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Removal Action Report for the C-Area Groundwater Operable Unit Bio-Barrier Non-Time Critical Removal Action

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LIST OF ABBREVIATIONS AND ACRONYMS

~	approximate, approximately
105-C	C-Area Reactor Building
amsl	above mean sea level
BAC-9	EOS Bioaugmentation Culture 9
bgs	below ground surface
CAGW	C-Area Groundwater
Cascade	Cascade Technical Services
cm	centimeter
DPT	direct-push technology
EMP	Effectiveness Monitoring Plan
EOS	EOS Remediation, LLC
FFA	Federal Facility Agreement
fl oz	fluid ounce
ft	foot/feet
g	gram
gal	gallon
gpm	gallon per minute
in.	inch
kg	kilogram
km	kilometer
L	liter
lbs	pounds
Lpm	liter per minute
m	meter
MAZ	Middle Aquifer Zone
MCL	Maximum Contaminant Level
mi	mile
North Wind	North Wind Portage
NTC	non-time critical
O&M	operation and maintenance
OU	Operable Unit
PCR/CMIR/RACR	Post-Construction Report/Corrective Measures Implementation Report/Remedial Action Completion Report
psi	pounds per square inch
RA	Removal Action
RADP	Removal Action Design Plan
RAO	removal action objective
RAR	Removal Action Report
RSER/EE/CA	Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis

LIST OF ABBREVIATIONS AND ACRONYMS

SCDHEC	South Carolina Department of Health and Environmental Control
SEMS	Superfund Enterprise Management System
SRNS	Savannah River Nuclear Solutions
SRS	Savannah River Site
TBD	to-be-determined
TCE	trichloroethylene
µg/L	microgram per liter
UIC	Underground Injection Control
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
UTRA	Upper Three Runs Aquifer
VOC	volatile organic compound
WSRC	Westinghouse Savannah River Company

1.0 GENERAL DESCRIPTION

1.1 Purpose and Scope

This Removal Action Report (RAR) documents the completion of field implementation of the Bio-Barrier Non-Time Critical (NTC) Removal Action (RA) for the distal portion of the trichloroethylene (TCE) groundwater plume of the C-Area Groundwater (CAGW) Operable Unit (OU). The Savannah River Site (SRS) notified the United States Environmental Protection Agency (USEPA) Region 4 and South Carolina Department of Health and Environmental Control (SCDHEC) regarding completion of the construction activities and verification on August 14, 2019. This report summarizes construction activities performed to implement the requirements defined within the Removal Action Design Plan (RADP) with the Effectiveness Monitoring Plan (EMP) for the CAGW OU (Savannah River Nuclear Solutions [SRNS] 2018a).

This report includes the following items:

- A brief description of the OU background, including a brief statement on the NTC RA requirements and objectives presented in the RADP;
- A chronology of completed events related to remediation of the OU;
- A summary of construction activities performed;
- Deviations from the original design of the approved RADP;
- Performance standards and quality control inspections, including a summary of performance test results documenting verification of compliance with the acceptance criteria in the RADP;
- Final verification of the NTC RA completion;
- As-built documentation; and
- Project costs.

1.1.1 Document Format

This RAR was prepared in accordance with the requirements for submittal of regulatory documents identified in the Federal Facility Agreement (FFA) (FFA 1993) between the United States Department of Energy (USDOE), USEPA, and SCDHEC. The format of this RAR was based on the Post-Construction Report/Corrective Measures Implementation Report/Remedial Action Completion Report (PCR/CMIR/RACR) protocol format, as applicable to the RAR, found in the *Environmental Compliance and Area Completion Projects Regulatory Document Handbook* (SRNS 2012) approved by the USEPA and SCDHEC.

The CAGW OU NTC RA is complete and does not require long-term operation and maintenance (O&M) of constructed equipment or systems for treatment of contaminants in the source unit or in the groundwater. Rather the EMP will be implemented for five years to determine if the NTC RA reduced TCE concentrations in groundwater and surface water (SRNS 2018a).

1.2 Operable Unit Background

C Area is situated near the center of the SRS (Figure 1). The primary SRS operation facility in C Area was the C-Reactor which operated between 1955 and 1985. Known sources associated with reactor operations, such as the C-Reactor Seepage Basins (904-66G, -67G, and -68G), C-Reactor Area TCE Vadose Zone Source, C-Reactor Purification Area Tritium Source, and other non-specified sources, resulted in tritium and volatile organic compound (VOC) contamination in groundwater.

1.2.1 General Description and Location of CAGW OU

The CAGW OU is located within the SRS and extends approximately (~) 2-kilometers (km) (1.2-miles [mi]) south of the C-Area Reactor perimeter fence to Castor Creek and 2-km (1.2-mi) west of the C-Area Reactor perimeter fence to Fourmile Branch. Located in the Fourmile Branch watershed, the CAGW OU encompasses groundwater beneath C Area, which flows west to Fourmile Branch and south to Castor Creek. The CAGW OU

includes a groundwater subunit and a surface water subunit. The groundwater subunit consists of two plumes: 1) a southern TCE and tritium plume originating near the C-Area Reactor Building (105-C) extending west to Fourmile Branch and south to Castor Creek, and 2) a northern tritium plume in the vicinity of the Twin Lakes drainage, originating near the Retention Basin for 105-C Containment (904-89G) and extending to Fourmile Branch. VOC contamination in the Twin Lakes area is associated with releases from the C-Area Burning/Rubble Pit that is being remediated by monitored natural attenuation and is not part of the CAGW OU scope.

1.2.2 Nature and Extent of Contamination in CAGW OU

The nature and extent of contamination at the CAGW OU was investigated beginning in 1998 using groundwater monitoring wells and direct-push technology (DPT) samples (WSRC 2004). The CAGW OU TCE groundwater plume extends south from 105-C to Castor Creek and an unnamed tributary to Castor Creek (Figure 2). Data from 2016 monitoring showed a small area above 100 micrograms per liter (µg/L) TCE near 105-C in the Upper Aquifer Zone of the Upper Three Runs Aquifer (UTRA), two wells exceeding 50 µg/L TCE at the distal portion of the plume in the Middle Aquifer Zone (MAZ) of the UTRA, and low levels of VOC contamination in the middle of the plume (Figure 2 and Figure 3). To support the RA, additional characterization of the discharge area of the distal plume in 2017 to 2019 demonstrated that the TCE contamination is limited to the MAZ which is ~5-meters (m) (16-feet [ft]) thick in the discharge area.

Six wells (CRW023C, CRW024C, CRW025C, CRW026C, CRW027C, and CRW028C) were installed in 2018 and 2019 to collect baseline data and monitor the effectiveness of the CAGW OU NTC RA (Figure 4). Of these six wells, upgradient well CRW024C within Injection Area 1 had the highest TCE result (30.9 µg/L) in 2019. Well CRW023C was installed as an upgradient monitoring well within Injection Area 2, and the highest TCE result in 2019 was 23.4 µg/L. In 2019, TCE was above the maximum contaminant level (MCL) (5.0 µg/L) in three surface water stations: CCT-03 (10.9 µg/L), CCT-02 (6.62 µg/L), and CCT-01 (9.38 µg/L). These three surface water stations are located on

the small unnamed tributary that discharges to Castor Creek (Figure 4). This data indicates the margins of the TCE plume have shifted slightly towards the east relative to the 2016 CAGW OU TCE plume location. TCE has been detected in Castor Creek above detection limits but has not been detected above the MCL.

1.3 Removal Action Requirements and Objectives

1.3.1 Removal Action Objectives

The NTC removal action objective (RAO) is to protect human health and the environment by reducing TCE groundwater concentrations so that the MCL (5.0 µg/L) is not exceeded in the tributary to Castor Creek (SRNS 2018b).

This NTC RA will reduce TCE concentrations discharging to surface water and support the final remedial action for the CAGW OU. There is no current or projected future use of groundwater or surface water as a drinking water source at the CAGW OU, and site access is currently controlled by SRS facility security and administrative controls. Site specific land use controls are expected to be part of the final remedial action for the CAGW OU.

1.3.2 Selected Removal Action

In December 2016, the USDOE, USEPA, and SCDHEC identified the distal portion of the CAGW OU TCE plume as a candidate for a NTC RA. The Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) for CAGW OU (SRNS 2018b) evaluated the following three cleanup alternatives based on effectiveness, ease of implementation and cost analysis: 1) No Action, 2) Treatment Barrier Using Emulsified Edible Oil, and 3) In Situ Chemical Oxidation Using Sodium Persulfate. The RSER/EE/CA was approved in 2018 and the Action Memorandum selected a Treatment Barrier Using Emulsified Edible Oil as the technology to implement in the distal portion of the plume (Figure 4) (USDOE 2018). The selected alternative included the following key elements, as detailed in the RADP for the CAGW OU (SRNS 2018a):

1) Inject an emulsified oil mixture and bioaugmentation supplement along two transects to create two treatment barriers in the MAZ perpendicular to the groundwater flow (Figure 4). The treatment barriers will sequester and biodegrade TCE.

