ENVIRONMENTAL CONSIDERATIONS DURING TRENCHLESS REHABILITATION, SPRAY APPLIED PIPE LINERS (SAPL)

GeoTree Solutions
Kurt Chirbas , PE (IL) CPESC
Kurt.Chirbas@Henkel.com
(916) 215-3163

PRESENTATION OVERVIEW

- What is the trenchless method called “Spray Applied Pipe Lining” (SAPL) background
- What is a GeoPolymer Mortar for SAPL
- Environmental elements to consider for selecting a trenchless method(s) for a specific project
- Evaluating the environment elements during design, construction, and post construction
- Environmental advantages of SAPL vs other Trenchless methods
- Case studies of SAPL with examples of environmental aspects being addressed within the project

MIGHT THE ENVIRONMENT BE IMPACTED (DUST OR SPILL) FOR THIS SAPL INSTALLATION?

GENERAL STEPS WHEN CONSIDERING WHICH TRENCHLESS METHOD TO CONSIDER:

A) **Evaluate the condition of the Existing conveyance system:**

- When it was built, as-builts, pipe material, dimensions, lengths, etc.
- Conditions by visual and/or CCTV, water intrusion, crown and invert conditions, sediment loading
- Current conveyance system dimensions (ovality, corrosion rate, etc.)
- Operation conditions such as flow characteristics, H2S values, velocity, debris flow, pressure, gravity, lateral connections, etc..
- Access to conveyance system, depth to crown of pipe, groundwater table, other external loads such as traffic, etc.

B) **Determine type of rehabilitation**

- Point repair
- Invert repair
- Crown repair
- Segment repair
- Overall relining
- Partial or Full structural repair

CONTINUATION …. GENERAL STEPS WHEN CONSIDERING WHICH TRENCHLESS METHOD TO CONSIDER:

C) Different trenchless rehabilitation methods

- Cured in Place Pipe (CIPP)
- Slip Lining
- Spray Applied Pipe Lining (SAPL)
- Fiber Reinforced Polymer (FRP)
- Spiral wound

D) Evaluating which methods to consider

- Size, shape and length of pipe
- Structural or lining
- Hydraulic flow capacity
- Bypass
- Access (current and/or potential excavation)
- Environment (air, water, aquatic, treatment plant)
- Disruption of traffic, utilities, public
- Segment/phase installation requirements
- Weather
- Construction time/contingency
- Cost
- Meeting overall Goal of the rehabilitation (longevity, performance, etc.)

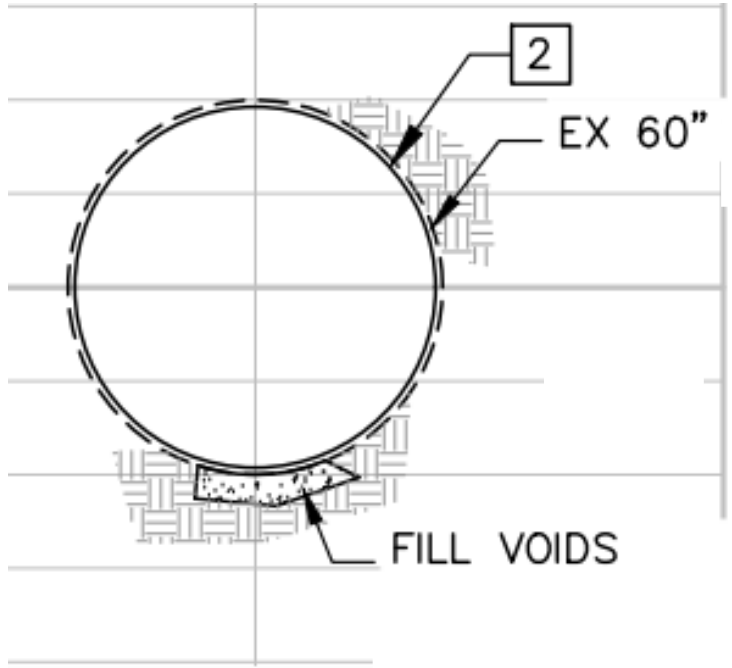
POTENTIALLY DEVELOP A MATRIX EVALUATION TO DETERMINE WHICH TRENCHLESS TECHNOLOGIES TO CONSIDER FOR A PROJECT :

Identify import criteria's for your project to consider which method(s) might be the best option:

Project name and pipe size evaluation matrix Example				
Factor (1 -Worst & 4 Best)	CIPP	Slip Lining	Spiral wound	SAPL
Above Ground Site Preparation/Foot Print	1	3	3	4
Weather contraints	1	2	2	4
Environment Requirements	1	2	3	4
Bypass Pumping Requirements	1	3	3	3
Permit Requirements	1	3	3	3
Construction Duration	1	2	4	3
Maintain Existing Flow Capacity	4	3	2	3
50 YR LifeCycle	4	4	1	4
Cost	3	1	4	4
Overall Scores	15	19	20	24

You might consider specifying 2 Trenchless methods based on evaluation. Bids become more competitive.

SAPL: A NEW PIPE WITHIN AN OLD PIPE/TUNNEL FOR RELINING OR STRUCTURAL REHABILITATING



Structural rehabilitation min thickness

30" ≤ X < 54"	T_{min} = 1.00" x $(1500/FS)^{0.5}$	and Tmin can not go below 1.00" no matter what FS is
54" ≤ X ≤ 84"	T_{min} = 1.50" x $(1500/FS)^{0.5}$	and Tmin can not go below 1.50" no matter what FS is
84" < X ≤ 102"	T_{min} = 1.75" x $(1500/FS)^{0.5}$	and Tmin can not go below 1.75" no matter what FS is
102"< X ≤ 120"	T_{min} = 2.00" x $(1500/FS)^{0.5}$	and Tmin can not go below 2.00" no matter what FS is

(FS) Flexural Strength by ASTM C78

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SPRAYED APPLIED PIPE LINER (SAPL)

Just for clarification:

There are two separate categories for SAPL:

- Geopolymer/Cement Mortars - for Structural rehabilitation like GeoSpray (Stand alone - typically without other reinforcement requirements)
- Polymer Lining (epoxy, polyurethane or polyurea) - for lining (protection)

When referring specifically to mortars it can also be called or referred to as:

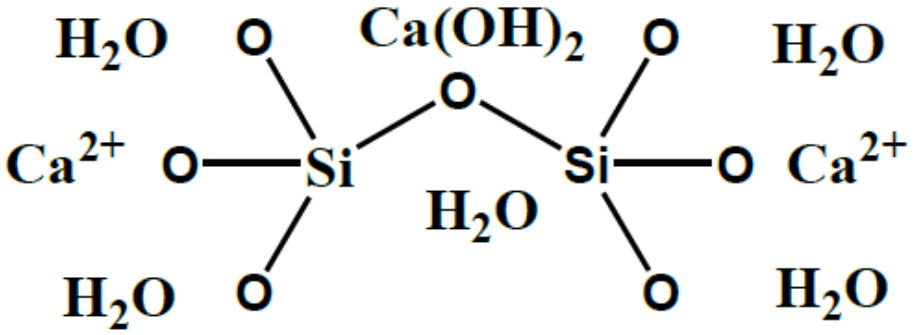
- Centrifugally Cast Concrete Pipe (CCCP)
- Centrifugally Cast Concrete Pipe Liner (CCCPL)
- Spray Applied Liners (SAL)
- Spray in Place Pipe (SIPP)

