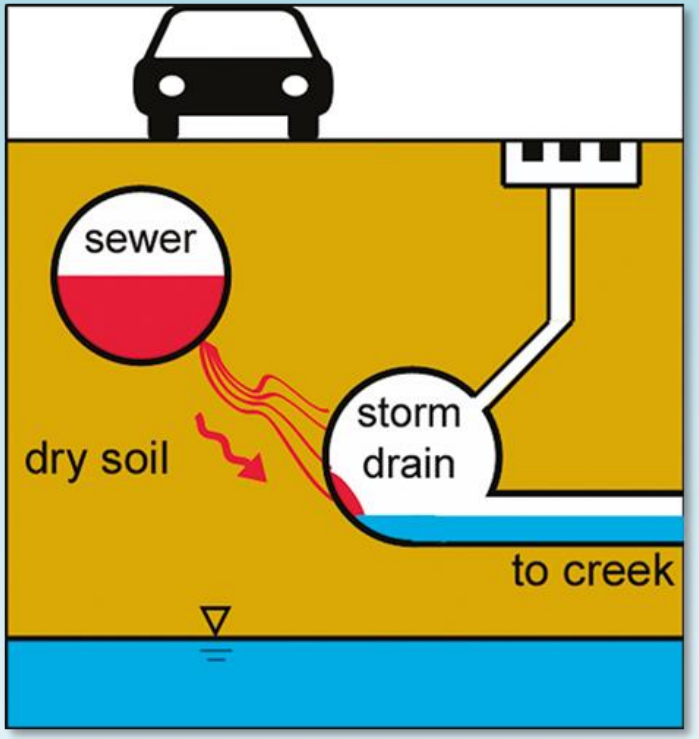
Is an Exfiltration Enforcement Action in Your Future?

San Diego Region

"Exfiltration" Investigative Order



(Sercu et al. 2011, ES&T)

BACWA Collection Systems Committee
January 30, 2020

Steve Jepsen
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What will be covered

1. A brief sewer related water quality history
2. What is the problem?
3. The Sewer “Exfiltration” Investigative Order
4. Exfiltration theories and approaches

A History of Water Quality

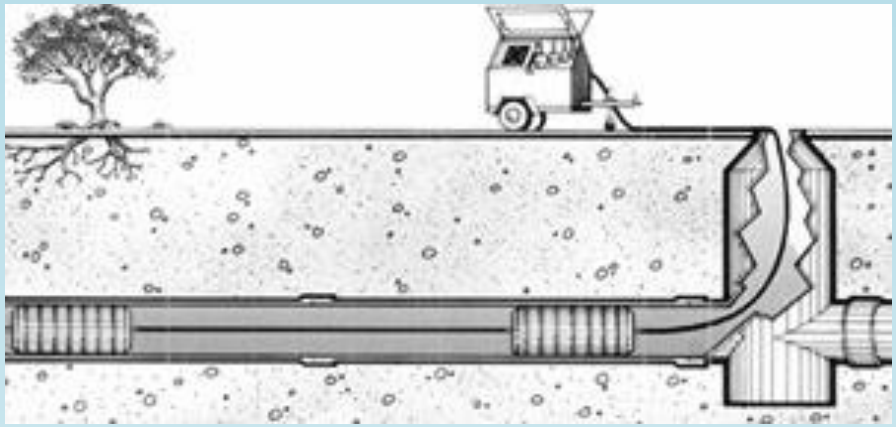
1. Roman Empire – 800 BC mains, 100 AD laterals
2. Industrial Revolution – 1800s
3. Porter-Cologne Act - 1969
4. Clean Water Act – 1972
5. CMOM - 1998
6. WDR – 2006 (2020?)
7. MS4 – 2013 (latest version)

What's the Problem?

* Water Quality from Urban Runoff continues to be an issue
* There are little or no direct funding sources for stormwater quality programs
* Senate Bill 231 – Hertzberg attempts to remedy this by including storm drain in the definition of sewer

Are Sewers a Bacteria Source? **No**

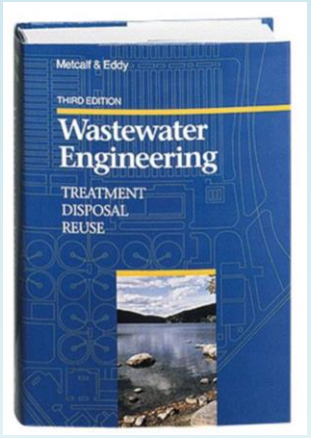
UC Irvine, OCSD, Brown and Caldwell Study 2005 –
Quantifying Sub-surface discharges from Individual Sewer Defects



Metcalf & Eddy Water Treatment Book has a chapter dedicated to how natural treatment systems, in the soil, effectively treat bacteria and viruses

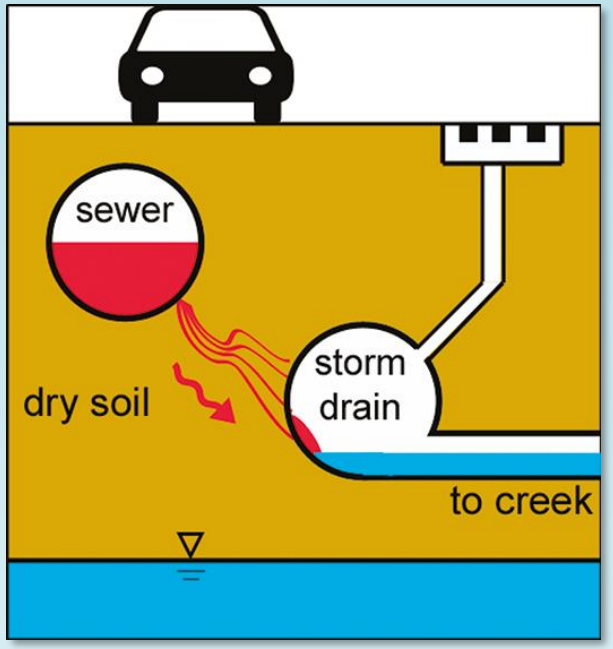
TABLE 14-7
Treatment performance of onsite system components and intermittent or recircu