2) Establish and utilize fifteen DPT injection points to construct the treatment barriers (Figure 4): five injection points ~20.2- to 23.2-m (66- to 76-ft) below ground surface (bgs) and ten injection points ~10.1- to 13.1-m (33- to 43-ft) bgs in the distal portion of the groundwater plume location. Inject within a 3.05-m (10-ft) section of the MAZ where the groundwater TCE contamination is present. Within Oil Injection Area 1 the MAZ depth and thickness were determined by the core described at well CRW024C. Within Oil Injection Area 2 the MAZ depth and thickness was determined by the core described at well CRW023C. Lithology CPTs CGW-68, CGW106, CSB-107, CSB-108 and CSB-122 provided a regional context for the MAZ depth and thickness. A schematic cross section of the area is shown in Figure 5.

3) Inject an emulsified oil mixture consisting of EOS Remediation, LLC (EOS) emulsified oil, dilution water with a dechlorination agent (e.g., ascorbic acid), and a buffer (e.g., EOS CoBupHMg™).

4) Inoculate the emulsified edible oil mixture with 2 liters (L) (0.528 gallons [gal]) of unconcentrated EOS Bioaugmentation Culture 9 (BAC-9), an enriched bioaugmentation culture of *Dehalococcoides mccartyi* and enzymes in a water-based medium.

Several changes were made to the CAGW OU removal action design based on an independent technical review, which are documented in Section 3.0 of this document.

1.4 Chronology of Events

Table 1 provides the Chronology of Events.

2.0 CONSTRUCTION ACTIVITIES

The CAGW OU NTC RA construction activities consisted of creating two subsurface bio-barriers by injecting an oil mixture, microbes, and buffer into the aquifer using DPT.

The CAGW OU construction team consisted of the following subcontractors: North Wind Portage (North Wind) and Cascade Technical Services (Cascade). North Wind provided Technical Oversight, Health and Safety Officer services, and delivery and receipt of rental equipment and injection materials for the NTC RA. Cascade provided services for assembly and disassembly of the injection system, the installation of fifteen temporary injection points, and for monitoring the mixing and injection of emulsified oil into the subsurface.

2.1 Construction Details

The emulsified oil was injected at two separate locations: 1) Injection Area 1 containing five injection points; and 2) Injection Area 2 containing ten injection points (Figure 4). A Geoprobe® 7822 DPT drill rig was used to install the five temporary injection screen zones to about 20.1- to 23.2-m (66- to 76-ft) bgs in Injection Area 1, and ten temporary injection screen zones to about 10.1- to 13.1-m (33- to 43-ft) bgs in Injection Area 2. Steel DPT rods of 5.72-centimeters (cm) (2.25-inches [in.]) diameter were driven into the subsurface to the target depths at each location. The downhole end of the rod string contained a disposable drive point above which were two 1.52-m (5-ft) screen zones. The 1.52-m (5-ft) screen zones consisted of 4.4- cm (1.75-in.) diameter, mill-perforated, steel outer screen, lined with two 1.52-m (5-ft) long polyvinyl chloride slotted injection inner screens with an inside diameter measurement of 1.905-cm (0.75-in.) and a 0.254-millimeter (0.010-in.) screen slot size to allow for direct contact with the formation and to prevent clogging of the outer screen by fine-grained sand. Upon reaching the total depth at each location, the emulsified oil mixture, the BAC-9, the EOS buffer product (CoBupHMg™), and chase water were injected through the screen zone.

The injection strategy at each DPT location had five different components: 1) One-half of the emulsified oil mixture batch was injected into the subsurface, 2) the BAC-9 microbial supplement was injected into the subsurface, 3) the other half of the emulsified oil mixture batch was injected into the subsurface, 4) the EOS CoBupHMg™ buffer was injected into the subsurface, and 5) chase water injection. Mixing of each component occurred in alternating batches using two 9,464 L (2,500 gal) polyethylene tanks. The emulsified oil mixture had the following batch recipe at each injection point: 5,205 L (1,375 gal) of

dilution water; 136 kilograms (kg) (300 pounds [lbs]) of sodium bicarbonate (baking soda); 0.91 kg (2 lbs) of ascorbic acid (vitamin C) used to dechlorinate and deoxygenate the dilution water; 2.37 L (80 fluid ounces [fl oz]) of vitamin B-12 (an essential nutrient for the microbes); and 1,041 L (275 gal) of EOS emulsified oil. After all the emulsified oil mixture and EOS BAC-9 was injected, 151 L (40 gal) of EOS CoBupHMg™ was mixed with 757 L (200 gal) of water and injected into the aquifer. Finally, 1,136 L (300 gal) of chase water was injected into the aquifer. Domestic water, used as chase water and dilution water, was sourced from N-Area Central Shops. A total of 8,290 L (2,190 gal) of oil mixture, buffer and chase water were injected at each injection location.

Upon injecting the required volume for that location, the rod string was retracted. The rods and screen were then removed from the ground, grout rods were inserted into the borehole to the total depth and grout was used to abandon each injection borehole. Grouting activities and decontamination of the equipment (rods, mixing tanks, hoses and pumps) was completed on August 12, 2019. All equipment was demobilized from the injection site on August 14, 2019.

2.2 Construction Delays

No major delays were encountered during the construction/injection process of this RA. While minor operational delays were encountered, the overall time spent in the field injecting the emulsified oil mixture into the aquifer was less than the 30 days estimated by SRS. Fewer days in the field were required as the average injection rates ranged from 22.9 liters per minute (Lpm) (6.04 gallons per minute [gpm]) to 55.3 Lpm (14.6 gpm), which were twice as high as anticipated by SRS based on previous experience.

2.3 Waste Management

There was no radioactive or hazardous waste associated with this project. All job waste from well installations (CRW023C and CRW024C) and DPT oil injections, including personal protective equipment was disposed of as sanitary waste (SGCP 2017). All decontamination water and soil were land applied on location for well installations

(CRW023C and CRW024C), including the soil cores from these wells. All decontamination water, including any incidental soil on the outside of the DPT rods, was land applied on location for DPT oil injections.

3.0 DEVIATIONS FROM ORIGINAL DESIGN

After submittal and regulatory approval of the CAGW OU RADP (SRNS 2018a) and CAGW OU Underground Injection Control (UIC) Permit Application (SRNS 2019), an independent technical review identified several design and construction changes to improve the CAGW OU NTC RA performance and likelihood for success. The project team reviewed and agreed with all proposed changes, provided those changes to the CAGW OU UIC Permit to Operate to SCDHEC (Appendix A), and obtained approval from SCDHEC prior to implementation to ensure compliance with regulatory requirements (Appendix B). SRS notified SCDHEC prior to the start of injection activities, as appropriate (Appendix C).

Table 2 provides a summary of all such changes, including the basis and resolution of deviations from the original design. Where applicable, a statement is provided on whether the deviation still meets a performance criterion.

4.0 VERIFICATION SAMPLING, TESTING, ANALYSIS, PERFORMANCE STANDARDS, AND CONSTRUCTION QUALITY CONTROL

4.1 Performance Requirements/Standards

The CAGW OU RADP with EMP (SRNS 2018a), the CAGW OU UIC Permit Application (SRNS 2019), and the CAGW OU UIC Permit to Operate changes letter (Appendix A) specify the performance requirements for the CAGW OU NTC RA.

4.1.1 Initial CAGW OU Design and Operational Requirements

The CAGW OU RADP with EMP (SRNS 2018a) listed the following design criteria:

a) Five DPT injection points 5-m (16- ft) apart along the northern transect will have screen zone depths of ~16.8- to 19.8-m (55- to– 65-ft) bgs. Ten DPT injection points along the southern transect will have screen zone depths of ~9.8- to 12.8-m (32- to 42-ft) bgs.

b) The groundwater will first be inoculated with BAC-9, an enriched bioaugmentation culture of *Dehalococcoides mccartyi* and enzymes in a water-based medium. It is estimated that about 2 L (0.528 gal) of unconcentrated BAC-9 will be used at each injection location. Nitrogen will be used as a carrier gas for the injection of the bioaugmentation culture to avoid adding oxygen into the groundwater.

c) The emulsified oil mixture will consist of EOS emulsified oil, dilution water with a dechlorination agent, and a buffer. Dilution water obtained from N-Area Central Shops contains chlorine which can kill the microbes, so the dilution water must be dechlorinated with a chemical agent (e.g., sodium thiosulfate, or sodium ascorbate) prior to mixing with the emulsified oil. A buffer solution (e.g., 1.6 to 1.8% sodium hydroxide with 6.9 to 7.1% sodium bicarbonate or CoBupHMg™) will be mixed into the dechlorinated dilution water to raise the groundwater pH to ~7.

d) The oil mixture ratios for each injection location are as follows: 2 L (0.528 gal) of unconcentrated BAC-9 injected first followed by 1,041 L (275 gal) EOS emulsified oil; 5,205-L (1,375-gal) dilution water with 14 g (0.494 ounce) of dechlorination agent and 5.3-L (1.4-gal) buffer solution (1.6 to 1.8% sodium hydroxide with 6.9 to 7.1% sodium bicarbonate).

e) The buffer (1.6 to 1.8% sodium hydroxide with 6.9 to 7.1% sodium bicarbonate) to dilution water ratio is nominally 1 to 1,000; but more or less buffer may be needed to adjust the final oil mixture pH to 9 +/- 0.5 prior to injection.

f) To avoid adding oxygen to the groundwater, the emulsified oil mixture will be purged with nitrogen gas for five minutes and then injected into the groundwater.

g) At each DPT injection location, the contaminated aquifer is ~3-m (10-ft) thick, based on two recent cores from the two injection areas. At each location, ~6,246 L (1,650 gal) of oil mixture will be injected through a 3-m (10-ft) DPT screen zone (e.g., two Geoprobe™ 2.25-in. diameter 5-ft Mill-Slotted DPT rods, or equivalent). This

volume is based on the assumption that 40% of the available pore space is filled with the oil mixture out to a radius of 2.44 m (8 ft).

h) The final amount of BAC-9 and emulsified oil mixture pumped into each DPT injection point will be recorded for all locations.