Cement Mortar Lining (CML) is a term typically used in water pipe:

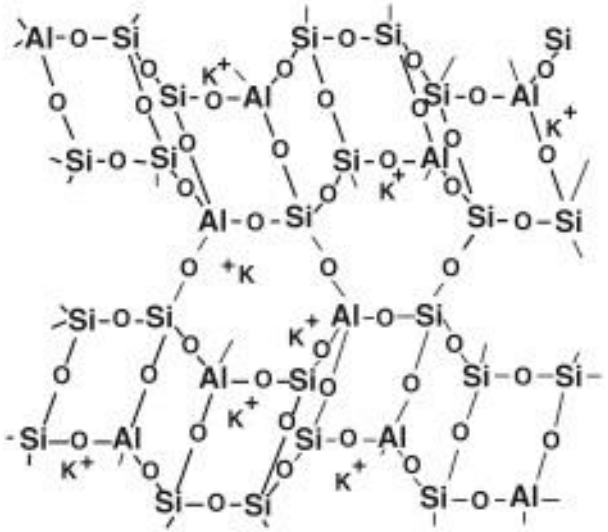
Usually for lining steel water pipe (AWWA M28) for corrosion and water quality, typically not for structural rehabilitation, with an applied liner thickness around ½ inch using OPC.

CML under AWWA 602, also NSF 61 , Taste and Smell certification

CHEMISTRY PRIMER: OPC VS GEOPOLYMERS



Typical Hydrated OPC Structure
$CA(OH)_2$ corrosion issue



Typical Geopolymer Structure
Min. bad actors, stronger bond

Geopolymer mortar should be composed of at minimum 70% Pozzolanic material selected from the list of: SiO_2, MgO, Al_2O_3, Fe_2O_3 and be verified by third party certified X-ray Fluorescence (XRF) testing.

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GEOSPRAY MORTAR ADVANTAGES:

Physical Properties

Test Method	Duration	GeoSpray	Conventional Repair Mortar
Compressive Strength ASTM C-39/C-109	1 Day 28 Days	Min. 2,500 psi / 17 MPa Min. 8,000 psi / 55 MPa	5000 psi / 34 MPa
Flexural Strength ASTM C-78	7 Day 28 Days	750 psi / 5.2 MPa 1500 psi / 10.3 MPa	500 psi / 3.4 MPa
Modulus of Elasticity ASTM C-469	1 Day 28 Days	3,000,000 psi / 20700 MPa 5,800,000 psi / 40000 MPa	3,000,000 psi / 20700 MPa
Bond Strength to Concrete ASTM C-882	1 Day 28 Days	Min 900 psi / 6.2 MPa Min. 2,500 psi / 17 MPa	N/A
Set Time ASTM C-807 Initial Cure Time	Initial Set Final Set	60 - 75 Minutes 90 - 110 Minutes	120 Minutes 300 minutes
Freeze Thaw Durability ASTM C-666	300 Cycles	100% Zero loss	80% to 90% 10% to 20% degradation
Shrinkage ASTM C-1090	28 Days	0.00% @ 65% R. H.	0.35% to 0.50% Shrinkage
Tensile Strength ASTM C-496	28 Days	Min. 800 psi / 5.5 MPa	400 psi / 2.7 MPa
Abrasion Resistance ASTM C-1138	5 Cycles @ 28 Day Maturity	2.7% Loss	4.7% Loss
Rapid Chloride Ion Permeability ASTM C-1202	28 Days	Very Low	N/A

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GEOSPRAY MORTAR ADVANTAGES:

Self Bonding Properties

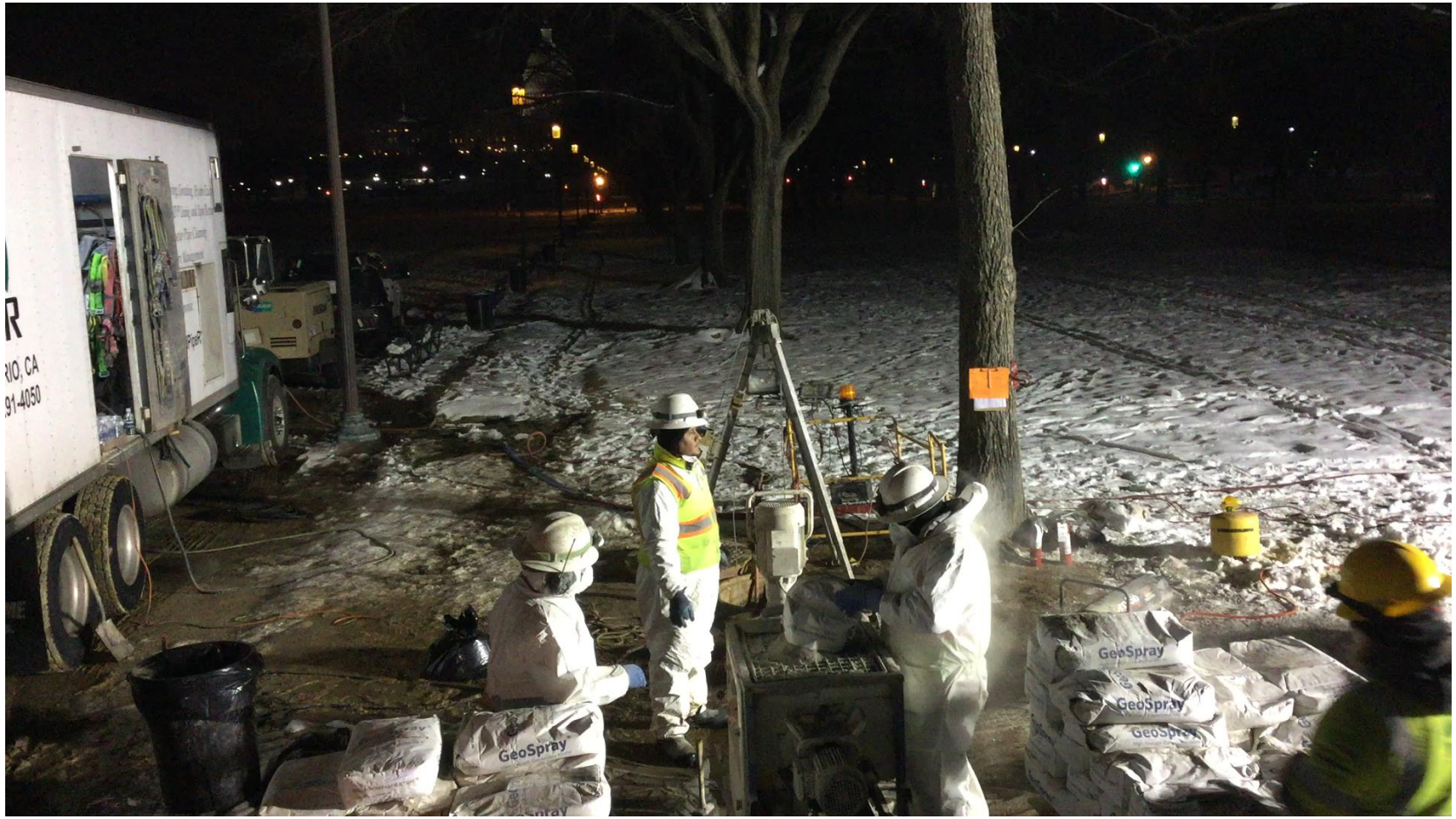
Results:

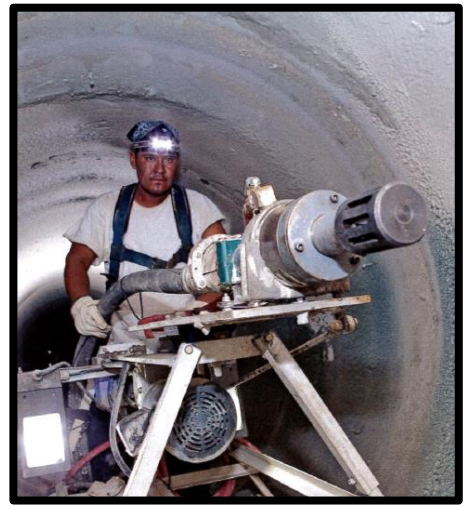
- Samples cast of GeoSpray (both halves) when tested under compression did not break at the joint.
- The chemical nature of GeoSpray allows for chemical bonding across the interface - even with pours 28 days apart - resulting in a monolithic structure.
- Samples cast of competitive OPC-based product always broke along the joint

GeoSpray

Portland Based Competitor

STRUCTURAL SAPL - GEOPOLYMER LINING SYSTEM





GEOPOLYMER SHOTCRETE APPLICATION

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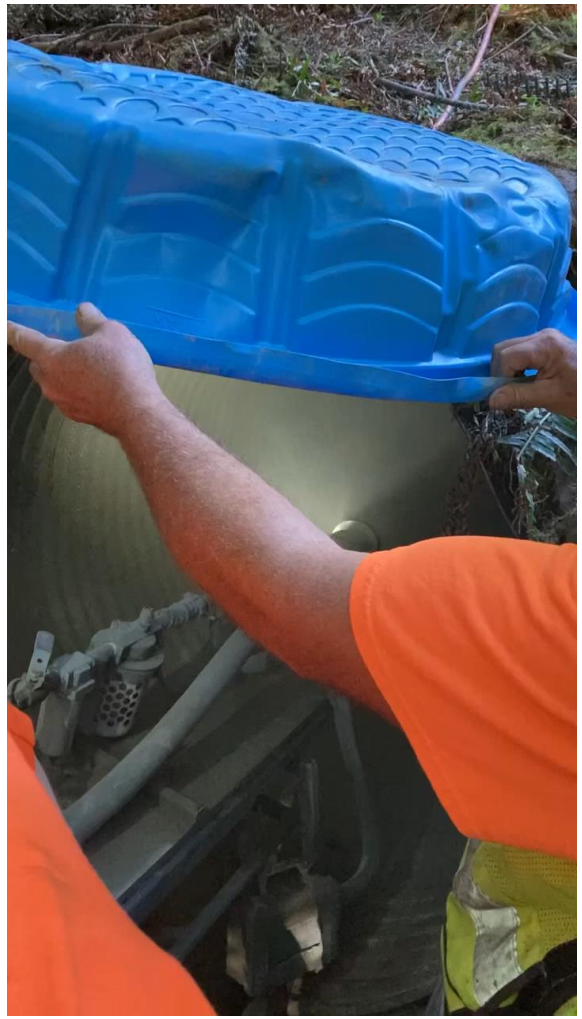
SAPL GEOPOLYMER
(SPIN CAST AND SHOTCRETE APPLICATION)



WHAT ARE THE POTENTIAL ENVIRONMENTAL IMPACTS ON ANY REHABILITATION/CONSTRUCTION PROJECT

- Groundwater
- Stormwater/runoff
- Soil
- Air
- Wildlife
- Aquatic Life
- Vegetation
- Noise

ENVIRONMENTAL REGULATIONS CONTINUE TO EVOLVE AS IT RELATES TO CONSTRUCTION SITES:

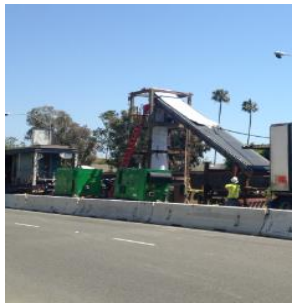
- Federal
- State
- County
- City

WHY ARE THESE CONSTRUCTION LAWS IMPORTANT ?

- Ensure asset owners, design engineers, and contractors adhere to regulations
- Minimize impact to the environment and to the public

ENVIRONMENTAL ELEMENTS TO CONSIDER WHEN SELECTING TRENCHLESS METHOD FOR A SPECIFIC PROJECT

- Air emission that include VOCs, dust, and/or odor concerns during construction activities, curing process and how it impacts the site
- Stormwater/Streamwater impacted during construction activities, its impacts to runoff water, return to flow of conveyance or wastewater treatment facility.
- Bypass layout and impact specially when working with streams and creeks for wildlife and aquatic life (active vs passive bypass)
- Impact to the public/residence and traffic
- Excavation requirements and/or surrounding area disturbance to facility the rehabilitation like insertion pit

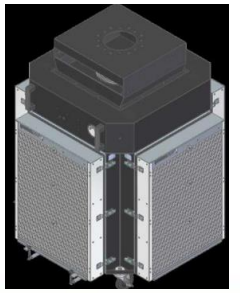






CONSIDER ENVIRONMENTAL ELEMENTS UP FRONT AS THEY MAY HAVE A MAJOR IMPACT

- Design elements (construction layout, construction sequence, countering groundwater, access to pipe, excavation plans, etc.)
- Construction schedule and/or duration (seasonal, climate, bypass volume, etc.)
- Permit requirements (air, water, NPDES, DNR, Army Corp, state, county or local regulations, etc.)
- Monitoring requirements and action levels becoming more standard for (air, water, noise, traffic, wildlife, etc.)
- Special Construction equipment (water treatment, air filters, containments, noise reducers, etc.) other contingency plans

California Water Boards | State Water Resources Control Board



CONTINUE… CONSIDER ENVIRONMENTAL ELEMENTS UP FRONT AS THEY MAY HAVE A MAJOR IMPACT

- Public exposure, traffic and parking disruption
- Wildlife and aquatic exposure or treatment plant operations
- Construction materials and curing process for selected rehabilitation method
- Ask your supplier about potential issues and/or testing results for toxicity during installation, curing, first flush or exposed to wildlife (air and water)
- Overall cost of the project (every element mentioned above)
- Exposure to asset owner and contractor (fines, lawsuits, losing license, employee termination etc.)

EPA United States Environmental Protection Agency

Short-term Methods for Estimating the Chronic Toxicity of Effluents and

Underground Pipe Catches Fire

Exposure to lawsuits, also known as litigation risk or legal risk, is the possibility that a company or individual will be sued. This risk can arise from a company's products, services, actions/non-actions, or other events.

