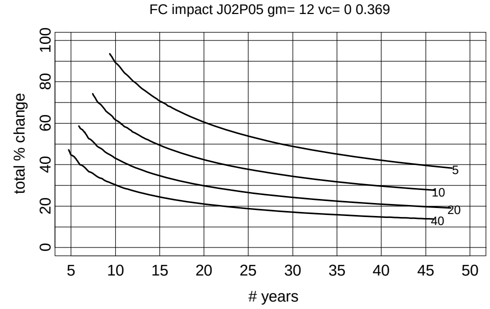
FC impact J01TBN3 gm= 2 vc= 0 0.082



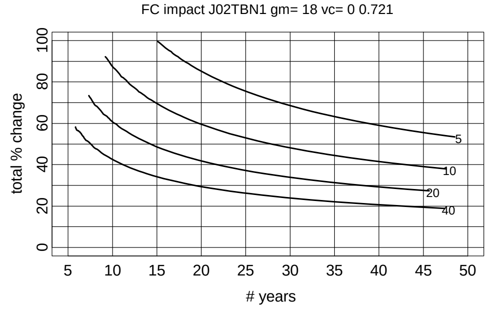
FC impact J01TBN4 gm= 2 vc= 0.011 0.09



FC impact J02P05 gm= 12 vc= 0 0.369



FC impact J02TBN1 gm= 18 vc= 0 0.721



FC impact J03P01 gm= 3 vc= 0 0.267

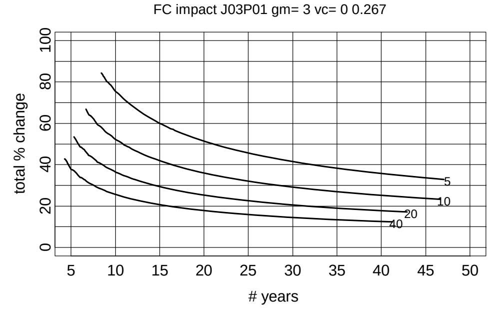


Figure B-6b (continued). Power analysis of a trend monitoring design for fecal coliform impact at the remaining drains in the Aliso Creek watershed.

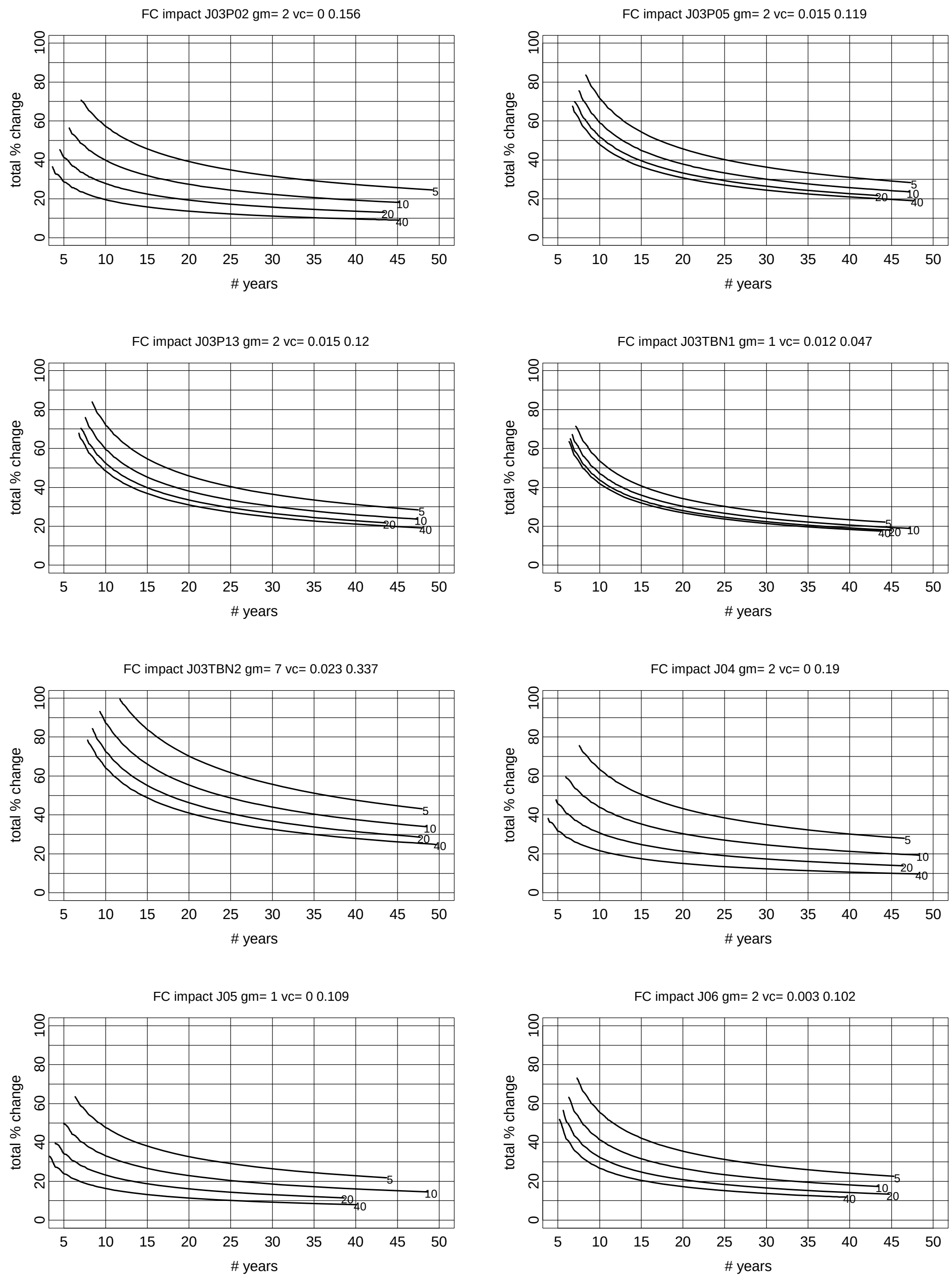


Figure B-6b (continued). Power analysis of a trend monitoring design for fecal coliform impact at the remaining drains in the Aliso Creek watershed.

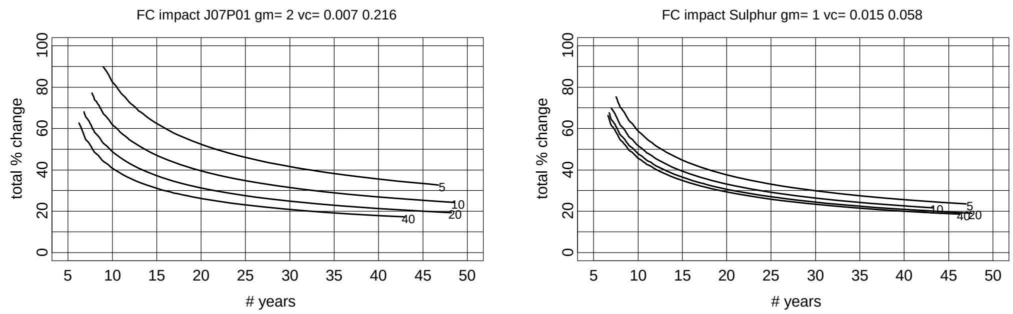
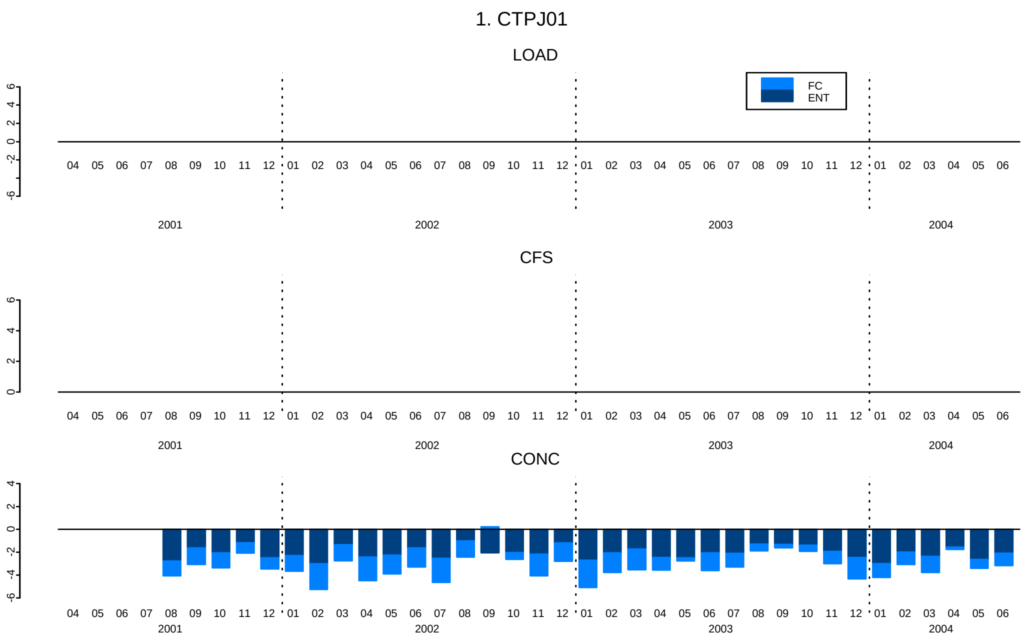


Figure B-7. Patterns of bacterial loads, concentration in the discharge, and discharge flow at all monitored drains. All parameters calculated as deviations from the long-term system mean. The dark portion of each vertical bar indicates Enterococcus and the blue portion fecal coliform. "Load" is bacterial load in the pipe discharge; "CFS" is the measure of flow (cubic feet/second) in the discharge, "CONC" is concentration in the discharge. Rank of this station, from highest to lowest, on each parameter is presented at the top of the figure.



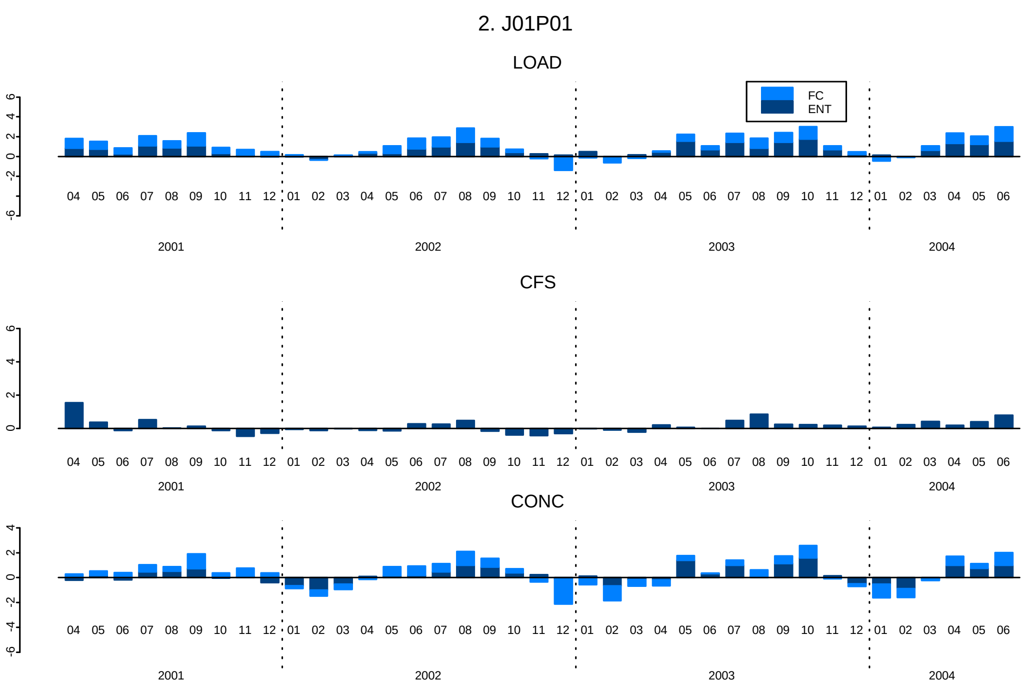
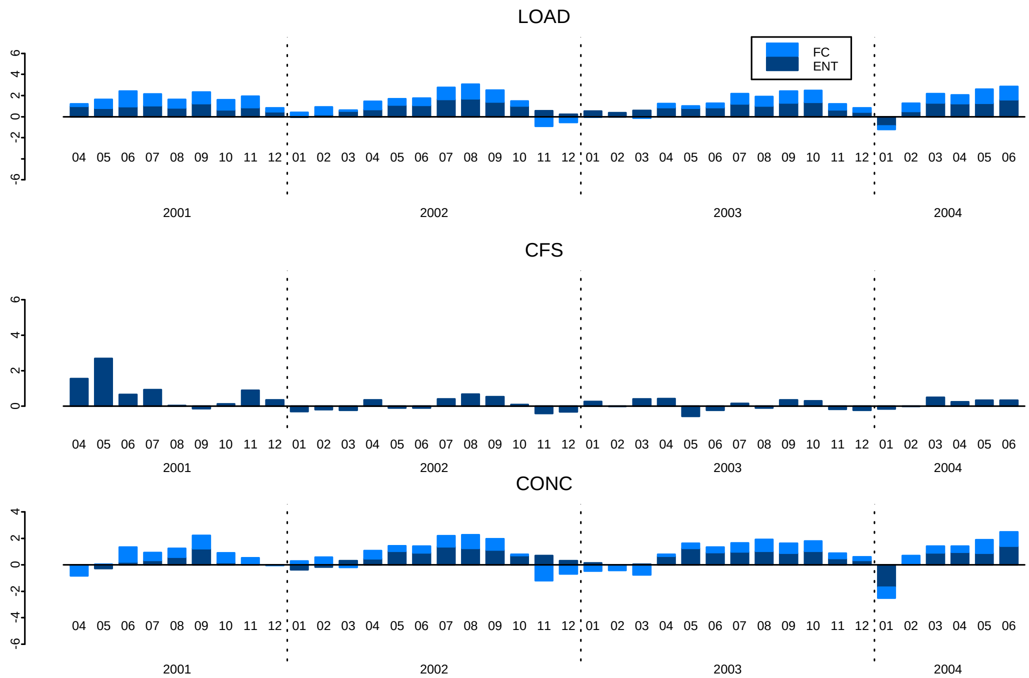


Figure B-7 (continued).