4.1.2 Final CAGW OU Design and Operational Requirements

In March 2019, the SRS requested approval to install fifteen DPT injection points at the CAGW OU to create two edible oil treatment barrier areas. In April 2019, the SCDHEC approved the request and issued the UIC Permit to Construct and Permit to Operate. After an independent third-party technical review of the project to ensure that the appropriate quantities of injectates would be used, SRS requested approval to modify the quantity and injectates for the edible oil injections. SCDHEC approved the request and issued a modified UIC Permit to Operate. These changes serve as the final performance standards and were made to increase the potential of success for this NTC RA. The final key summary parameters of the NTC RA are as follows:

a) Fifteen DPT injection points are planned to create two treatment barriers (Figure 4): five injection points ~19.7- to 22.7-m (64.5- to 74.5-ft) bgs in Oil Injection Area 1 and ten injection points ~10.2- to 13.3-m (33.5- to 43.5-ft) bgs in Oil Injection Area 2 to treat the distal portion of the groundwater plume.

b) Each injection will be within the MAZ where the groundwater contamination is present.

c) Approximately 136 kg (300 lbs) of sodium bicarbonate will be included in the emulsified oil mixture and after all the oil mixture is injected into the subsurface, then an additional 151 L (40 gal) of EOS CoBupHMg™ buffer mixed with 757 L (200 gal) of dilution water will be injected into the subsurface. The goal is to raise groundwater pH to the optimal range, 6 to 8, for bioremediation.

d) Within Oil Injection Area 1, SRS planned to inject up to 5,205 L (1,375 gal) of EOS emulsified oil, up to 4.54 kg (10 lbs) of ascorbic acid, up to 11.8 L (400 fl oz) of vitamin B-12, up to 10 L (2.64 gal) of unconcentrated BAC-9, 680 kg (1,500 lbs) of sodium bicarbonate, up to 755 L (200 gal) CoBupHMg™ buffer and up to 35,490 L (9,375 gal)

of dilution water and chase water. SRS estimated this would create a bio-barrier in the MAZ 3-m (10-ft) high, 24.4-m (80-ft) long and 4.88-m (16.0-ft) thick.

e) Within Oil Injection Area 2, SRS planned to inject up to 10,410 L (2,750 gal) of EOS emulsified oil, up to 9.08 kg (20 lbs) of ascorbic acid, up to 23.7 L (800 fl oz) of vitamin B-12, up to 20 L (5.28 gal) of unconcentrated BAC-9, 1,360 kg (3,000 lbs) of sodium bicarbonate, up to 1,510 L (400 gal) CoBupHMg™ buffer and up to 70,980 L (18,750 gal) of dilution water and chase water. SRS estimated this would create a bio-barrier in the MAZ 3-m (10-ft) high, 48.8-m (160-ft) long and 4.88-m (16.0-ft) thick.

f) Nominally, at each of the fifteen DPT injection points, SRS planned to inject ~1,041 L (275 gal) of EOS emulsified oil, ~0.91 kg (2 lbs) of ascorbic acid, ~2.37 L (80 fl oz) of vitamin B-12, ~2 L (0.528 gal) of unconcentrated BAC-9, ~136 kg (300 lbs) of sodium bicarbonate, ~151 L (40 gal) CoBupHMg™ buffer, and up to 7,098 L (1,875 gal) of dilution water and chase water.

4.1.3 Achieving Final Design Requirements

The final design requirements, as detailed by the changes to the UIC Permit to Operate (Section 4.1.2), are compared against the field performance to determine if the requirements have been met. The design requirements for this project were met based on the following:

a) Oil Injection Area 1 injection elevations were intended to match the screen zone elevation for well CRW024C (42.29- to 45.37-m [138.7- to 148.8-ft] above mean sea level [amsl]). Oil Injection Area 2 injection elevations were intended to match the screen zone elevation for well CRW023C (46.16- to 49.21-m [151.4- to 161.4-ft] amsl). No tolerances were defined for injection elevations, but the differences in injection elevations due to surface topography (maximum of 5.4-ft at CCIW 15) are not expected to affect the RA performance, because the oil mixture and buffer will flow into the more permeable MAZ sand zone and not into the clay layers above or below the MAZ sand (Appendix D).

b) The emulsified oil mixture injections were primarily within the MAZ where the groundwater contamination is present. Within Oil Injection Area 1 the MAZ depth and thickness was determined by the core described at well CRW024C. Within Oil Injection Area 2 the MAZ depth and thickness was determined by the core described at well CRW023C. Lithology CPTs CGW-68, CGW106, CSB-107, CSB-108 and CSB-122 provide a regional context for the MAZ depth and thickness.

c) The emulsified oil mixture contained 136 kg (300 lbs) of sodium bicarbonate, per the final design. After all the emulsified oil mixture was injected into the subsurface, an additional 151 L (40 gal) of EOS CoBupHMg™ buffer mixed with 757 L (200 gal) of dilution water was injected into the subsurface, per the final design. The goal of these two buffers is to raise groundwater pH to the optimal range, 6 to 8, for bioremediation by the microbes. Five wells (CRW023C, CRW024C, CRW026C, CRW027C and CRW028C) monitor the groundwater chemistry near Oil Injection Areas 1 and 2. These wells have pH measurements taken every sample event and will identify pH changes in the groundwater. These data will be reported in the annual CAGW OU Removal Action Effectiveness Monitoring Reports.

d) Within Oil Injection Area 1 a total of 5,205 L (1,375 gal) of EOS emulsified oil, 4.55 kg (10 lbs) of ascorbic acid, 11.8 L (400 fl oz) of vitamin B-12, 10 L (2.64 gal) of unconcentrated BAC-9, 680 kg (1,500 lbs) of sodium bicarbonate, 755 L (200 gal) CoBupHMg™ buffer was injected into the subsurface, per the final design. 35,490 L (9,375 gal) of dilution water was injected into the subsurface in Oil Injection Area 1, as this was a sufficient amount of water for the emulsified oil mixture, CoBupHMg™ buffer and chase water.

e) Within Oil Injection Area 2 a total of 10,410 L (2,750 gal) of EOS emulsified oil, 9.1 kg (20 lbs) of ascorbic acid, 23.7 L (800 fl oz) of vitamin B-12, 20 L (5.28 gal) of unconcentrated BAC-9, 1,360 kg (3,000 lbs) of sodium bicarbonate, 1,510 L (400 gal) CoBupHMg™ buffer was injected into the subsurface, per the final design. 70,980 L (18,750 gal) of dilution water was injected into the subsurface in Oil Injection Area 2,

as this was a sufficient amount of water for the emulsified oil mixture, CoBupHMg™ buffer and chase water.

f) At each of the fifteen DPT injection points, SRS injected 1,041 L (275 gal) of EOS emulsified oil, 0.91 kg (2 lbs) of ascorbic acid, 2.37 L (80 fl oz) of vitamin B-12, 2 L (0.528 gal) of unconcentrated BAC-9, 136 kg (300 lbs) of sodium bicarbonate, 151 L (40 gal) CoBupHMg™ buffer and 7,098 L (1,875 gal) of dilution water.

4.2 Construction and Quality Control

There were five primary quality control parameters the subcontractor was required to meet for the CAGW OU NTC RA:

1) Prior to the start of mixing and injection operations, the injection system had to pass a hydrostatic test (see Section 4.2.1);

2) The injection system had to pass an acceptance inspection (see Section 4.2.2);

3) Continuous monitoring of key injection parameters (e.g., pressure and flow rate) and total amount of oil, buffer, microbes, water, and nutrients injected at each location (see Section 4.2.3);

4) The EOS emulsified oil and EOS CoBupHMg™ buffer could not exceed 37.8°C (100°F) or be stored lower than 1.67°C (35°F) per the manufacturer's instructions (see Section 4.2.4); and

5) The BAC-9 culture was to be stored at 4°C (40°F). To achieve that criteria, the BAC-9 canisters were stored in a cooler surrounded by ice during the day and only taken out of the cooler to inject the microbes into the subsurface. At night the BAC-9 canisters were stored in a controlled refrigerator.

4.2.1 Hydrostatic Test

The hydrostatic test was conducted from July 10, 2019 through July 15, 2019. Cascade set up the injection system per the injection procedures for operation, then a B31.3 certified pressure technician conducted and approved the hydrostatic test.