Parameter	Raw waste (1)	Septic tank effluent (2)	1.0 ft below bottom of leachfield trench (3)	3.0 ft below bottom of leachfield trench (4)
BOD_5, mg/L	210–530	140–200	0	0
SS, mg/L	237–600	50–90	0	0
Nitrogen, mg/L				
Total	35–80	25–60	—	—
NH_4^+	7–40	20–60	20[b]	—
NO_3^-	<1	<1	40[b]	40[b]
Total phosphorus, mg/L	10–27	10–30	10[b]	1[b]
Fecal coliforms, MPN/100 mL	10^6–10^{10}	10^3–10^6	^{20}–10^2	0
Viruses, PFU/mL[c]	Unknown	10^5–10^7	^{20}–10^3	0



Are Sewers a Bacteria Source? **Yes**

* City of Santa Barbara Studies
  - Bacteria found in storm drains
  - Dogs used to identify sources
  - Human specific HF 183
  - Sewers shown to be a source
  - Dye tests confirm sewer exfiltration into storm drain occurring



(Sercu et al. 2011, ES&T)

San Diego Regional Investigative Order

Investigative Order No. R9-2019-0014 (June 12, 2019):

An Investigative Order Requiring the Submittal of Technical and Monitoring Reports to Identify and Quantify the Sources and Transport Pathways of Human Fecal Material to the Lower San Diego River Watershed.

- The order directs agencies in the San Diego River Watershed to identify and **quantify** the sources and pathways of human fecal material discharges to the San Diego River and its tributaries.

Here is the Proof?

The order is in response to a Surfer Health Study prepared by SCCWRP and other studies that have identified human fecal matter in the San Diego Watershed

SCCWRP – Surfer Health Study

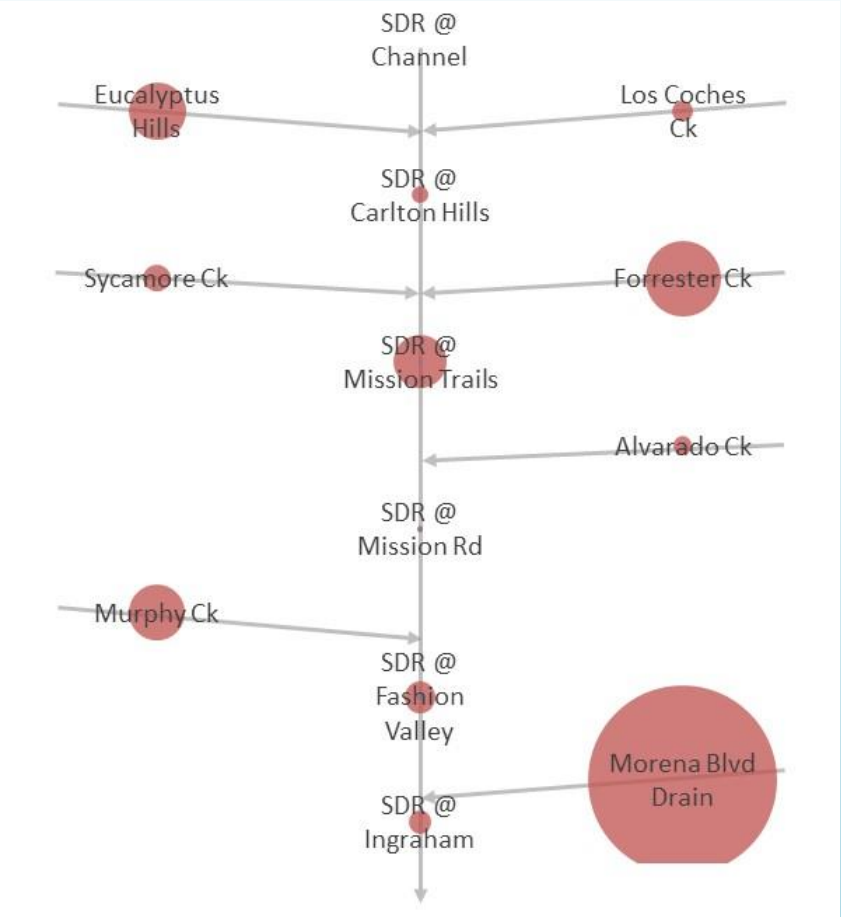
* In the winters of 2013/2014 and 2014/2015, a Surfer Health Study (SHS) was conducted by the California Coastal Water Research Project (SCCWRP), at Ocean Beach and Tourmaline Beach.

* The study measured illness rates of surfers after ocean exposure.

* Results indicated an increased rate of GI illness following ocean exposure compared with not entering the water (25 illnesses/1000 swimmers, vs. 18 illnesses/1000 swimmers). This illness rate increased even further following wet weather (up to 30 illnesses/1000 swimmers).

* USEPA criteria for recreational waters is 32-36 illnesses/1000 swimmers.

Concentrations of Human Marker (HF183) In San Diego River



Storm Date: 1/31-2/1/2016

The Exfiltration Order Problems

* Justification for the Investigative order is the 5 illness increase out of 1000 during a wet weather event
* During wet weather, higher FIBs doesn't make sense for exfiltration
* Lack of nexus between the entities named in the order and their relative contribution to the problem
* SCCWRP cost benefit analysis does not support the approach taken by the Order
* Water Code sections 13267(b) and 13255(c) - burden of compliance must bear a reasonable relationship to the need and benefits of the order

The Exfiltration Order

Footnote in the Order:

12 Exfiltration refers to the leakage of sewage wastewater through minute cracks, gaps or breaks in sanitary sewer collection system infrastructure or private laterals to the surrounding environment. or through the material making up the system itself (e.g. vitrified clay pipe (VCP). For regulatory purposes any sewage exfiltration release from a public sanitary sewer system is defined as a sanitary sewer overflow (SSO) and any sewage exfiltration release from a private lateral is defined as a private lateral sewage discharge (PLSD). Exfiltration may be related to construction practices and/or materials, infrastructure deterioration, inadequate preventive maintenance programs, or insufficient planned system rehabilitation or replacement programs which have resulted in deteriorated pipes, manholes, and pump stations that allow sewage containing high levels of suspended solids, pathogenic organisms, toxic pollutants, nutrients, oil, and grease to exit the systems and contaminate adjacent ground and surface waters, and/or enter the storm drain.

