ICRI
CONCRETE REPAIR
Restore | Repurpose | Renew

2025 SPRING CONVENTION

AUSTIN, TEXAS • APRIL 13 – 16, 2025

www.icri.org

Wendy Rouleau

Prime Resins, Inc.

Injection Grouting Addresses Concerns of Spillway Failure Due to Undermining

PIER MASTERS
ENGINEERED EXCELLENCE

DRW BY: _____

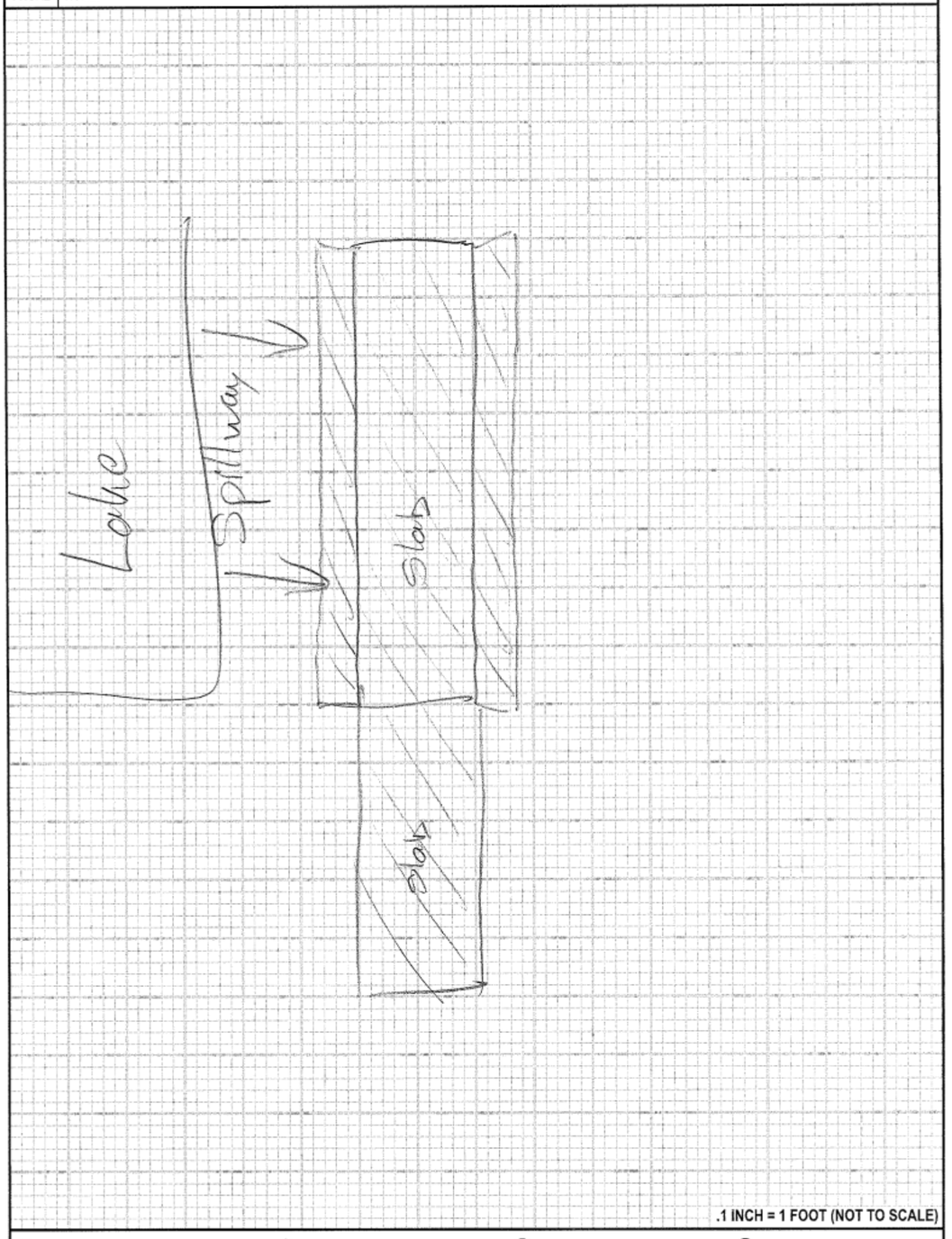
13501 ARRINGTON ROAD • GRANDVIEW, MO 64030 • 816-763-1500 • FAX: 816-763-2867

NAME: DATE::

ADDRESS: CITY: STATE:

JOB ADDRESS: CITY: STATE:

PHONE | HOME: OFF: EX. FAX: CELL: EMAIL:



.1 INCH = 1 FOOT (NOT TO SCALE)

● - PROPOSED PIERS	● - _____ PIERS	⊗ - _____ PIERS	⊖ - _____ PIERS
○ - RECOMMENDED PIERS	> - HELICAL TIE-BACK	⊢ - CARBON FIBER - CFL	▨ - MUDJACKING
≶ - VERTICAL CRACK	VVV - HORIZONTAL CRACK	⊏ - CARBON FIBER - CR	▩ - _____
⊣⊢ - VERTICAL WALL RESTRAINTS	⊖ - RECOMMENDED TIE-BACK		© 6/12/15