3. J01P03



4. J01P04

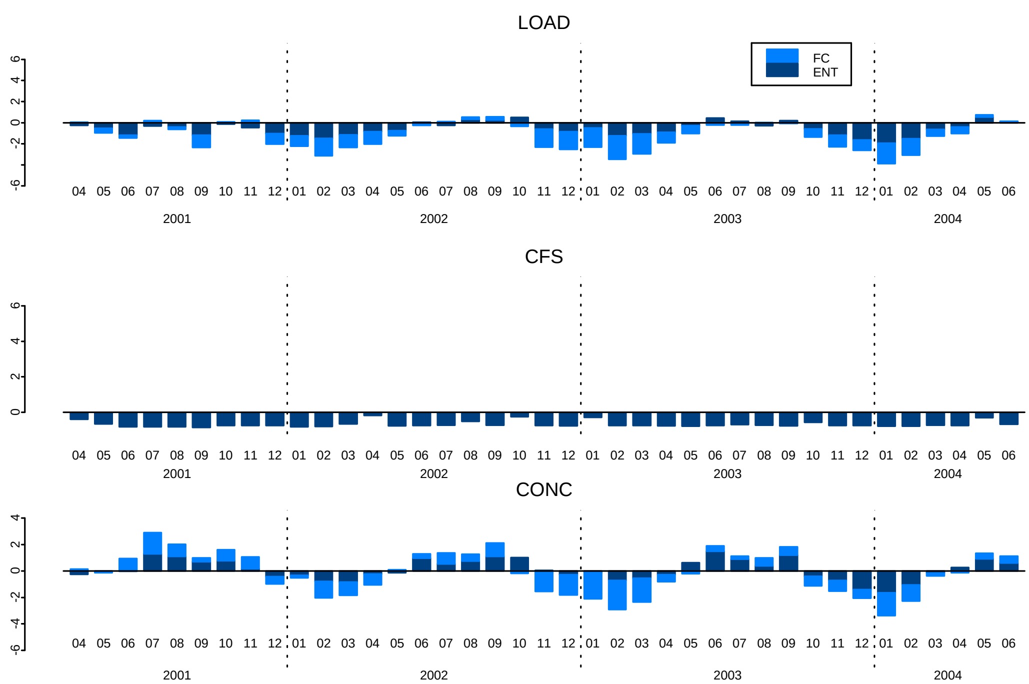
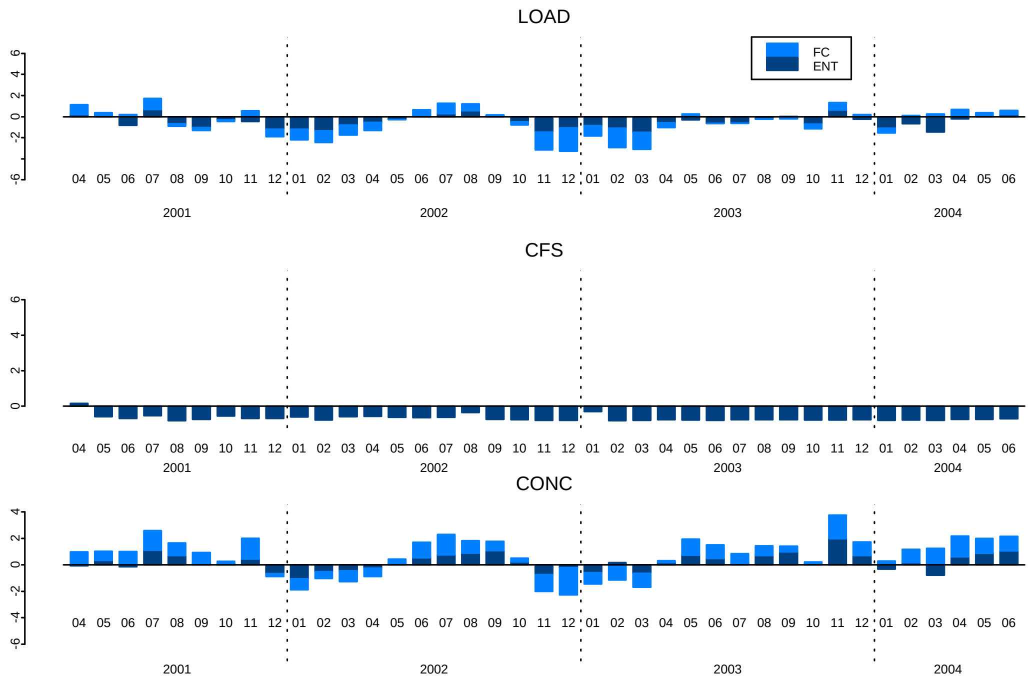


Figure B-7 (continued).

5. J01P05



6. J01P06

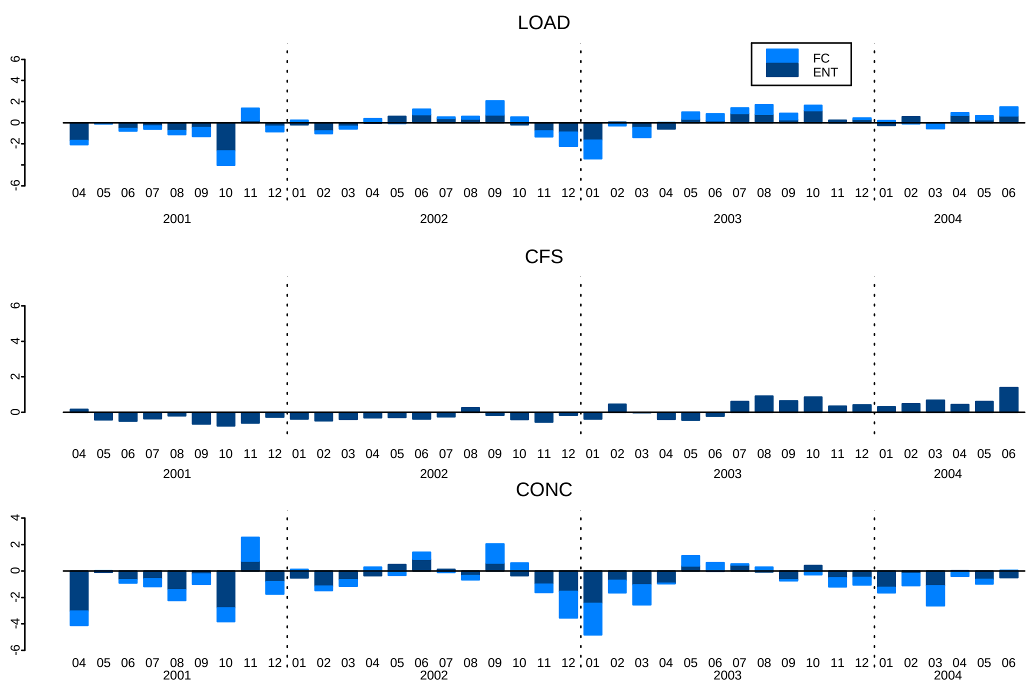
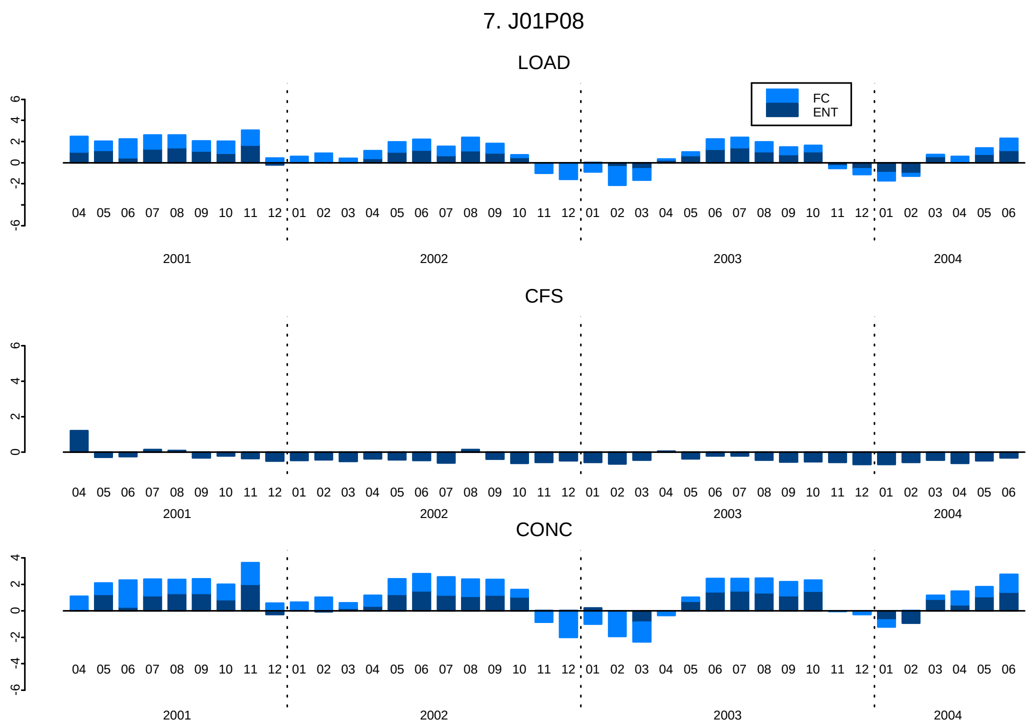


Figure B-7 (continued).



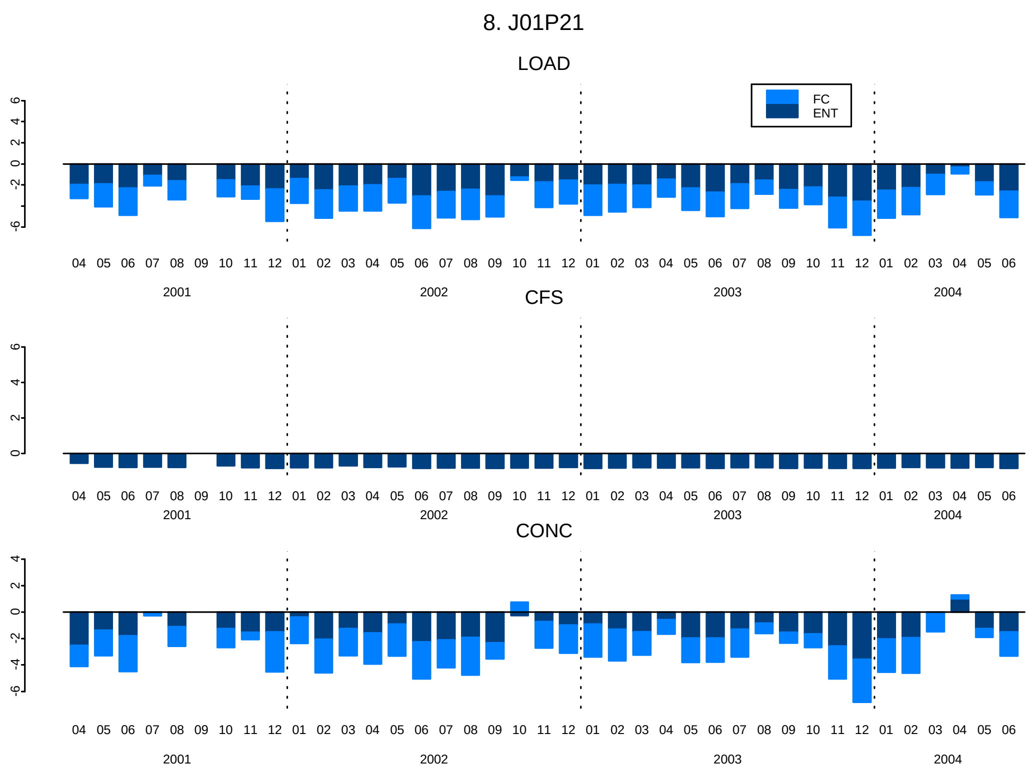
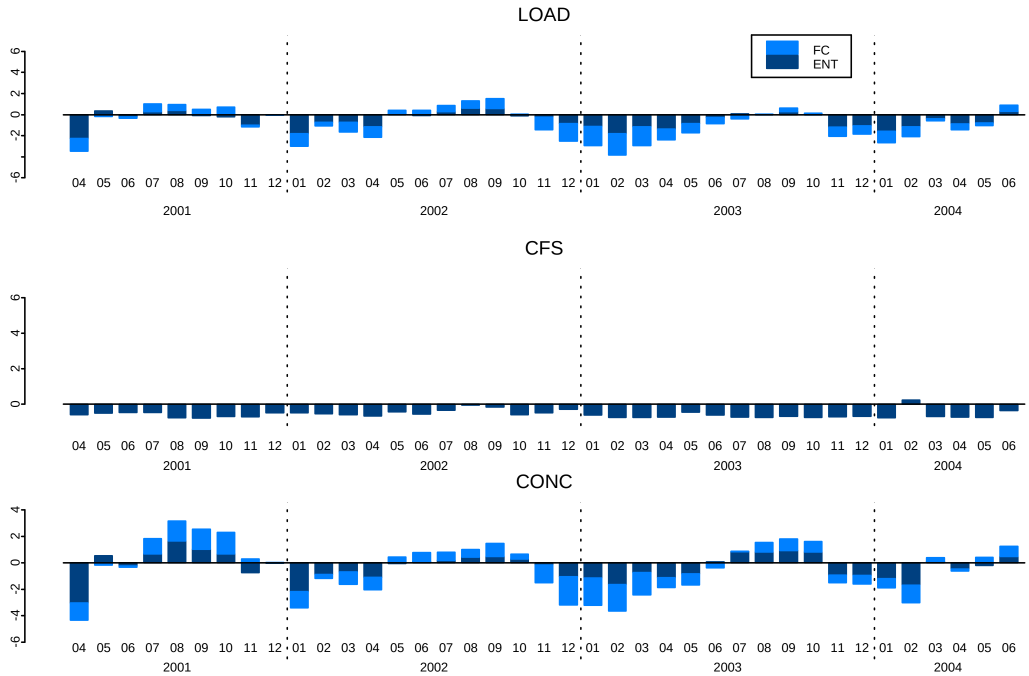


Figure B-7 (continued).

