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EA Engineering, Science, and Technology, Inc., PBC
EA is a 100% Employee-Owned Public Benefit Corporation
IMPROVING THE QUALITY OF THE ENVIRONMENT IN WHICH WE LIVE, ONE PROJECT AT A TIME®

March 7, 2023

Mr. Tim Noger
Project Manager/Geoscientist Supervisor
New Mexico Environment Department
Petroleum Storage Tank Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505

RE: PetroFix® Injection Pilot Test Letter Report
Santa Fe County Judicial Complex
327 Sandoval Street, Santa Fe, New Mexico
Contract: 19-667-3200-0007
Facility ID: 53763 Release ID: 4597 Deliverable ID: 4260-5

Dear Mr. Noger:

EA Engineering, Science, and Technology, Inc., PBC (EA) is submitting this letter report documenting the completion of the PetroFix® injection pilot test in the West De Vargas plume of the Santa Fe County Judicial Complex (Figure 1). Work was completed following the *Change of Scope of Work for Injection Pilot Test – West De Vargas Plume, dated June 3, 2022,* approved by the New Mexico Environment Department (NMED) Petroleum Storage Tank Bureau (PSTB) on June 29, 2022.

Scope, Variance, and Injection by Well

Between February 2, 2023, and February 7, 2023, the following quantities of PetroFix® were injected into the injection wells DV-1 through DV-25:

	gallons	*pounds*	*gallons*	*feet bgs*		
	PetroFix® Volume	**Electron Acceptor Mass**	**Total Solution Volume**	**Number of Points**	**Target Zone**	**Method**
Actual	999	502	9,382	25	25-40	Injection Wells
Design	998	489	10,872	25	25-40	Injection Wells
Variance	1.4	13	-1,490	No Variance	No Variance	No Variance

feet bgs = feet below ground surface

The above table also presents the design quantities for 20% target pore volume for the estimated 20% effective porosity and the variance between the executed scope and the design.

The target volume could not be delivered into points DV-1 through DV-5. After injection of 60-75 gallons, the injection pressure spiked to 60-80 pounds per square inch by the gauge (psig), and flow seized. The assembly on DV-4 was blown off the wellhead. The first injection at these points was performed on February 3, 2023, the second injection was performed on February 4, 2023, and the third on February 6, 2023. All attempts resulted in similar performance. PetroFix® and electron acceptors designated for DV-1 through DV-5 were reapportioned into DV-7 through DV-15. Therefore, the total design volume/mass of PetroFix® and electron acceptors was injected at the site; however, the volume of water was less than projected. The details are provided below:

			Design	39.92	19.56	434.9
	Actual			Variance		
Units	*gallons*	*pounds*	*gallons*	*gallons*	*pounds*	*gallons*
Well	**PetroFix® Volume Actual**	**Electron Acceptor Mass Actual**	**Total Solution Volume Actual**	**PetroFix® Volume**	**Electron Acceptor Mass**	**Total Solution Volume**
DV-1	15.3	7.7	158	-25	-12	-277
DV-2	15.3	7.7	158	-25	-12	-277
DV-3	15.3	7.7	158	-25	-12	-277
DV-4	7.0	3.5	68	-33	-16	-367
DV-5	3.5	1.0	20	-36	-19	-415
DV-6	58.7	29.7	515	19	10	80
DV-7	50	25.3	420	10	6	-15
DV-8	56.9	28.8	495	17	9	60
DV-9	56.9	28.8	495	17	9	60
DV-10	56.9	28.8	495	17	9	60
DV-11	53	26.6	410	13	7	-25
DV-12	53	26.6	410	13	7	-25
DV-13	53	26.6	410	13	7	-25
DV-14	52.8	26.6	555	13	7	120
DV-15	53	26.7	410	13	7	-25
DV-16	40	20	290	0	0	-145
DV-17	40	20	435	0	0	0
DV-18	39.8	20	435	0	0	0
DV-19	39.8	20	435	0	0	0
DV-20	39.8	20	435	0	0	0
DV-21	40	20	435	0	0	0
DV-22	39.4	20	435	-0.5	0	0
DV-23	40	20	435	0	0	0
DV-24	40	20	435	0	0	0
DV-25	40	20	435	0	0	0
Grand Total	**999**	**502**	**9,382**	**1.4**	**13**	**-1,490**

In addition to the February 2023 injection, in July 2022, PetroFix® solution was injected into DV-1, DV-5, and DV-12, as follows:

Units	*gallons*	*pounds*	*gallons*	*gallons*	*gallons*
Well	**PetroFix®**	**Electron Acceptor**	**Injectate Volume**	**Chase Water**	**Total Volume**
DV-1	30.2	15	423	100	523
DV-5	30.2	15	423	100	523
DV-12	30.2	15	423	100	523

The crew mobilized to the site on February 3, 2023, and demobilized on February 7, 2023. Injection wells locations are shown in ***Drawing C-1***. Photographs are presented in ***Appendix A***. Field records are provided in ***Appendix B***. The design quantities are shown in ***Table 1***. Injection details are provided in ***Table 2***. Injection summary by well and day are provided in ***Table 3***.

Injection Pressure and Flowrates

Units	*pounds per square inch*	*gallons per minute*
Well ID	**Average of Sustained Pressure**	**Average of Average Flow Rate**
DV-1	60	0.9
DV-2	60	0.7
DV-3	60	0.8
DV-4	80	1.0
DV-5	60	0.3
DV-6	20	1.1
DV-7	15	1.0
DV-8	20	1.2
DV-9	20	1.0
DV-10	20	1.2
DV-11	20	1.4
DV-12	20	1.4
DV-13	20	1.4
DV-14	10	1.7
DV-15	20	1.3
DV-16	20	1.2
DV-17	5	1.6
DV-18	15	1.7
DV-19	5	1.7
DV-20	10	1.7
DV-21	10	1.6
DV-22	10	1.7
DV-23	10	1.6
DV-24	15	1.6
DV-25	10	1.6
Average	**16.8**	**1.4**

Daily Injection Summary

Units	*gallons*	*pounds*	*gallons*
Date	**PetroFix® Volume**	**Electron Acceptor Mass**	**Total Solution Volume**
02/03/23	28	14	305
02/04/23	248	125	1,975
02/05/23	399	200	4,350
02/06/23	195	97	1,552
02/07/23	130	66	1,200
Grand Total	**999**	**502**	**9,382**

Organizations, Entities, and Personnel

Provided below are the organizations, entities, and personnel that participated in the execution of this project.

Organization/Entity	Name	Title
NMED PSTB	Tim Noger	Project Manager
NMED PSTB	Katherine MacNeil, P.E.	Bureau Engineer
EA Engineering	Mike McVey, P.G., C.P.G.	Project Manager
EA Engineering	Vener Mustafin, P.E.	Engineer
EA Engineering	Daniel O'Brien	Scientist
Cascade Environmental	Cisco Gutierrez	Operations Manager
Cascade Environmental	Mike Martin	Project Manager
Cascade Environmental	Aaron Zapf	Driller
Cascade Environmental	Jose Mendoza	Helper

Cascade Environmental was subcontracted to perform the PetroFix® injection pilot test. Mike McVey, EA project manager, procured contractors and arranged access, schedule, and personnel. Daniel O'Brien, EA scientist, oversaw and documented the work. Vener Mustafin, EA engineer, visited the site on the first night of the injection, maintained daily phone contact with the crew, reviewed daily injection logs, directed the work, and provided daily updates to NMED PSTB.