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Lake Quivira, KS

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Lake Quivira, KS

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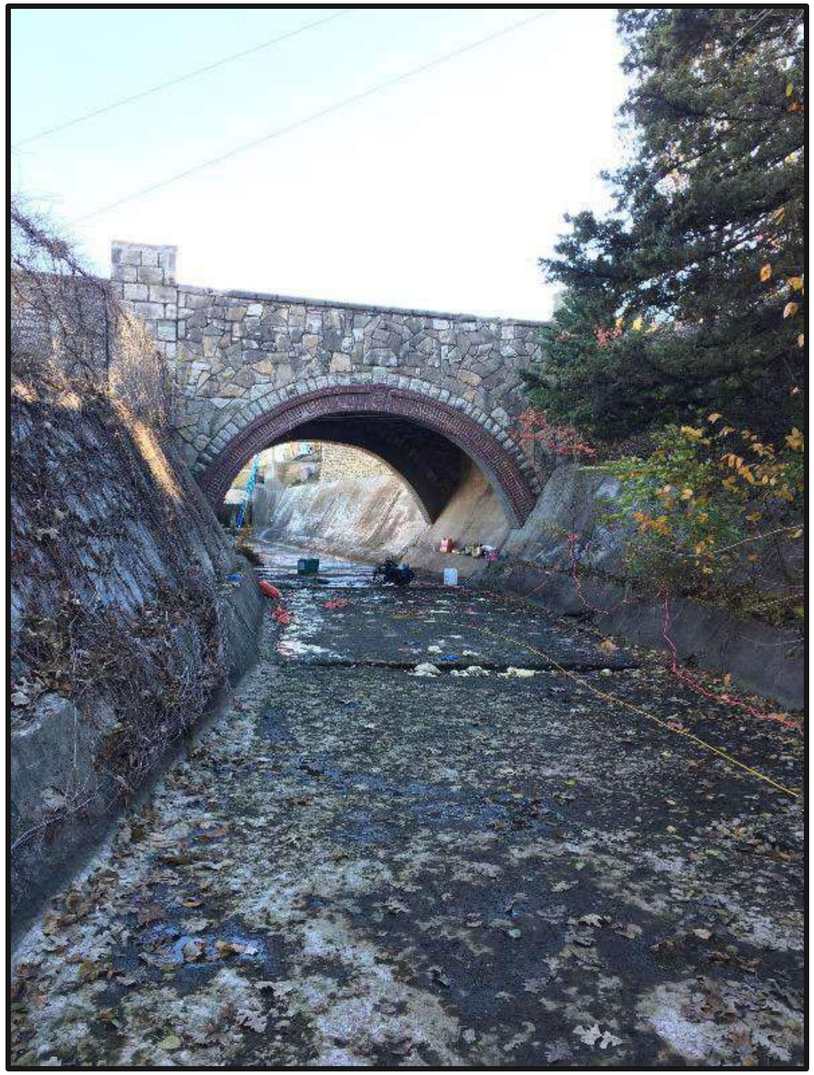
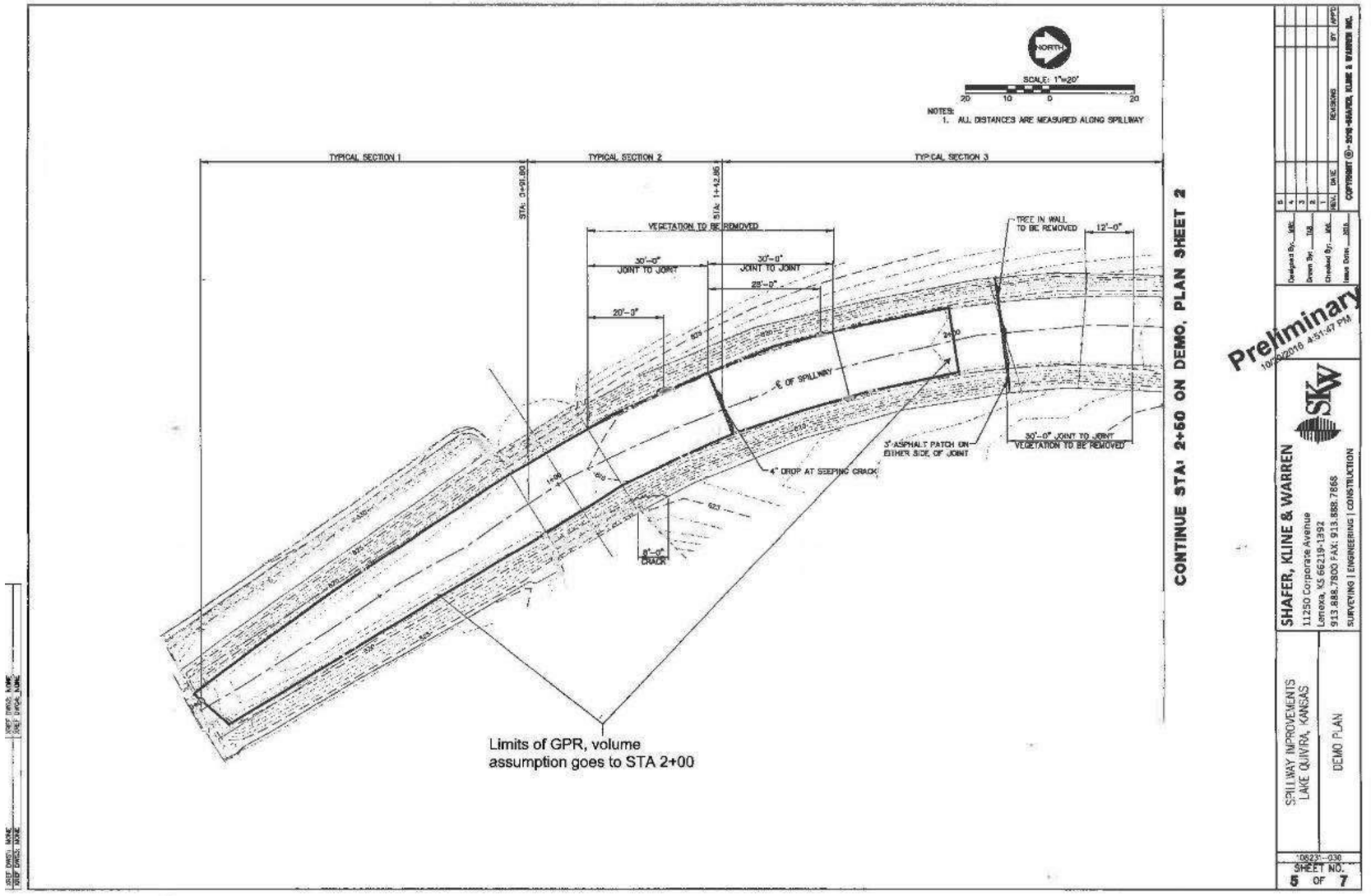
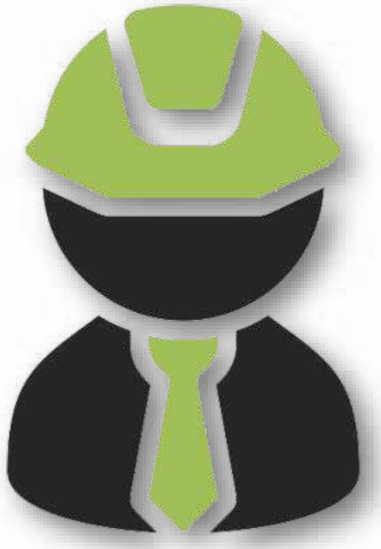




Preliminary Drawings

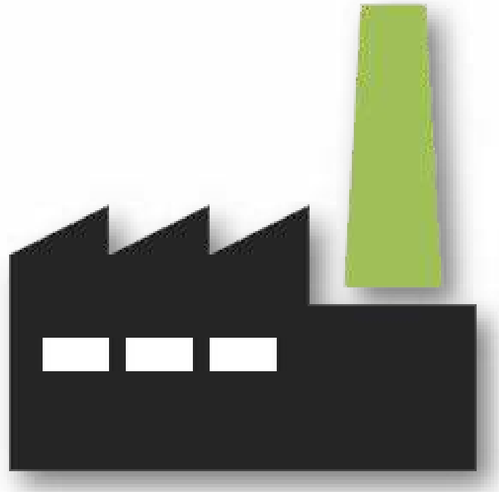
Solution INVESTIGATION



Engineer

Specialty Contractor

Distributor



Manufacturer

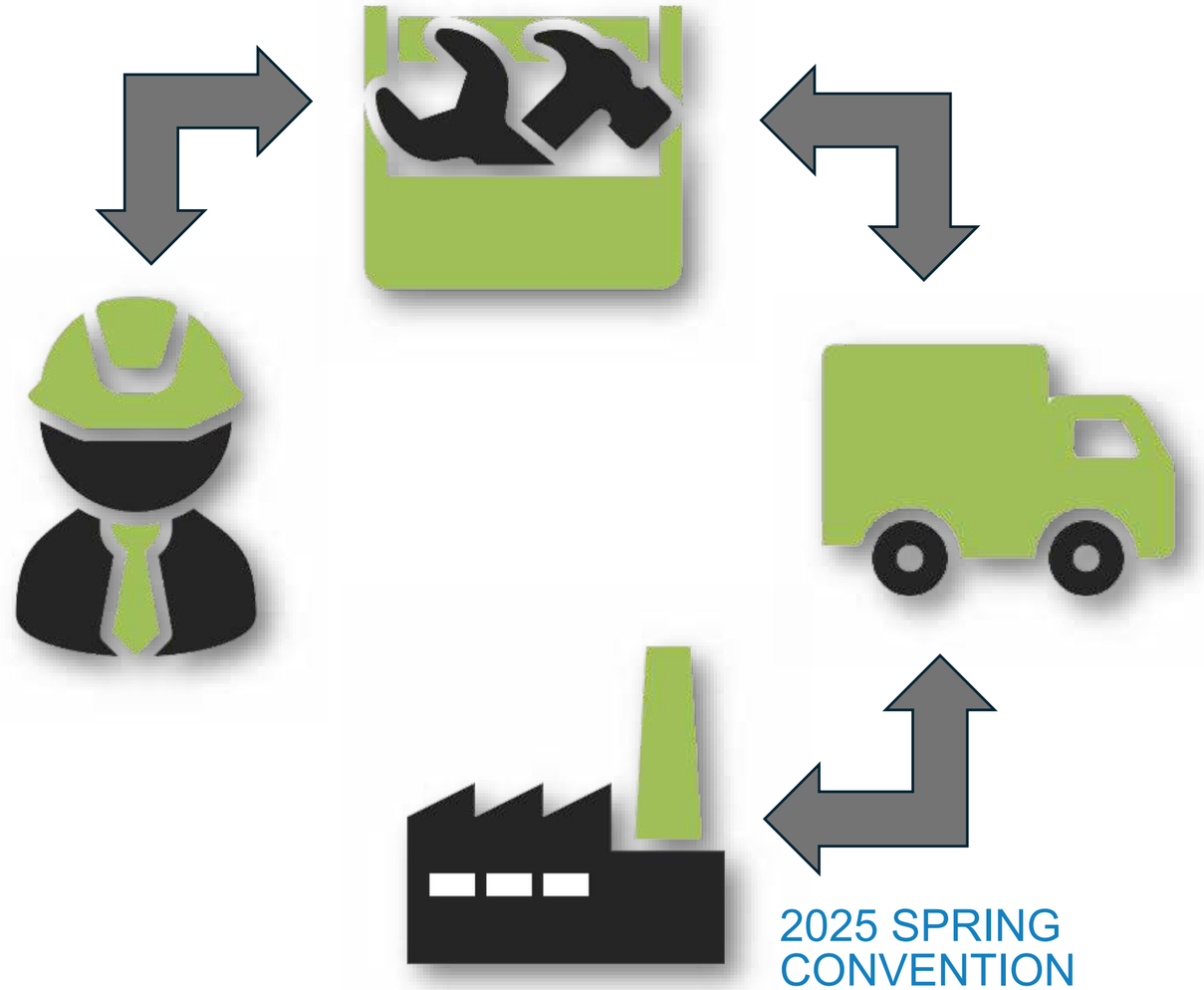
Live Content Slide

When playing as a slideshow, this slide will display live content

Poll: What area of the repair industry do you represent?