9. J01P22



10. J01P23

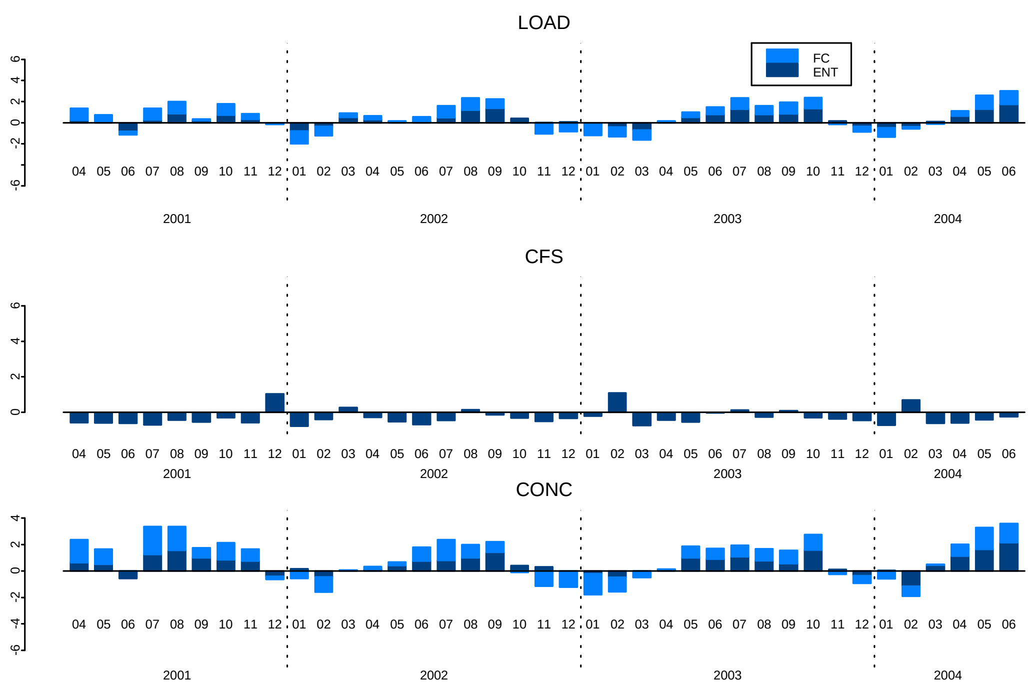
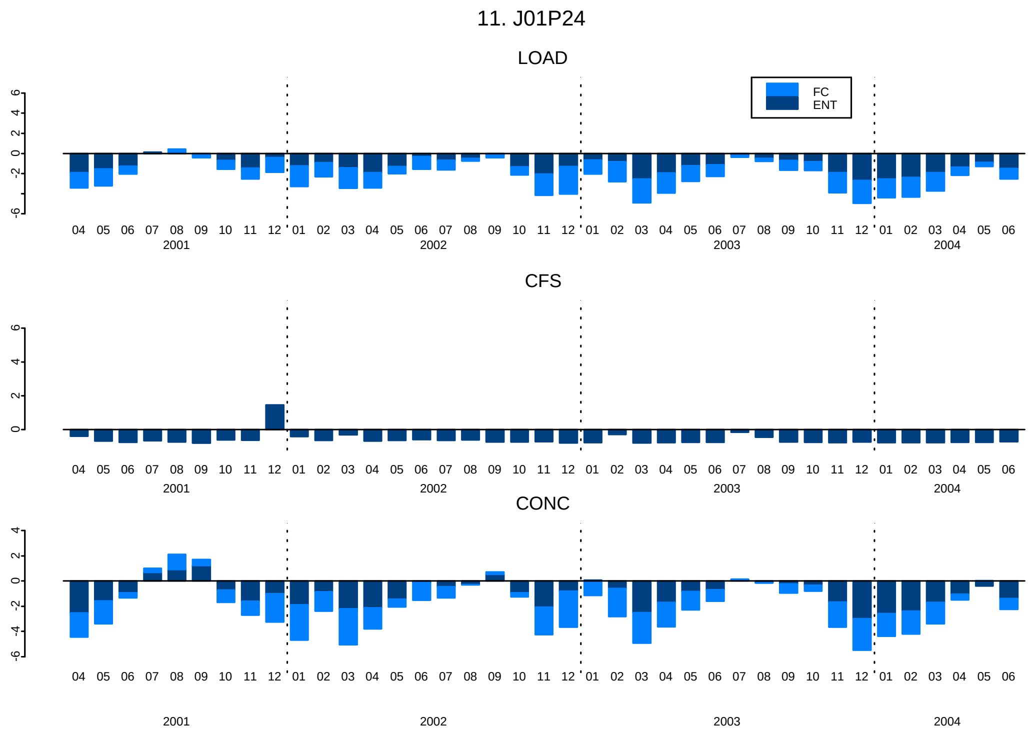


Figure B-7 (continued).



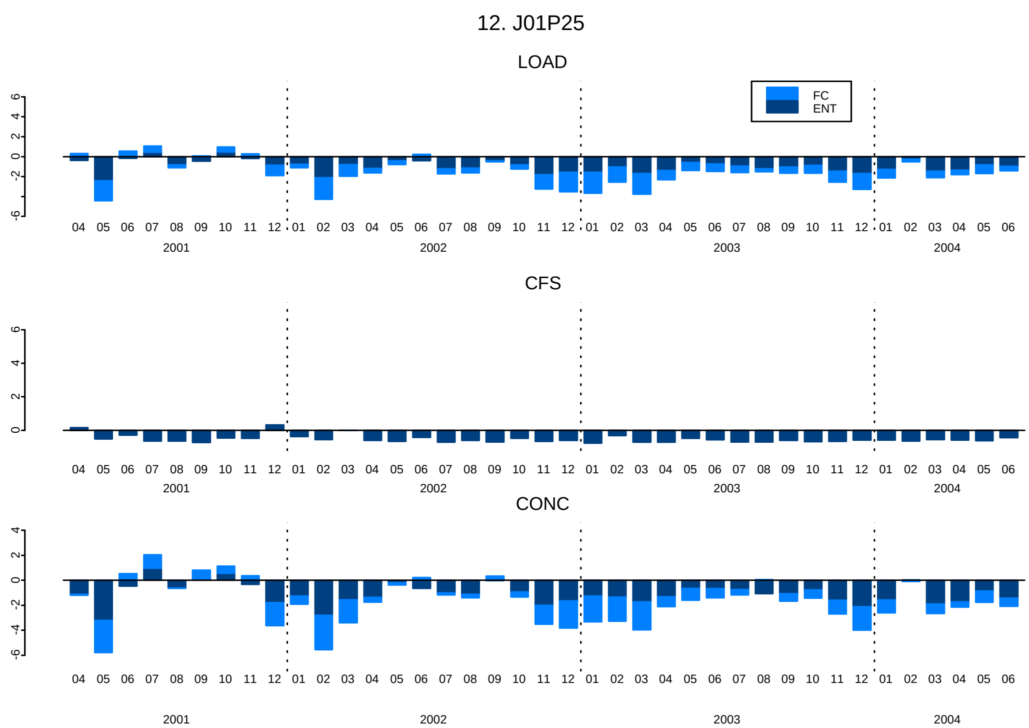
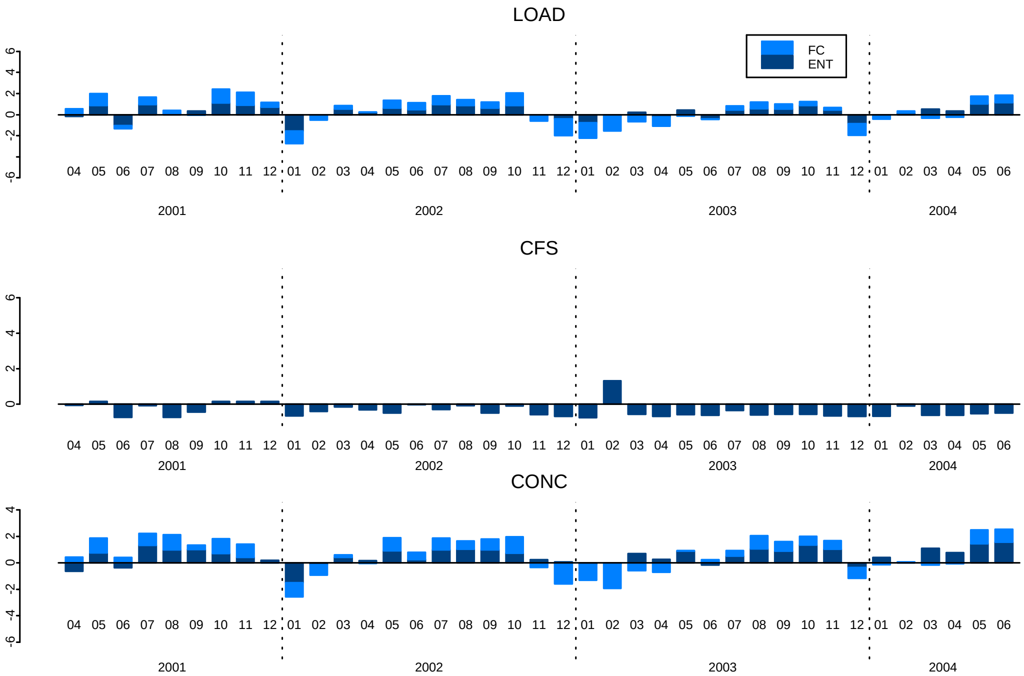


Figure B-7 (continued).

13. J01P26



14. J01P27

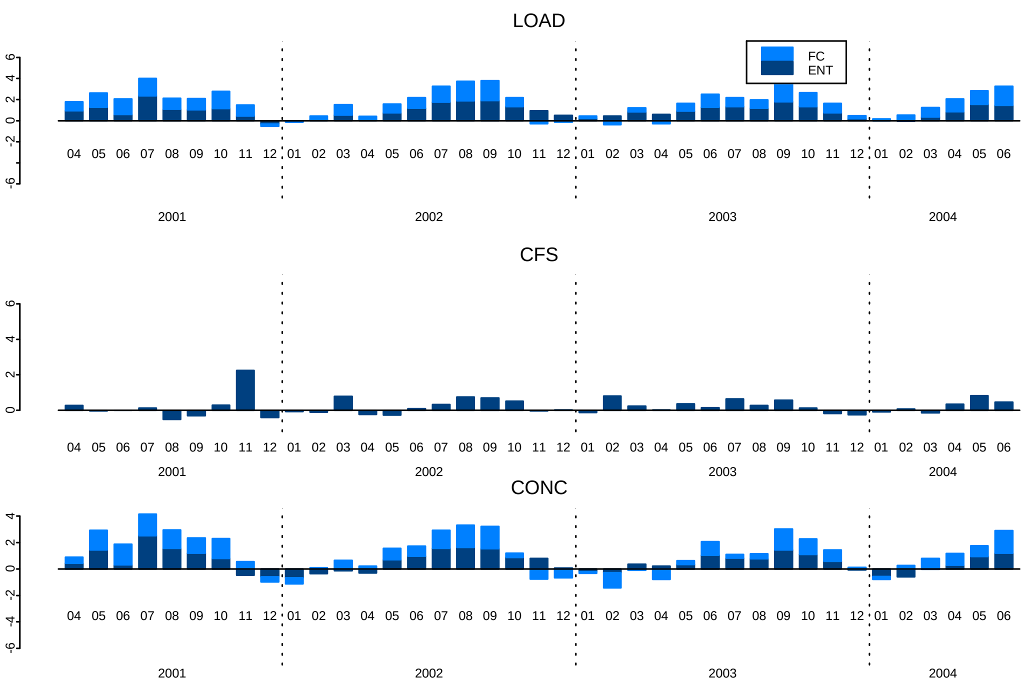
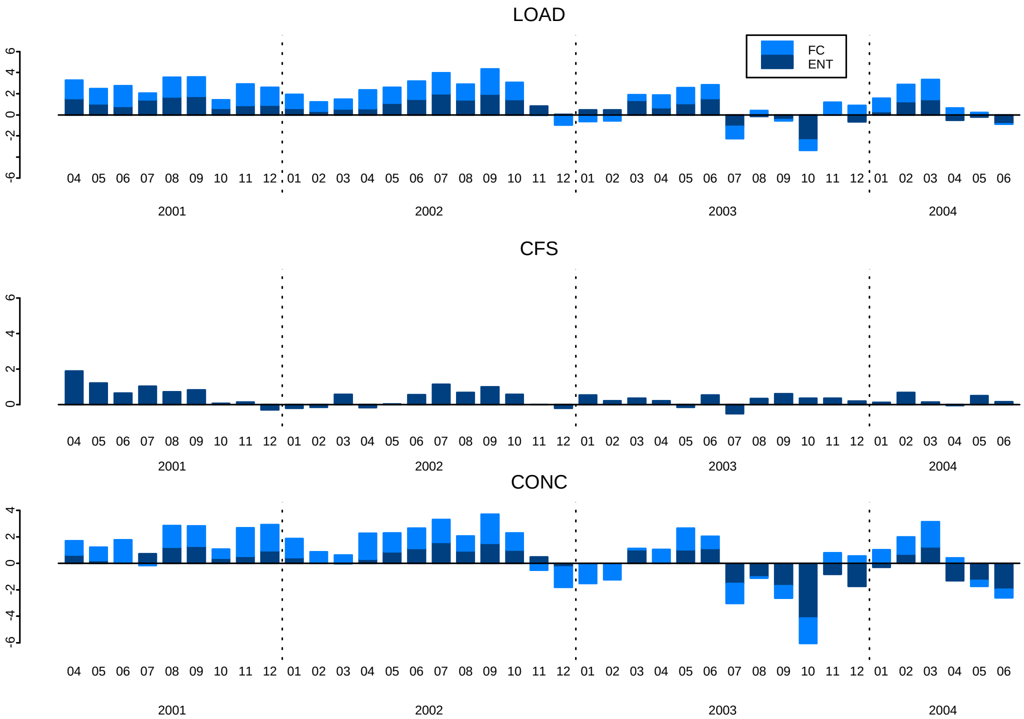


Figure B-7 (continued).