Repeated in the Order:

a. *Exfiltration* - The (agency name here) has not reported to the San Diego Water Board any estimation regarding the exfiltration of wastewater from the sanitary sewer collection system to the Lower San Diego River Watershed.

The Exfiltration Order Requires

Requires agencies in the watershed to:

* Identify and quantify relative contributions of suspected sources of human fecal material in wet weather discharges to the San Diego River
* Determine the transport pathways of such discharges
* Determine how this information will be used by each Discharger to assess the effectiveness of current management measures in preventing discharges of human fecal matter into the San Diego River, its tributaries, and the downstream beach coastal waters

The Exfiltration Order Response

* CASA and SCAP prepared a joint comment letter with assistance from Downey Brand
* Assisted other stakeholders with their comment letters
* Ongoing outreach to SCCWRP to offer assistance with collection system understanding
* SCCWRP prepared a Workplan: **Quantifying Sources of Human Fecal Contamination Loading to the San Diego River – December 6, 2019** (currently being reviewed by San Diego Regional Board)
* SCCWRP is working on a prototype exfiltration measurement device funded by the County of San Diego as a part of a NOV settlement

SCAP Workshop

1. **Types of sewer pipe, construction methods and bedding materials**
   a) Collection system basics Pipe materials, joint types and potential for leakage
   b) Pipe bedding materials

2. **Soil types and how exfiltrated sewage would migrate in the soil types**
   a. Sand
   b. Clay
   c. Sedimentary
   d. Rock

3. **Microbial treatment that occurs in soil and septic systems**

4. **Types of human fecal matter indicators**
   a. Indicators used to date
   b. HF 183
   c. Microbial Communities

Half Time!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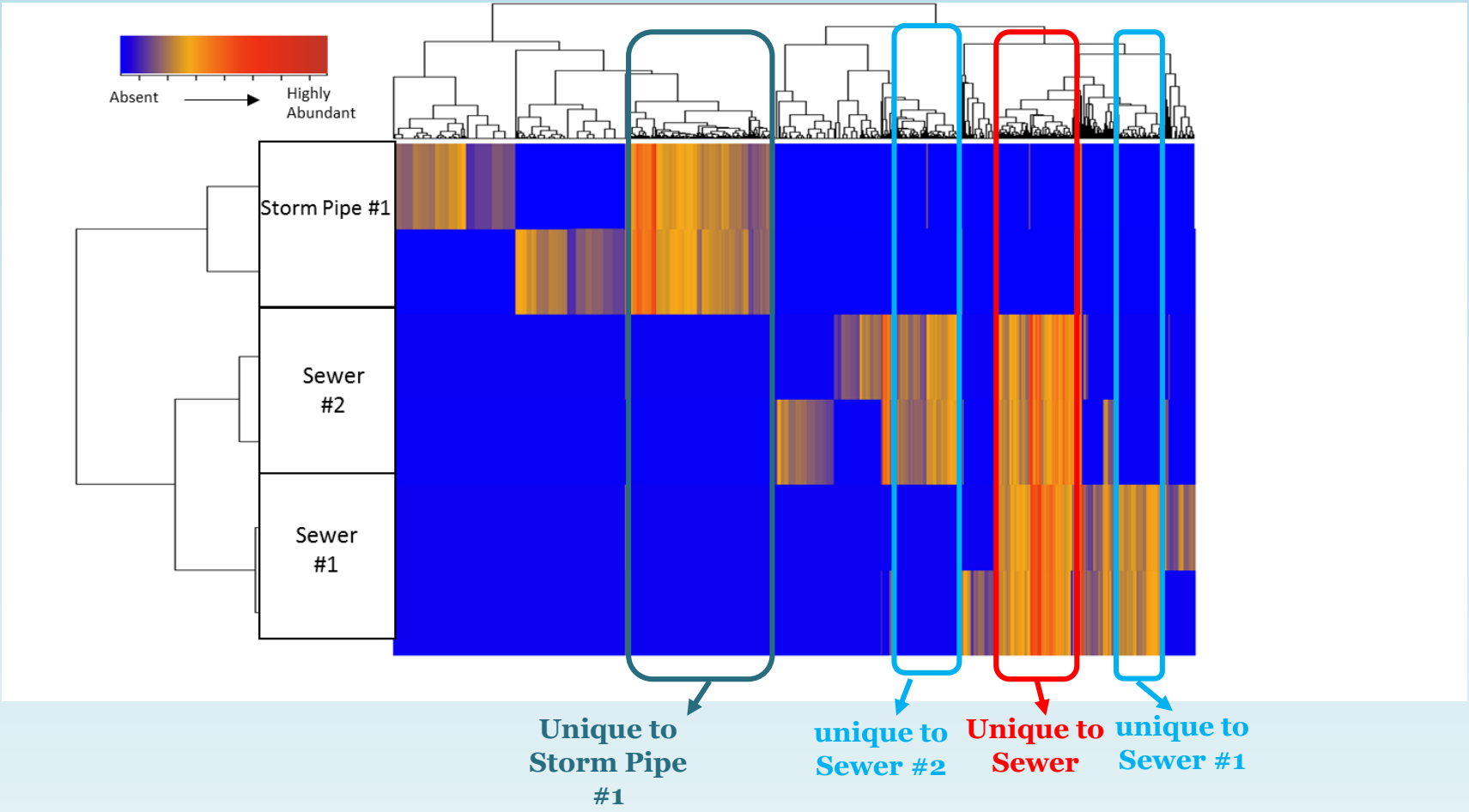
SCCWRP Workplan Tasks