Solution Selection QUESTIONS

What is the structure made from?
What's the condition?
Settling? Voids?
Compressive strength needs?
NSF requirements?
Access limits?
Budget/Timing?



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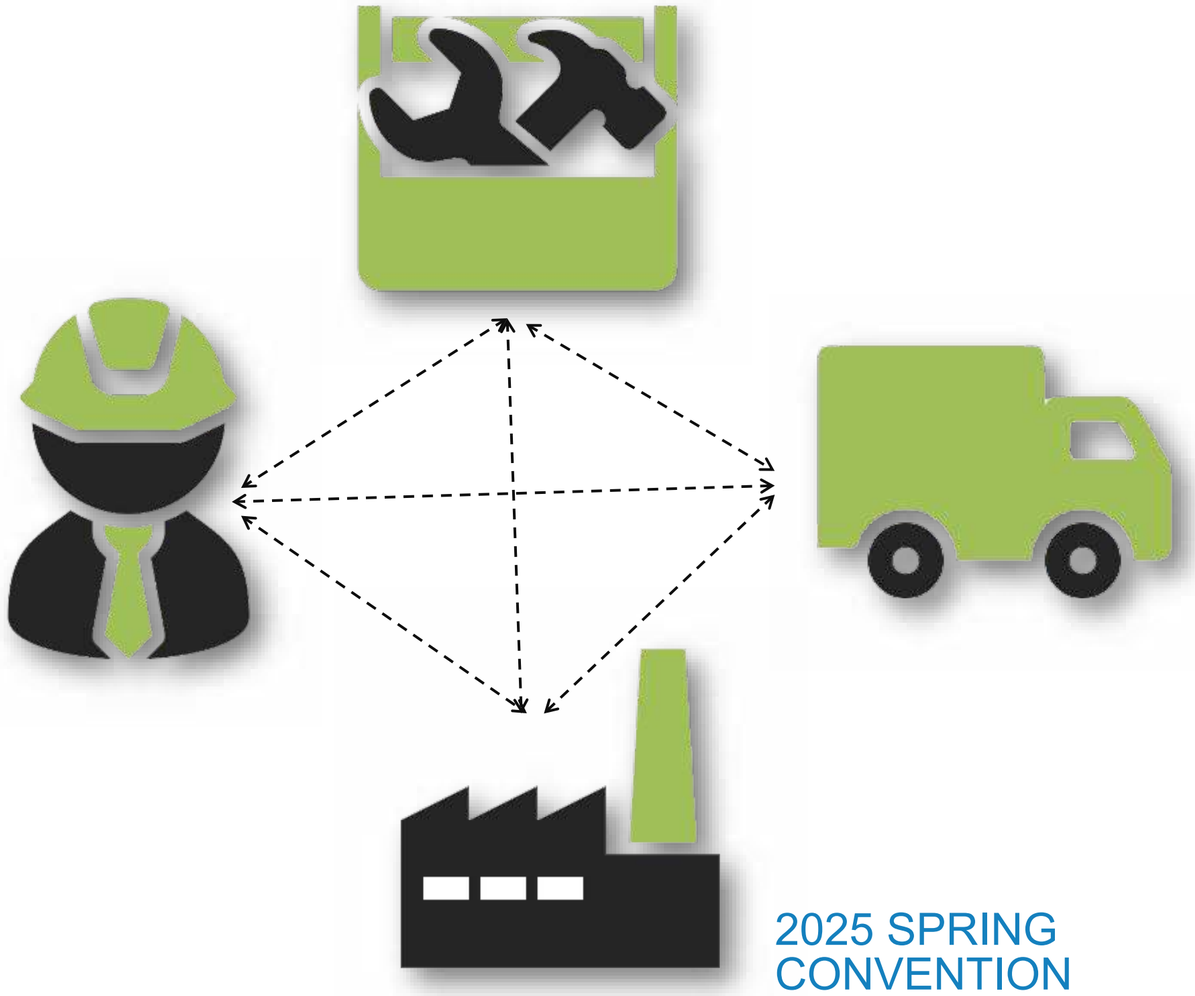


Trenchless TECHNOLOGY

What is Chemical Grouting?

Liquid resin that turns into an impermeable solid in a predictable timeframe used to:

- Stop leaks in above ground structures
- Stop infiltration into below grade structures
- Stabilize/Improve soils
- Control groundwater
- Seal annular spaces
- Fill voids
- Stabilize and lift concrete slabs

Chemical GROUTING

- Chemical Grouts are used to make long lasting repairs quickly and economically.
- There are several types of Chemical Grouts. Selection depends on several factors.

Primary Grout FAMILIES

Polyurethane Grouts
- Water Reactive
- Hydrophilic
- Hydrophobic
- Two-Component

Acrylic Grouts
- Acrylate
- Acrylamide

Cementitious Grouts

Water Reactive Polyurethane Grouts

Characteristics of Hydrophilic Foams & Gels

- Single Component
- Water Initiates Reaction
- Closed Cell / Watertight Foam or Impermeable Gel
- Flexible – use where structure will have movement
- Above & Below Grade Structures
- Chemical Bond to Concrete
- Classified to ANSI/NSF 61 products

Water Reactive Polyurethane Grouts

Hydrophilic Uses

- Flexible Foams
  - Sealing hairline cracks in concrete
  - Sealing active leaks/Pipe Penetrations
  - Joint Sealing with oakum technique

- Flexible Gel
  - Curtain grouting manholes to seal leaks
  - Soil Stabilization
  - Dams, Tunnels, Below grade concrete walls

Water Reactive Polyurethane Grouts

Characteristics of Hydrophobic Foams

- Single Component
- Water Initiates Reaction
- Closed Cell / Watertight Foam
- Rigid – flexible phobics available
- Requires a Catalyst which % affect reaction time and expansion
- Mechanical Seal
- More expansion & rapid expansion compared to a hydrophilic
- Classified to ANSI/NSF 61 products

Water Reactive Polyurethane Grouts

Hydrophobic Uses

- Gushing Leaks
- Manhole Rehabilitation
- Probe Grouting for Pipe Sealing
- Pipe and Culvert Repairs
- Seawall/Bulkhead Restoration
- Spillways - Earthen Dam Breaches
- Soil Stabilization

Water Reactive Polyurethane Grouts

Hydrophobic Catalyst

- Vary percentage based on desired expansion rate and travel
- Minimum – 0.5% - Soil Stabilization
- Maximum – 10% - Gushing Leaks
- Small job – mix in small batches
- Mix Well!