LOOKING AT SPECIFIC ENVIRONMENT ELEMENTS DURING DESIGN, CONSTRUCTION AND POST CONSTRUCTION

- **Permits** (agencies are starting to require ecotoxicity testing and are holding permits until you have the data or requiring restrictions and/or air purifiers, water filtration, temperature control, etc. as it relates to air and water issues that could potentially be impacted during construction) and **how long it takes to receive the permit**

- **Monitoring** (during and after installation) to verify public, wildlife and aquatic verification or water from particulates, odor and/or VOC **have not been impacted and contingency plan if exceeded limits occur during or immediately after construction. Watch for potential hick-ups at treatment plant when return to service for sanitary.**

- **Environmental testing** (during installation which includes any processes in the field, curing and first flush) **more than just a Safety Data Sheet (SDS)**

REGULATORY EXPOSURE RATE

Table 3.1. Gas-Phase Regulatory Standards/Guidelines for S

Agency	Guidelines or Standards		Short-Term Guideline/Standard			
			Value (mg/m^3)***	Value (ppm)	Averaging Time	Basis
Occupational Safety and Health Administration (OSHA) (from ACGIH)	Construction Permissible Exposure Limit (PEL) Standard		420	100	8-hr	Health
			840	200	8-hr ceiling (must not be exceeded for any 15-min. period)	Health
			2,520	600	5-min.	Health
National Institute for Occupational Safety and Health (NIOSH)	Recommended Exposure Limit (REL)		215	50	10-hr	Health
			425	100	15-min	Health
US Environmental Protection Agency (EPA)	Acute Exposure Guideline Level (AEGL)	Level 1 (discomfort/ transient effects)	85	20	10-min	Health
			85	20	30-min	Health
			85	20	1-hr	Health
			85	20	4-hr	Health
			85	20	8-hr	Health
		Level 2 (serious, irreversible impacts)	980	230	10-min	Health
			680	160	30-min	Health
			550	130	1-hr	Health
			550	130	4-hr	Health
			550	130	8-hr	Health
		Level 3 (life-threatening)	8080	1,900	10-min	Health
			8080	1,900	30-min	Health
			4680	1,100	1-hr	Health
			1450	340	4-hr	Health
			1450	340	8-hr	Health

https://live-nassco.pantheonsite.io/wp-content/uploads/2021/06/NASSCO-CUIRE-Final-Report-04-30-2018-1.pdf

Exhibit B-2. National Ambient Air Quality Standards[a]

Pollutants	Primary Standards Value	Primary Standards Averaging Period	Secondary Standards
CO	9 ppm (10 mg/m^3)	8 hours	None
CO	35 ppm (40 mg/m^3)	1 hour	None
NO_2	53 ppb	Annual (Arithmetic average)	Same as primary
NO_2	100 ppb	1 hour	None
O_3	0.075 ppm	8 hours	Same as primary
PM_{10}	150 $\mu g/m^3$	24 hours	Same as primary
$PM_{2.5}$	15.0 $\mu g/m^3$	Annual (Arithmetic average)	Same as primary
$PM_{2.5}$	35 $\mu g/m^3$	24 hours	Same as primary
SO_2	75 ppb	1 hour	None
SO_2	None	None	500 ppb average period of 3 hours
Pb	0.15 $\mu g/m^3$	Rolling 3-month average	Same as primary

Source: EPA's NAAQS website at: https://www.epa.gov/naaqs. The information in the table is current as of September 2012. Please refer to the website to check for updates as well as to review additional notes that pertain to these standards. The standards are codified at 40 Code of Federal Regulations (CFR) part 50.

[a] $\mu g/m^3$ = microgram per cubic meter; CO = carbon monoxide; mg/m^3 = milligram per cubic meter; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; PM_{10} and $PM_{2.5}$ = particulate matter with an aerodynamic diameter equal to or less than 10 microns and 2.5 microns, respectively; ppb = part per billion; ppm = part per million; SO_2 = sulfur dioxide.

https://www.faa.gov/sites/faa.gov/files/about/office_org/headquarters_offices/apl/1-air-quality.pdf

ENVIRONMENTAL COMPARISON OF SAPL GEOPOLYMER MORTAR VS OTHER TRENCHLESS METHODS

Relative Environment Comparison between Trenchless Technologies - Large Diameter Pipe

Trenchless technology	Air Emission Consideration *	Water Quality (immediate after curing) for Storm	Disposal or Treatment Requirements	Carbon Foot print	Bypass	Construction Footprint	Insertion Pit/Excavation	Traffic Disruption	Public Disruption
SAPL - GeoPolyer (GeoSpray)	Particulates	Pass - Eco testing	Cleaning of Equipment	Low	Internal or External	Small	Existing manhole	Low	Low
CIPP*									
UV	Odor/VOC	Ask for Ecotesting	Resin Containment	High	External	Large	Depends	Moderate/High	Moderate/High
Steam	Odor/VOC	Ask for EcoTesting	Potential Air Filtration/Resin Containmnet	High	External	Large	Depends	Moderate/high	Moderate/high
Hot Water	Odor/VOC	Ask for Ecotesting	Treating Process Water/Resin Containment	High	External	Large	Depends	Moderate/High	Moderate/High
Slip Lining	Particulates (mixing on site grout)	Ask Ecotest on grout	Cleaning of Equipment	High	Internal or external	Large	Yes	Significant	Significant
Carbon Fiber Polymers	Odor/VOC	Ask for Ecotesting	Resin Containment/Cleaning of Equipment	Moderate	External	Compact	Existing manhole	Low	low

*Evaulate wetout over hole installations

CASE STUDIES

TEC talks

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STRUCTURAL REHABILITATION OF A 60” DIAMETER AND A 72 ” X 110 ” ARCH CULVERT

Product: GeoSpray 61 Geopolymer Mortar

Location: City of Orinda, California

TEC talks

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ENVIRONMENTAL ELEMENTS OF PROJECT

- Wildlife and aquatic life in stream - Permitting and Ecotoxicity Testing
- Dust control - Minimize exposure to public and surrounding area
- Erosion protection - minimum disturbance to stream and hillside
- Traffic disturbance - main street for public traffic
- Public disturbance - foot traffic and construction equipment
- Hazard containment – eliminate potential spills
- Vegetation protection - minimize impacting or distorting vegetation
- Noise – minimize noise in a residential area

ENVIRONMENTAL ELEMENTS OF PROJECT

from Army Corps. Did you get this comment for your other Projects?

Application of the geopolymer mortar inside the storm drains would constitute permanent discharge of fill into waters of the US if the storm drains are fully within our jurisdiction.

If you'd like to assume the 3 storms drains are within our jurisdiction, would you please provide quantity estimates for the discharge of the mortar for each of the locations? If you'd rather proceed with a jurisdictional determination to assess exactly how much each drain is within our jurisdiction, we can go that route too. The latter route would add several weeks to the permitting process.

ENVIRONMENTAL ELEMENTS OF PROJECT

5.1 Regulatory Compliance and Work Windows

1. **Design Conformance**. The Project shall be constructed in conformance with the Application materials and as described in this Certification. The geopolymer mortar shall not be used for the repairs until the Permittee has demonstrated the cured product is not acutely toxic to aquatic life. The Permittee shall fully comply with engineering plans, specifications, and technical reports submitted in the Application or supplemental materials required as part of this Certification. Any changes to information provided in the Application must be submitted to the Water Board and receive Executive Officer approval before the changes are implemented;