4.2.2 Injection System Acceptance Inspection

An acceptance inspection of the injection system was conducted in accordance with SRS Manual 8Q, *Employee Safety*, Procedure 51, *Final Acceptance Inspection of New, Altered, or Dispositioned Facilities or Equipment*, on July 15, 2019. The inspection identified the following five safety, procedural, or administrative items that had to be corrected prior to starting injection operations:

1) A camlock fitting needed to have a pin, or be replaced with a self-locking fitting;
2) Not all valves were labeled, and the labels needed to match the injection procedure;
3) The tanks needed to be labeled with injection ingredients and hazard diamond to match the injection procedure;
4) The nitrogen cylinders needed to be labeled, and the labels needed to match the injection procedure; and
5) A slow leak was identified on the recirculation pump hose, which needed to be fixed.

All five items were verified as corrected on July 16, 2019.

4.2.3 Continuous Monitoring of Injections

The total amount of planned components for the CAGW OU NTC RA were injected into the subsurface as identified in the final design. At each of the fifteen injection locations the following components were injected into the MAZ:

1) 1,041 L (275 gal) of EOS emulsified oil;
2) 0.91 kg (2 lbs) of ascorbic acid;
3) 2.37 L (80 fl oz) of vitamin B-12;
4) 136 kg (300 lbs) of sodium bicarbonate;
5) 2 L (0.528 gal) of unconcentrated BAC-9;
6) 151 L (40 gal) CoBupHMg™ buffer; and
7) 7,098 L (1,875 gal) of dilution and chase water.

The minimum average flow rate for the oil mixture was 22.9 Lpm (6.04 gpm), and the maximum average flow rate for the oil mixture was 55.3 Lpm (14.6 gpm) for all fifteen of the injection locations (Table 3). The minimum average injection pressure was 3.45 bar (50 pounds per square inch [psi]), and the maximum average injection pressure was 10.7 bar (155 psi) for all fifteen of the injection locations. Parameters and amounts were monitored and recorded in field notes (Table 4), provided by the subcontractor (Appendix E), as verification that the RA was completed in accordance with the final design. The oil injection crew visually monitored for day-lighting (i.e., oil observed at the ground surface) at all locations. Day-lighting was observed on two occasions: 1) On 7-18-2019 at CCIW-01 the emulsified oil mixture was observed at the ground surface around the DPT rod; 2) On 7-30-2019 at CCIW-13, the emulsified oil mixture was observed at the ground surface around the DPT rod. At CCIW-01 the injection was stopped immediately, all fittings and connectors were tightened, the DPT screen heighted was adjusted up by one foot, and injections were resumed without issue. At CCIW-13, the injection was immediately stopped, the rods were pulled, the first rod was re-taped and tightened. Then the rods were driven back to the target depth and the injection was resumed without issue Rather than true day-lighting from over-pressurization, both observed cases were due to a loose connections at the top of the DPT rods. These two episodes caused only minor delays.

Observation of the emulsified oil mixing process shortly after injection began led to a process improvement for all ten injections in Oil Injection Area 2. One-half of the emulsified oil mixture at CCIW-02 was injected on July 23, 2019, and the second half was to be injected on July 24, 2019, following injection of the BAC-9. After sitting over-night, the project team observed oil separation in the 9,464 L (2,500 gal) polyethylene tank (Figure 6). Approximately 757 L (200 gal) of EOS was still in the tank, but only about 520 L (137.5 gal) should have been in the remaining half-batch. It was determined that mixing of the oil via recirculation was occurring primarily in the lower half of the tanks because of the height of the tanks and the injection and extraction port locations being near the bottom of the tanks. Although the total amount of oil injected is not affected, it is not clear if the proportional differences in oil over the course of the injection may cause the bio-

barrier to sequester less efficiently in Oil Injection Area 1. This issue was resolved in Oil Injection Area 2 by mixing only one-half of a batch of the oil mixture at one time, and then injecting it into the aquifer to ensure a better distribution of the EOS emulsified oil in the subsurface (Figure 7). The mixing and injecting procedures were revised to reflect this change, which caused approximately a 2-day delay.

4.2.4 EOS Temperature Requirements

To ensure the EOS emulsified oil and EOS CoBupHMg™ buffer did not exceed the specified temperature range, the totes and pails were stored in a shaded area of Oil Injection Area 2 (Figure 4). The air temperature was monitored daily and during the project time frame (July 10, 2019 to August 8, 2019) the minimum air temperature was 18.3°C (65°F) and the maximum air temperature was 37.2°C (99°F) (Appendix E). In addition, the temperature was measured for each batch of oil mixture and buffer. The highest temperature measured for the oil mixture was 35.3°C (95.5°F), and the highest temperature measured for the buffer was 34.4°C (93.9°F). Collectively, temperature data indicated the EOS emulsified oil and EOS CoBupHMg™ buffer did not exceed 37.8°C (100°F), the manufacturer's upper limit.

5.0 VERIFICATION OF RA COMPLETION AND FINAL INSPECTION

As detailed in Section 4.0, construction activities required for the RA have met the performance requirements established in the approved RADP with EMP for the CAGW OU (SRNS 2018a) and the approved CAGW OU UIC Permit Application (SRNS 2019), with acceptable deviations as detailed in Section 3.0. The RA described in this RAR is expected to achieve the RAO outlined in the RSER/EE/CA for CAGW OU (SRNS 2018b). Verification of RA completion is addressed in Section 5.1. The RA implementation was accepted based on field observations and evidence provided by the subcontractor as detailed in Section 5.2.

5.1 Verification of RA Completion

Members of the CAGW OU Project Team conducted frequent site visits to ensure the emulsified edible oil injections were being performed according to the approved design. No outstanding issues resulted from field observations. The subcontractor provided field notes taken throughout the duration of the RA, provided in Appendix E. Site visits and field notes provided adequate verification that injection totals were met at all 15 locations.

5.2 Final Acceptance of CAGW OU Removal Action Completion

Based on field observations and field notes provided by the subcontractor, the RA field activities were completed on August 14, 2019. RA project completion was accepted by SRS on September 5, 2019, with the subcontractor delivery of the final field summary report.

6.0 AS-BUILT DOCUMENTATION

6.1 Well Modifications

In support of this NTC RA, four downgradient groundwater monitoring wells (CRW025C, CRW026C, CRW027C, and CRW028C), one upgradient groundwater monitoring well in Injection Area 1 (CRW024C), and one upgradient groundwater monitoring well in Injection Area 2 (CRW023C) were installed in the CAGW OU for effectiveness monitoring (Figure 4). The NTC RA consisted of fifteen DPT injection points. Following each injection, a 5% bentonite grout slurry was used to abandon each DPT borehole to the surface using a tremie pipe system and in accordance with South Carolina regulations. Well records and soil boring installation reports are provided in Appendix D for the monitoring wells and DPT borings.

7.0 POST-RAR ACTIVITIES

Removal actions at the CAGW OU are complete. Land use of the entire CAGW OU area will be controlled consistent with the SRS Land Use Control Assurance Plan (WSRC 1999) to prevent use

of groundwater or surface water that exceeds MCLs. There is no current or projected future use of groundwater or surface water as a drinking water source at the CAGW OU and site access is controlled by SRS facility security and administrative controls. Site specific land use controls are expected to be addressed as part of the final remedial action for the CAGW OU.

7.1 Removal Action Effectiveness Review

The RAO to protect human health and the environment is to reduce discharge of groundwater contaminated with TCE above the MCL (5 µg/L) to surface water, so that the MCL is no longer exceeded in the unnamed tributary to Castor Creek. The CAGW OU NTC RA, consisting of injecting an emulsified edible oil mixture inoculated with a microbial culture, is expected to achieve the 75% mass flux reduction in TCE that is required to meet the RAO. Verification will be provided by the results of the approved EMP in support of the RADP (SRNS 2018a).

In accordance with the closure requirements of the RADP, the annual effectiveness monitoring reports for the CAGW OU NTC RA will evaluate the overall effectiveness of the RA in reducing TCE mass in the MAZ and its sustainability. Any potential future actions will be addressed by the USDOE, USEPA, and SCDHEC as part of the CAGW OU final remedial decision process.

8.0 PROJECT COSTS

Table 5 provides a cost comparison of the final costs for the RA to the original RSER/EE/CA cost estimate. The RSER/EE/CA total capital cost estimate was $799,744 and the total O&M cost estimate was $517,322, for a total project cost estimate of $1,317,066 (SRNS 2018b). The cost breakdown is limited to that which was presented in the RSER/EE/CA.

The final actual total capital cost, as provided in Table 5, was $987,996, which was 23.5% higher than estimated in the RSER/EE/CA. The deviation in cost is attributed to the increase in the amount of injection points for the RA and a change in the emulsified oil mixture formula, as detailed in Section 3.0. These changes were made to the RA design in order to increase the chance

of success for this technology in meeting the objectives of the RA. O&M costs for this RA are to-be-determined (TBD), as O&M is ongoing.