Planning and preparation

Task	Description
Procurement	EA procured Cascade Environmental to perform the injection.
Access	EA obtained access and coordinated with the affected parties.
Water Source	Cascade Environmental obtained permission from the City of Santa Fe to use potable water from a city's fire hydrant.
Storage	PetroFix® and equipment were stored onsite.
HASP	EA updated the Health and Safety Plan.
Traffic Plan	Cascade delineated the work area with traffic barrels and tape.

PetroFix®	EA coordinated with NMED PSTB to pick up the PetroFix® totes from the NMED PSTB storage facility in Santa Fe and transport it to the site.
PetroFix® Delivery	Cascade picked up 1,000 gallons of PetroFix® and 500 pounds of Electron Acceptors from the NMED PSTB storage facility in Santa Fe and delivered them to the site.
Mobilization	Cascade Environmental and EA mobilized to the site on February 3, 2023.
Demobilization	Cascade Environmental and EA demobilized from the site on February 7, 2023.

Equipment, Tools, and Materials

Equipment	Details
Support Trucks	Ford F350 and Ford F250
Injection Module	Trailer-Mounted Custom
Generator	Trailer-Mounted Multiquip 150 kVA
Injection Tool	Custom wellhead assembly with a sight glass, control valve, and pressure gauge
Injection Pump	Liberty Progressive Cavity LL6 SSB
Mixing Vessel	300-gallon steel
Mixer Type and Model	Paddle Mixer with Leeson E57946 Motor
Manifold - Flowmeter	Flowmec 1" Digital, TM Series, Totalizing
Manifold - Pressure Gauge	Ashcroft 200 psi
Concrete Type and Container Size	Quikrete Ready-Mix® Concrete, 60-pound bags
Asphalt Patch Type and Container Size	Sack Cold Patch, 50-pound bags
Water Source	City of Santa Fe Fire Hydrant
Water Container Type and Volume	Plastic tote, 275-gallon capacity
PetroFix®	Four 250-gallon plastic totes
Electron Acceptor	Twenty-five 20-pound pales for a total of 500 pounds

Methodology

Process	Description
Injection	Injection into pre-installed injection wells through a manifold using custom wellhead assembly. Several points were manifolded together and fluids were injected simultaneously.
Mixer	Mixing was performed within a 300-gallon mixing vessel using an integral paddle mixer.
PetroFix® Homogenization	PetroFix® was homogenized within the 250-gallon totes using a handheld mechanical mixer before adding it to the mixing vessel. The PetroFix® had been stored since May 2021, moreover, the freezing temperatures further influenced the viscosity.
Water Source	Potable water was obtained from a fire hydrant along Sandoval Street and a potable water faucet at the 200 W. De Vargas Condominium Complex.

Mixing	Water was added to the mixing vessel and then the homogenized PetroFix® was transferred using a transfer pump; finally, the electron acceptor was added before the injection.
Injection	The injection was performed using a progressive cavity pump.
Injection Monitoring	The flow rate was monitored using a totalizing flowmeter. The pressure was monitored using a fixed pressure gauge. Mixing volumes were measured using gradations on the mixing tank.
Site Cleanup	Plastic was placed under pumps and around the equipment. When spills occurred, they were mitigated by vacuuming liquids and washing surfaces. Filtered fluids were reused for the injection.
Asphalt Restoration	Asphalt was restored using a cold patch.
Washing	Surfaces were pressure washed after completion of the injection.

Claim

EA intends to invoice the full approved amount of $305,670.34 (including NMGRT of 7.75%) for Deliverable ID 4260-5. If you have any questions or comments, please feel free to contact us.

Respectfully,

EA Engineering, Science, and Technology, Inc., PBC

Vener Mustafin, P.E.
Senior Engineer

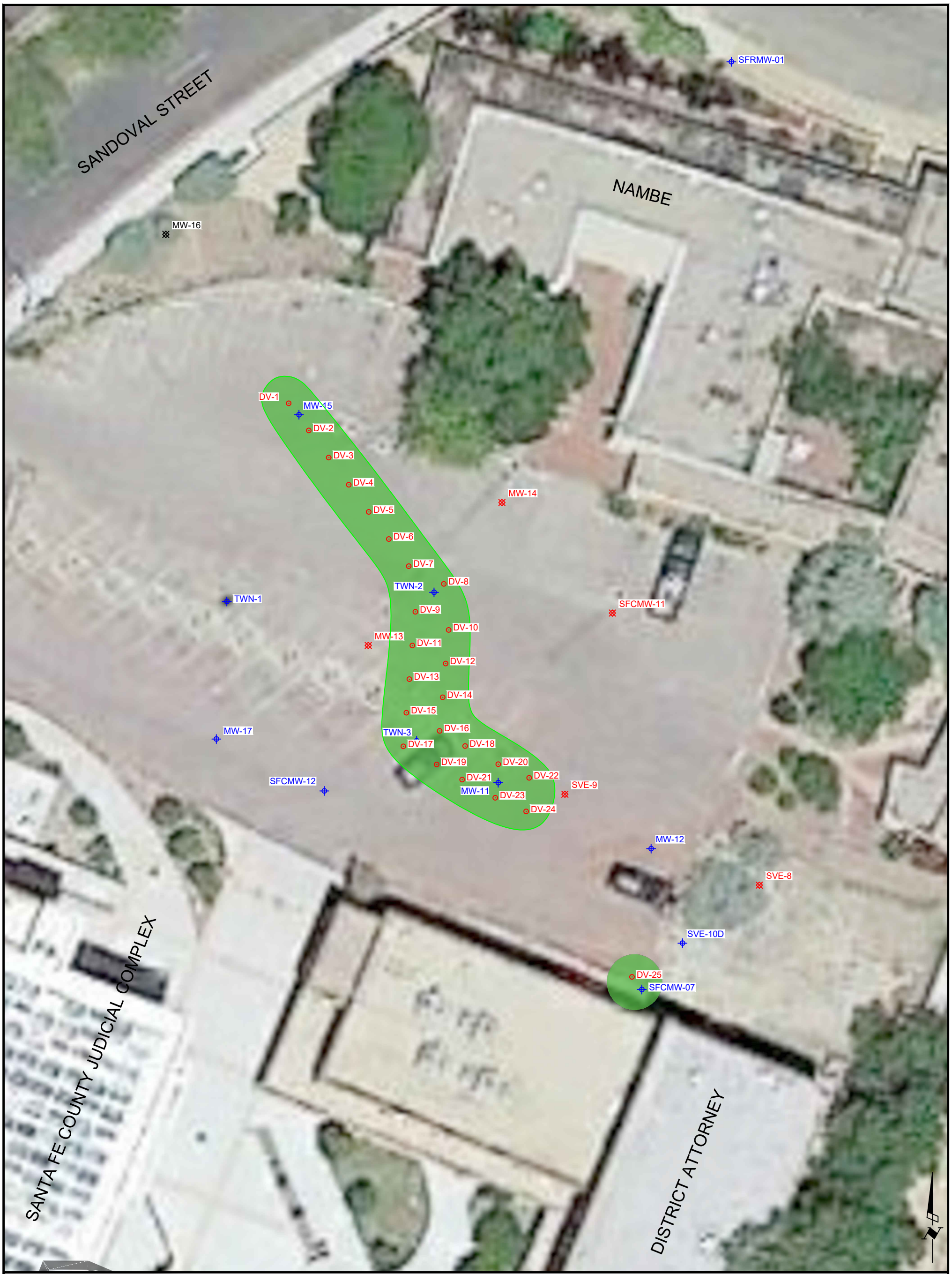
Michael D. McVey, P.G., C.P.G.
Project Manager/Senior Hydrogeologist

Attachments:

Drawing C-1 Injection Plan
Table 1 Design Quantities – 20% Effective Porosity and 20% Target Pore Volume
Table 2 PetroFix® Injection Details
Table 3 PetroFix® Injection Summary by Point and Day
Appendix A Photographs
Appendix B Field Records

DRAWING

P:\Active Projects\PSTB State lead\Santa Fe County Judicial Complex_SFCJC\Reports\4071-1 CRP\Figures



LEGEND:

- MONITORING WELL
- SOIL VAPOR EXTRACTION WELL
- DV-1 — INJECTION POINTS
- TARGET TREATMENT AREA

SCALE IN FEET: 20 10 0 20

SANTA FE COUNTY JUDICIAL COMPLEX
SANTA FE, NEW MEXICO

DRAWING C-1
WEST DE VARGAS PLUME INJECTION PLAN

PROJECT #:	6347001	PROJECT PHASE:	01	PROJECT MANAGER:	MM

320 Gold Avenue, SW Suite 1300
Albuquerque, NM 87102
Phone: (505) 224-9013
EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC. PBC

TABLES

Table 1. Design Quantities - 20% Effective Porosity and 20% Target Pore Volume

		gallons	*pounds*	*gallons*	*gallons*	*gallons*	*gallons*
Plume	**Number of Wells**	**Total PetroFix® Volume**	**Total Mass of Electron Acceptor**	**Total Injectate Volume**	**Application Rate PetroFix® Per Well**	**Mass of Electron Acceptor Per Well**	**Volume of Injectate per Well**
West De Vargas	25	998	489	10,922	39.92	19.56	434.9

Table 2. PetroFix® Injection Details
West De Vargas Plume, Santa Fe County Judicial Complex, Santa Fe, NM

						psi	*gpm*	*gallons*	*pounds*	*gallons*	*gallons*	
Well ID	Start Date	Start Time	End Date	End Time	Batch	Sustained Pressure	Average Flow Rate	PetroFix® Volume	Electron Acceptor Mass	Water Volume	Total Solution Volume	Day Lighting
DV-1	02/03/23	21:30	02/03/23	22:45	1	60	1.5	6.9	3.5	68.0	75	
DV-1	02/04/23	11:45	02/04/23	13:00	2	60	1.0	6.9	3.5	68.0	75	
DV-1	02/06/23	18:45	02/06/23	19:10			0.3	1.5	0.7	6.5	8	
DV-2	02/03/23	9:30	02/03/23	22:45	1	60	1.0	6.9	3.5	68.0	75	
DV-2	02/06/23	18:45	02/06/23	19:10			0	1.5	0.7	6.5	8	
DV-2	02/04/23	11:45	02/04/23	13:00	2	60	1.0	6.9	3.5	68.0	75	
DV-3	02/03/23	21:30	02/03/23	22:45	1	60	1.0	6.9	3.5	68.0	75	
DV-3	02/06/23	18:45	02/06/23	19:10			0.3	1.5	0.7	6.5	8	
DV-3	02/04/23	11:45	02/04/23	13:00	2	60	1.0	6.9	3.5	68.0	75	
DV-4	02/03/23	21:30	02/03/23	22:00	1	80	2.0	5.5	2.8	54.4	60	X
DV-4	02/06/23	18:45	02/06/23	19:10			0	1.5	0.7	6.5	8	
DV-5	02/06/23	18:45	02/06/23	19:01		60	0.3	3.5	1.0	16.5	20	
DV-6	02/03/23	22:00	02/03/23	22:45	1	20	1.0	1.8	0.9	18.1	20	
DV-6	02/04/23	10:40	02/04/23	11:25	2	20	1.7	6.9	3.5	68.0	75	
DV-6	02/06/23	19:30	02/06/23	20:19	3	20	1.2	11.0	5.5	49.0	60	
DV-6	02/06/23	20:33	02/06/23	21:36	4	20	1.0	6.5	3.3	53.6	60	
DV-6	02/06/23	21:41	02/06/23	22:48	5	20	1.0	6.5	3.3	53.6	60	
DV-6	02/06/23	22:32	02/06/23	23:20	6	20	1.0	6.5	3.3	53.6	60	
DV-6	02/06/23	23:25	02/06/23	0:08	7	20	1.0	6.5	3.3	53.6	60	
DV-6	02/07/23	0:15	02/07/23	1:10		20	1.0	6.5	3.3	53.6	60	
DV-6	02/07/23	1:13	02/07/23	1:50		20	1.0	6.5	3.3	53.6	60	
DV-7	02/06/23	19:30	02/06/23	20:19	1	15	1.0	11.0	5.5	49.0	60	
DV-7	02/06/23	20:33	02/06/23	21:36	2	15	1.0	6.5	3.3	53.6	60	
DV-7	02/06/23	21:41	02/06/23	22:48	3	15	1.0	6.5	3.3	53.6	60	
DV-7	02/06/23	22:32	02/06/23	23:20	4	15	1.0	6.5	3.3	53.6	60	
DV-7	02/06/23	23:25	02/06/23	0:08	5	15	1.0	6.5	3.3	53.6	60	
DV-7	02/07/23	0:15	02/07/23	1:10	6	15	1.0	6.5	3.3	53.6	60	
DV-7	02/07/23	1:13	02/07/23	1:50	7	15	1.0	6.5	3.3	53.6	60	
DV-8	02/04/23	10:40	02/04/23	11:25	1	20	1.5	6.9	3.5	68.0	75	
DV-8	02/06/23	19:30	02/06/23	20:19	2	20	1.2	11.0	5.5	49.0	60	
DV-8	02/06/23	20:33	02/06/23	21:36	3	20	1.0	6.5	3.3	53.6	60	
DV-8	02/06/23	21:41	02/06/23	22:48	4	20	1.0	6.5	3.3	53.6	60	
DV-8	02/06/23	22:32	02/06/23	23:20	5	20	1.0	6.5	3.3	53.6	60	
DV-8	02/06/23	23:25	02/06/23	0:08	6	20	1.0	6.5	3.3	53.6	60	
DV-8	02/07/23	0:15	02/07/23	1:10	7	20	1.1	6.5	3.3	53.6	60	
DV-8	02/07/23	1:13	02/07/23	1:50		20	1.6	6.5	3.3	53.6	60	
DV-9	02/04/23	10:40	02/04/23	11:25	1	20	1.7	6.9	3.5	68.0	75	
DV-9	02/06/23	19:30	02/06/23	20:19	2	20	1.2	11.0	5.5	49.0	60	

Table 2. PetroFix® Injection Details
West De Vargas Plume, Santa Fe County Judicial Complex, Santa Fe, NM