Two-Component Polyurethane Grouts

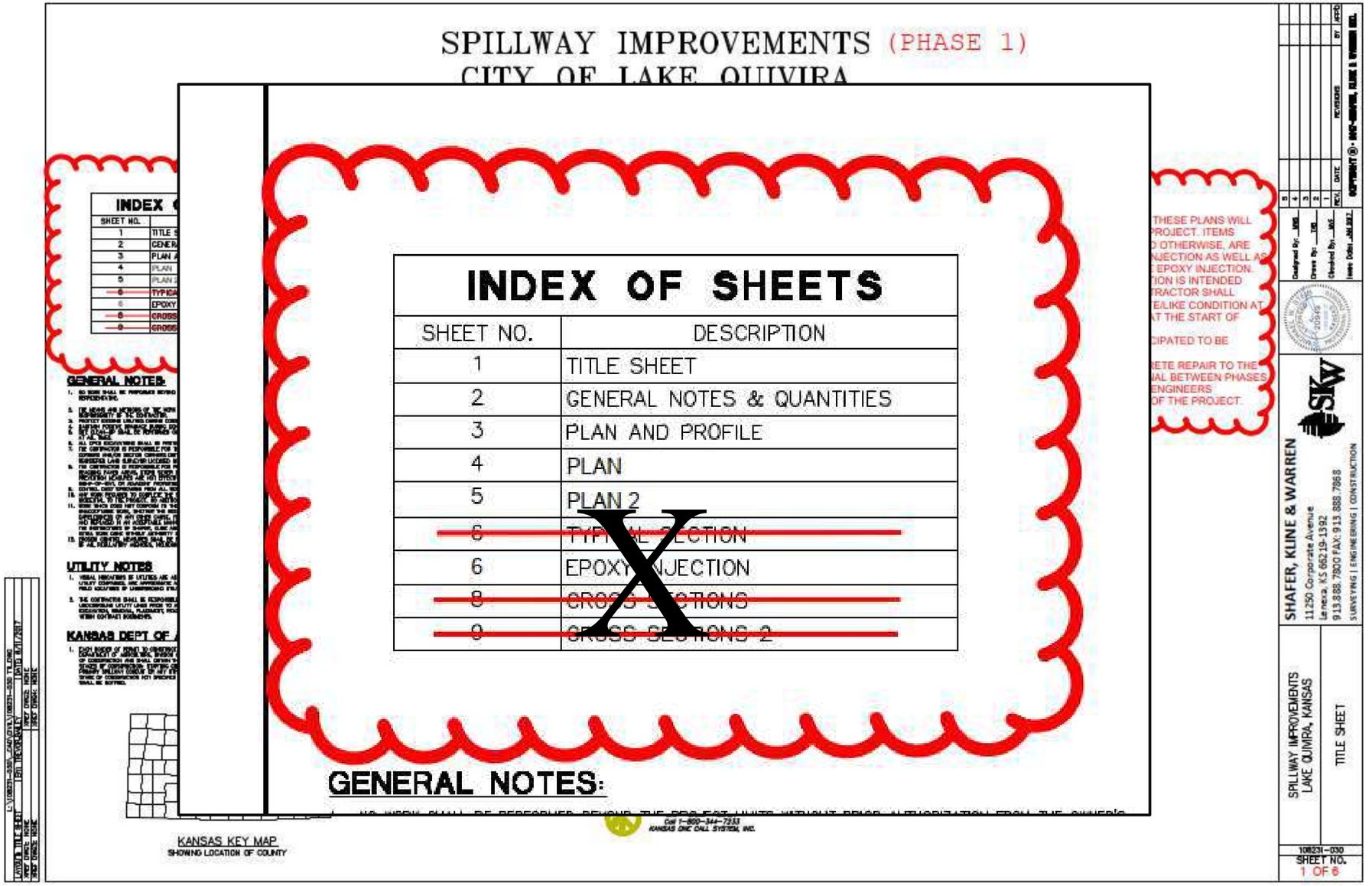
Characteristics of Two-Component Polyurethanes

- Reaction of A & B Component
- Closed Cell, Hydro Insensitive
- Typically, High Exothermic / Rapid Reaction
- Available in Multiple Densities
- High Compressive Strengths
- Highly Expansive / Develops Hydraulic Lift
- Requires Special Equipment (most)

Two-Component Polyurethane Grouts

Two-Component Uses

- Void Fill
- Soil Stabilization
  - Bridge Approach
  - Under Structures
- Slab Lifting
  - Highways/Roads
  - Buildings/Industrial Slabs
  - Driveways/Sidewalks


SPILLWAY IMPROVEMENTS (PHASE 1)
CITY OF LAKE QUIVIRA
INDEX OF SHEETS
SHEET NO. | DESCRIPTION
1 | TITLE SHEET
2 | GENERAL NOTES & QUANTITIES
3 | PLAN AND PROFILE
4 | PLAN
5 | PLAN 2
6 | EPOXY INJECTION
GENERAL NOTES:
KANSAS KEY MAP
SHOWING LOCATION OF COUNTY
SHAFER, KLINE & WARREN
SPILLWAY IMPROVEMENTS
LAKE QUIVIRA, KANSAS
TITLE SHEET
SHEET NO.
1 OF 8

Structural vs. Non-Structural Defects

Structural Repairs

- Epoxy
- Rigid
- Restrains crack from moving

Non-Structural Repairs

- Polyurethane
- Flexible
- Allows for movement

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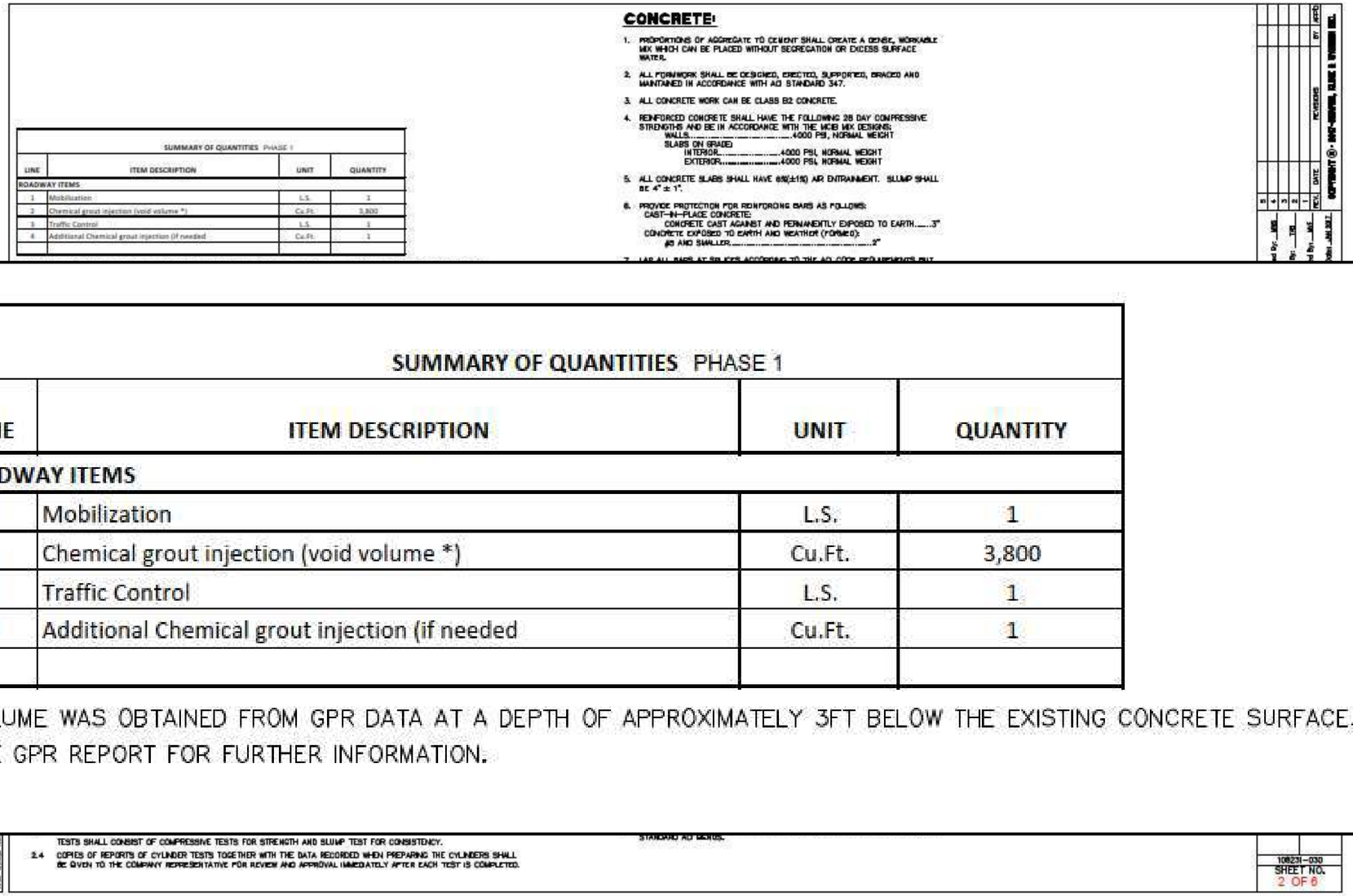


CONCRETE:

1. PROPORTIONS OF AGGREGATE TO CEMENT SHALL CREATE A DENSE, WORKABLE MIX WHICH CAN BE PLACED WITHOUT SEGREGATION OR EXCESS SURFACE WATER.
2. ALL FORMWORK SHALL BE DESIGNED, ERECTED, SUPPORTED, BRACED AND MAINTAINED IN ACCORDANCE WITH AO STANDARD 347.
3. ALL CONCRETE WORK CAN BE CLASS B2 CONCRETE.
4. REINFORCED CONCRETE SHALL HAVE THE FOLLOWING 28 DAY COMPRESSIVE STRENGTHS AND BE IN ACCORDANCE WITH THE MDSB MIX DESIGNS:
   WALLS.....4000 PSI, NORMAL WEIGHT
   SLABS ON GRADE)
   INTERIOR.....4000 PSI, NORMAL WEIGHT
   EXTERIOR.....4000 PSI, NORMAL WEIGHT
5. ALL CONCRETE SLABS SHALL HAVE 6%(±1%) AIR ENTRAINMENT. SLUMP SHALL BE 4" ± 1".
6. PROVIDE PROTECTION FOR REINFORCING BARS AS FOLLOWS:
   CAST-IN-PLACE CONCRETE:
   CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH.....3"
   CONCRETE EXPOSED TO EARTH AND WEATHER (FORMED):
   #5 AND SMALLER.....2"

TESTS SHALL CONSIST OF COMPRESSIVE TESTS FOR STRENGTH AND SLUMP TEST FOR CONSISTENCY.