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9.0 REFERENCES

FFA, 1993. *Federal Facility Agreement for the Savannah River Site,* Administrative Docket No. 89-05-FF (Effective Date: August 16, 1993)

SGCP, 2017. *IDW Management Strategy Form, C-Area Groundwater Characterization, Castor Creek,* SGCP-IDW-2017-0006, Rev 0, November 2017, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2012. *Environmental Compliance and Area Completion Projects Regulatory Document Handbook,* ERD-AG-003, Rev 17, June 2012, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2018a. *Removal Action Design Plan with Effectiveness Monitoring Plan for the C-Area Groundwater Operable Unit (U),* SRNS-RP-2018-00807, Rev 1, October 2018, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2018b. *Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) for C-Area Groundwater Operable Unit (U),* SRNS-RP-2017-00365, Rev 1, February 2018, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2019. *Underground Injection Control Permit Application for the Implementation of the Non-Time Critical Removal Action at the C-Area Groundwater Operable Unit (U),* SRNS-RP-2019-00030, Rev 1, March 2019, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USDOE, 2018. *Action Memorandum and Responsiveness Summary for the Non-Time Critical Removal Action for the C-Area Groundwater Operable Unit (U),* SEMS Number: 82, IACD-18-150, dated May 18, 2018, Department of Energy Savannah River Operations Office, P.O. Box A, Aiken, South Carolina

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site,* WSRC-RP-98-4125, Rev 1.1, August 1999, Latest Update, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

WSRC, 2004. *RCRA Facility Investigation/Remedial Investigation Report for the C-Area Reactor Groundwater (CRGW) Operable Unit (U),* WSRC-RP-2003-4073, Rev 1, May 2004, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

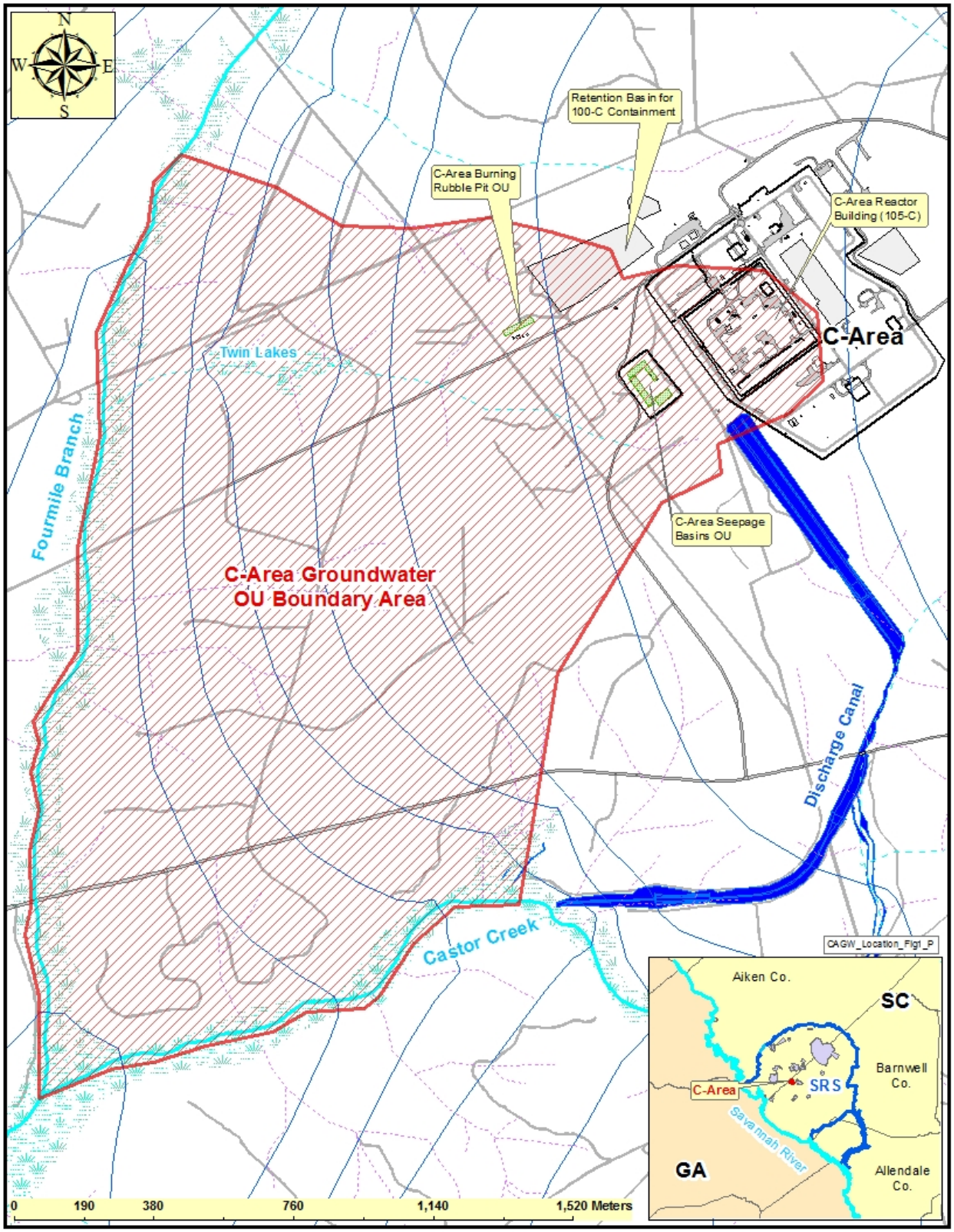

Figure 1. CAGW OU Location on SRS Map

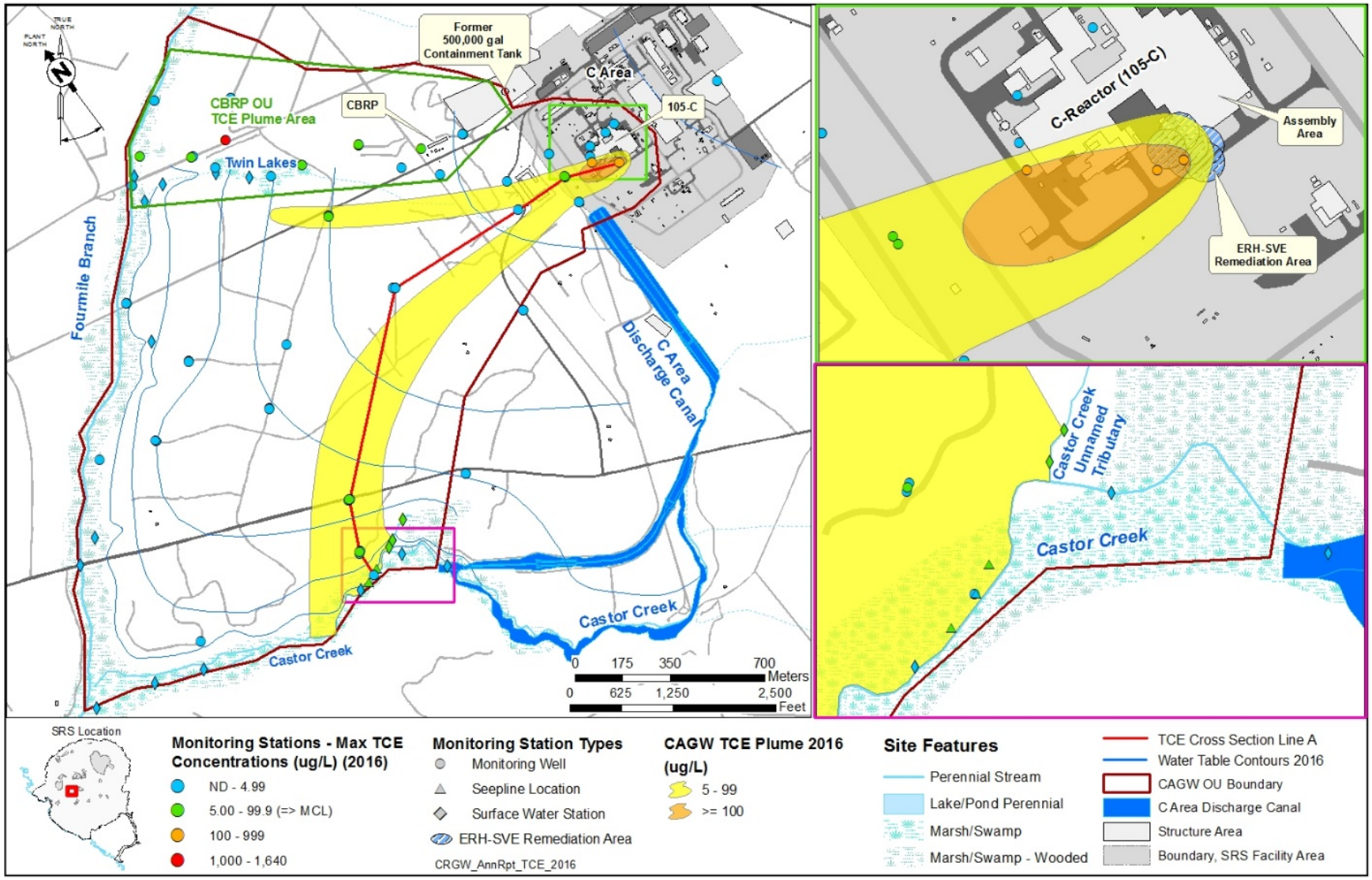

Figure 2. CAGW OU TCE Plume (2016)