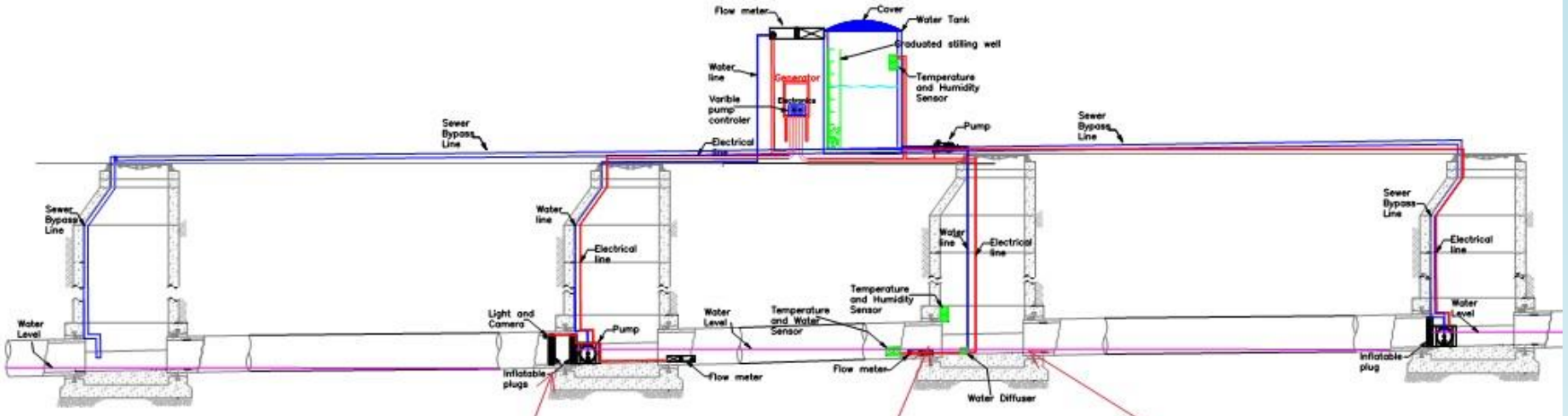
1. **Steering Committee and Technical Advisory Committee**
2. **GIS Foundation**
3. Human Fecal Contamination from **Exfiltration of Publicly Owned Collection Systems**
    - **Microbial Community Profiling**
4. Human Fecal Contamination from **Exfiltration of Private Laterals**
5. Human Fecal Contamination from **Homeless Encampments**
6. Human Fecal Contamination from **Septic Systems**
7. Human Fecal Contamination from **Dry Weather Illicit Connections/Illicit Discharge**
8. **Frequency and Magnitude of Sanitary Sewer Overflows**
9. **Reporting and Data Management**

Microbial Community Profiling



Exfiltration Measurement Device

Need to review pipe test segments for laterals & slope of pipe.
Volume of water required for test is a concern, variables include size, slope, length.
Test segment should not have laterals.