2.4 COPIES OF REPORTS OF CYLINDER TESTS TOGETHER WITH THE DATA RECORDED WHEN PREPARING THE CYLINDERS SHALL BE GIVEN TO THE COMPANY REPRESENTATIVE FOR REVIEW AND APPROVAL IMMEDIATELY AFTER EACH TEST IS COMPLETED.

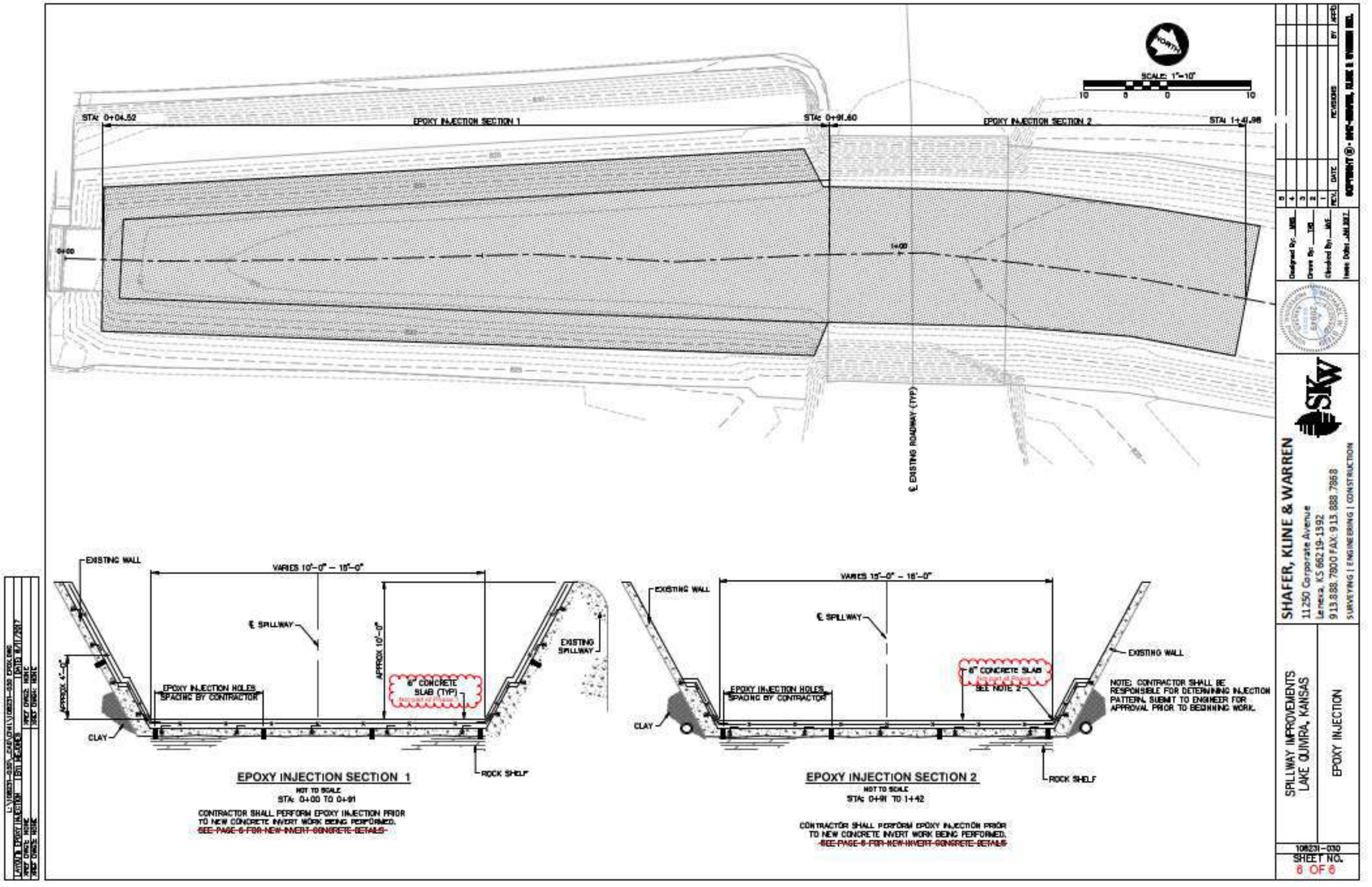
STANDARD AO MDSB.

10823I-030
SHEET NO.
2 OF 8

SUMMARY OF QUANTITIES PHASE 1

LINE	ITEM DESCRIPTION	UNIT	QUANTITY
ROADWAY ITEMS			
1	Mobilization	L.S.	1
2	Chemical grout injection (void volume *)	Cu.Ft.	3,800
3	Traffic Control	L.S.	1
4	Additional Chemical grout injection (if needed	Cu.Ft.	1

* VOLUME WAS OBTAINED FROM GPR DATA AT A DEPTH OF APPROXIMATELY 3FT BELOW THE EXISTING CONCRETE SURFACE. SEE GPR REPORT FOR FURTHER INFORMATION.


STA: 0+04.52
EPOXY INJECTION SECTION 1
STA: 0+91.60
EPOXY INJECTION SECTION 2
STA: 1+49.98
SCALE: 1"=10'
0+00
1+00
℄ EXISTING ROADWAY (TYP)
EXISTING WALL
VARIES 10'-0" – 15'-0"
℄ SPILLWAY
APPROX 4'-0"
APPROX 10'-0"
EPOXY INJECTION HOLES SPACING BY CONTRACTOR
6" CONCRETE SLAB (TYP)
EXISTING SPILLWAY
CLAY
ROCK SHELF
EPOXY INJECTION SECTION 1
NOT TO SCALE
STA: 0+00 TO 0+91
CONTRACTOR SHALL PERFORM EPOXY INJECTION PRIOR TO NEW CONCRETE INVERT WORK BEING PERFORMED.
SEE PAGE 6 FOR NEW INVERT CONCRETE DETAILS
VARIES 15'-0" – 18'-0"
EXISTING WALL
℄ SPILLWAY
EPOXY INJECTION HOLES SPACING BY CONTRACTOR
6" CONCRETE SLAB
SEE NOTE 2
EXISTING WALL
CLAY
ROCK SHELF
NOTE: CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING INJECTION PATTERN. SUBMIT TO ENGINEER FOR APPROVAL PRIOR TO BEGINNING WORK.
EPOXY INJECTION SECTION 2
NOT TO SCALE
STA: 0+91 TO 1+42
CONTRACTOR SHALL PERFORM EPOXY INJECTION PRIOR TO NEW CONCRETE INVERT WORK BEING PERFORMED.
SEE PAGE 6 FOR NEW INVERT CONCRETE DETAILS
SHAFER, KLINE & WARREN
11250 Corporate Avenue
Lenexa, KS 66219-1392
913.888.7900 FAX: 913.888.7958
SURVEYING | ENGINEERING | CONSTRUCTION
SPILLWAY IMPROVEMENTS
LAKE QUIMPA, KANSAS
EPOXY INJECTION
10823I-030
SHEET NO.
6 OF 6