15. J01P28



16. J01P30

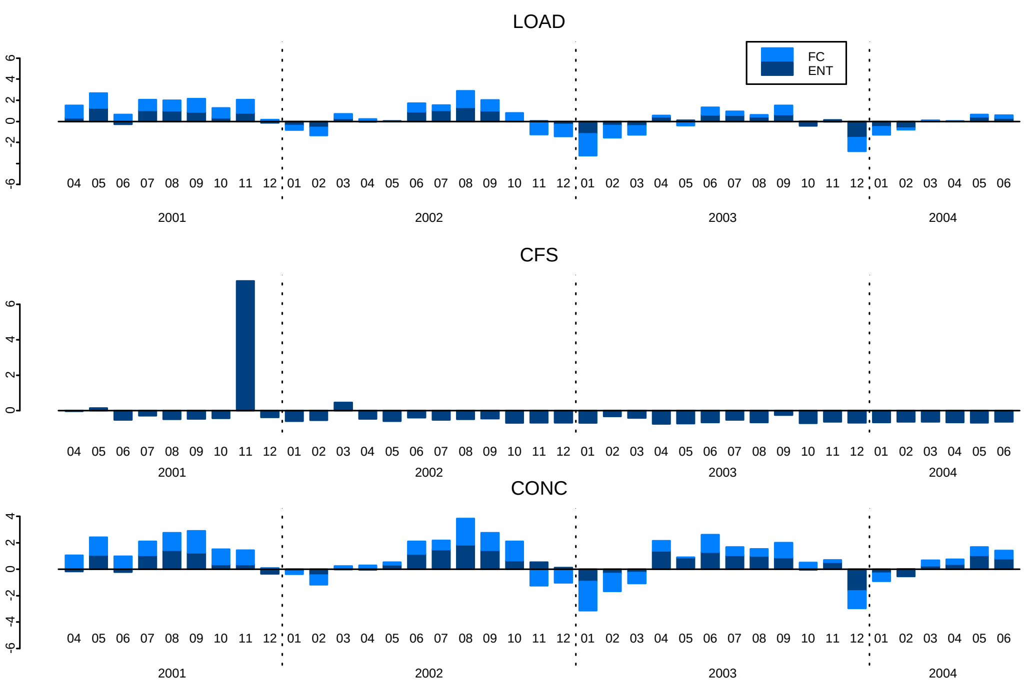
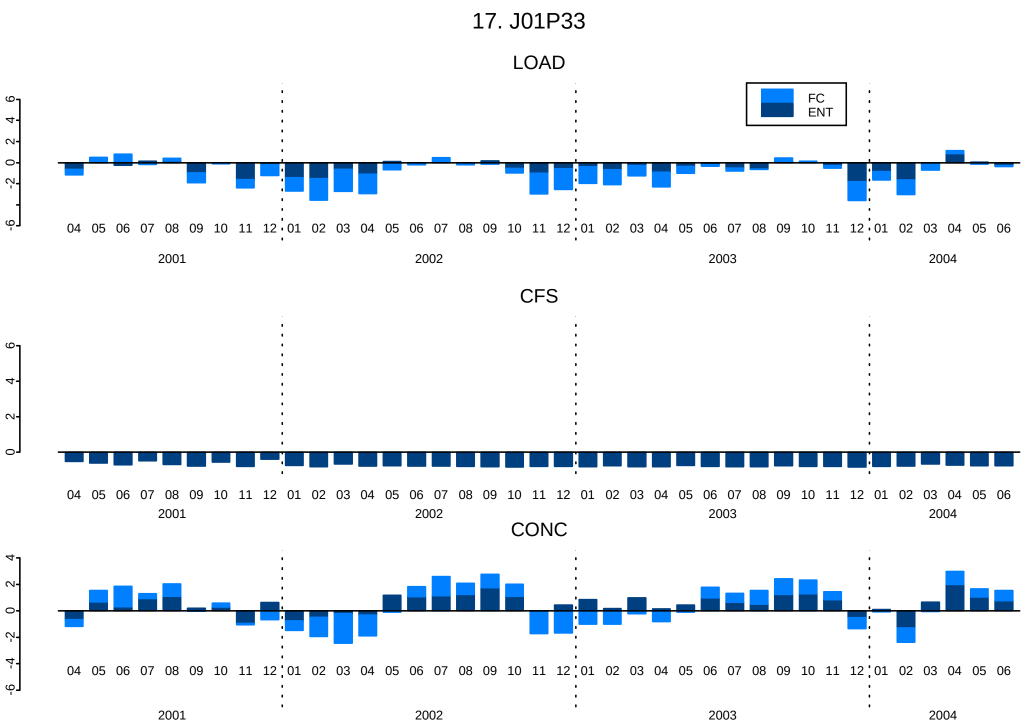


Figure B-7 (continued).



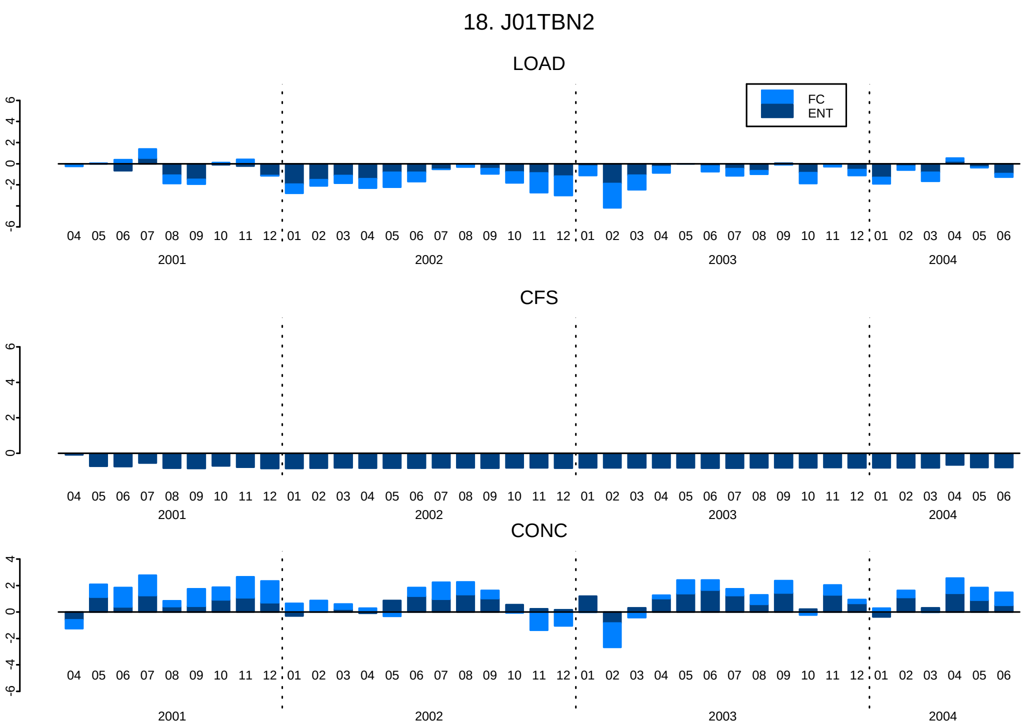
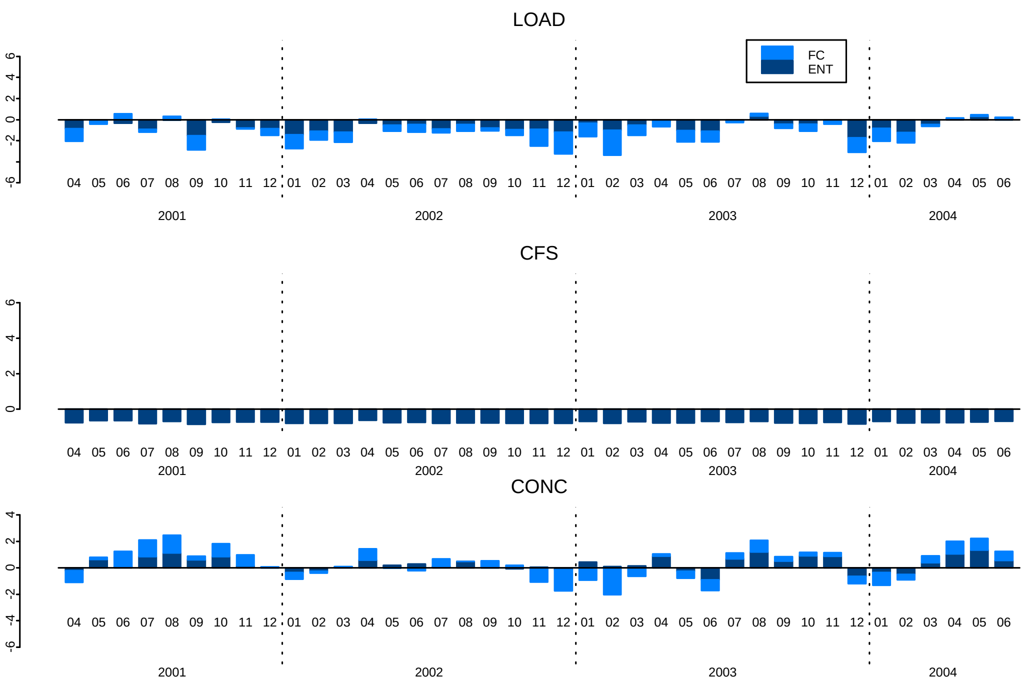


Figure B-7 (continued).