						psi	*gpm*	*gallons*	*pounds*	*gallons*	*gallons*	
Well ID	**Start Date**	**Start Time**	**End Date**	**End Time**	**Batch**	**Sustained Pressure**	**Average Flow Rate**	**PetroFix® Volume**	**Electronic Acceptor Mass**	**Water Volume**	**Total Solution Volume**	**Day Lighting**
DV-9	02/06/23	20:33	02/06/23	21:36	3	20	1.0	6.5	3.3	53.6	60	
DV-9	02/06/23	21:41	02/06/23	22:48	4	20	1.0	6.5	3.3	53.6	60	
DV-9	02/06/23	22:32	02/06/23	23:20	5	20	1.0	6.5	3.3	53.6	60	
DV-9	02/06/23	23:25		0:08	6	20	0	6.5	3.3	53.6	60	
DV-9	02/07/23	0:15	02/07/23	1:10	7	20	1.0	6.5	3.3	53.6	60	
DV-9	02/07/23	1:13	02/07/23	1:50		20	1.0	6.5	3.3	53.6	60	
DV-10	02/04/23	10:40	02/04/23	11:25	1	20	1.5	6.9	3.5	68.0	75	
DV-10	02/06/23	19:30	02/06/23	20:19	2	20	1.2	11.0	5.5	49.0	60	
DV-10	02/06/23	20:33	02/06/23	21:36	3	20	1.0	6.5	3.3	53.6	60	
DV-10	02/06/23	21:41	02/06/23	22:48	4	20	1.0	6.5	3.3	53.6	60	
DV-10	02/06/23	22:32	02/06/23	23:20	5	20	1.3	6.5	3.3	53.6	60	
DV-10	02/06/23	23:25	02/07/23	0:08	6	20		6.5	3.3	53.6	60	
DV-10	02/07/23	0:15	02/07/23	1:10	7	20	1.1	6.5	3.3	53.6	60	
DV-10	02/07/23	1:13	02/07/23	1:50		20	1.6	6.5	3.3	53.6	60	
DV-11	02/04/23	13:30	02/04/23	14:30	1	20	1.0	8.0	4.0	50.0	58	
DV-11	02/04/23	14:35	02/04/23	15:25	2	20	1.2	8.0	4.0	50.0	58	
DV-11	02/04/23	15:29	02/04/23	16:10	3	20	1.4	8.0	4.0	50.0	58	
DV-11	02/04/23	16:14	02/04/23	17:05	4	20	1.1	8.0	4.0	50.0	58	
DV-11	02/04/23	17:10	02/04/23	18:00	5	20	1.2	8.0	4.0	50.0	58	
DV-11	02/07/23	17:48	02/07/23	18:10				6.5	3.3	53.6	60	
DV-11	02/07/23	18:14	02/07/23	18:38			2.5	6.5	3.3	53.6	60	
DV-12	02/04/23	13:30	02/04/23	14:30	1	20	1.0	8.0	4.0	50.0	58	
DV-12	02/04/23	14:35	02/04/23	15:25	2	20	1.2	8.0	4.0	50.0	58	
DV-12	02/04/23	15:29	02/04/23	16:10	3	20	1.4	8.0	4.0	50.0	58	
DV-12	02/04/23	16:14	02/04/23	17:05	4	20	1.1	8.0	4.0	50.0	58	
DV-12	02/04/23	17:10	02/04/23	18:00	5	20	1.2	8.0	4.0	50.0	58	
DV-12	02/07/23	17:48	02/07/23	18:10				6.5	3.3	53.6	60	
DV-12	02/07/23	18:14	02/07/23	18:38			2.5	6.5	3.3	53.6	60	
DV-13	02/04/23	13:30	02/04/23	14:30	1	20	1.0	8.0	4.0	50.0	58	
DV-13	02/04/23	14:35	02/04/23	15:25	2	20	1.2	8.0	4.0	50.0	58	
DV-13	02/04/23	15:29	02/04/23	16:10	3	20	1.4	8.0	4.0	50.0	58	
DV-13	02/04/23	16:14	02/04/23	17:05	4	20	1.1	8.0	4.0	50.0	58	
DV-13	02/04/23	17:10	02/04/23	18:00	5	20	1.2	8.0	4.0	50.0	58	
DV-13	02/07/23	17:48	02/07/23	18:10				6.5	3.3	53.6	60	
DV-13	02/07/23	18:14	02/07/23	18:38			2.5	6.5	3.3	53.6	60	
DV-14	02/05/23	9:00	02/05/23	9:32	1	10	1.8	8.0	4.0	50.0	58	
DV-14	02/05/23	9:35	02/05/23	10:13	2	10	1.5	8.0	4.0	50.0	58	
DV-14	02/05/23	10:17	02/05/23	10:51	3	10	1.8	5.6	2.8	54.4	60	

Table 2. PetroFix® Injection Details
West De Vargas Plume, Santa Fe County Judicial Complex, Santa Fe, NM

						psi	*gpm*	*gallons*	*pounds*	*gallons*	*gallons*	
Well ID	**Start Date**	**Start Time**	**End Date**	**End Time**	**Batch**	**Sustained Pressure**	**Average Flow Rate**	**PetroFix® Volume**	**Electronic Acceptor Mass**	**Water Volume**	**Total Solution Volume**	**Day Lighting**
DV-14	02/05/23	10:56	02/05/23	11:35	4	10	1.5	4.2	2.1	55.6	60	
DV-14	02/05/23	11:40	02/05/23	12:15	5	10	1.5	4.2	2.1	55.6	60	
DV-14	02/05/23	12:20	02/05/23	12:55	6	10	1.6	4.2	2.1	55.6	60	
DV-14	02/05/23	13:00	02/05/23	13:32	7	10	1.9	4.2	2.1	55.6	60	
DV-14	02/05/23	13:38	02/05/23	13:53	8	10	1.7	1.4	0.8	18.2	19	
DV-14	02/07/23	17:48	02/07/23	18:10				6.5	3.3	53.6	60	
DV-14	02/07/23	18:14	02/07/23	18:38				6.5	3.3	53.6	60	
DV-15	02/04/23	11:45	02/04/23	13:00	1	20	1.0	6.9	3.5	68.0	75	
DV-15	02/04/23	13:30	02/04/23	14:30	2	20	1.0	8.0	4.0	50.0	58	
DV-15	02/04/23	14:35	02/04/23	15:25	3	20	1.2	8.0	4.0	50.0	58	
DV-15	02/04/23	15:29	02/04/23	16:10	4	20	1.4	8.0	4.0	50.0	58	
DV-15	02/04/23	16:14	02/04/23	17:05	5	20	0.8	9.1	4.6	50.0	41	
DV-15	02/07/23	17:48	02/07/23	18:10				6.5	3.3	53.6	60	
DV-15	02/07/23	18:14	02/07/23	18:38			2.5	6.5	3.3	53.6	60	
DV-16	02/04/23	13:30	02/04/23	14:30	1	20	1.0	8.0	4.0	50.0	58	
DV-16	02/04/23	14:35	02/04/23	15:25	2	20	1.2	8.0	4.0	50.0	58	
DV-16	02/04/23	15:29	02/04/23	16:10	3	20	1.4	8.0	4.0	50.0	58	
DV-16	02/04/23	16:14	02/04/23	17:05	4	20	1.1	8.0	4.0	50.0	58	
DV-16	02/04/23	17:10	02/04/23	18:00	5	20	1.2	8.0	4.0	50.0	58	
DV-17	02/05/23	14:05	02/05/23	14:40	1	5	1.7	5.5	2.8	54.4	60	
DV-17	02/05/23	14:45	02/05/23	15:22	2	5	1.6	5.5	2.8	54.4	60	
DV-17	02/05/23	15:25	02/05/23	16:00	3	5	1.7	5.5	2.8	54.4	60	
DV-17	02/05/23	16:03	02/05/23	16:40	4	5	1.7	5.5	2.8	54.4	60	
DV-17	02/05/23	16:43	02/05/23	17:20	5	5	1.6	5.5	2.8	54.4	60	
DV-17	02/05/23	17:23	02/05/23	18:00	6	5	1.6	5.5	2.8	54.4	60	
DV-17	02/05/23	18:03	02/05/23	18:40	7	5	1.6	5.5	2.8	54.4	60	
DV-17	02/05/23	18:42	02/05/23	18:54	8	5	1.3	1.5	0.4	13.7	15	
DV-18	02/05/23	9:00	02/05/23	9:32	1	15	1.8	8.0	4.0	50.0	58	
DV-18	02/05/23	9:35	02/05/23	10:13	2	15	1.5	8.0	4.0	50.0	58	
DV-18	02/05/23	10:17	02/05/23	10:51	3	15	1.8	5.6	2.8	54.4	60	
DV-18	02/05/23	10:56	02/05/23	11:35	4	15	1.7	4.2	2.1	55.6	60	
DV-18	02/05/23	11:40	02/05/23	12:15	5	15	1.8	4.2	2.1	55.6	60	
DV-18	02/05/23	12:20	02/05/23	12:55	6	15	1.7	4.2	2.1	55.6	60	
DV-18	02/05/23	13:00	02/05/23	13:32	7	15	1.9	4.2	2.1	55.6	60	
DV-18	02/05/23	13:38	02/05/23	13:53	8	15	1.4	1.4	0.8	18.2	19	
DV-19	02/05/23	9:00	02/05/23	9:32	1	5	1.8	8.0	4.0	50.0	58	
DV-19	02/05/23	9:35	02/05/23	10:13	2	5	1.5	8.0	4.0	50.0	58	
DV-19	02/05/23	10:17	02/05/23	10:51	3	5	1.8	5.6	2.8	54.4	60	