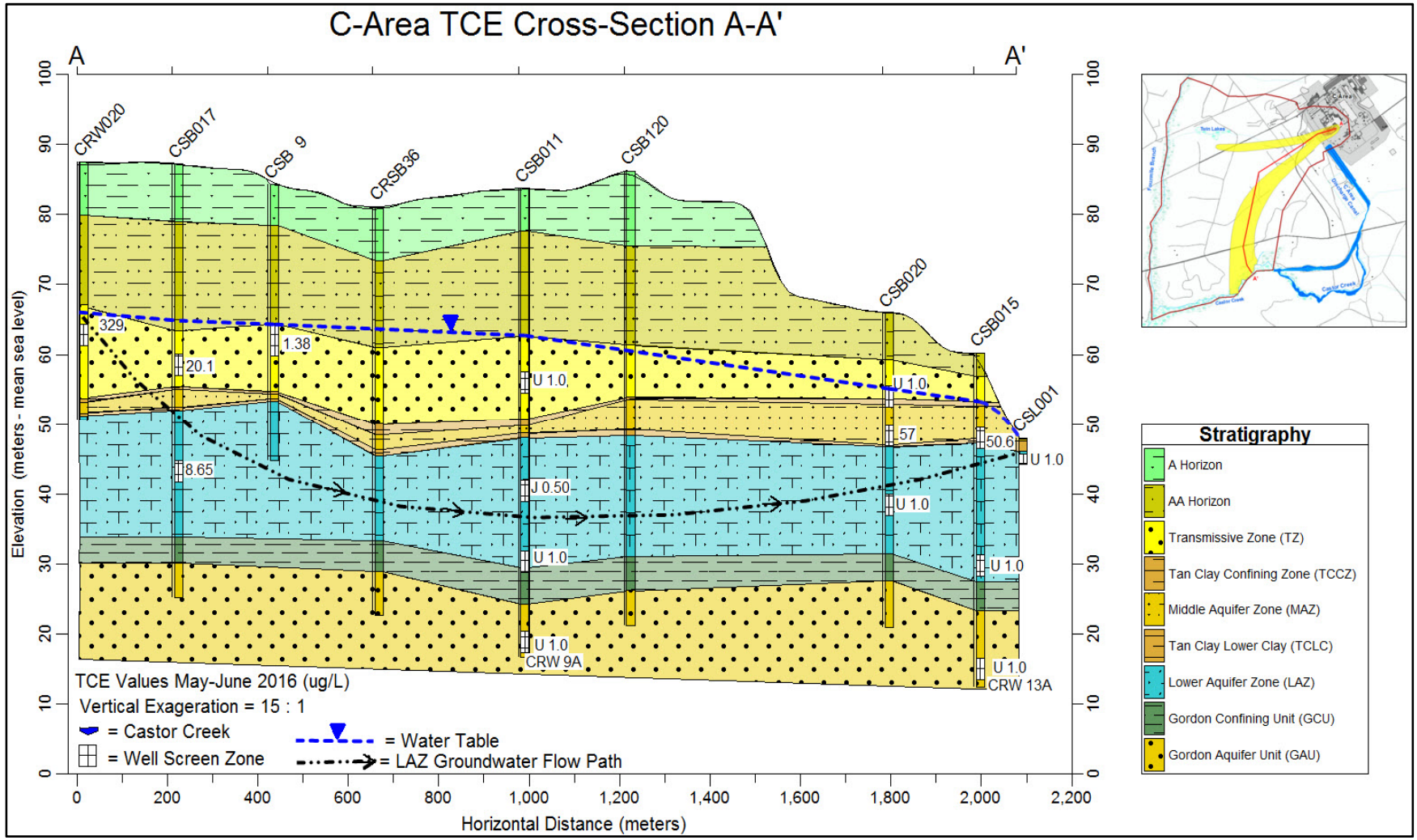

Figure 3. CAGW OU Cross Section A – A' with 2016 TCE Values (µg/L)