19. J01TBN3



20. J01TBN4

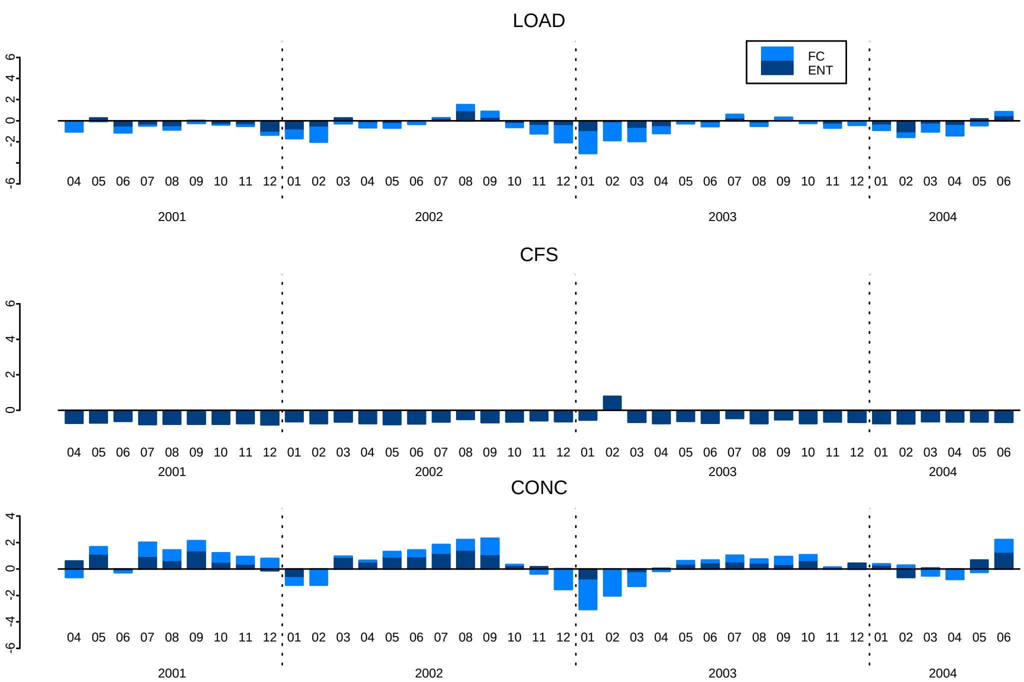
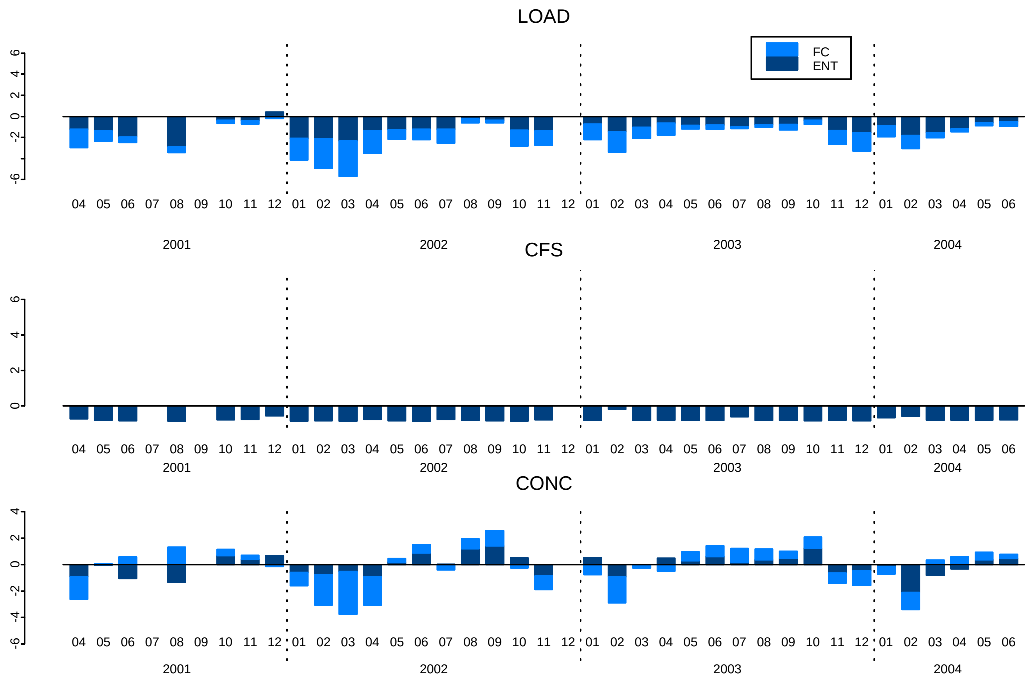


Figure B-7 (continued).

21. J01TBN7



22. J01TBN8

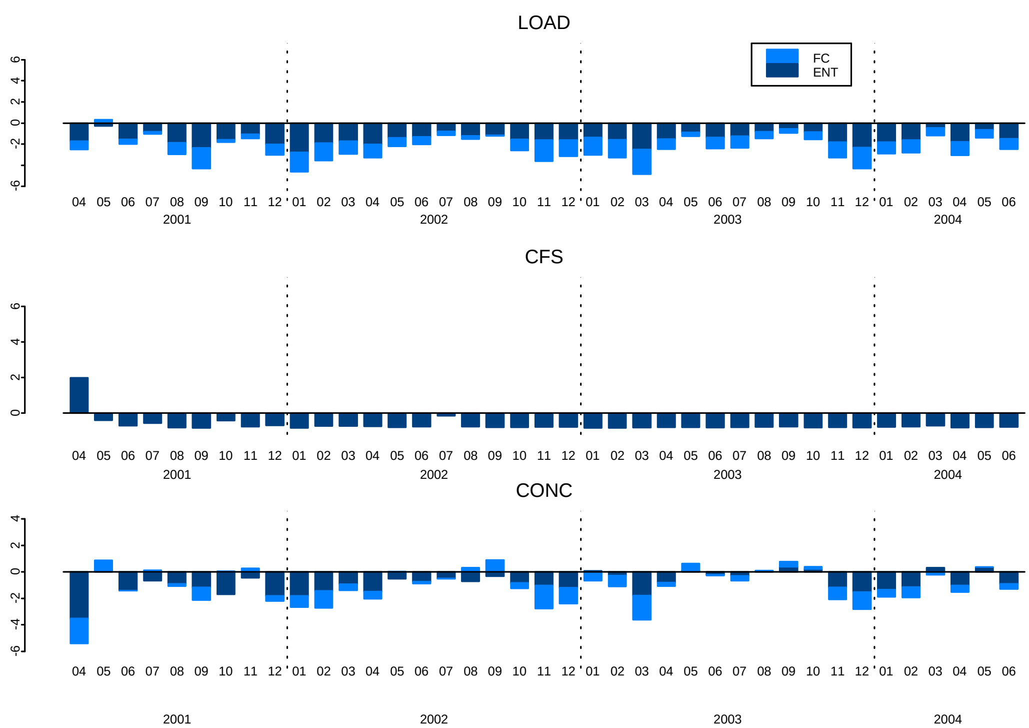
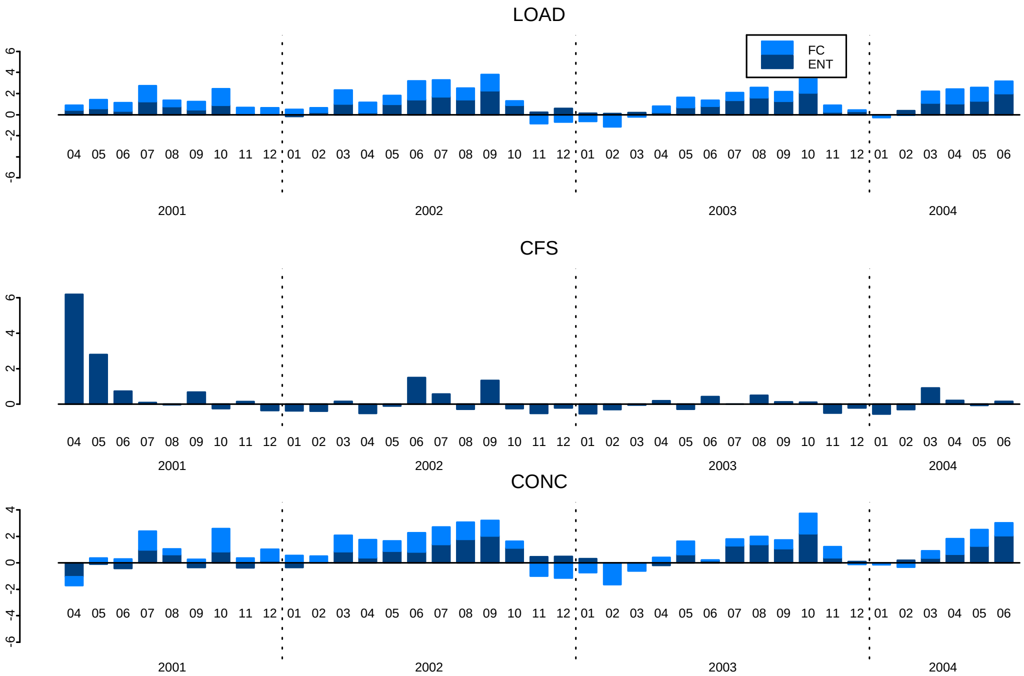


Figure B-7 (continued).

23. J02P05



24. J02P08

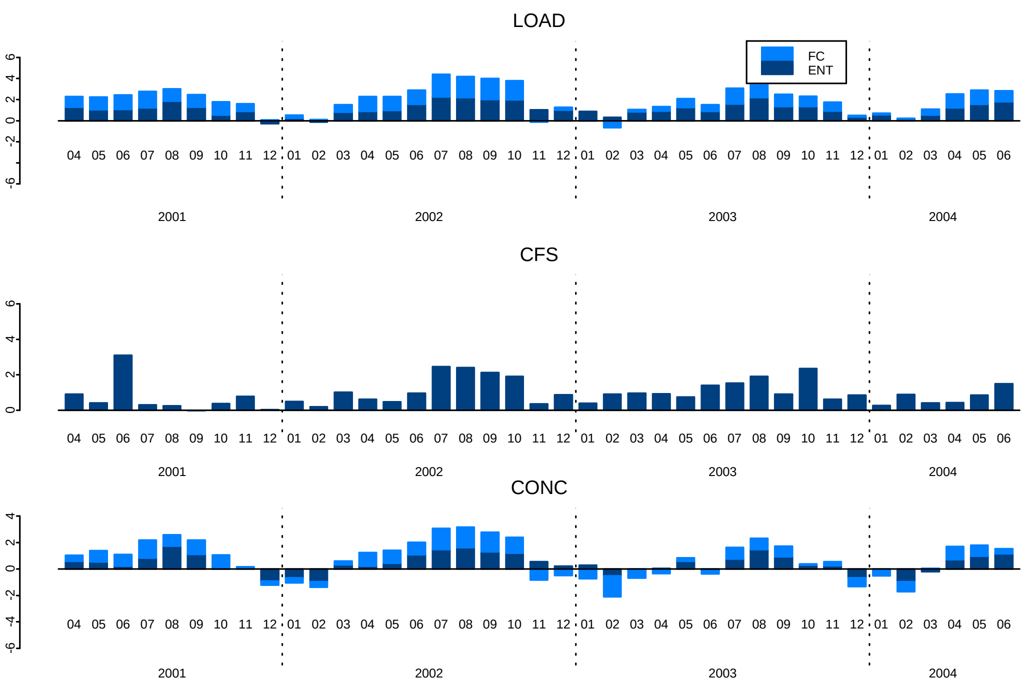
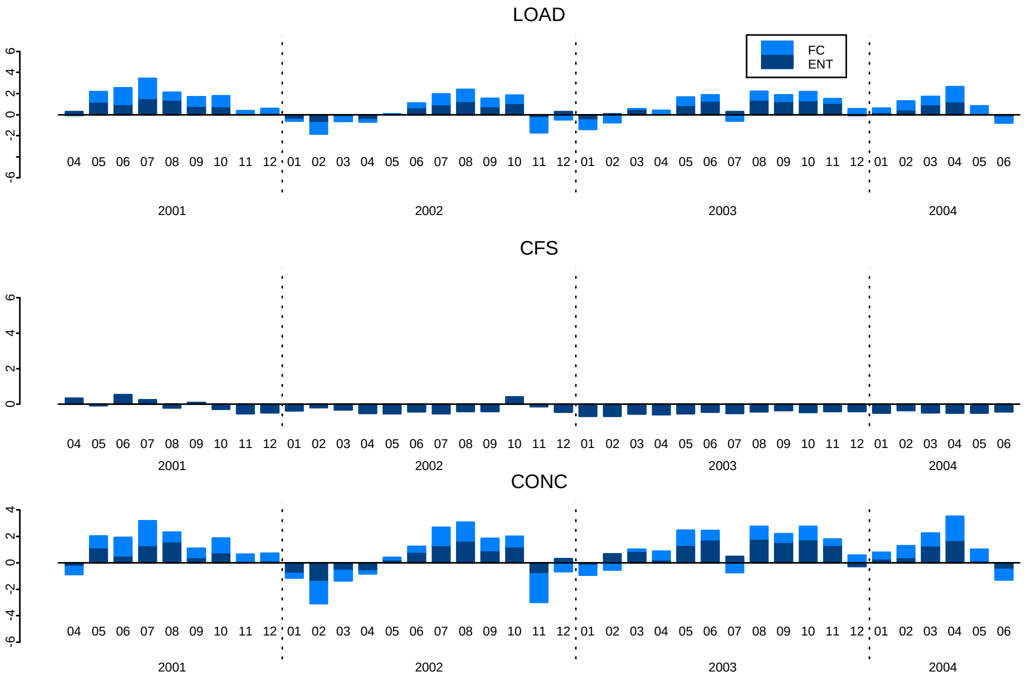


Figure B-7 (continued).