Table 2. PetroFix® Injection Details
West De Vargas Plume, Santa Fe County Judicial Complex, Santa Fe, NM

						psi	*gpm*	*gallons*	*pounds*	*gallons*	*gallons*	
Well ID	**Start Date**	**Start Time**	**End Date**	**End Time**	**Batch**	**Sustained Pressure**	**Average Flow Rate**	**PetroFix® Volume**	**Electronic Acceptor Mass**	**Water Volume**	**Total Solution Volume**	**Day Lighting**
DV-19	02/05/23	10:56	02/05/23	1:35	4	5	1.7	4.2	2.1	55.6	60	
DV-19	02/05/23	11:40	02/05/23	12:15	5	5	1.8	4.2	2.1	55.6	60	
DV-19	02/05/23	12:20	02/05/23	12:55	6	5	1.7	4.2	2.1	55.6	60	
DV-19	02/05/23	13:00	02/05/23	13:32	7	5	1.9	4.2	2.1	55.6	60	
DV-19	02/05/23	13:38	02/05/23	13:53	8	5	1.4	1.4	0.8	18.2	19	
DV-20	02/05/23	9:00	02/05/23	9:32	1	10	1.8	8.0	4.0	50.0	58	
DV-20	02/05/23	9:35	02/05/23	10:13	2	10	1.5	8.0	4.0	50.0	58	
DV-20	02/05/23	10:17	02/05/23	10:51	3	10	1.6	5.6	2.8	54.4	60	
DV-20	02/05/23	10:56	02/05/23	11:35	4	10	1.7	4.2	2.1	55.6	60	
DV-20	02/05/23	11:40	02/05/23	12:15	5	10	1.7	4.2	2.1	55.6	60	
DV-20	02/05/23	12:20	02/05/23	12:55	6	10	1.7	4.2	2.1	55.6	60	
DV-20	02/05/23	13:00	02/05/23	13:32	7	10	1.9	4.2	2.1	55.6	60	
DV-20	02/05/23	13:38	02/05/23	13:53	8	10	1.4	1.4	0.8	18.2	19	
DV-21	02/05/23	14:05	02/05/23	14:40	1	10	1.7	5.5	2.8	54.4	60	
DV-21	02/05/23	14:45	02/05/23	15:22	2	10	1.6	5.5	2.8	54.4	60	
DV-21	02/05/23	15:25	02/05/23	16:00	3	10	1.7	5.5	2.8	54.4	60	
DV-21	02/05/23	16:03	02/05/23	16:40	4	10	1.7	5.5	2.8	54.4	60	
DV-21	02/05/23	16:43	02/05/23	17:20	5	10	1.6	5.5	2.8	54.4	60	
DV-21	02/05/23	17:23	02/05/23	18:00	6	10	1.6	5.5	2.8	54.4	60	
DV-21	02/05/23	18:03	02/05/23	18:40	7	10	1.6	5.5	2.8	54.4	60	
DV-21	02/05/23	18:42	02/05/23	18:54	8	10	1.3	1.5	0.4	13.7	15	
DV-22	02/05/23	9:00	02/05/23	9:32	1	10	1.8	8.0	4.0	50.0	58	
DV-22	02/05/23	9:35	02/05/23	10:13	2	10	1.5	8.0	4.0	50.0	58	
DV-22	02/05/23	10:17	02/05/23	10:51	3	10	1.8	5.6	2.8	54.4	60	
DV-22	02/05/23	10:56	02/05/23	11:35	4	10	1.7	4.2	2.1	55.6	60	
DV-22	02/05/23	11:40	02/05/23	12:15	5	10	1.6	4.2	2.1	55.6	60	
DV-22	02/05/23	12:20	02/05/23	12:55	6	10	1.7	4.2	2.1	55.6	60	
DV-22	02/05/23	13:00	02/05/23	13:32	7	10	1.9	4.2	2.1	55.6	60	
DV-22	02/05/23	13:38	02/05/23	13:53	8	10	1.3	1.0	0.8	18.0	19	
DV-23	02/05/23	14:05	02/05/23	14:40	1	10	1.7	5.5	2.8	54.4	60	
DV-23	02/05/23	14:45	02/05/23	15:22	2	10	1.6	5.5	2.8	54.4	60	
DV-23	02/05/23	15:25	02/05/23	16:00	3	10	1.7	5.5	2.8	54.4	60	
DV-23	02/05/23	16:03	02/05/23	16:40	4	10	1.7	5.5	2.8	54.4	60	
DV-23	02/05/23	16:43	02/05/23	17:20	5	10	1.6	5.5	2.8	54.4	60	
DV-23	02/05/23	17:23	02/05/23	18:00	6	10	1.6	5.5	2.8	54.4	60	
DV-23	02/05/23	18:03	02/05/23	18:40	7	10	1.6	5.5	2.8	54.4	60	
DV-23	02/05/23	18:42	02/05/23	18:54	8	10	1.3	1.5	0.4	13.7	15	
DV-24	02/05/23	14:05	02/05/23	14:40	1	15	1.7	5.5	2.8	54.4	60	

Table 2. PetroFix® Injection Details
West De Vargas Plume, Santa Fe County Judicial Complex, Santa Fe, NM

						psi	*gpm*	*gallons*	*pounds*	*gallons*	*gallons*	
Well ID	**Start Date**	**Start Time**	**End Date**	**End Time**	**Batch**	**Sustained Pressure**	**Average Flow Rate**	**PetroFix® Volume**	**Electronic Acceptor Mass**	**Water Volume**	**Total Solution Volume**	**Day Lighting**
DV-24	02/05/23	14:45	02/05/23	15:22	2	15	1.6	5.5	2.8	54.4	60	
DV-24	02/05/23	15:25	02/05/23	16:00	3	15	1.7	5.5	2.8	54.4	60	
DV-24	02/05/23	16:03	02/05/23	16:40	4	15	1.7	5.5	2.8	54.4	60	
DV-24	02/05/23	16:43	02/05/23	17:20	5	15	1.6	5.5	2.8	54.4	60	
DV-24	02/05/23	17:23	02/05/23	18:00	6	15	1.6	5.5	2.8	54.4	60	
DV-24	02/05/23	18:03	02/05/23	18:40	7	15	1.6	5.5	2.8	54.4	60	
DV-24	02/05/23	18:42	02/05/23	18:54	8	15	1.3	1.5	0.4	13.7	15	
DV-25	02/05/23	14:05	02/05/23	14:40	1	10	1.7	5.5	2.8	54.4	60	
DV-25	02/05/23	14:45	02/05/23	15:22	2	10	1.6	5.5	2.8	54.4	60	
DV-25	02/05/23	15:25	02/05/23	16:00	3	10	1.7	5.5	2.8	54.4	60	
DV-25	02/05/23	16:03	02/05/23	16:40	4	10	1.7	5.5	2.8	54.4	60	
DV-25	02/05/23	16:43	02/05/23	17:20	5	10	1.6	5.5	2.8	54.4	60	
DV-25	02/05/23	17:23	02/05/23	18:00	6	10	1.6	5.5	2.8	54.4	60	
DV-25	02/05/23	18:03	02/05/23	18:40	7	10	1.6	5.5	2.8	54.4	60	
DV-25	02/05/23	18:42	02/05/23	18:54	8	10	1.3	1.5	0.4	13.7	15	
						16.8	**1.39**	**999**	**502**	**8,399**	**9,382**	