ENVIRONMENTAL ELEMENTS OF PROJECT

5.3 Pre-Construction Reporting and Other Requirements

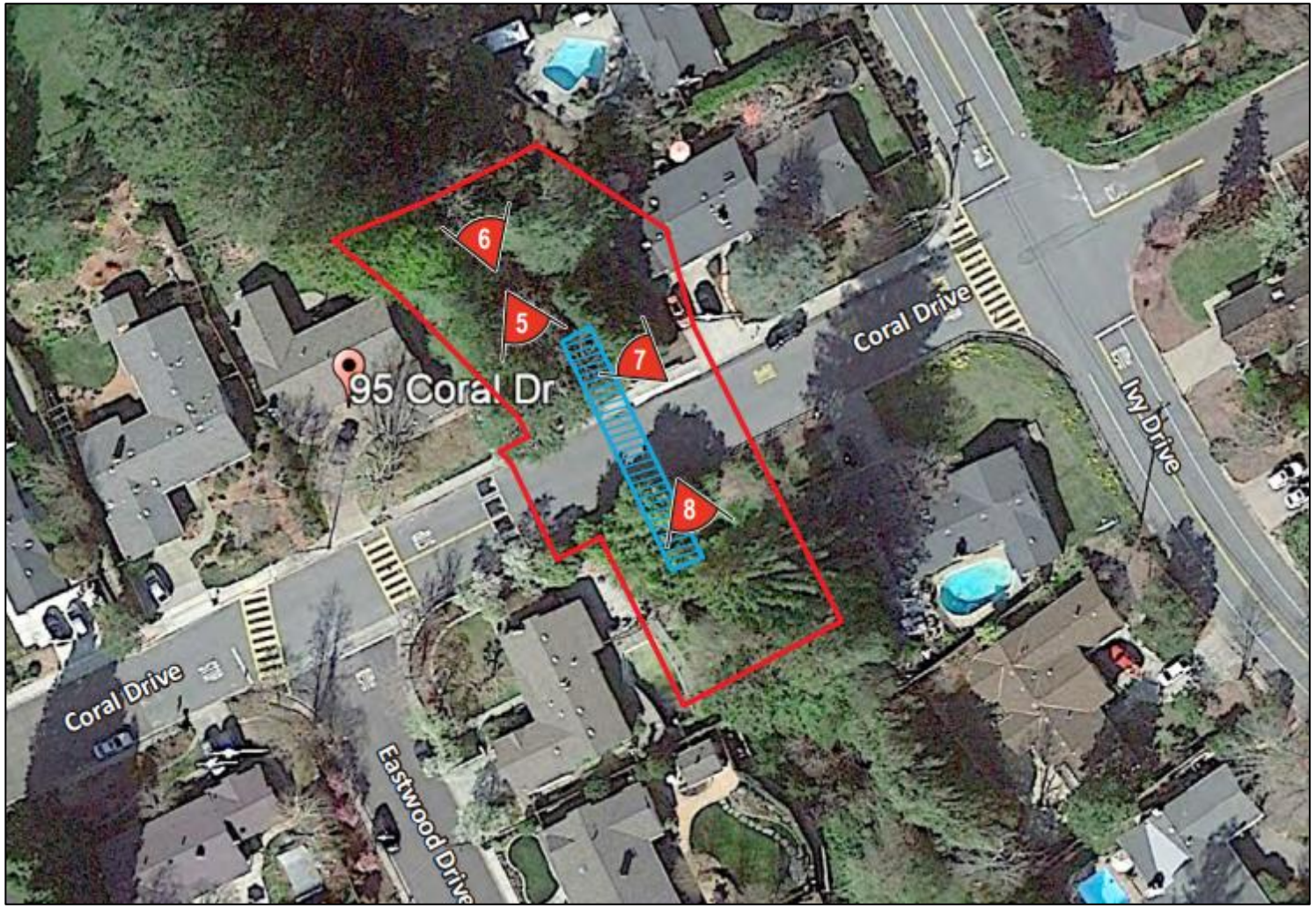
11. **Geopolymer Mortar Toxicity Testing.** Geopolymer mortar shall not be used for the culvert repairs until the Permittee has demonstrated that the cured product is not acutely toxic to aquatic life. To demonstrate that the liner material is non-toxic to aquatic life, the material shall be tested by measuring the survival of test organisms in a 96-hour bioassay. Test organisms shall be

for in-situ application in the culverts. If final or intermediate results of an acute bioassay test indicate that the percentage of surviving test organisms is less than 70 percent, the Permittee shall extend the curing time, up to 30 days, prior to sample collection and repeat the test. If the control survival rate is less than 70 percent, the bioassay test shall be restarted with new fish/alternative species. If a test species survival rate of 70 percent or less is observed after the material is fully cured, then the geopolymer mortar shall not be used for culvert repairs. The test results shall be submitted, satisfactory to the Executive Officer, within 30 days of the start of construction. Test results shall include the following, at a minimum, for each

Rationale: *This condition is necessary to ensure that Project implementation does not impact water quality in ways that impair the designated beneficial uses of waters of the State (Basin Plan Chs. 3 and 4) and to ensure minimization of impacts to waters of the State.*

Specifications called out Acute Toxicity of leachates Water and Marine Organisms EPA-821-R-03-012 (LC100 – 100% Survival with 6 hour cure time to resume flow of water through pipe)

AERIAL VIEW OF SITE WITH DENSE STREAM VEGETATION



PROJECT SITE AREA

View 1

View 2

View 3

View 4

PROJECT SITE AREA

View 1

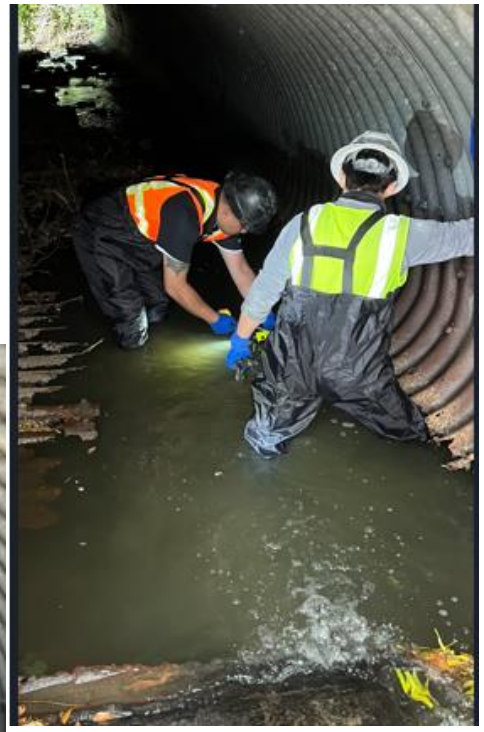
View 2

View 3

View 4

View 5

72 INCH X 110 INCH CMP ARCH MORAGA DRIVE



COMPLETE PROJECT

Project Outcome

- Ecotoxicity testing for permit approval
- Release water 6 hours after installation
- No effects to aquatic life
- Minimum disturbance to the public
- Small footprint allowing traffic to continue
- No dust issues
- Minimal disturbance to stream back vegetation

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FROM THE FIELD

ADV

Culvert rehabilitation project minimizes environmental impacts

6/19/2024 | 0 | 5 MIN READ

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By Kurt S. Chirbas Sr., P.E., CPESC

Concrete collaboration

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STRUCTURAL REHABILITATION OF A 36” X 58” CULVERT