25. J02TBN1



26. J03P01

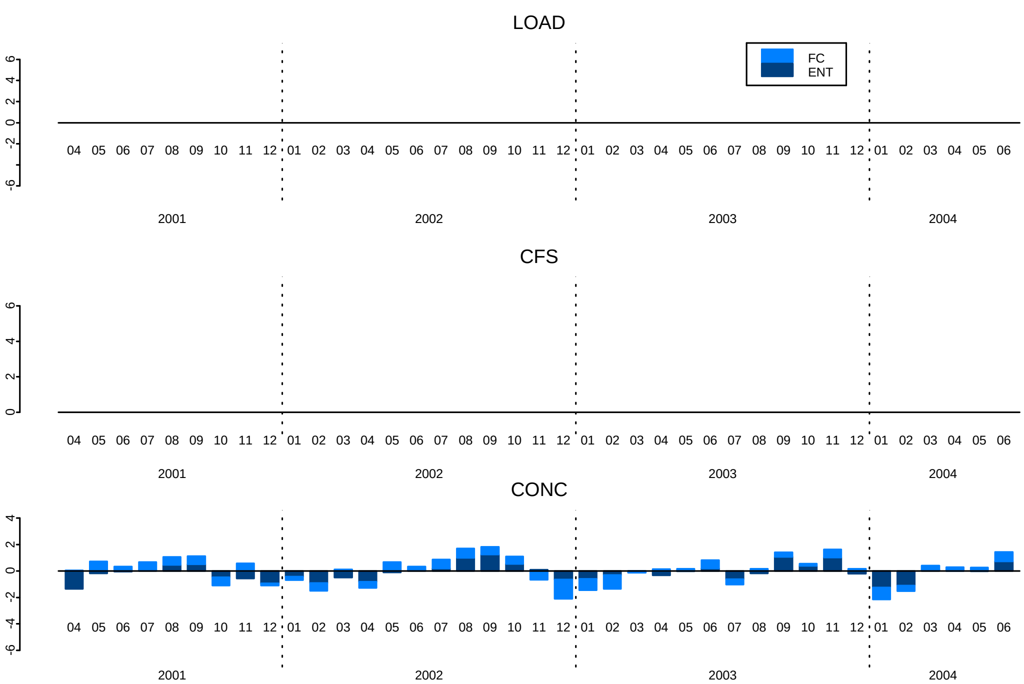
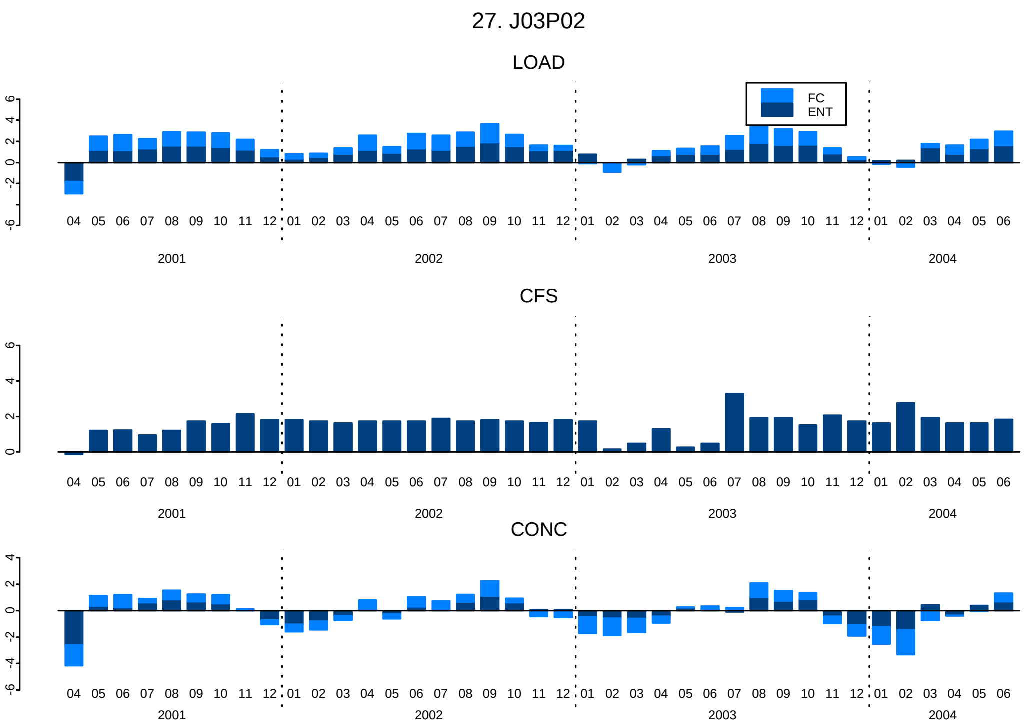


Figure B-7 (continued).



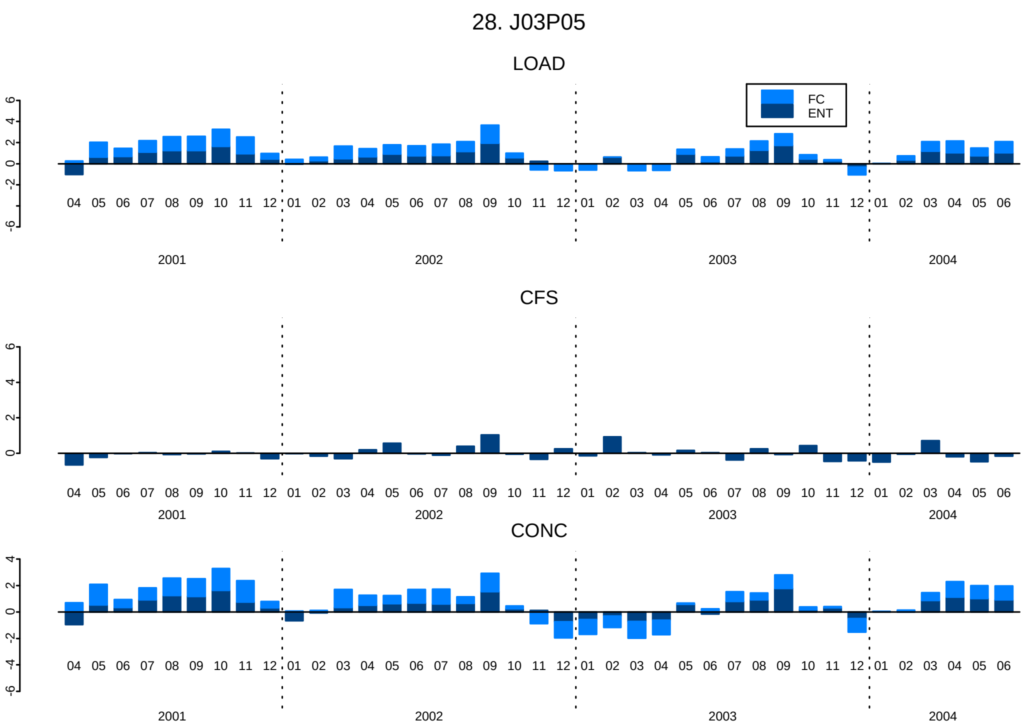
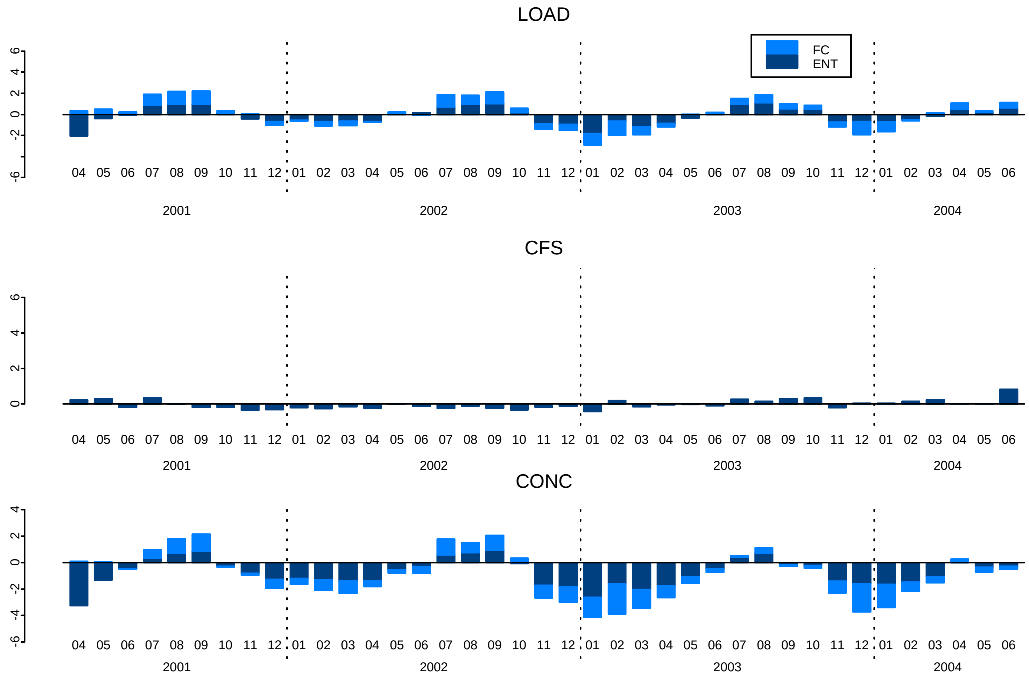


Figure B-7 (continued).

29. J03P13



30. J03TBN1

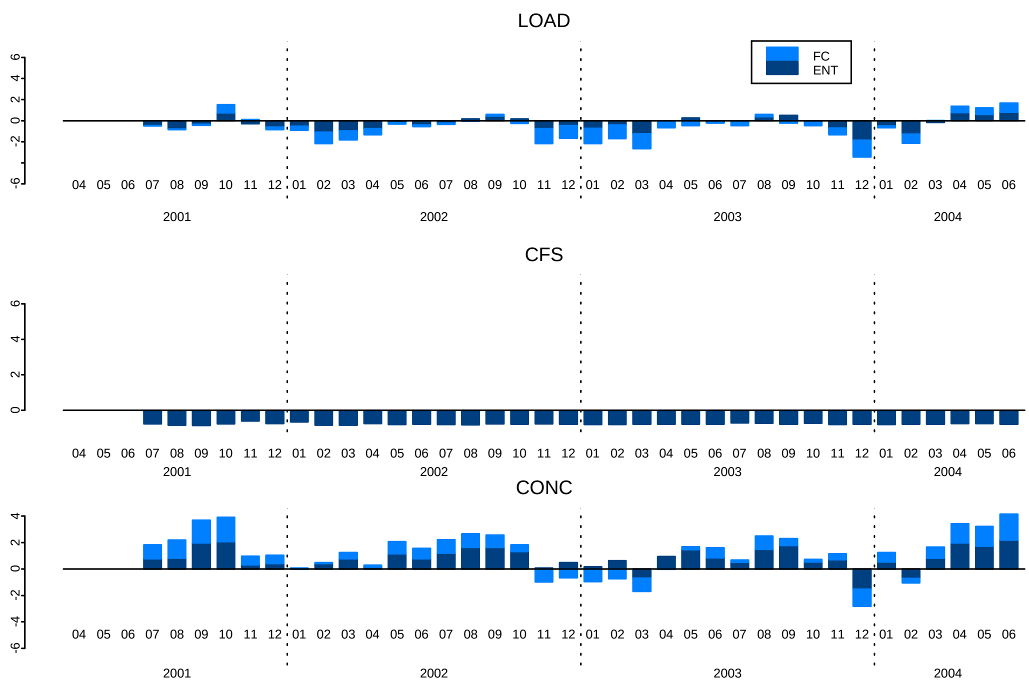
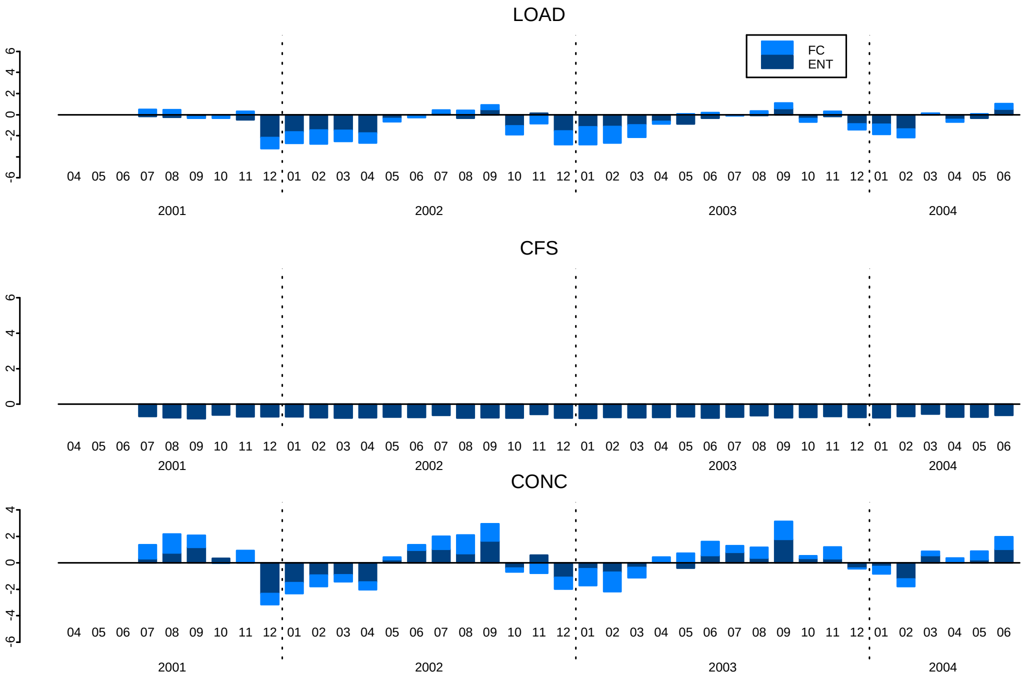


Figure B-7 (continued).