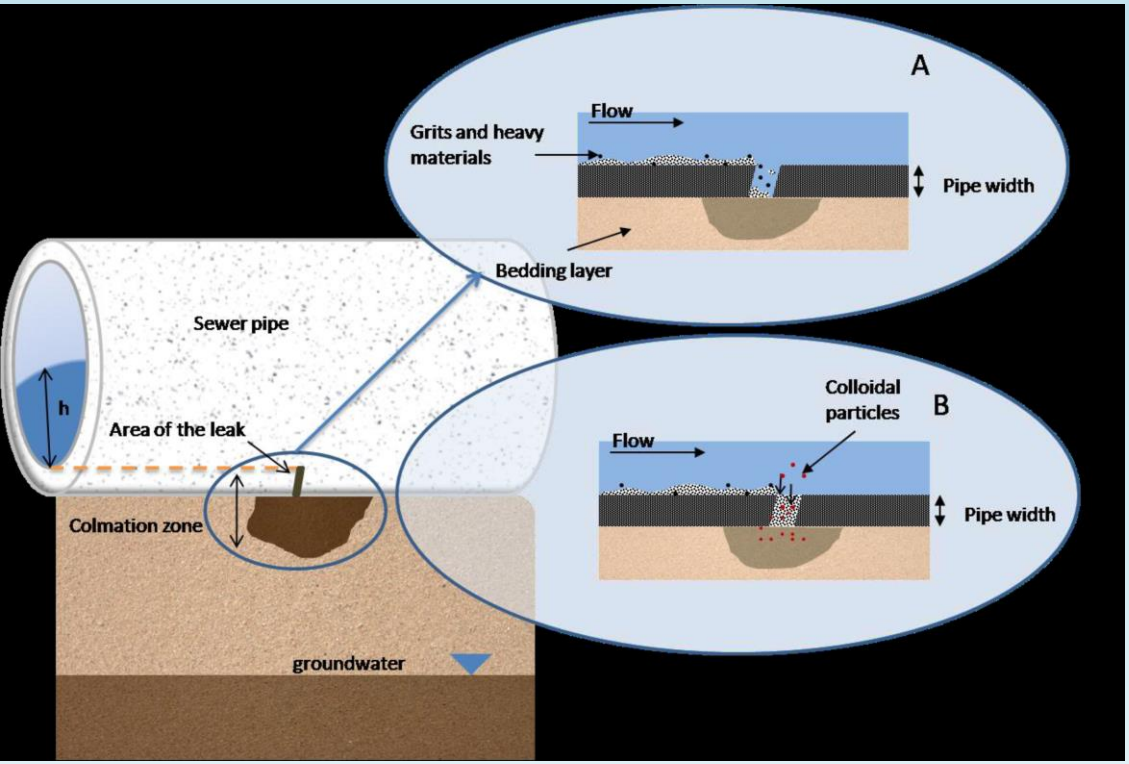


Mechanical plug

Weir/diffusing device to release inflow at controlled rate

Additional plug

Colmation Layer

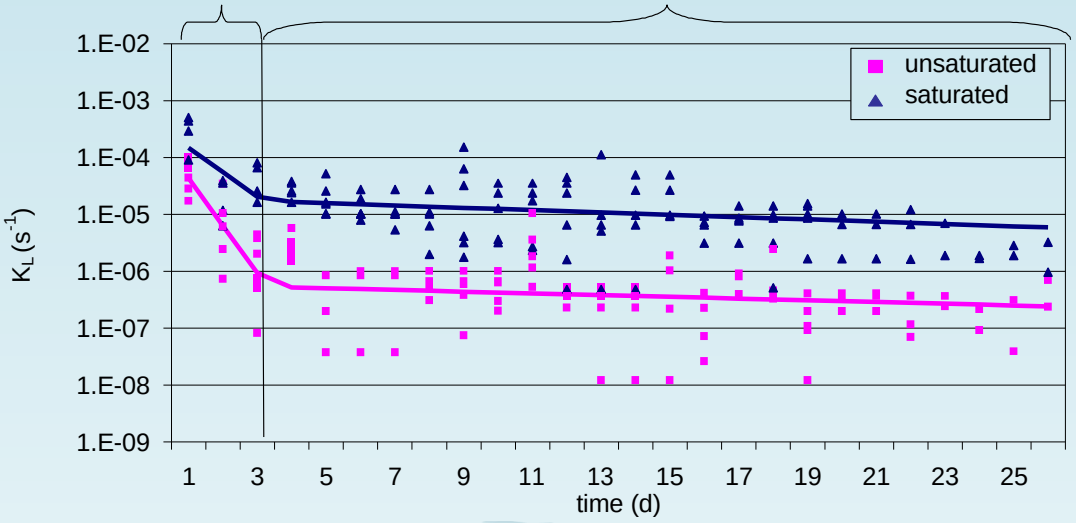


- Colmation Layer (i.e., clogging layer)
- Accumulation of suspended solids and biomass
  - 1 to 5 cm thick
  - Reduces K and porosity
  - Exfiltration rate decreases
  - Leakage factor defined as
  - $K_L = K_c/Z_b$
    - K_c = conductivity of colmation layer
    - Z_b = thickness of colmation layer

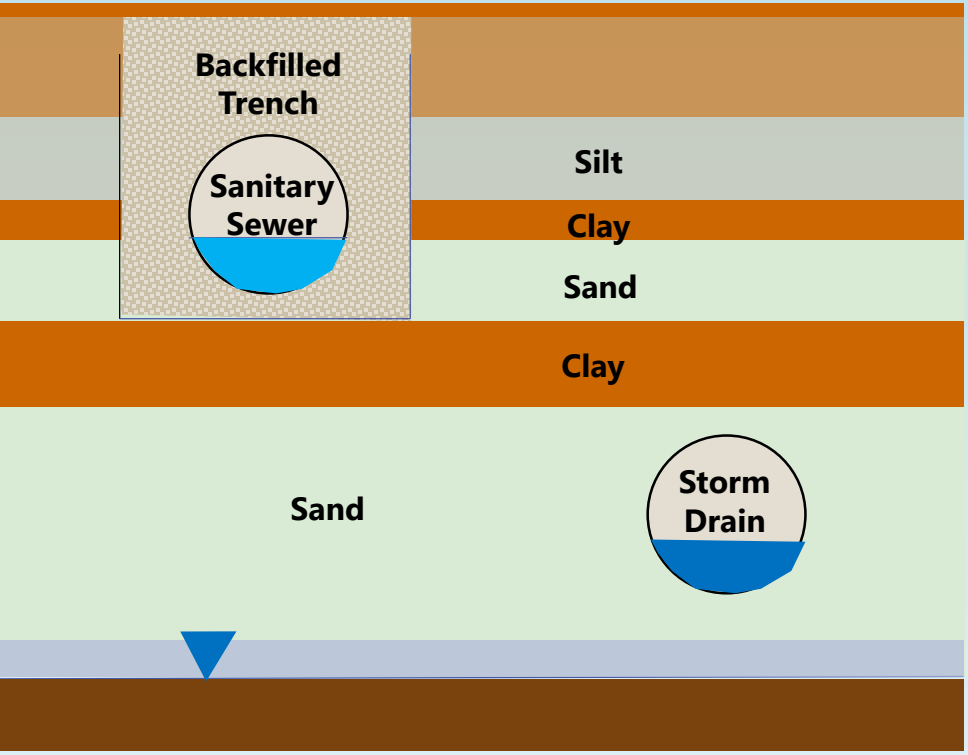
Colmation Layer

Exfiltration and formation of colmation layer

- **Study related K_L to capillary pressure and colmation layer**
- **Initial leak**
  - **Capillary pressure induces higher gradient and leakage rate**
  - **As colmation layer develops, decrease in K_L**
    - **1 to 2 orders magnitude in 3 days**