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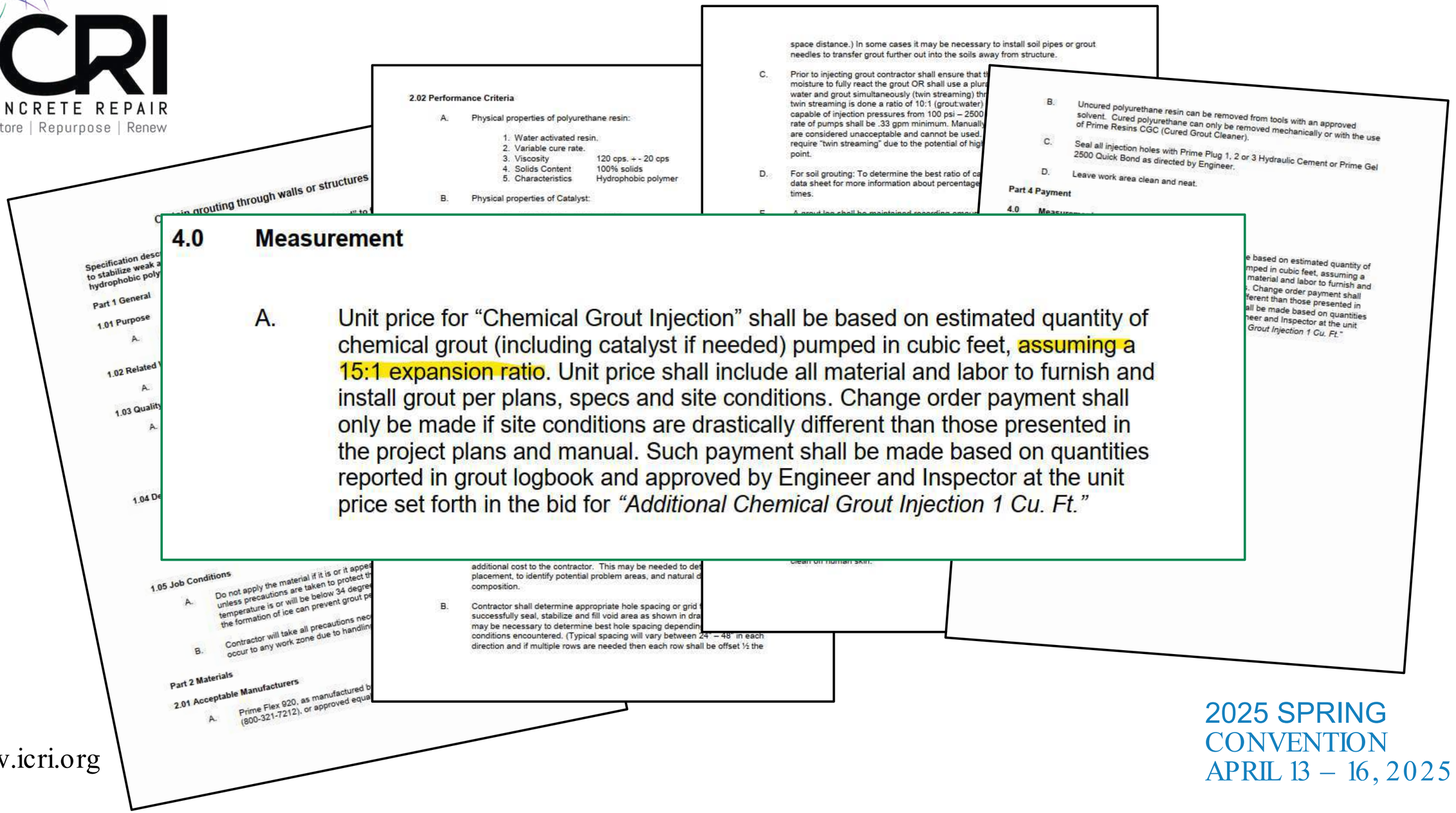


4.0 Measurement

A. Unit price for "Chemical Grout Injection" shall be based on estimated quantity of chemical grout (including catalyst if needed) pumped in cubic feet, assuming a 15:1 expansion ratio. Unit price shall include all material and labor to furnish and install grout per plans, specs and site conditions. Change order payment shall only be made if site conditions are drastically different than those presented in the project plans and manual. Such payment shall be made based on quantities reported in grout logbook and approved by Engineer and Inspector at the unit price set forth in the bid for *"Additional Chemical Grout Injection 1 Cu. Ft."*

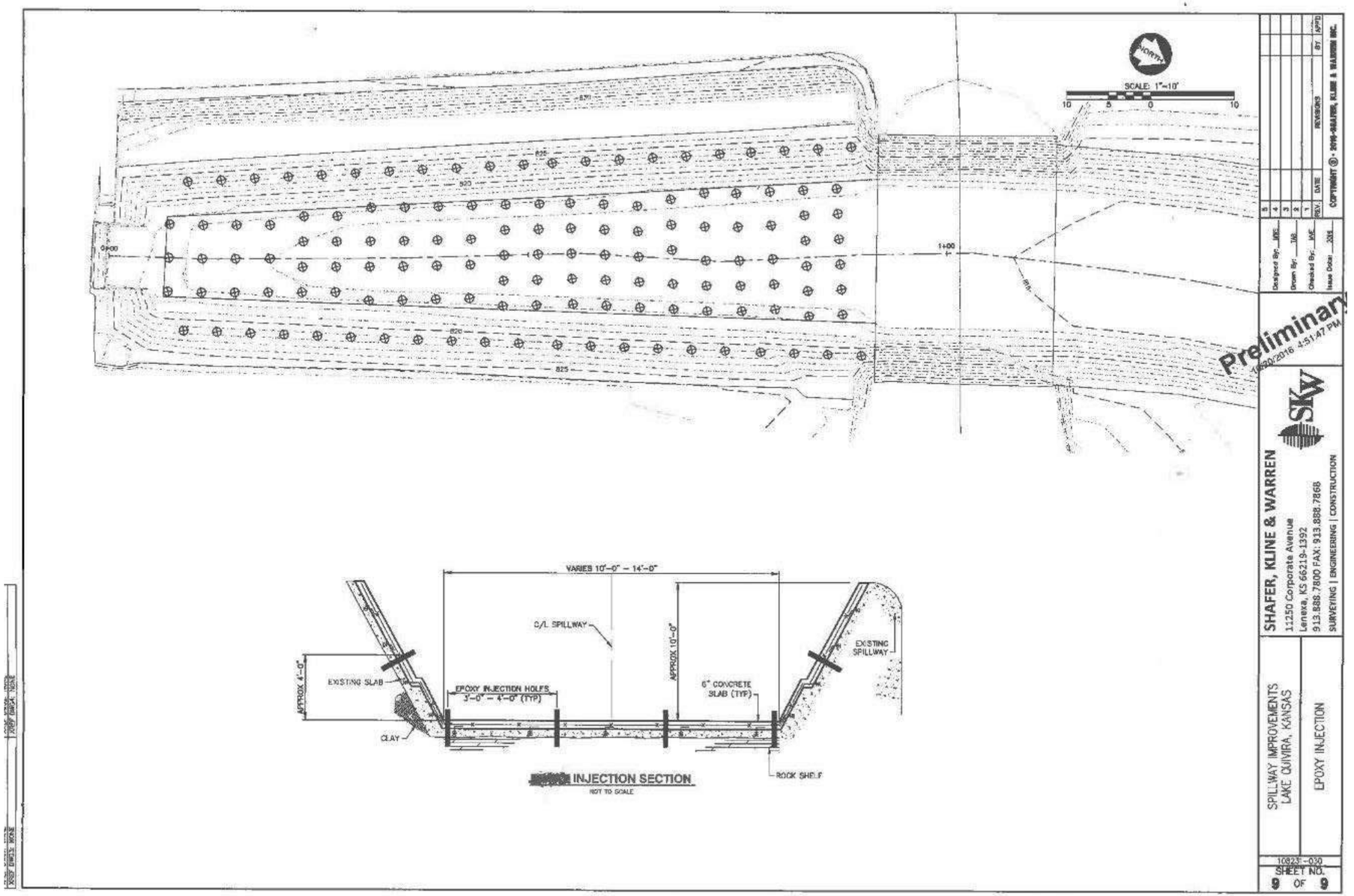
Resin Volume Calculations

GPR Void– 3800 ft3

Product – Hydrophobic Polyurethane (Prime Flex 920)

Assume 15x expansion– adjusted catalyst (Prime Kat) %

$$\frac{3800\ \text{ft}^3 \quad 7.48\ \text{gal}}{\text{ft}^3 \quad 15\text{x}} = 1895\ \text{gal}$$