Product: GeoSpray 61 Geopolymer Mortar

Location: Seattle, Washington

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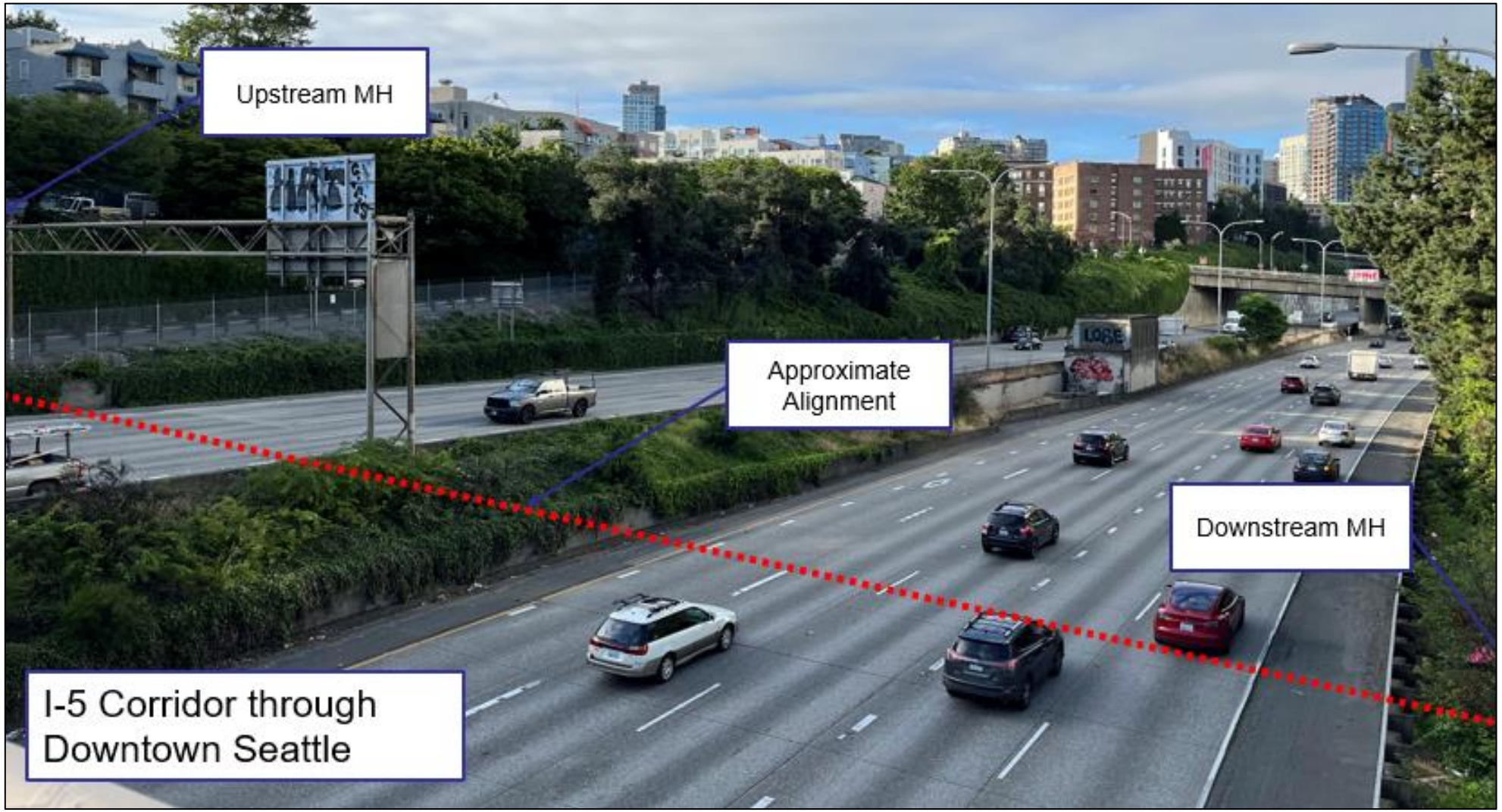
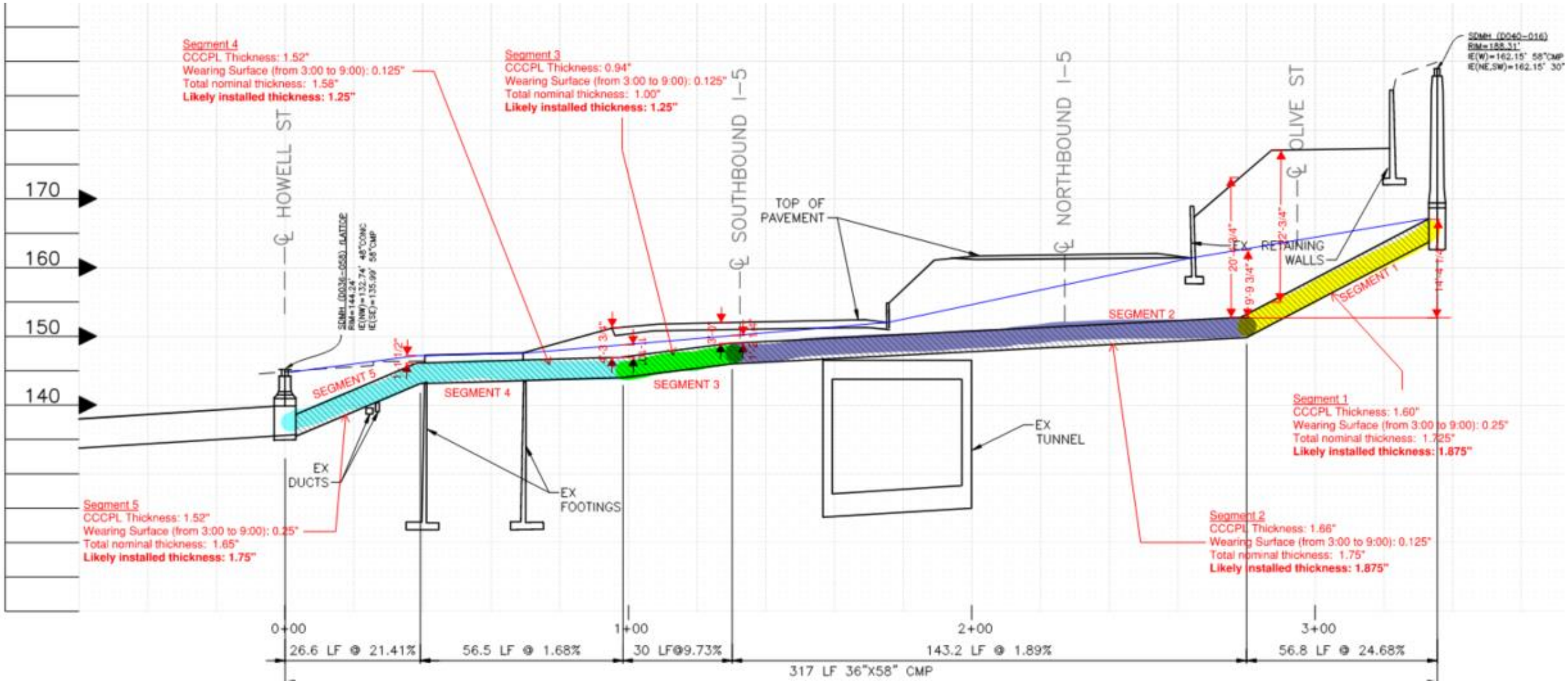
ENVIRONMENTAL SUBMITTAL PLAN REQUIREMENTS INCLUDED:

- Dust control
- Erosion control
- Tree, Vegetation and soil protection
- Traffic disturbance - main street for public traffic
- Public disturbance - foot traffic and construction equipment
- Waste Management Plan
- Spill/Hazard containment – eliminate potential spills
- Noise mitigation - residential area (even if adjacent to I-5 ☺)
- Stormwater Management