31. J03TBN2



32. J04

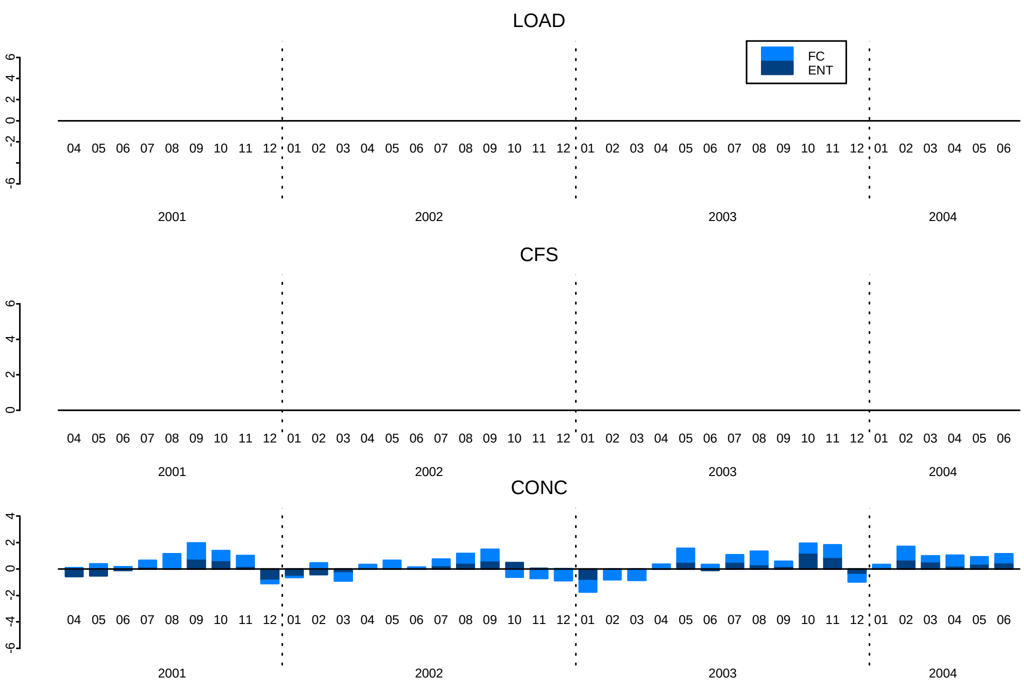
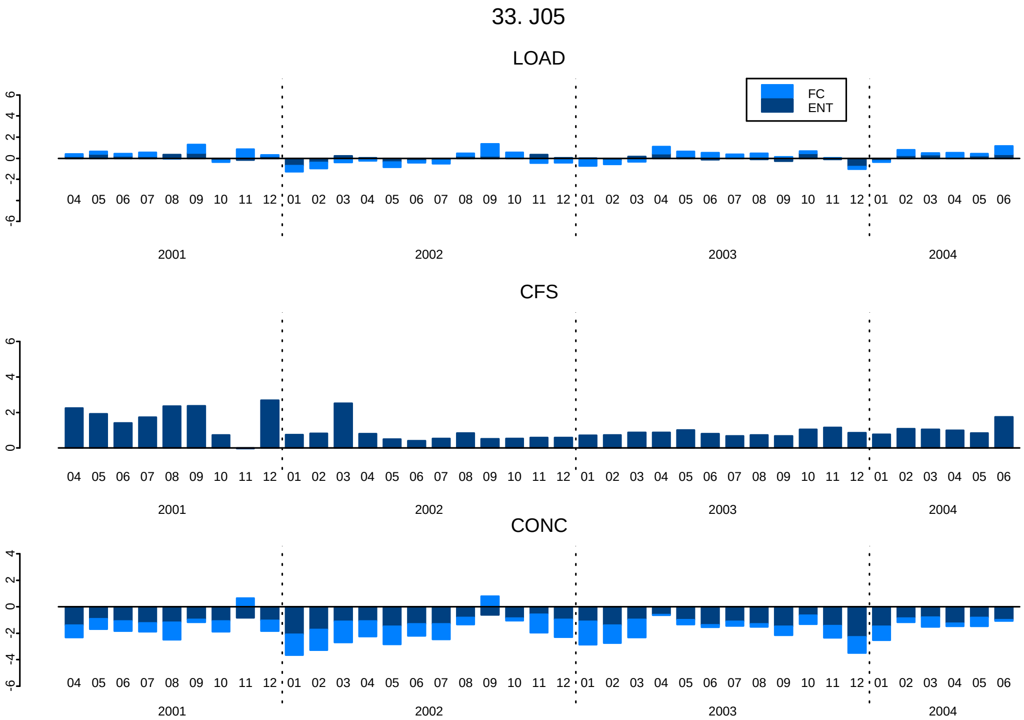


Figure B-7 (continued).



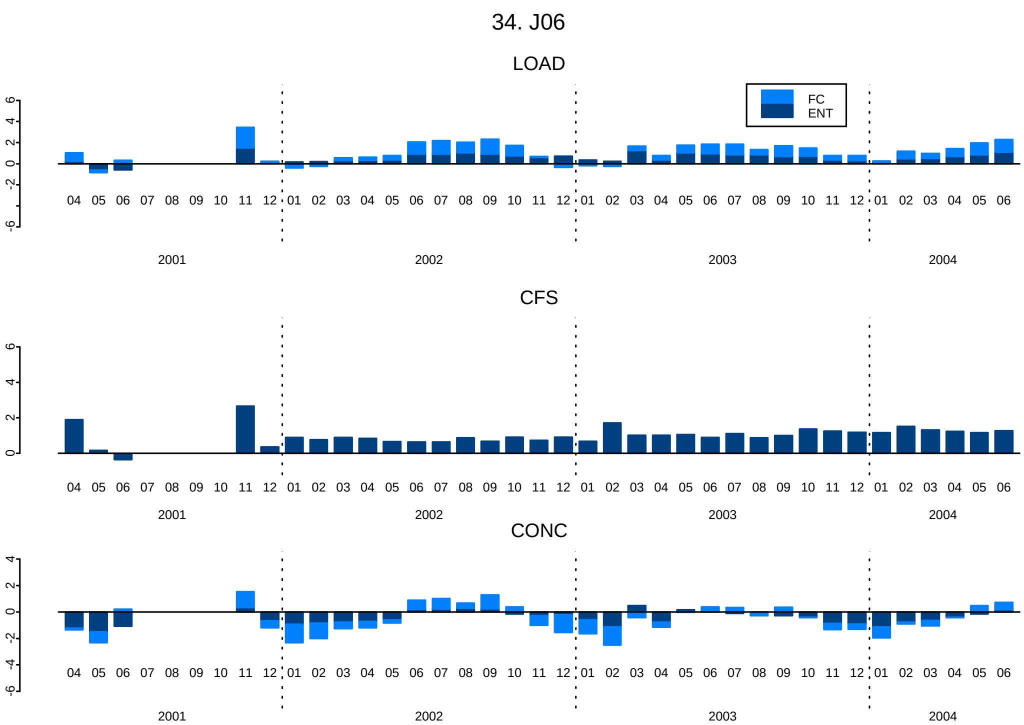
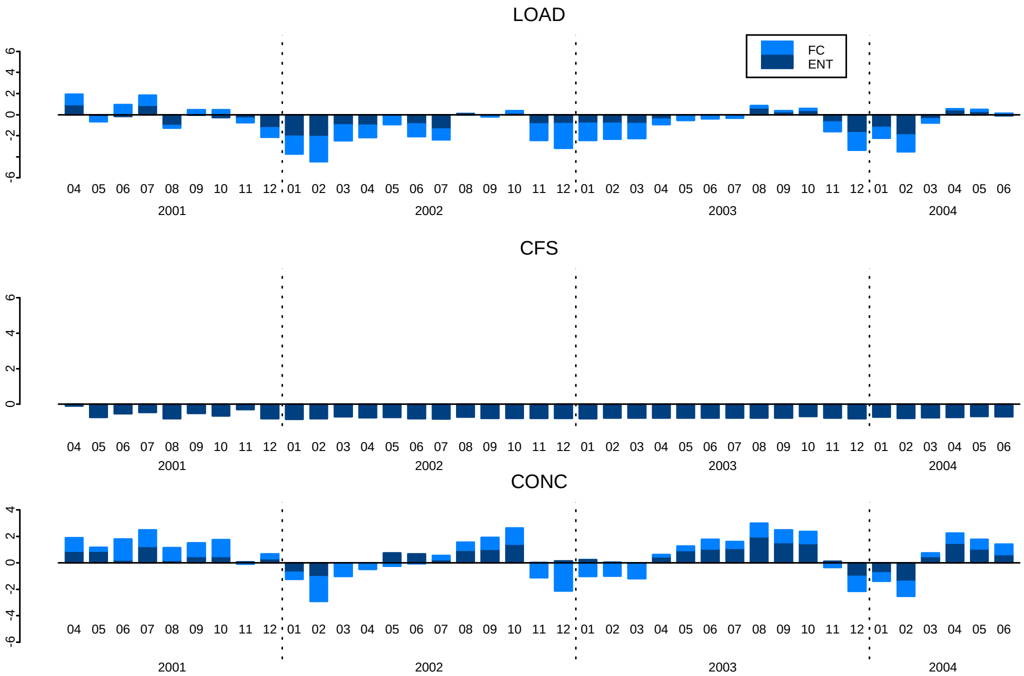


Figure B-7 (continued).

35. J07P01



36. J07P02

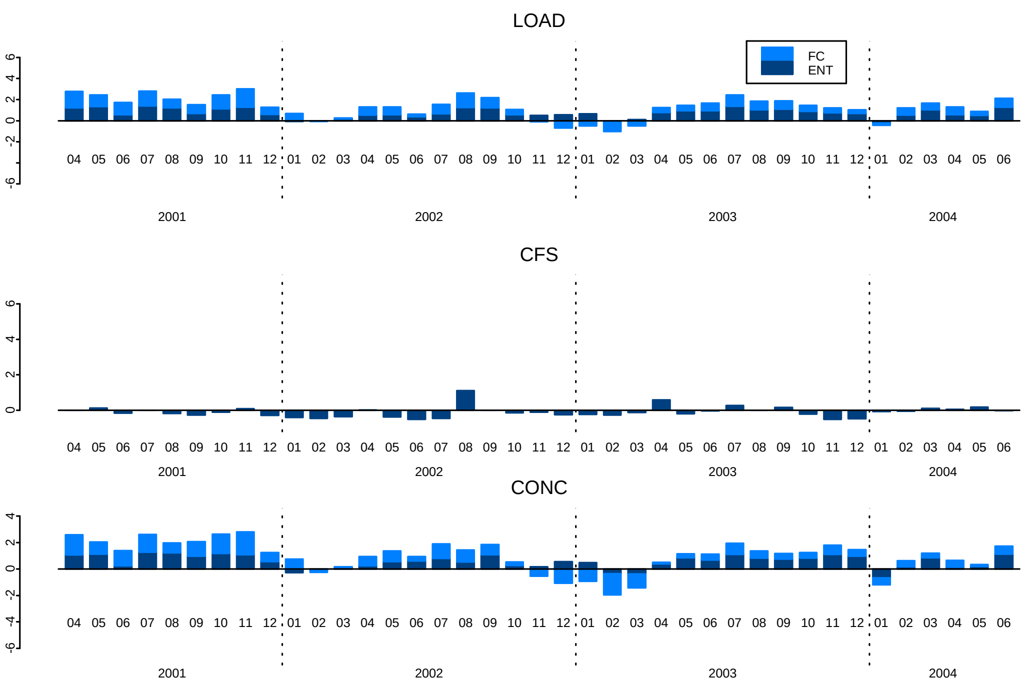


Figure B-8. Linear correlation between impact (difference between downstream and upstream concentrations) and load for Enterococcus at each pipe.

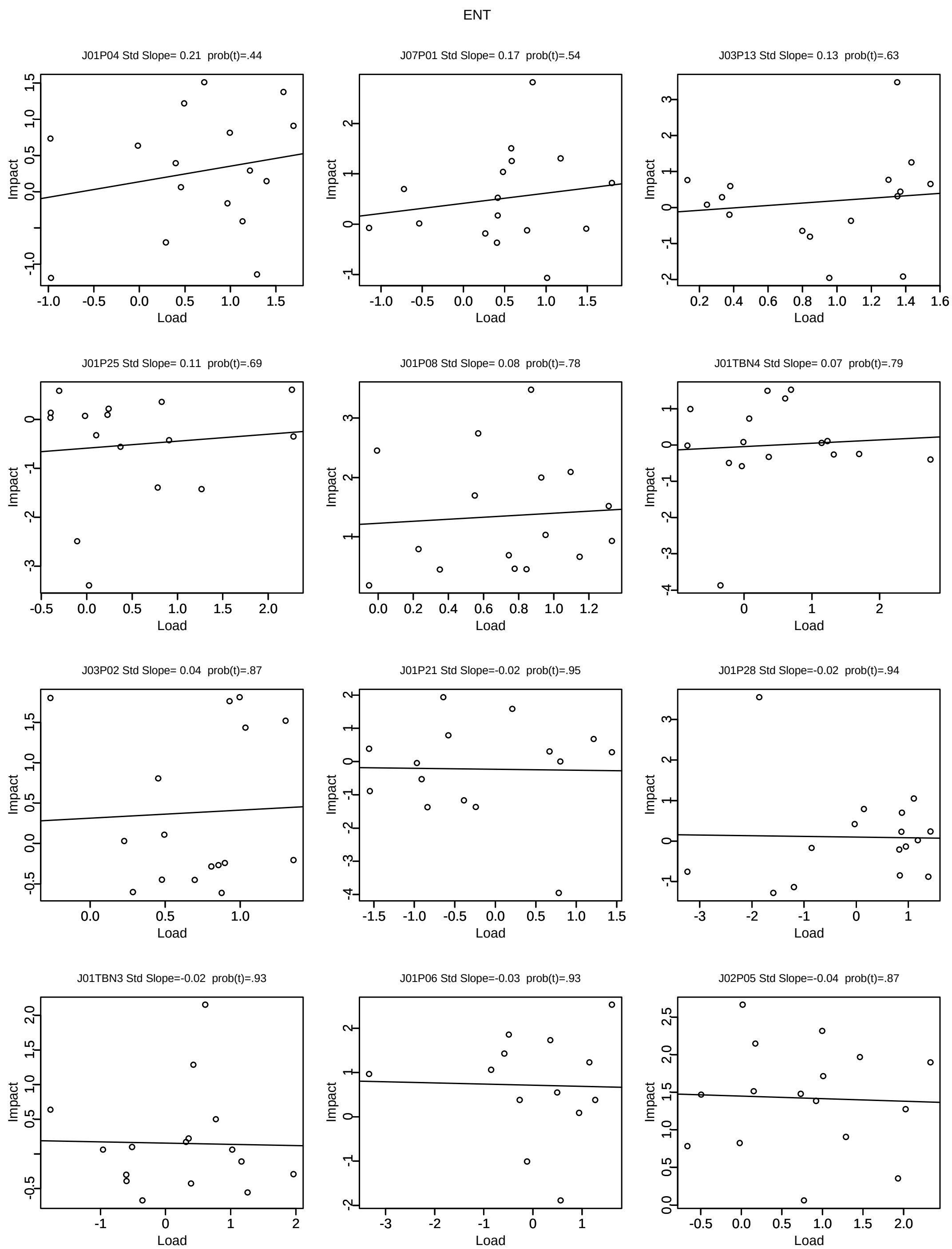


Figure B-8 (continued). Linear correlation between impact (difference between downstream and upstream concentrations) and load for Enterococcus at each pipe.