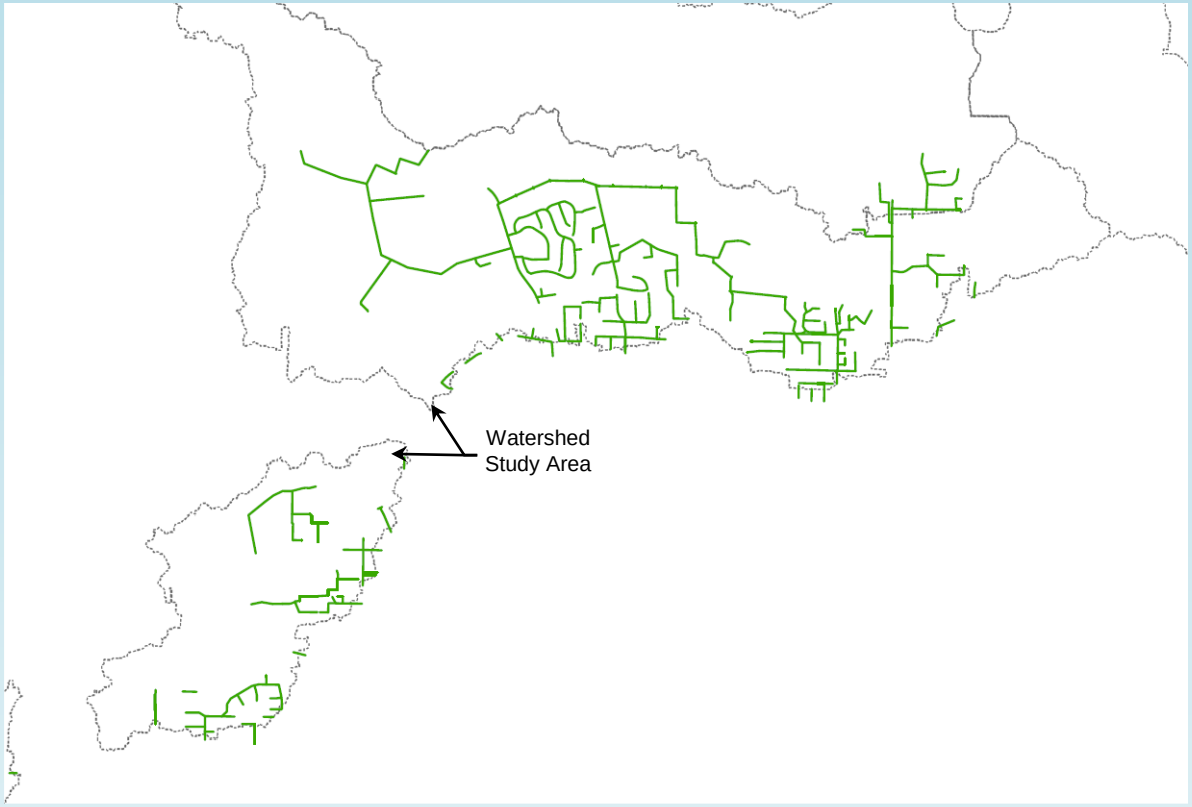
Infiltration Scenarios



- What about infiltration to storm drain?
- Exfiltration from sewer must travel to storm drain
  - Driven by gradient (consistent?)
  - Preferential flow paths
  - Entry point at storm drain
    - Overcome hydrostatic and pore pressures at entry point

Desktop GIS Approach

- **507 pipes**
- **93,000 ft (18 miles)**



Desktop GIS Investigation

- Contributing Factors
  - Pipe Crossings
  - Vertical Separation
  - Sewer Pipe Condition/Age
  - Storm Drain Material/Age
  - Soil Type

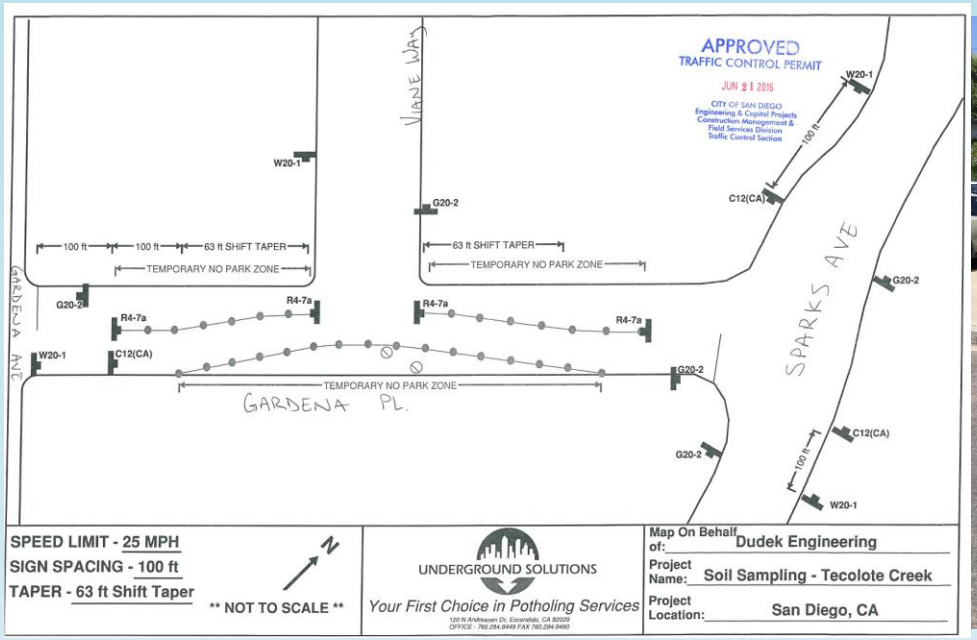
Desktop GIS Priority Ratings

- Scoring matrix-based
  - 19 of 507 (4%) sewer pipe segments above storm drain
  - 12 of 19 (2%) also cross storm drain
  - 6 of 12 (1%) also have defect
  - 2 of 6 (0.3%) also in sandy soil → highest rating

Site ID	Spatial Relationship				Ground Water					Sewer Pipe Priority Rating					Storm Drain Pipe Priority Rating					Soil Priority Rating			FINAL	Rank
	Vert. Dist.	Horz. Dist	Avg	Total	In Valley?	Swr Depth	Vert. Dist.	Avg	Total	Flow Depth	Defect	EMA	Avg	Total	SD Mat'l	Size	Age	Avg	Total	Perm. (in/hr)	Avg	Total	SCORE	
116	5	1	3.0	**9.0**	3	3	5	3.7	**3.7**	1	0	0	0.3	**1.7**	2	3	2	2.3	**2.3**	3	3.0	**6.0**	22.7	8
176	5	3	4.0	**12.0**	3	2	5	3.3	**3.3**	2	2	0	1.3	**6.7**	2	5	2	3.0	**3.0**	1	1.0	**2.0**	27.0	3
223	5	3	4.0	**12.0**	3	1	5	3.0	**3.0**	1	0	0	0.3	**1.7**	2	5	2	3.0	**3.0**	1	1.0	**2.0**	21.7	10
225	5	2	3.5	**10.5**	3	2	5	3.3	**3.3**	2	0	0	0.7	**3.3**	2	5	2	3.0	**3.0**	1	1.0	**2.0**	22.2	9
257	4	3	3.5	**10.5**	3	1	5	3.0	**3.0**	1	2	0	1.0	**5.0**	3	3	2	2.7	**2.7**	1	1.0	**2.0**	23.2	7
277	5	3	4.0	**12.0**	3	1	5	3.0	**3.0**	1	2	0	1.0	**5.0**	2	3	2	2.3	**2.3**	1	1.0	**2.0**	24.3	5
302	5	3	4.0	**12.0**	1	1	5	2.3	**2.3**	0	3	0	1.0	**5.0**	2	2	2	2.0	**2.0**	1	1.0	**2.0**	23.3	6
333	5	3	4.0	**12.0**	3	2	5	3.3	**3.3**	2	4	0	2.0	**10.0**	3	4	3	3.3	**3.3**	3	3.0	**6.0**	34.7	1
368	5	1	3.0	**9.0**	3	2	5	3.3	**3.3**	1	4	0	1.7	**8.3**	4	1	3	2.7	**2.7**	1	1.0	**2.0**	25.3	4
590	4	3	3.5	**10.5**	1	1	5	2.3	**2.3**	1	3	1	1.7	**8.3**	3	2	2	2.3	**2.3**	3	3.0	**6.0**	29.5	2