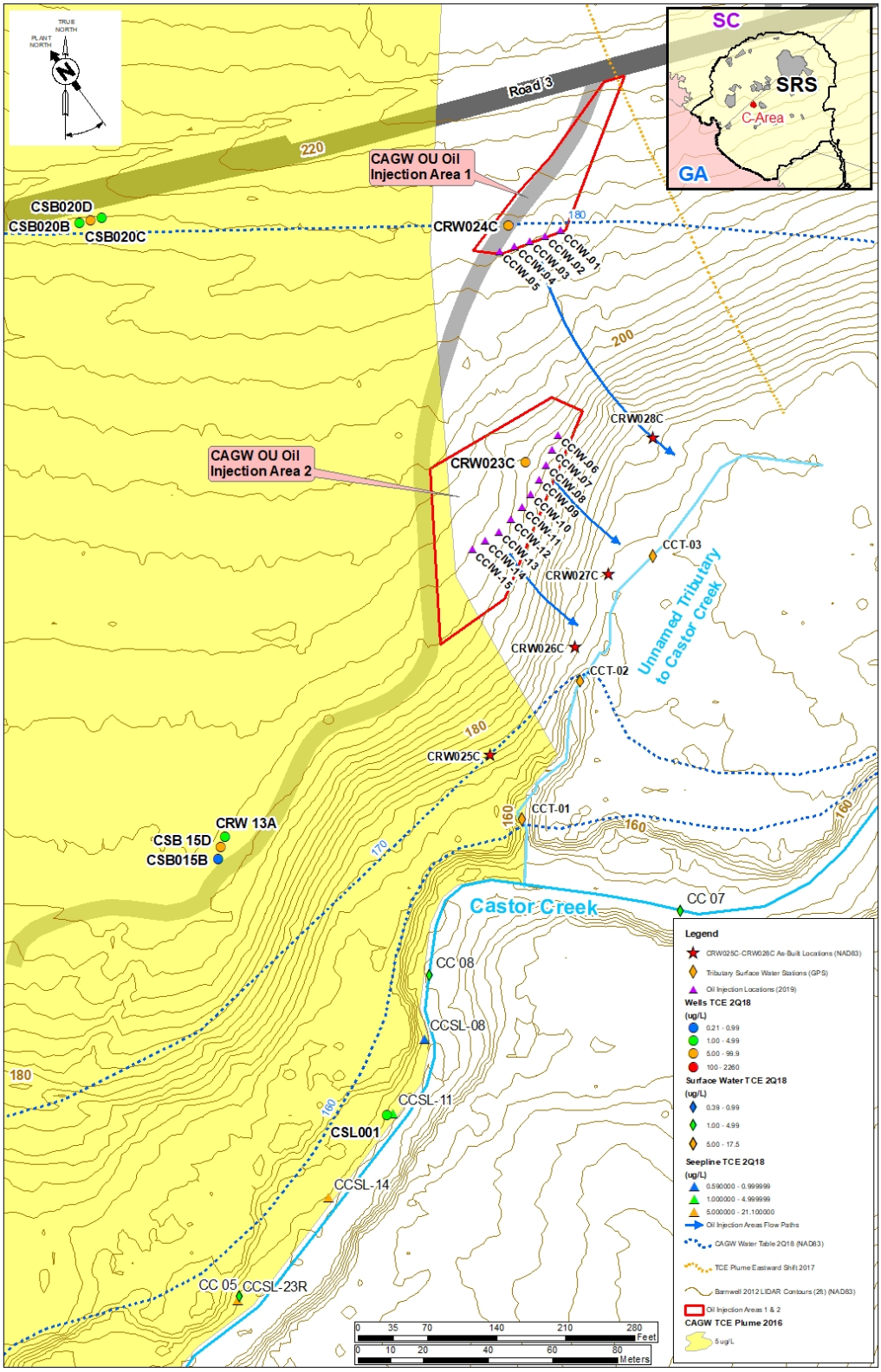

Figure 4. CAGW OU Pre-Removal Action Site Plan

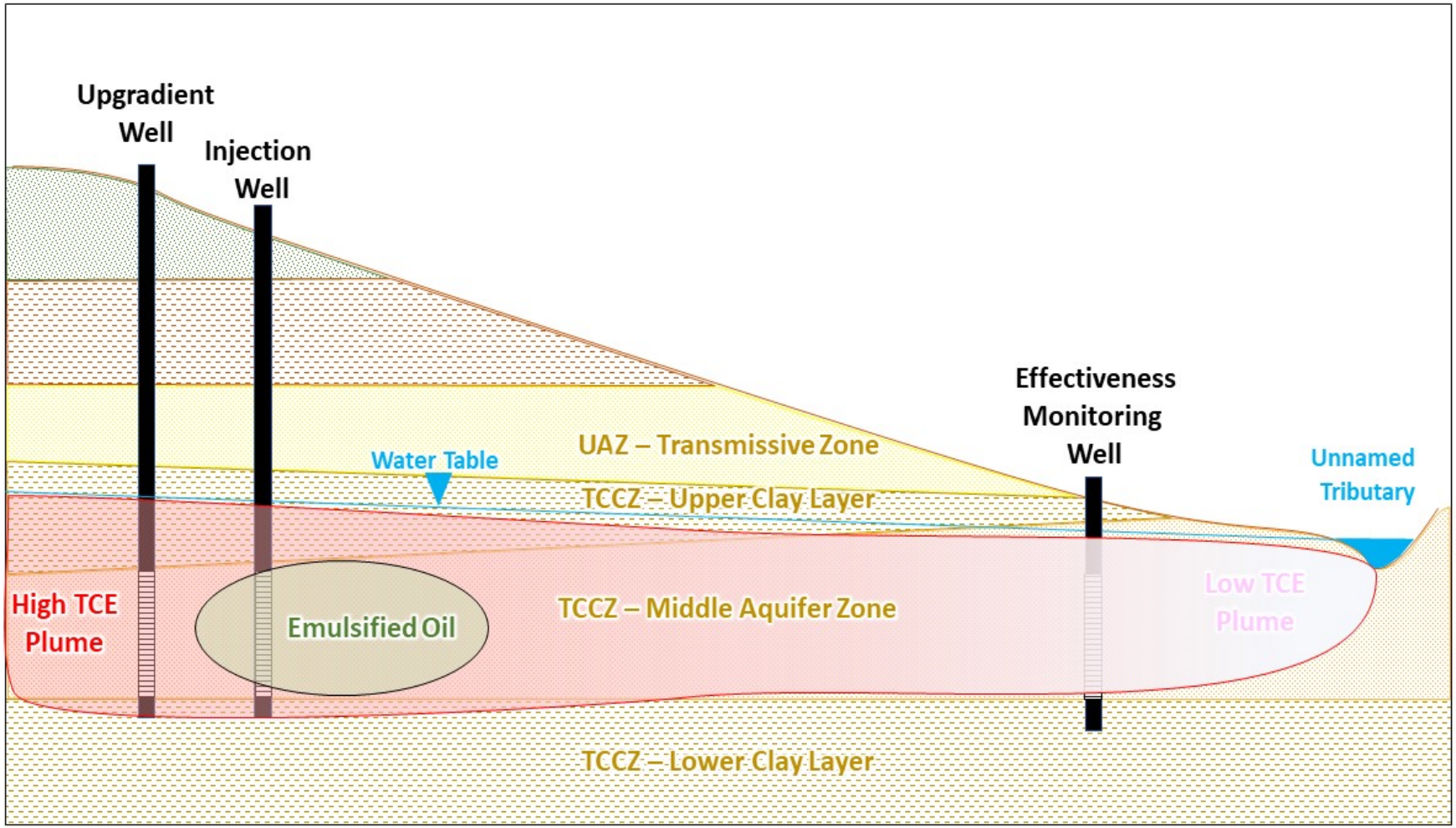

Figure 5. Schematic of CAGW OU Removal Action Process



Figure 6. EOS Emulsified Oil Mixture Separation



Figure 7. EOS Emulsified Oil Mixture Half-Batch Mixing

Table 1. Chronology of Events

Description of Activity	Date
SRS submit CAGW OU Action Memorandum and Responsiveness Summary to USEPA and SCDHEC	May 18, 2018
SRS submit CAGW OU RADP with EMP (Rev. 1) to USEPA and SCDHEC	October 18, 2018
Removal Action Start	November 19, 2018
SCDHEC issues CAGW OU UIC Permit to Operate (Permit #SCHE03020559)	April 8, 2019
Submittal of the Request to Change the CAGW OU UIC Permit to Operate	May 15, 2019
SCDHEC issues CAGW OU UIC Permit to Operate (Permit #SCHE03020559M1)	May 20, 2019
Initiate Emulsified Oil, Microbes, and Buffer Injections	July 18, 2019
Complete Emulsified Oil, Microbes, and Buffer Injections	August 8, 2019
Complete Clean-up of Field Area	August 14, 2019

Table 2. Summary of Design Changes

Item		Change	Reason
1		Increased the amount of ascorbic acid at each injection location from 20 grams (g) (0.04 lbs) to 907 g (2.0 lbs).	Inject enough ascorbic acid to dechlorinate and deoxygenate the groundwater and chase water not just the dilution water for the emulsified oil mixture. This meets the performance objective.
2		Added 2.37 L (80 fl oz) of vitamin B-12 at each injection location.	Vitamin B-12 is an essential nutrient for the microbes. This meets the performance objective.
3		Added 136 kg (300 lbs) of sodium bicarbonate and decreased the EOS CoBupHMg™ from 757 L (200 gal) to 151 L (40 gal) at each injection location.	The sodium bicarbonate is more conducive to the microbial culture while the CoBupHMg™ provides longer lasting pH buffering of the aquifer, which is also important for the well-being of the microbial culture. This meets the performance objective.
4		Nitrogen gas was not utilized to remove oxygen from the oil mixture.	The increase in ascorbic acid made the nitrogen purge step unnecessary. This meets the performance objective.
5		Injecting 1,136 L (300 gal) of clean chase water was added as a final step at each injection location.	The addition of clean chase water as a final step was done to help push/mix all the mixture components into the aquifer.

Table 3. Oil Injection Locations, Depths and Injection Rates

Location ID	SRS East Coodinates	SRS North Coodinates	Ground Elevation (ft-msl)	Start Inject Date	Finish Inject Date	Injection Interval	Avg. Injection Rate of Emulsified Oil Mixture (gpm)	Avg. Injection Rate of CoBupHMg™ (gpm)	Avg. Injetion Rate of Chase Water (gpm)	Total Liquid Volume Injected (Gal)	Total BAC-9 Inected (Liters)	Grout Date	Amount (Gal) of Grout	# Bags Portland	Comment
CCIW-01	41169.49	65476.32	212.3	7/18/2019	7/18/2019	66-76'	7.75	5.63	8.75	2,190	2 L	7/22/2019	25	4	Mixed oil in one batch
CCIW-02	41153.95	65481.18	213.9	7/23/2019	7/24/2019	66-78' *	6.04	5.22	16.67	2,190	2 L	7/29/2019	25	4.5	Mixed oil in one batch
CCIW-03	41138.40	65486.00	213.8	7/18/2019	7/18/2019	66-76'	13.87	15.00	9.38	2,190	2 L	7/22/2019	25	4	Mixed oil in one batch
CCIW-04	41122.82	65490.97	214.1	7/24/2019	7/24/2019	66-76'	13.98	15.00	14.29	2,190	2 L	7/25/2019	25	4	Mixed oil in one batch
CCIW-05	41107.12	65495.70	214.1	7/23/2019	7/23/2019	66-76'	12.04	11.43	9.38	2,190	2 L	7/25/2019	25	4	Mixed oil in one batch
CCIW-06	41045.98	65310.67	196.9	8/5/2019	8/6/2019	33-43'	12.60	8.89	11.54	2,190	2 L	8/7/2019	15	2	Mixed oil in two, half-batches
CCIW-07	41031.94	65301.52	195.1	8/6/2019	8/6/2019	33-43'	9.02	7.50	9.09	2,190	2 L	8/7/2019	15	2	Mixed oil in two, half-batches
CCIW-08	41018.10	65292.90	194.2	8/5/2019	8/5/2019	33-43'	10.00	13.33	11.11	2,190	2 L	8/8/2019	15	2	Mixed oil in two, half-batches
CCIW-09	41003.70	65284.99	194.1	8/1/2019	8/1/2019	33-43'	13.64	14.12	14.29	2,190	2 L	8/6/2019	15	2.5	Mixed oil in two, half-batches
CCIW-10	40987.88	65278.46	194.7	8/7/2019	8/7/2019	33-43'	12.41	9.60	12.00	2,190	2 L	8/8/2019	15	2	Mixed oil in two, half-batches
CCIW-11	40972.68	65272.56	196.5	7/31/2019	7/31/2019	33-43'	14.60	20.00	14.29	2,190	2 L	8/1/2019	15	2	Mixed oil in two, half-batches
CCIW-12	40957.10	65269.40	197.8	8/7/2019	8/8/2019	33-43'	13.20	11.43	15.00	2,190	2 L	8/8/2019	15	2	Mixed oil in two, half-batches
CCIW-13	40939.21	65266.34	199.3	7/30/2019	7/31/2019	33-43'	10.78	10.00	10.71	2,190	2 L	8/1/2019	15	2	Mixed oil in two, half-batches
CCIW-14	40922.68	65267.05	199.5	8/8/2019	8/8/2019	33-43'	10.65	8.57	11.11	2,190	2 L	8/12/2019	15	2	Mixed oil in two, half-batches
CCIW-15	40906.62	65268.11	199.8	7/30/2019	7/30/2019	33-43'	13.87	13.33	12.50	2,190	2 L	8/1/2019	15	2	Mixed oil in two, half-batches

* = Please note that the oil injectables were injected at the interval of 66-76ft, but the CoBupH buffer and chase water were injected in the 68-78ft interval per SRNS direction due to low injection rates at 66-76ft.