SCALE: 1"=10'
0+00
1+00
825
820
815
VARIES 10'-0" – 14'-0"
C/L SPILLWAY
APPROX 10'-0"
EXISTING SLAB
EPOXY INJECTION HOLES
3'-0" – 4'-0" (TYP)
6" CONCRETE SLAB (TYP)
EXISTING SPILLWAY
CLAY
ROCK SHELF
INJECTION SECTION
NOT TO SCALE
Preliminary
10/20/2016 4:51:47 PM
SHAFER, KLINE & WARREN
11250 Corporate Avenue
Lenexa, KS 66219-1392
913.888.7800 FAX: 913.888.7868
SURVEYING | ENGINEERING | CONSTRUCTION
SPILLWAY IMPROVEMENTS
LAKE QUIVIRA, KANSAS
EPOXY INJECTION
10823-030
SHEET NO.
9 OF 9

Equipment Requirements

- Titan Modified Airless Sprayer
- High Pressure Control Valve
- Bang in Ports
- Drill & Drill Bits

Project Scope

- Pre-drill 3/8”Holes in Pattern
- Install Bang in Ports
- Pump till refusal/travel
- Re-drill & inject as needed
- Pull Ports
- Seal Holes

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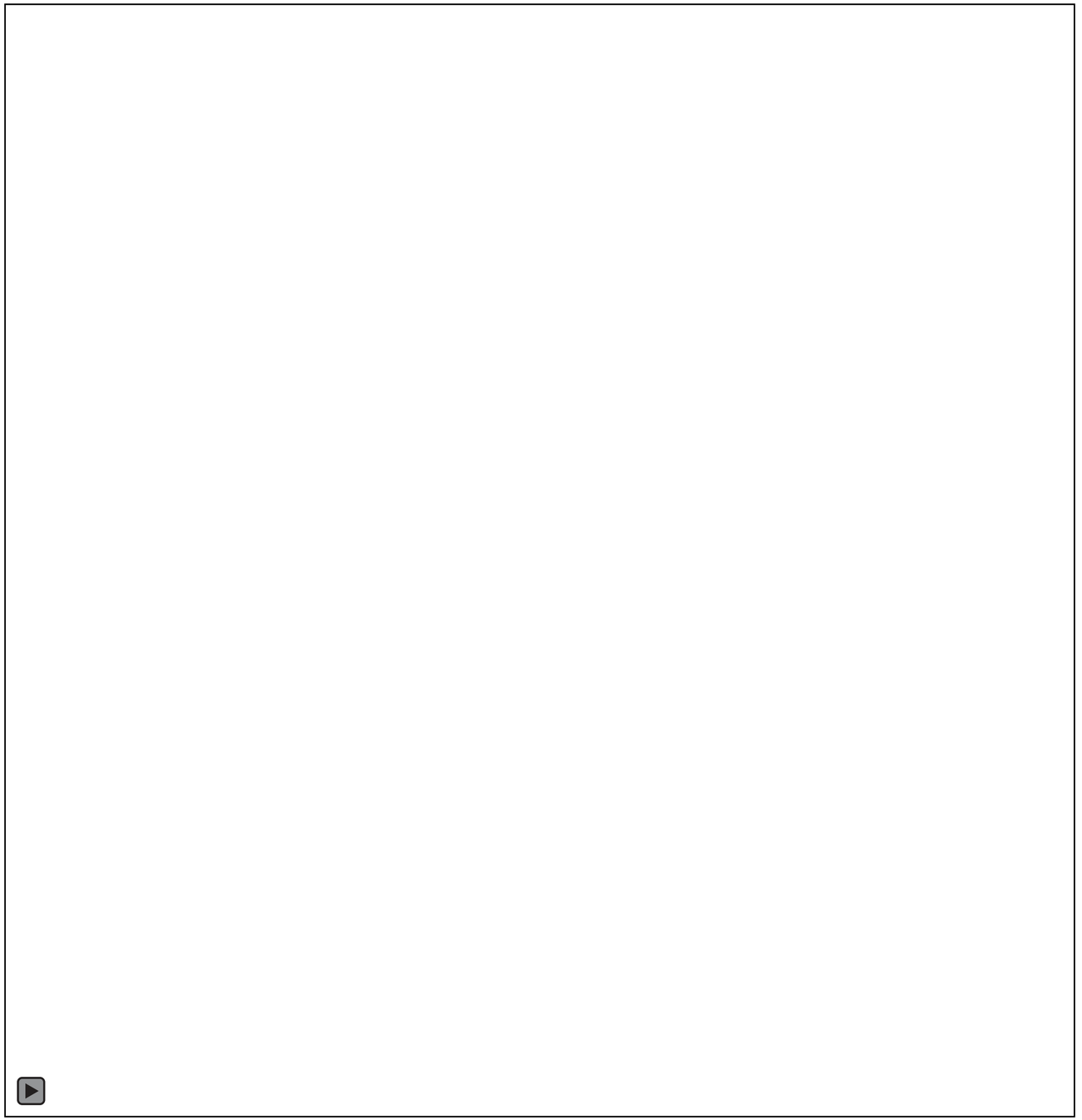

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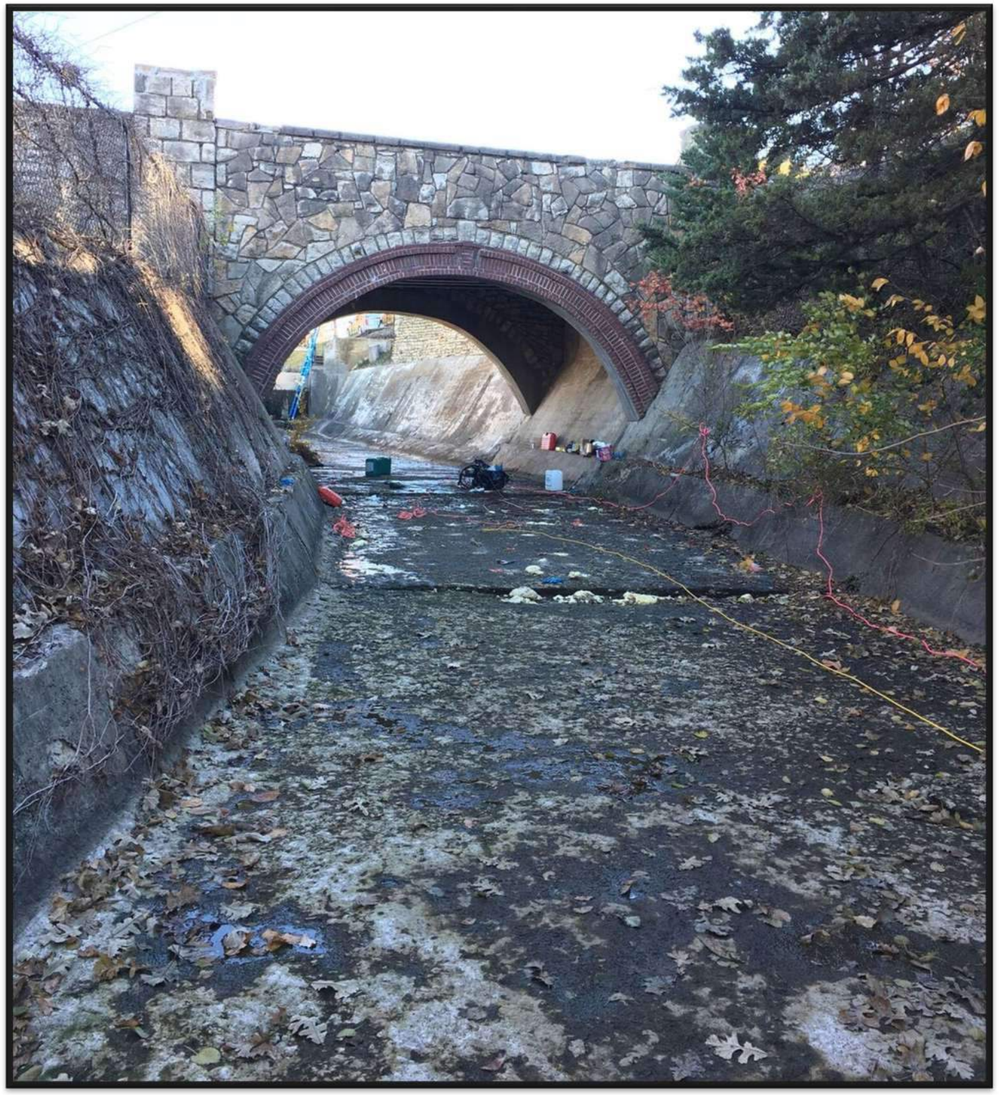
After first rain, spillway dried out completely.