Field-based Approach

Field Based Approach Preparation



Traffic Control

WPCP

Field-based Approach

Air Knife Technology

Bore Hole (to pipe bedding)

Field-based Approach

Direct Push Rig

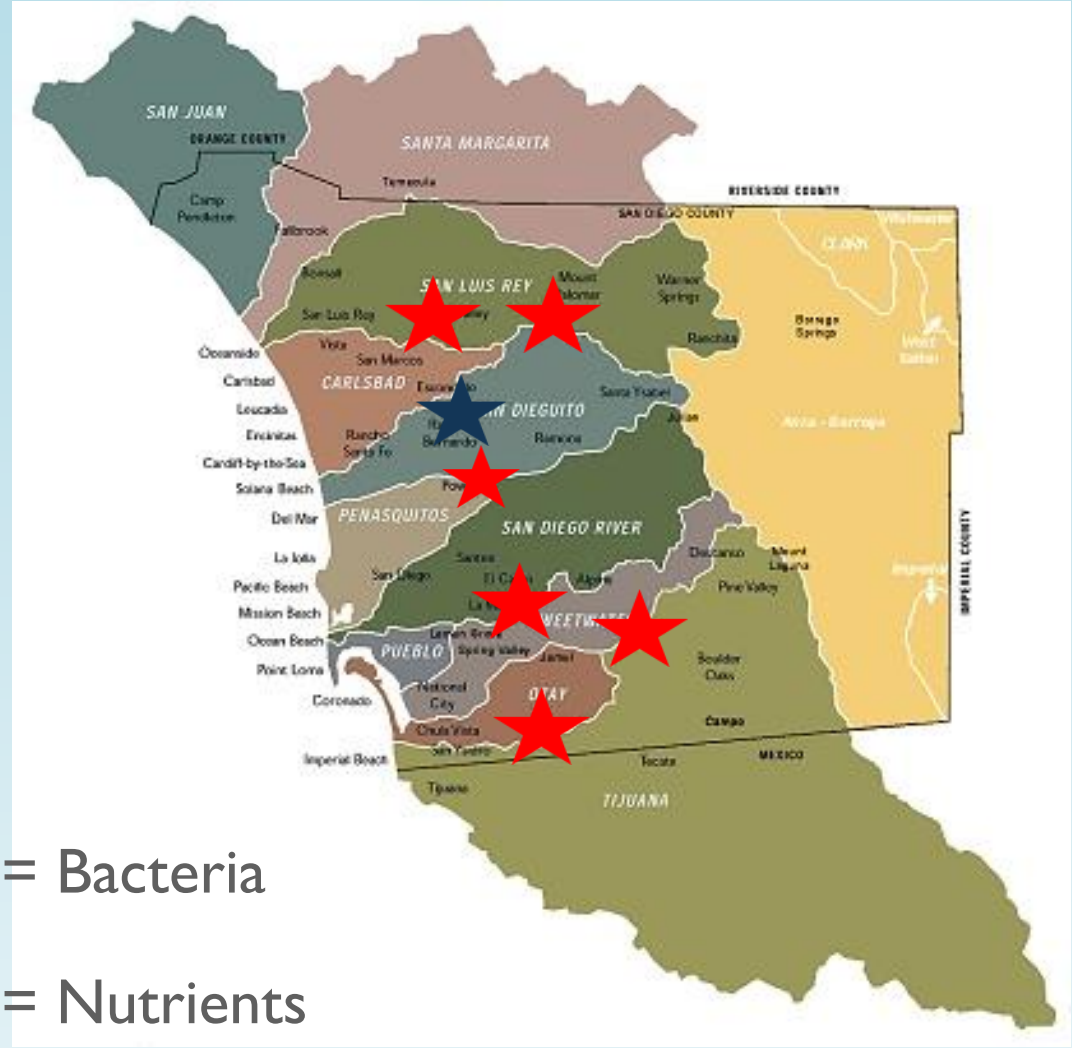
Processing

Sample Collection

Results

- No evidence of moisture in soil
- Constituent analysis results generally negative
  - Indicator detected in one sample
  - Emerging constituents not detected
- Downstream MS4 FIB sample very high
- Challenging logistics