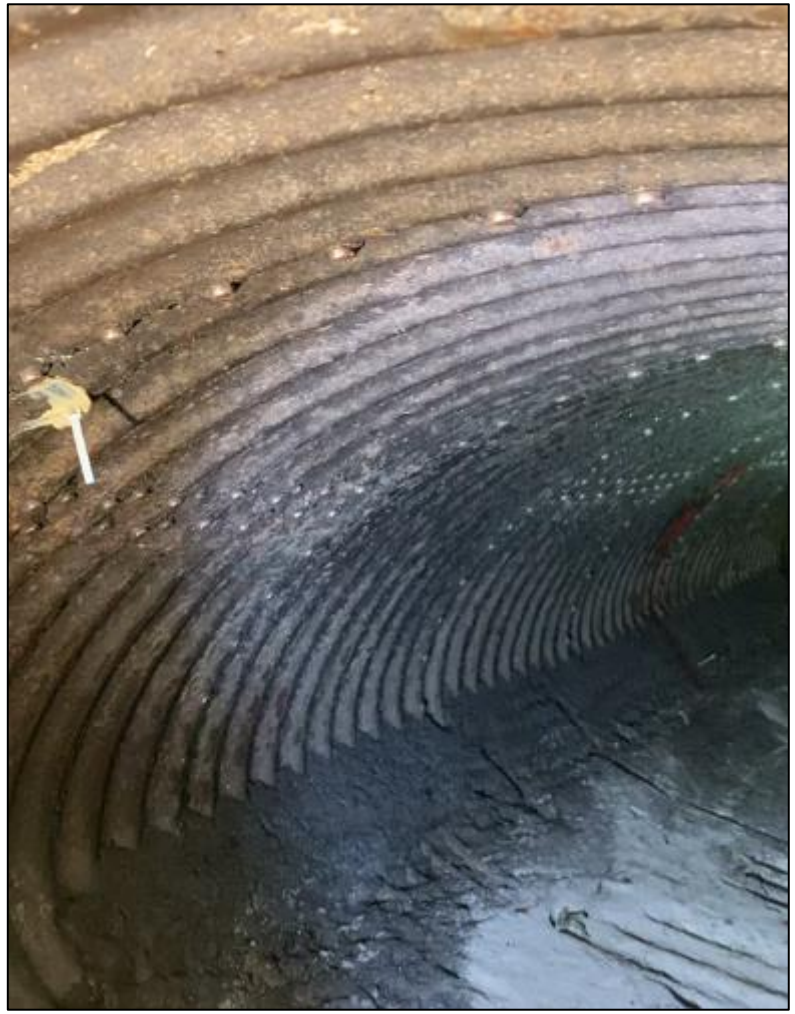
PROJECT SITE AREA



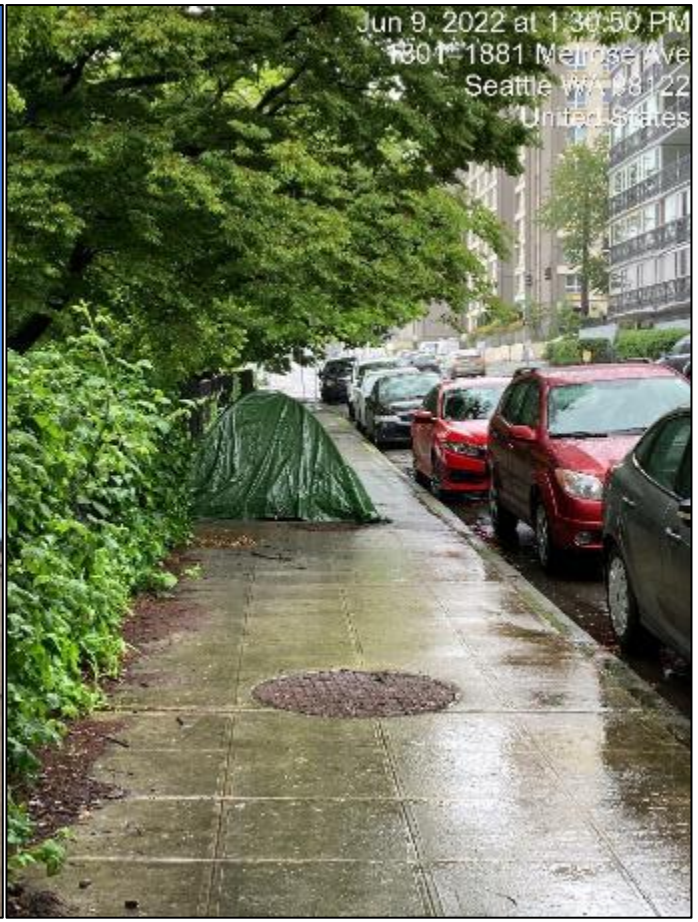
PROFILE OF CULVERT



CONDITION OF CULVERT



SMALL FOOTPRINT AREA FOR CONSTRUCTION



DUST CONTROL REQUIREMENTS

7-24.7(2) ODOR AND DUST CONTROL PLAN

The Contractor shall submit an Odor and Dust Control Plan to the Engineer for approval prior to starting construction. The Plan shall outline the specific measures and procedures to be implemented if the Owner or Contractor receives a public complaint regarding dust emissions or other construction-related odors. Specific measures to address odor complaints may include ventilating upstream and downstream maintenance holes; odor monitoring; using pressure cleaners, fans, or other measures to reduce or eliminate dust or odors; and other industry standard practices that may minimize project-related dust and/or odors.

COMPLETED LINING

Project outcome

- No impacted to traffic
- Air monitoring indicated no effects to air quality
- Minimal disturbance to the public
- Small footprint to minimize parking issues

NASTT NO-DIG SHOW

North American Society for Trenchless Technology (NASTT)
2023 No-Dig Show
Portland, Oregon
May 1, 2023

MA-T6-02

STRUCTURAL REHABILITATION OF A 96” RCP

Product: GeoSpray 61 Geopolymer Mortar

Location: Santa Rosa, California

TEC talks

GEOTREE

WHAT WERE THE ENVIRONMENTAL ELEMENTS OF PROJECT FOR GEOSPRAY 61 MORTAR

- Wildlife and aquatic life in stream permitting (EcoToxicity Testing)
- Dust control (Minimize exposure to public and surrounding area)
- Erosion Protecting (minimum disturbance to stream and hillside)
- Public distribution (foot traffic and construction equipment)
- Spills (contain all spills)
- Vegetation (minimize impacting or distorting vegetation)
- Noise (reduce noise because it is a residential area)

REGIONAL WATER BOARD AND FISH WILDLIFE FAVORABLE PROPOSED REDUCTION IN CURE TIME

Email correspondence from Authorities to SCWA:

CA Fish & Wildlife: "*After discussion with my team and with the water board, we concur with a conditioned acceptance of the use you have described. The condition of approval is what Kaete has laid out below in terms of a water quality monitoring. I would like to see your plan to monitor water quality before the sealant is used.*"

Regional Water Board: "*I have discussed this with other staff at my office. We believe it is acceptable with the cure time you propose. We would like to see a water quality monitoring plan and a contingency plan. A water quality plan may have something like upstream and downstream pH monitoring at specific time intervals after water is returned to the tube. Something like, within 30 min, then 2 hours, then… we leave it to you to propose something. A contingency plan would describe what measures you would take if the monitoring showed a spike in pH.*"