Ended up using only around 540 gallons…

Bid called for 1895 gallons.



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GPR possible issues related to…

- Water seepage
- Delamination in sidewalls
- Imaging shallow targets
- Surveying on an angle

Chemical Injection to Underseal Spillway

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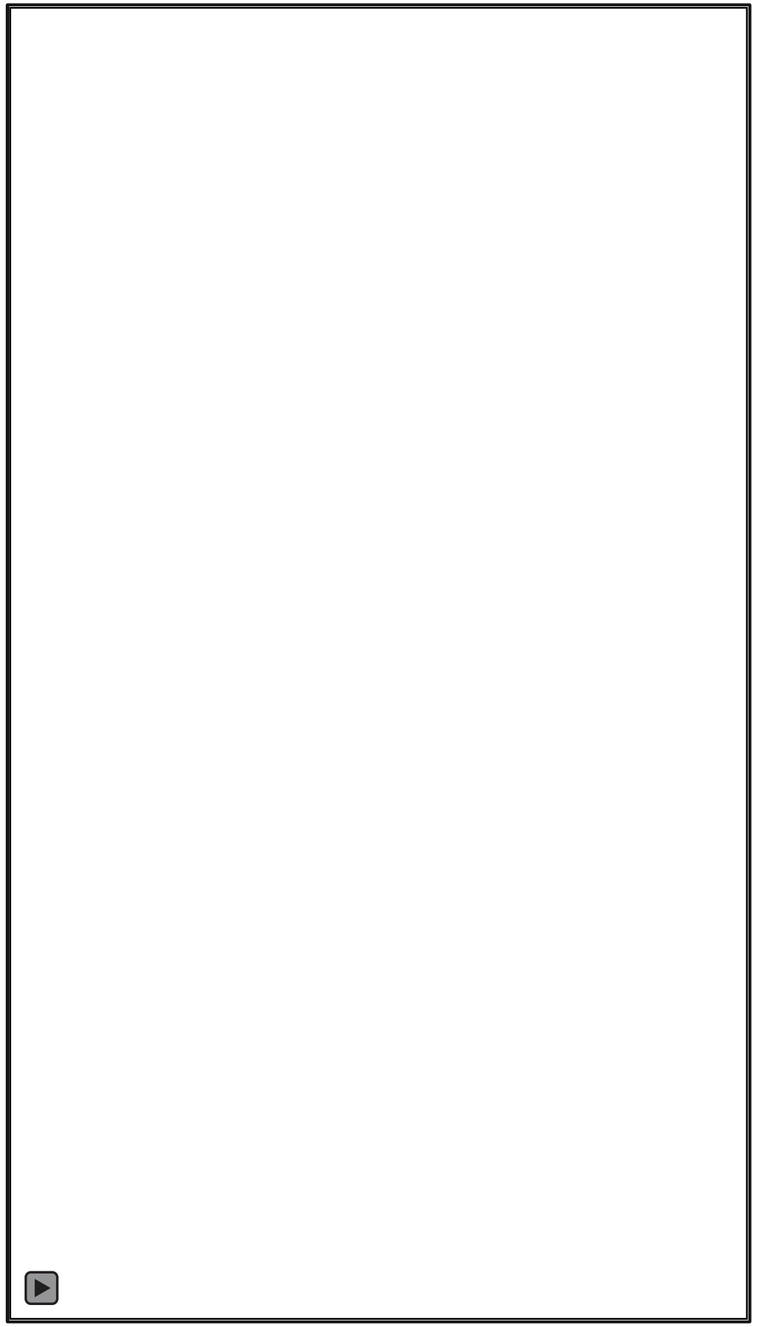
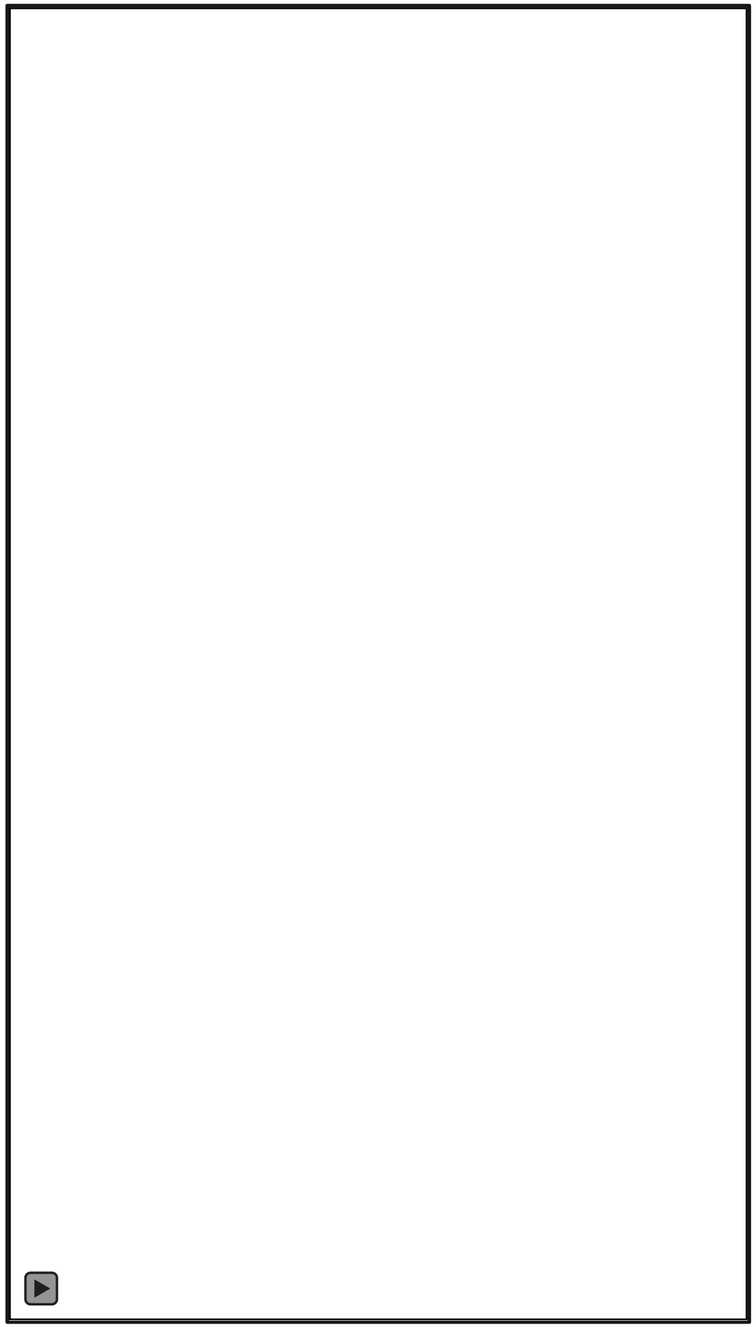
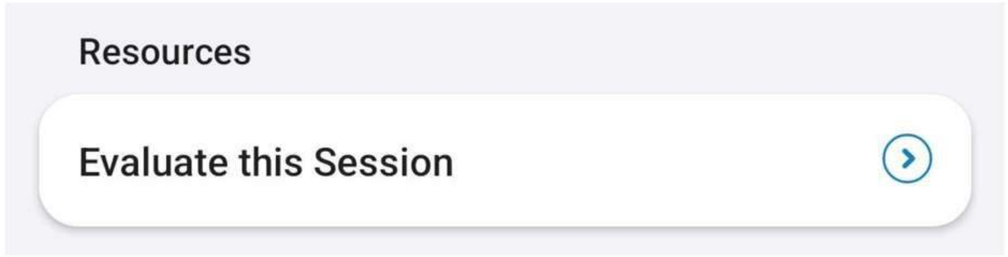




Summary

- Open discussions with the whole team (owner, engineer, contractor, distributor, manufacturer) lead to enhanced outcomes.
- Structural repairs require an epoxy while non-structural repairs (leak sealing) require a polyurethane.
- Always follow “best practices” for injection grouting but understand that field evaluations & specifications are not always without error, so one must adjust to observed conditions and be flexible.
- Product Manufacturers are excellent resources with extensive experience. Take advantage.

SESSIONEVALUATION



To complete the session evaluation, open the ICRI Convention App.

Under **Plan Your Event,** select Schedule, and then the Technical Session you are attending. Select the sub-session you are attending, scroll down to Resources, and select Evaluate this Session.

ANY QUESTIONS?

Wendy Rouleau
Vice President
Business Development

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Mobile: 470-609-4467