But There's More



★ Priority = Bacteria

★ Priority = Nutrients

And More

- **WQIP Strategies**
  - **Page 557 of 1,368**

ID	Strategy	Implementation Approach (Frequency of Inspections, B.3.b.(1)(a)(iv)) (Funds/Resources, B.3.b.(1)(b)(iv), B.3.b.(3)(a)(iii)) (Triggers, B.3.b.(1)(b)(v)) (Inventory BMPs, B.3.b.(1)(a)(ii))	Jurisdictional (B.3.b.(1)(a)) or Optional (B.3.b.(1)(b))	Implementation or Construction Year (B.3.b.(3)(a)(i); B.3.b.(3)(a)(ii))	Implementation Schedule (B.3.b.(3)(a)(iv))	Pollutants Addressed							Source (B.3.b(1)(a)(i))	Responsible City Department and Other Collaborating Departments or Agencies (B.3.b.(1)(c))
						Bacteria	Nutrients	Metals	Trash	Sediment	Flow	Habitat/ Wildlife		
MS4 Infrastructure														
DAM-12	Implementation of operation and maintenance activities (inspection and cleaning) for MS4 and related structures (catch basins, storm drain inlets, detention basins, etc.).	Refer to JRMP Section 7. The MS4 inventory is inspected by Public Works staff at least once per year. Based on the findings of the inspections, the City performs required cleanings and proper disposal of collected material. Removal of the collected trash and debris prevents the materials from being pushed through the system and into the receiving waters from runoff	Jurisdictional	FY16	Continuous-Ongoing	X		X	X	X			MS4	Public Works and Clean Water Program
DM-12.1	Perform catch basin cleaning	Inspect and clean catch basins annually	Jurisdictional	FY16	Continuous-Ongoing	X	X	X		X			MS4	Public Works and Clean Water Program
DM-12.2	Repair and replace MS4 components as needed to provide source control from MS4 infrastructure.	In order to limit inflow of pollutants and reduce pollutant loads, the City will take proactive measures to improve, repair, and replace MS4 components	Jurisdictional	FY16	Continuous-Ongoing	X	X	X		X			MS4	Public Works and Clean Water Program
DM-13	Implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers and identify sewer leaks and areas for sewer pipe replacement.	Refer to JRMP Section 4.7 and the City's Sanitary Sewer Management Plan. The conducts a variety of activities to effectively operate, maintain, repair and replace sewer mains, manholes, and pump stations.	Jurisdictional	FY15	Continuous - Ongoing	X							MS4	Public Works and Clean Water Program

"Implement controls to prevent infiltration of sewage into the MS4 from leaking sanitary sewers and identify sewer leaks and areas for sewer pipe replacement."

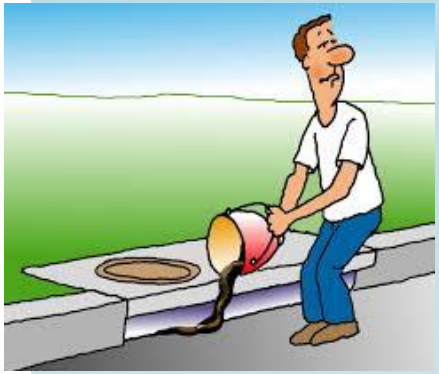
And Still More

- LA River eWMP Strategies
  - Page 92 of 694

#	WCM Category/ID	WCM	BMP effectiveness with respect to WQPs					Agency								
			Category I	Category II	Category III	Sediment reduction	Volume or flow reduction	Downey	Flood Control	Lakewood	Long Beach	Lynwood	Paramount	Pico Rivera	Signal Hill	South Gate
15	MCM-PIP-1	Stormwater resources on City website	◈	◈	◈	◈	◈	✗	✗	✗	✗	✗	--	✗	✗	✗
		Public Agency Activities														
16	MCM-PAA-1	Enhanced BMP requirements for fixed facility/field activities	◈	◈	◈	◈	◈	✗	✗	✗	✗	✗	--	✗	✗	✗
17	MCM-PAA-2	Reprioritization of catch basins and clean-out frequencies	◆	◆	◆	◆	◇	✗	✗	✗	✗	✗	--	✗	✗	✗
18	MCM-PAA-3	Integrated Pest Management Program	◈	◈	◈	◇	◇	✗	✗	✗	✗	✗	--	✗	✗	✗
19	MCM-PAA-4	Enhanced measures to control infiltration from sanitary sewers	◆	◆	◇	◇	◇	✗	✗	✗	✗	✗	--	✗	✗	✗

"Enhanced measures to control infiltration from sanitary sewers"

California City Liable for Contamination Spread by Leaky Sewers



Posted Feb. 6, 2019, 11:04 AM
By Peter Hayes

- 'Defects' in sewers spread contamination
- City splits cleanup costs with dry cleaner

The city of Visalia, Calif., is on the hook for half of all future Superfund cleanup costs for contamination that originated from a dry-cleaning business spread because of the city's poorly maintained sewer system, the Eastern District of California ruled.

While the contamination originated on a commercial laundry facility operated by Mission Linen Supply, the city contributed to the releases of perchloroethylene and other hazardous substances from its sewer system, the court said.

The sewers have numerous "defects," including holes, broken pipes, exposed soil, cracks, sags, separated joints, missing portions of pipe, root intrusion, debris, and blockages, the court said.

The contamination spread to ground water and contaminated drinking water wells, the court said.

In 2010, the California Department of Toxic Substances Control ordered Mission Linen to conduct environmental studies and cooperate in cleanup efforts.

Mission Linen in May 2015 filed a Superfund contribution claim against the city.

The court held a bench trial to allocate liability between the city and Mission Linen. Following the trial, the parties engaged in settlement talks for more than a year, but failed to reach a resolution.

Mission Linen and the city will evenly split all future response costs incurred by Mission related to the PCE plume, the court ruled.

The city is responsible for 100 percent of any repairs to the sewers that may be necessary.

Judge Anthony W. Ishii issued the ruling.

Greben & Associates represented Mission Linen Supply.

Herr Pedersen & Berglund, LLP and Wood Smith Henning & Berman LLP represented the city.

The case is Mission Linen Supply v. City of Visalia, 2019 BL 37490, E.D. Cal., No. 15-CV-0672, 2/5/19

Conclusions

* Bacteria are a frequent constituent of concern in watersheds
* Stormwater quality practitioners and scientists don't always understand collection systems
* Sewer Exfiltration/MS4 Infiltration is a prime suspect based on a lack of understanding of collection systems
* We need to get out in front of this issue and educate the regulators and stormwater quality practitioners

San Diego Investigative Order R9-2019-0014

https://www.waterboards.ca.gov/sandiego/water_issues/programs/san_diego_river_io/index.html

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