Table 3. PetroFix® Injection Summary by Point and Day
West De Vargas Plume, Santa Fe Country Judicial Complex, Santa Fe, NM

	02/03/23			02/04/23			02/05/23			02/06/23			02/07/23			Total PetroFix®	Total EA	Total Injectate
Well ID	**PetroFix®**	**EA**	**Injectate**	**PetroFix®**	**EA**	**Injectate**	**PetroFix®**	**EA**	**Injectate**	**PetroFix®**	**EA**	**Injectate**	**PetroFix®**	**EA**	**Injectate**			
DV-1	7	3.5	75	7	3.5	75				2	0.7	8				***15***	***8***	***158***
DV-2	7	3.5	75	7	3.5	75				2	0.7	8				***15***	***8***	***158***
DV-3	7	3.5	75	7	3.5	75				2	0.7	8				***15***	***8***	***158***
DV-4	6	2.8	60							2	0.7	8				***7***	***4***	***68***
DV-5										4	1.0	20				***4***	***1***	***20***
DV-6	2	0.9	20	7	3.5	75				37	18.7	300	13	6.6	120	***59***	***30***	***515***
DV-7										37	18.7	300	13	6.6	120	***50***	***25***	***420***
DV-8				7	3.5	75				37	18.7	300	13	6.6	120	***57***	***29***	***495***
DV-9				7	3.5	75				37	18.7	300	13	6.6	120	***57***	***29***	***495***
DV-10				7	3.5	75				37	18.7	300	13	6.6	120	***57***	***29***	***495***
DV-11				40	20	290							13	6.6	120	***53***	***27***	***410***
DV-12				40	20	290							13	6.6	120	***53***	***27***	***410***
DV-13				40	20	290							13	6.6	120	***53***	***27***	***410***
DV-14							40	20	435				13	6.6	120	***53***	***27***	***555***
DV-15				40	20	290							13	6.6	120	***53***	***27***	***410***
DV-16				40	20	290										***40***	***20***	***290***
DV-17							40	20	435							***40***	***20***	***435***
DV-18							40	20	435							***40***	***20***	***435***
DV-19							40	20	435							***40***	***20***	***435***
DV-20							40	20	435							***40***	***20***	***435***
DV-21							40	20	435							***40***	***20***	***435***
DV-22							39	20	435							***39***	***20***	***435***
DV-23							40	20	435							***40***	***20***	***435***
DV-24							40	20	435							***40***	***20***	***435***
DV-25							40	20	435							***40***	***20***	***435***
Grand Total	***28***	***14***	***305***	***248***	***125***	***1,975***	***399***	***200***	***4,350***	***195***	***97***	***1,552***	***130***	***66***	***1,200***	***999***	***502***	***9,382***

PetroFix® = PetroFix® volume in gallons
EA = electron acceptor in pounds
Total = total volume in gallons