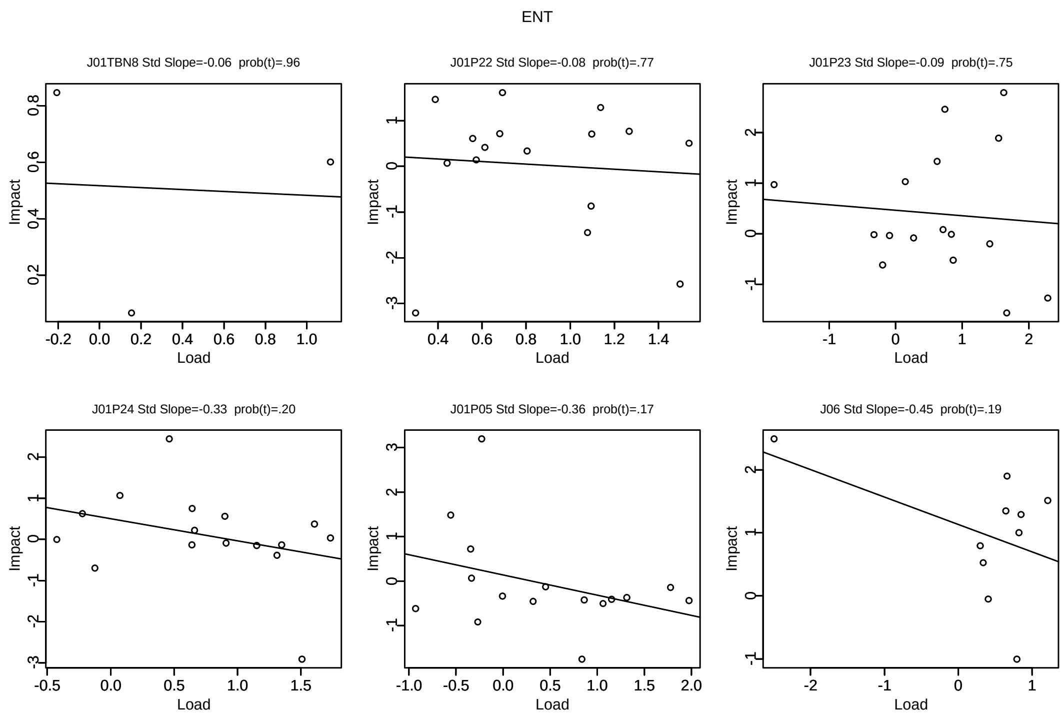


Figure B-9. Linear correlation between impact (difference between downstream and upstream concentrations) and load for fecal coliform at each pipe.

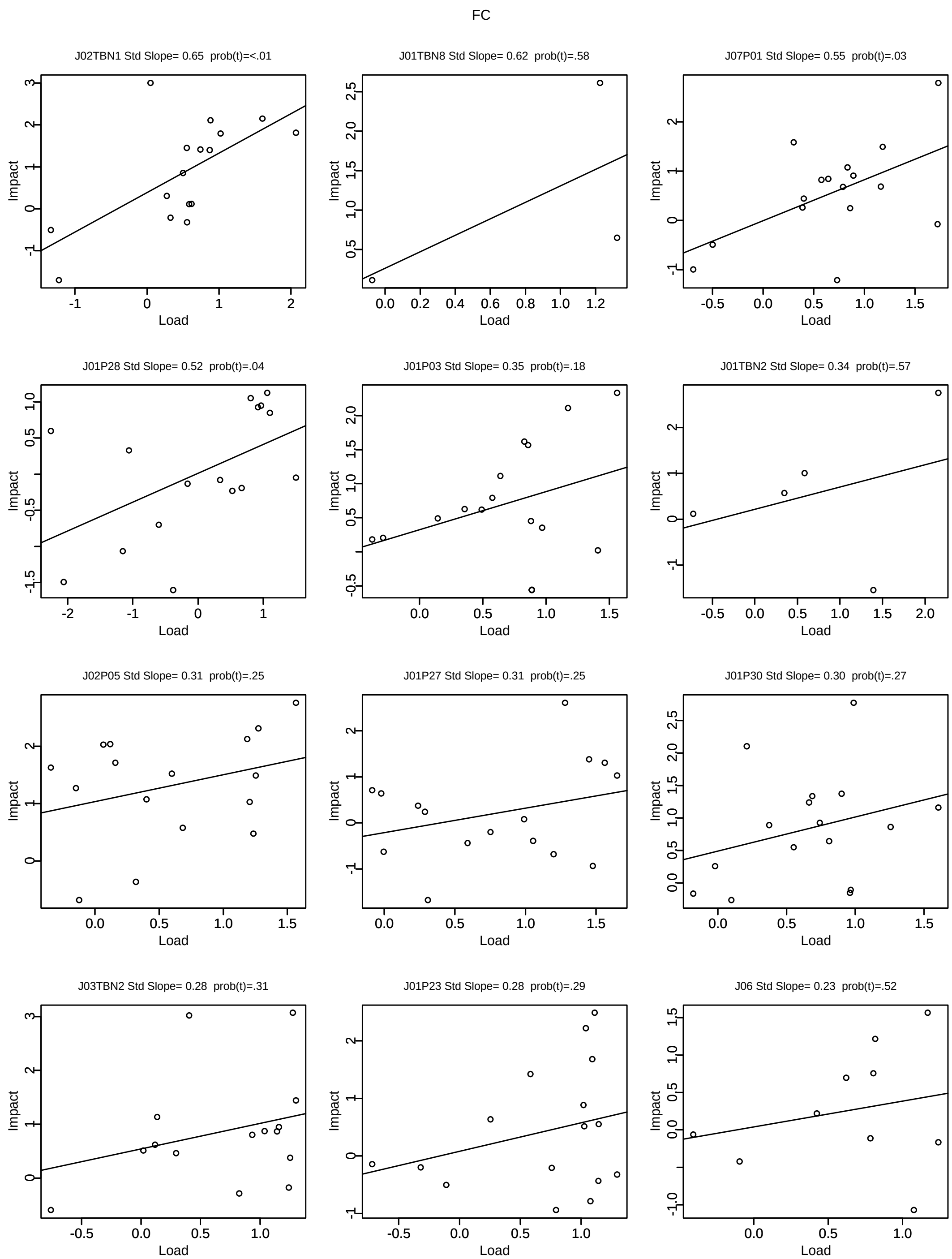


Figure B-9 (continued). Linear correlation between impact (difference between downstream and upstream concentrations) and load for fecal coliform at each pipe.

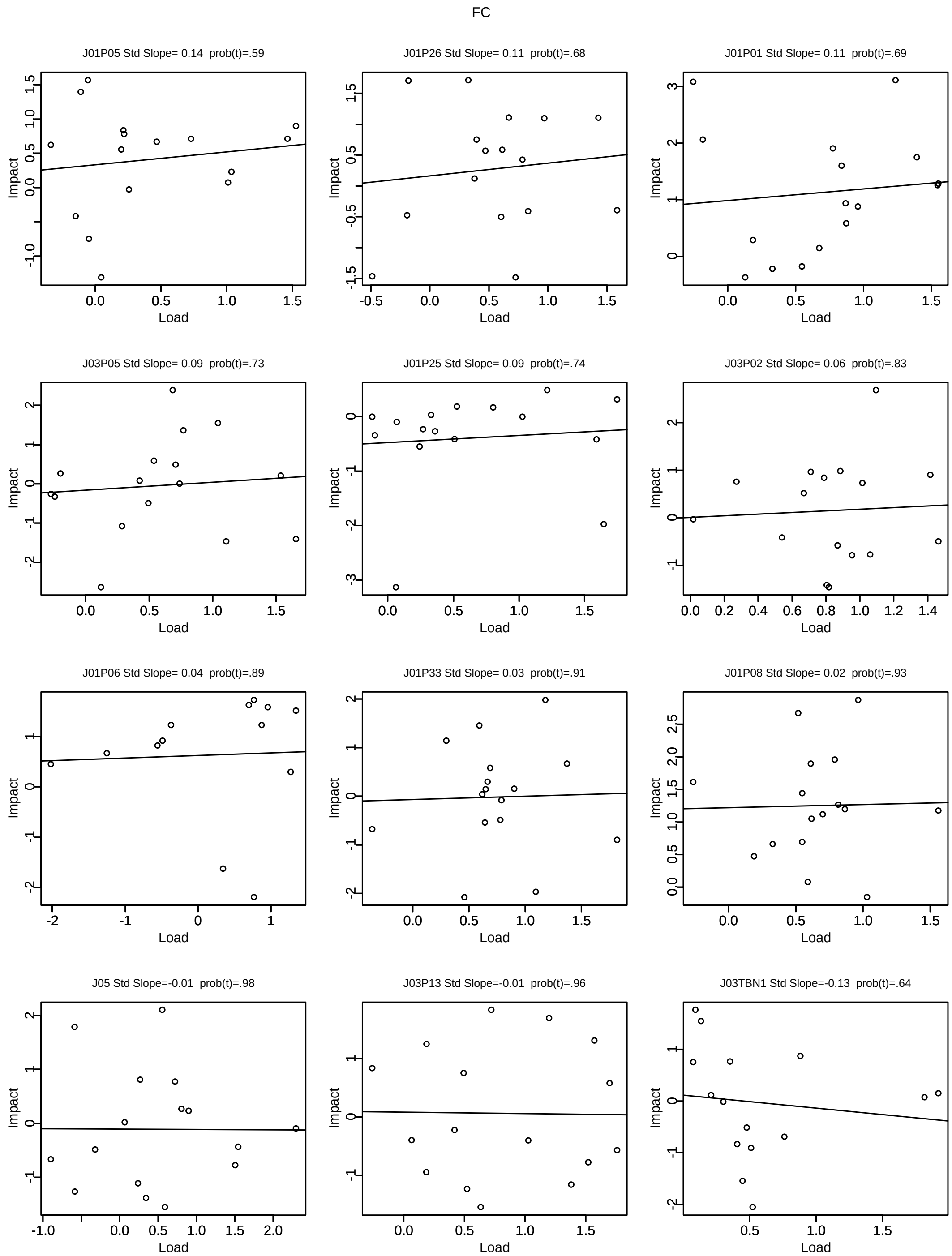


Figure B-9 (continued). Linear correlation between impact (difference between downstream and upstream concentrations) and load for fecal coliform at each pipe.

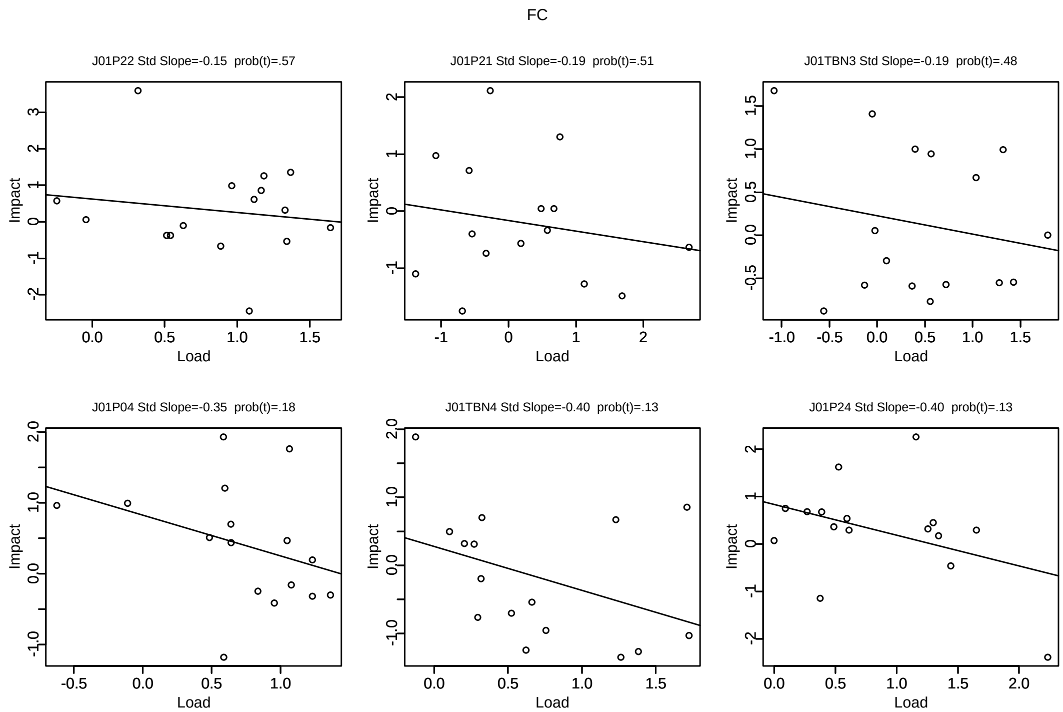


EXHIBIT 2

STRATEGY TABLES