PROJECT LAYOUT

ENTRANCE OF THE PIPE

EXIT OF PIPE AND BYPASS PIPE

PULLING HOSE FROM PIPE TO STAGING AREA

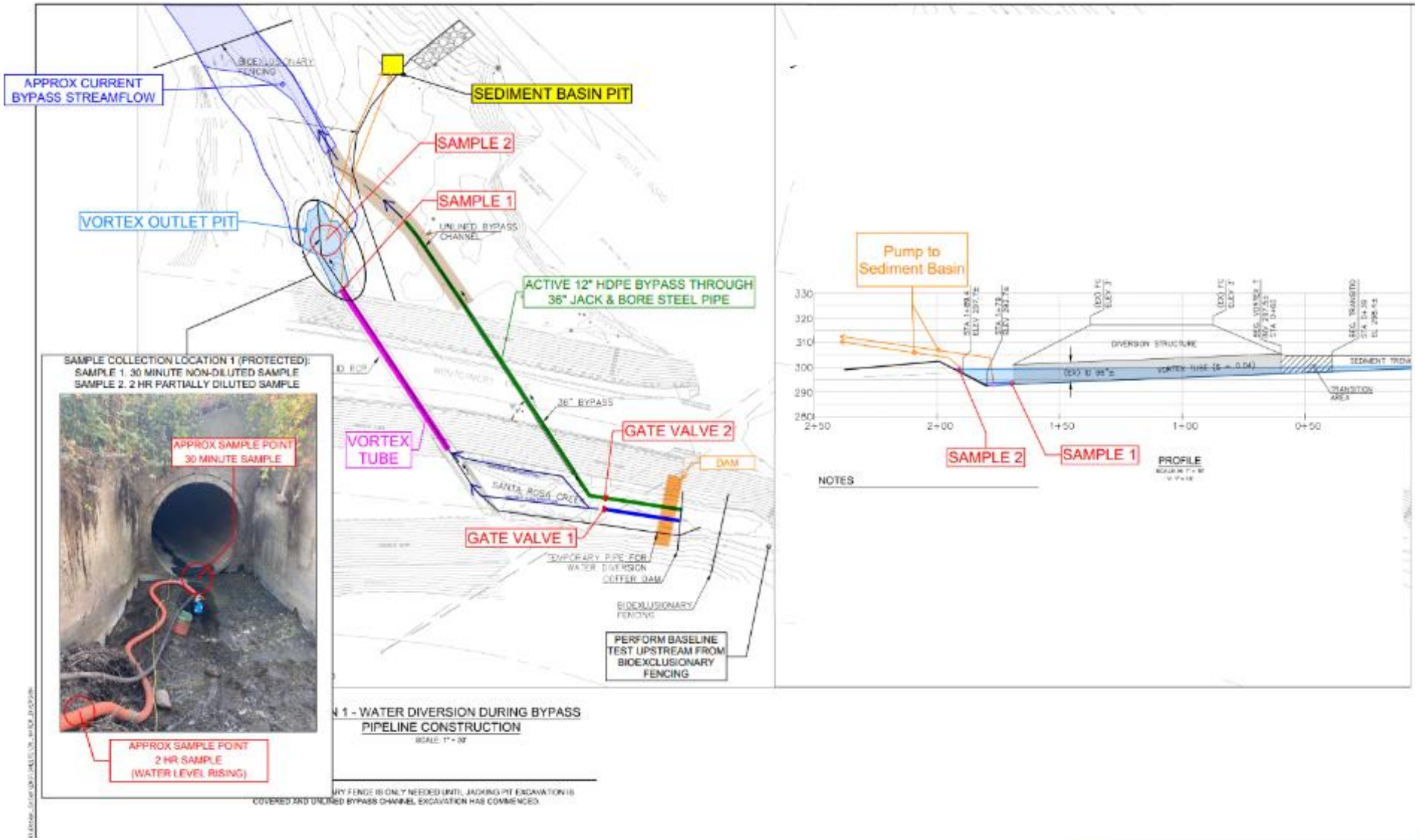
CALIFORNIA CONSTRUCTION GENERAL PERMIT

Table 5. Test Methods, Detection Limits, Reporting Units and Applicable NALs

Parameter	Test Method	Discharge Type	Min. Detection Limit	Reporting Units	Numeric Action Levels	(LUP Type 3) Receiving Water Monitoring Trigger
pH	Field test with calibrated portable instrument	Type 2 & 3	0.2	pH units	Lower = 6.5 upper = 8.5	Lower = 6.0 upper = 9.0
Turbidity	EPA 0180.1 and/or field test with calibrated portable instrument	Type 2 & 3	1	NTU	250 NTU	500 NTU

Specific agencies involved included: California Regional Water Board , US Fish and Wildlife Services and US Army Corps of Engineers

SAMPLING LOCATION FOR PH AND TURBIDITY



TESTING 1ST FLUSH WATER BEFORE ESTABLISHING FLOW THROUGH PIPE

	WQMP SAMPLING RECORD					
	Type	Time	NTU	pH	Result	Reference
1	Calibration	8:54 AM	-	-	-	1.a, 1.b, 1.c
2	Bypass Sample 1 (baseline)	9:00 AM	-	7.8	-	2.a, 2.b
3	Downstream Sample 1 (baseline)	9:05 AM	-	7.9	-	3.a
4	WQMP Sample 1	9:36 AM	-	8.0	PASS	4.a, 4.b
5	WQMP Sample 2	10:11 AM	-	8.0	PASS	5.a
6	Turbidity Upstream (added for record)	1:58 PM	1.35	-	PASS	6.a
6	Turbidity Downstream (added for record)	1:59 PM	3.89	-	PASS	6.b

View 1

View 2

View 3

REPORT SUBMITTED

1126623 Santa Rosa Creek Vortex Tube Rehabilitation

Water Quality Monitoring Plan Record DATE: 10/19/2021

Project Description:
The Work relevant to this document consisted of rehabilitation of Owner's vortex tube located at the Santa Rosa Creek diversion structure beneath Montgomery Drive, Santa Rosa, California. The Work included, but is not limited to, rehabilitation of approximately 112 linear feet of 8-foot diameter reinforced concrete pipe (Vortex Tube) via installation of Fiber Reinforced Mortar Lining (FRML).

Work Description:
FRML installation began on 10/07/21. Final placement of FRML (GeoSpray61 product) was completed Friday 10/15/21. 48 hours elapsed and work began to implement the approved Water Quality Management and Contingency Plan to restore streamflow through the vortex tube on Tuesday 10/19/21.

Calibration check of portable pH meter was performed. After the meter was confirmed to be calibrated, two stream samples were taken to establish pH baseline. The first sample, labeled *Bypass Sample 1* was taken on-site at the end of the bypass pipe. The second sample, labeled *Downstream Sample 1* was taken outside of the work area approximately 150' downstream. Once pH baseline measurements were

COMPLETED LINING

Project outcome

- Released water 24 hours after installation
- Water quality was not impacted for pH and turbidity for first flush
- No impacted to air emission
- Product met NSF 61 drinking standards

QUESTIONS ?

GeoTree Solutions understands rehabilitation within the environment

- Contact Kurt:

Kurt.Chirbas@Henkel.com
(916) 215-3163

➢ Contact Kurt:
Kurt.Chirbas@Henkel.com

www.geotreesolutions.com

GEOTREE

For PDH credit, email us at **GeoTreeInfo@cs-nri.com**

linkedin.com/company/geotree-solutions

@geotreesolutions

@geotreesolution