APPENDIX A - PHOTOGRAPHS

Injection Setup

JCB 506 Forklift

Trailer-Mounted MultiQuip 150 KVA Generator

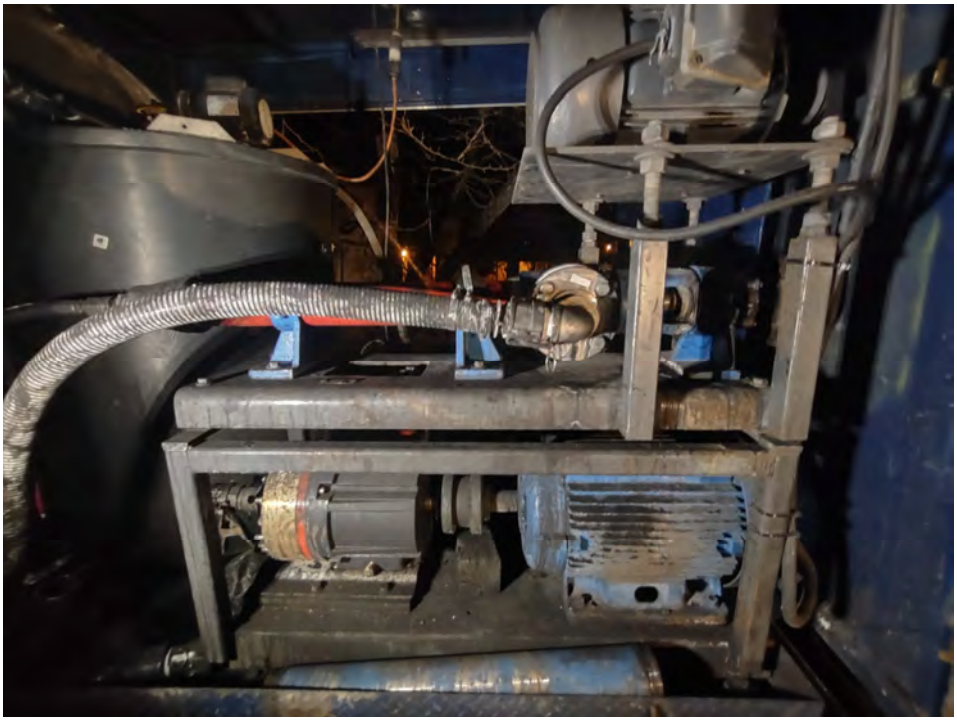
Custom Injection Trailer

PetroFix® Tote elevated with the forklift

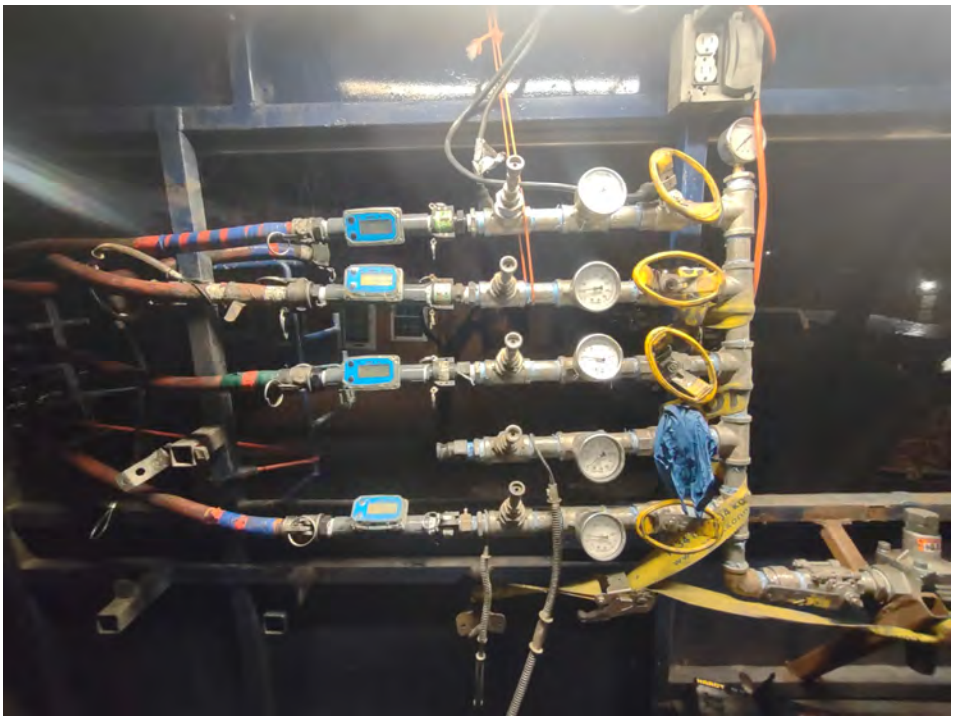
Diesel Heater to Keep PetroFix® Warm

Wellhead Assembly – View from Above

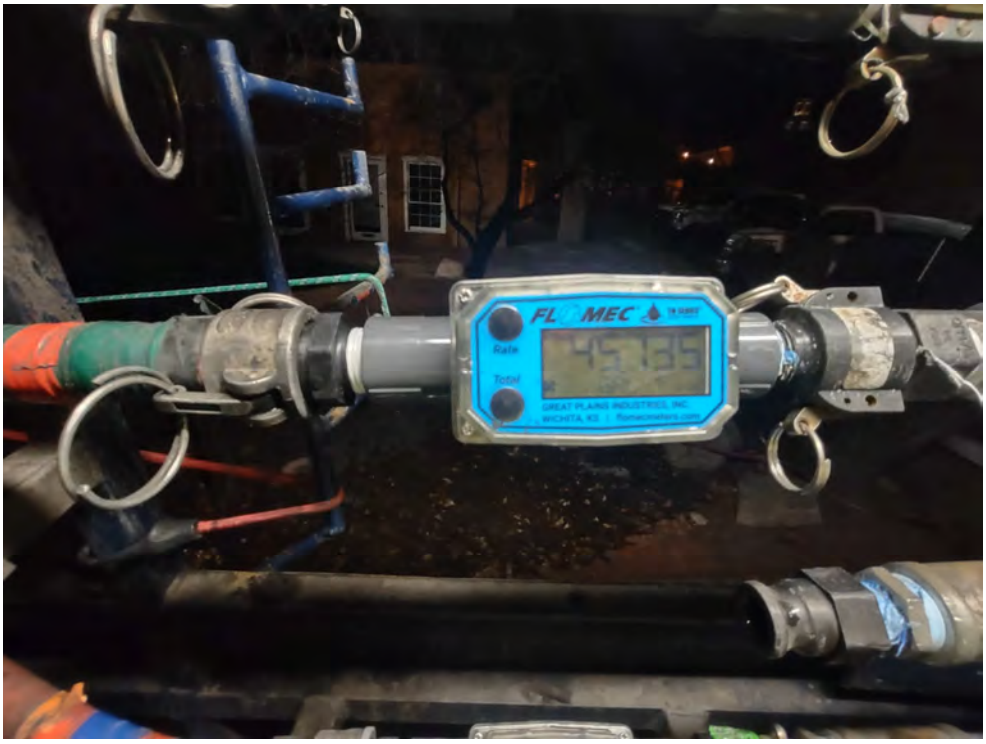
Wellhead Assembly – Profile View



Injection Pumps and Mixing Tank



Injection Manifold



Flomec Totalizing Flowmeter

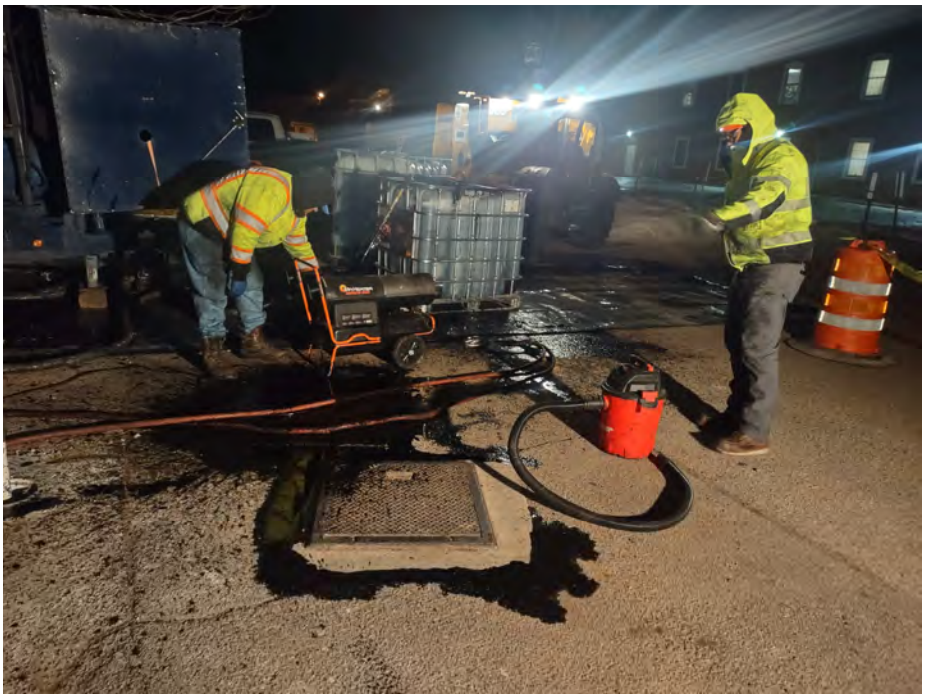
Scale to Weigh Electron Acceptors

300-gallon Mixing Vessel

Electron Acceptor

Injection Trailer

DV-4 Fitting Blew Off of the Wellhead



Cleanup of PetroFix® around DV-4 Using a Vacuum and Water

Cleaned up Surfaces before De-Mobilization

Equipment Loaded for De-Mobilization

Surfaces Prior to De-Mobilization

Pressure-Washed **Parking Lot** Surface Prior to De-Mobilization

APPENDIX B – FIELD RECORDS

Site Name: Santa Fe County Judicial Complex

JOB NUMBER:
AREA:
CLIENT: NMED PSTB

DATE: 2-3-23
EA STAFF: D. OBrien
PAGE: 1 of

Batch Mix	Volume PetroFlx	Volume Water	Volume Nutirents (Nitrate/Sulfat	Volume Nutirents (Nitrate)	Number of batches	Total Volume	COMMENTS (note variance in inj. rate or pressures; downtime and cause; break-through pressure.
	(gal)	(gal)	~~(gal)~~ lbs	(gal)	#	(gal)	
	27.6	272	13.8				

Injection

Injection Point	Injection Interval	Time	Flow Meter Reading - Start	Flow Meter Reading - End	Wellhead Volume (gal)	Wellhead Flow Rate (gpm)	Wellhead Pressure (psi)	COMMENTS
DV 1	–	2118	5	0.1	67		0-80	
DV 2		↓	↓	↓	67		↓	
DV 3					67			
DV 4					67			wellhead blown off with pressure
DV 6	–	2309	1	1	30		15	

2/3/2023

1730 - onsite, mike martin present and setting up

1804 - health and safety meeting conducted

1819 - setup continues

2022 - Succesful pump of water in DV1, DV2 DV3, DV4

2118 - Began injecting into DV1 DV2, DV3, DV4

2152 - DV4 exploded from high pressure injection continues on DV1, DV2, DV3 at slow rpm (0.1-0.2)

2304 DV6 connected for injection

2328 tank of first batch Emptied & Drillers Decided to begin cleanup and try tomorrow moving well to well, small amounts at a time to allow Dissipation

00:42 off site

Site Name: Santa Fe County Judicial Complex

JOB NUMBER:

AREA:

CLIENT: NMED PSTB

DATE: 2-4-2023

EA STAFF: D. OBrien

PAGE: 2 of

Batch Mix	Volume PetroFlx (gal)	Volume Water (gal)	Volume Nutirents (Nitrate/Sulfat (gal)	Volume Nutirents (Nitrate) (gal)	Number of batches #	Total Volume (gal)	COMMENTS (note variance in inj. rate or pressures; downtime and cause; break-through pressure.
	27.6 - 41.4	272 - 259	13.8 - 20.7				

Injection

Injection Point	Injection Interval	Time	Flow Meter Reading - Start	Flow Meter Reading - End	Wellhead Volume (gal)	Wellhead Flow Rate (gpm)	Wellhead Pressure (psi)	
DV 6		1008			75			
DV 8		↓			75			
DV 9					79			
DV 10		↓			75			
DV 1		1250			79			
DV 2					75			
DV 3					75			
DV 15		↓			75			
DV 11		1341			290			Batch increase in petrofix concentration wells taking Dosing better - 145 g water will be chased to achieve full 435
DV 12								
DV 13								
DV 15								
DV 16		↓			↓			

2/4/2023

0947 on site, beginning setup

1008 connecting to DV6, ~~DV7~~, DV8, DV9, DV10 for injection

1038 injecting into DV6, DV8, DV9, DV10

1124 injection stopped in DV6, DV8, DV9, DV10 Due to resistance/low flow/high pressure. Total injected volume 300g - 67.5/hole

1138 hooked up to DV1, DV2, DV3 to see if injection from 2/3/2023 has dissapated, DV15 ~~after~~ also connected for injection

1250 Batch completely injected into DV1, DV2, DV3, DV15 moving to new wells for next injection

1341 -injecting into DV11, DV12, DV13, DV15, DV16
- batch increased 50% concentration of petrofix and Electron acceptor

1431 injecting second batch into DV11, DV12 DV13, DV15, DV16 These wells are taking the Dose better

1636 batch 4 successfully injected into DV11, DV12, DV13, DV15, DV16

1806 final batch (3rd) injected into DV11, DV12, DV13, DV15, DV16
- full Dose of petrofix Delivered at higher concentration

1814 off site

Site Name: Santa Fe County Judicial Complex

JOB NUMBER:

AREA:

CLIENT: NMED PSTB

DATE: 2-5-2023

EA STAFF: D. O'Brien

PAGE: 3 of

Batch Mix	Volume PetroFlx (gal)	Volume Water (gal)	Volume Nutirents (Nitrate/Sulfat (gal)	Volume Nutirents (Nitrate) (gal)	Number of batches #	Total Volume (gal)	COMMENTS (note variance in inj. rate or pressures; downtime and cause; break-through pressure.

Injection

Injection Point	Injection Interval	Time	Flow Meter Reading - Start	Flow Meter Reading - End	Wellhead Volume (gal)	Wellhead Flow Rate (gpm)	Wellhead Pressure (psi)	
DV 14		0849	1.5	1.5	435		0	
DV 18		↓	↓	↓	↓		↓	
DV 19								
DV 20								
DV 22								
DV 17		1406	1.7	1.7	435		5	
DV 21			↓	↓	↓		10	
DV 23							0	
DV 24							0	
DV 25							0	

2/5/2023
0811 on site, Drillers begin setting up after health and safety meeting

0837 connecting to wells DV 14, ~~DV 17~~, DV 18, DV 19 DV 20, DV 22

0849 injecting into wells DV 14, DV 18, DV 19, DV 20

1344 injections complete in DV 22 wells DV 14, DV 18 DV 19, DV 20, DV 22

1353 connecting to wells DV 17, DV 21, DV 23, DV 24, DV 25

1406 injecting into DV 17, DV 21, DV 23, DV 24, DV 25

1845 injections complete in DV ~~22~~ 17, 21, DV 23, DV 24, DV 25 begin cleanup

1909 off site

Site Name: Santa Fe County Judicial Complex

JOB NUMBER: _____ DATE: 2/6/2023

AREA: _____ EA STAFF: _____

CLIENT: NMED PSTB PAGE: _____ of _____

Batch Mix	Volume PetroFlx (gal)	Volume Water (gal)	Volume Nutirents (Nitrate/Sulfat (gal)	Volume Nutirents (Nitrate) (gal)	Number of batches #	Total Volume (gal)	COMMENTS (note variance in inj. rate or pressures; downtime and cause; break-through pressure.
	55	243	27.5			300~~290~~	

Injection

Injection Point	Injection Interval	Time	Flow Meter Reading - Start	Flow Meter Reading - End	Wellhead Volume (gal)	Wellhead Flow Rate (gpm)	Wellhead Pressure (psi)	
DV 1		1842	0.2	0.1	4		40	• concentration increased
DV 2		↓			↓		↓	• 141g needed for DV 1, 2, 3
DV 3								
DV 4								• 188g needed for DV 4
DV 5								• 218g needed for DV 5 • Injection aborted due to high pressure and Low flow
DV 6		1933	1.0					• DV 6, 7, 8, 9, 10 Batch adjusted after first batch to: 31.25g petro flx 20 lbs Electron acceptor 268g H_2O
DV 7		↓	↓					
DV 8								
DV 9								
DV 10		↓	↓					• DV 6, 7, 8, 9, 10 will be dosed 6 batches with new recipe and 2 remaining batches will be dosed to DV 11, 12 13, 14, 15 - to make up for Lower water concentration in DV 11, 12, 13, 14, 15

2/6/2023

1724 on site contacted owner

1739 conducted Health and ~~Safety~~ meeting & Discussed scope of work

1842 injecting into DV1, DV2, DV3, DV4, DV5

1914 injection stopped - 6Pm started at 0.2 resistance after 8g Borwell was too high to continue injection

1939 injecting into DV6, DV7, DV8, DV9, DV10

2026 injection of ~~first~~ batch in DV6, DV7, DV8 DV9, DV10 complete and successful - contacting owner

2049 Batch changed to 31.25g Petroflx 20lbs Electronacceptor 268g water for 8 even batches - 6 in DV6, DV7 DV8, DV9, DV10 and 2 in DV11, DV12, DV13, DV14, DV15

2091 injecting secon batch (new recipe) into DV6, DV7, DV8, DV9, DV10 - new recipe is 31.25g PF, 20lbs EA, 268 H_2O

0211 final batch (6) complete in DV6, DV7, DV8, DV9, DV10 Begining Cleanup

0218 off site

Site Name: Santa Fe County Judicial Complex

JOB NUMBER: _____ DATE: 2/7/2023

AREA: _____ EA STAFF: D. O'Brien

CLIENT: NMED PSTB PAGE: _____ of _____

Batch Mix	Volume PetroFlx (gal)	Volume Water (gal)	Volume Nutirents (Nitrate/Sulfat (gal)	Volume Nutirents (Nitrate) (gal)	Number of batches #	Total Volume (gal)	COMMENTS (note variance in inj. rate or pressures; downtime and cause; break-through pressure.
	31.25	264	20				

Injection

Injection Point	Injection Interval	Time	Flow Meter Reading - Start	Flow Meter Reading - End	Wellhead Volume (gal)	Wellhead Flow Rate (gpm)	Wellhead Pressure (psi)	
DV 11		1746	1.0				0720	
DV 12		↓	↓				↓	
DV 13								
DV 14								
DV 15								

2/7/2023 SFJC Injections

1724 on site health and safty meeting followed by setup

1737 connecting to wells DV11, DV12, DV13, DV14, DV15

1746 pumping in wells DV11, DV12, DV13, DV14, DV15

1921 pomping in wells DV11, DV12, DV13, DV14, DV15 complete - clean up started

2106 off site