Table 4. Oil Injection Field Parameters

		Tank 1			Tank 2			
Station	Matrix	Temp. (°C)	DO (mg/L)	pH	Temp. (°C)	DO (mg/L)	pH	Comments
CCIW-01	Emulsified Oil Misture				34.2	0.40	8.21	Mixed in 1 Batch.
CCIW-02	Emulsified Oil Misture	33.7	0.78	8.26				Mixed in 1 Batch.
CCIW-03	Emulsified Oil Misture	35.3	0.94	8.24				Mixed in 1 Batch.
CCIW-04	Emulsified Oil Misture				30.2	0.66	8.15	Mixed in 1 Batch.
CCIW-05	Emulsified Oil Misture				32.2	0.93	8.11	Mixed in 1 Batch.
CCIW-06	Emulsified Oil Misture	28.7	0.95	8.17	30.6	0.64	8.15	Mixed in 2 Batches.
CCIW-07	Emulsified Oil Misture	29.0	0.70	7.86	28.6	0.12	8.39	Mixed in 2 Batches.
CCIW-08	Emulsified Oil Misture	25.7	0.98	8.05	25.3	0.98	8.25	Mixed in 2 Batches.
CCIW-09	Emulsified Oil Misture	31.3	0.95	8.21	29.6	0.98	8.26	Mixed in 2 Batches.
CCIW-10	Emulsified Oil Misture	29.2	0.97	7.23	28.7	0.91	8.47	Mixed in 2 Batches.
CCIW-11	Emulsified Oil Misture	30.9	0.95	8.51	30.7	0.16	8.43	Mixed in 2 Batches.
CCIW-12	Emulsified Oil Misture	30.1	0.90	8.14	32.0	0.66	8.08	Mixed in 2 Batches.
CCIW-13	Emulsified Oil Misture	29.6	0.94	8.18	30.4	0.95	8.23	Mixed in 2 Batches on 7/30.
CCIW-13	Emulsified Oil Misture	---	---	---	29.8	0.96	8.27	Injected on 7/31.
CCIW-14	Emulsified Oil Misture	32.1	0.91	8.10	31.6	0.91	8.25	Mixed in 2 Batches.
CCIW-15	Emulsified Oil Misture	31.0	0.43	8.38	30.7	0.22	8.36	Mixed in 2 Batches on 7/29
CCIW-15	Emulsified Oil Misture	29.8	0.79	9.22	30.0	0.82	8.14	Injected on 7/30.

Table 5. Project Cost Comparison

Cost Comparison Summary			
	RSER/EE/CA Cost ($)	**Actual Cost ($)**	**Delta Cost (%)**
Total Capital Costs	799,744	987,996	+23.5
Total O&M Costs	517,322	TBD	TBD
Total Project Costs	**1,317,066**	**TBD**	**TBD**

APPENDIX A

**Correspondence Between SRNS and SCDHEC on
Changes to the Underground Injection Control Permit to Operate,
Permit #SCHE03020559**

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Shelia Mcfalls

From:	Shelia Mcfalls
Sent:	Wednesday, May 15, 2019 11:25 AM
To:	Crawford, Bruce
Cc:	Fulmer, Susan; Heather Cathcart (cathcahe@dhec.sc.gov); Rob Pope (pope.robert@epa.gov); Jon Richards (richards.jon@epa.gov); Tufts, Jennifer; HENNESSEY, BRIAN; ADAMS, KAREN; HAMMETT, AVERY G; Chris Bergren; Mike Griffith; Amy Meyer; Thelesia Oliver; Susan Cornwell; Thomas Kmetz; Thomas Gaughan; J Ross; Sandra Smith; Terry Killeen; Joseph Burch; Lew Williams
Subject:	Request for Approval: Changes to the Underground Injection Control Permit for the C-Area Groundwater Operable Unit (Permit #SCHE03020559)
Attachments:	SodBicarbSDS.pdf

SRNS-J2000-2019-00368

Bruce,

References:

1. Letter, Amy J. Meyer (SRNS) to Bruce Crawford (SCDHEC), *Request for Approval of the Savannah River Site Underground Injection Control Permit Application for the Implementation of the Non-Time Critical Removal Action at the C-Area Groundwater Operable Unit (SRNS-RP-2019-00030, Revision 0, March 2019)*, SRNS-J2000-2019-00171, dated March 19, 2019
2. Letter, Bruce Crawford (SCDHEC) to Amy J. Meyer (SRNS), *Re: Underground Injection Control Permit # SCHE03020559 Savannah River Site – C-Area Groundwater Operable Unit Site Aiken County,* dated April 4, 2019 (Permit to Construct) (SRNS-OS-2019-00107)
3. Letter, Bruce Crawford (SCDHEC) to Amy J. Meyer (SRNS), *Re: Underground Injection Control Permit # SCHE03020559 Savannah River Site – C-Area Groundwater Operable Unit Site,* dated April 8, 2019 (Permit to Operate) (SRNS-OS-2019-00108)

The Savannah River Site (SRS) requested approval to augment a volatile organic compound (primarily trichloroethylene (TCE) with minor quantities of tetrachloroethylene) groundwater plume with emulsified oil substrate (EOS_{100}™) and an enriched bioaugmentation culture (EOS BAC-9) of Dehalococcoides mccartyi and enzymes in a water-based medium (Reference 1). The SRS also requested approval to inject an emulsified oil mixture (EOS_{100}™ emulsified oil, vitamin B-12, dechlorinated dilution water, and EOS $CoBupH_{Mg}$™ buffer) to act as a treatment barrier both by sequestering TCE at the injection points and enhancing the natural ability of the formation to biodegrade TCE at the point of injection. The emulsified oil mixture will be injected into 15 direct push technology (DPT) points. The dilution water will be dechlorinated with sodium ascorbate (ascorbic acid or vitamin C). The South Carolina Department of Environmental Control approved the request and issued an underground injection control (UIC) permit to construct and a UIC permit to operate (References 1 and 2, respectively).

The SRS requested an independent review of the project to ensure that the appropriate quantities of the injectates would be used. Based on this independent review, the amount of ascorbic acid (vitamin C) and vitamin B-12 have increased and the amount of $CoBupH_{Mg}$™ has decreased. Sodium bicarbonate is a new ingredient that will be used as part of the emulsified oil mixture (see attached Sodium Bicarbonate Safety Data

Sheet). Additional clean (potable) water will also be used. The increase in vitamin C and vitamin B-12, the reduction in the amount of CoBupH$_{Mg}$™, and the addition of sodium bicarbonate are better for the EOC BAC-9 microbes.

The planned solution for each DPT location is as follows: Add approximately 1,375 gallons of water to the mix tank followed by approximately 2 pounds of ascorbic acid (more may be added if needed), five 16-ounce bottles of vitamin B-12, approximately 275 gallons of EOS$_{100}$™ emulsified oil, and six 50-pound bags of sodium bicarbonate. Mix all the ingredients together and inject half of the volume into a DPT location. The injection will be paused to add approximately 0.528 gallons of EOS BAC-9; then the remaining EOS$_{100}$™ emulsified oil mixture will be injected. Once the mixing tank is empty, 40 gallons of EOS CoBupH$_{Mg}$™ and 200 gallons of dilution water (no conditioning necessary) will be added to the tank and mixed. The dilute EOS CoBupH$_{Mg}$™ mixture will be injected followed by 300 gallons of clean chase water. The process will not include a nitrogen gas purge step of the emulsified oil mixture prior to injection as the vitamin C and vitamin B-12 will remove the chlorine and oxygen.

Please review the information above and provide your approval of the changes by June 7, 2019.

Please contact me if you have any questions, comments, or concerns.

Thanks

Shelia L. McFalls | **Savannah River Nuclear Solutions, LLC** | Environmental Compliance & Area Completion Projects | shelia.mcfalls@srs.gov | 1.803.952.6819 office | 1.803.725.7243, #19367 pager |1.803.952.6403 fax |Savannah River Site | Building 730-4B, 3134 | Aiken, SC 29808



Safety Data Sheet

Innophos

Section 1: Identification of the Substance/Mixture and of the Company/Undertaking

1.1 Product identifier

Product Name • **Sodium Bicarbonate**

Synonyms • Baking Soda; Bicarbonate of Soda; Sodium Hydrogen Carbonate

CAS Number • 144-55-8

SDS Number/Grade • 40

EC Number • 205-633-8

Molecular Formula • $NaHCO_3$

1.2 Relevant identified uses of the substance or mixture and uses advised against

Relevant identified use(s) • Used in various food products

1.3 Details of the supplier of the safety data sheet

Manufacturer • Innophos

259 Prospect Plains Rd. Bldg A
Cranbury, NJ 08512-3706
United States

Telephone (Technical) • 609-495-2495

1.4 Emergency telephone number

Manufacturer • 800-424-9300 - Chemtrec - within USA and Canada

Manufacturer • +1 703-527-3887 - Chemtrec - outside USA and Canada (collect calls accepted)

Manufacturer • 615-386-7816 - Innophos Emergency Communication Team (ECT)

Section 2: Hazards Identification

EU/EEC

According to: Regulation (EC) No 1272/2008 (CLP)/REACH 1907/2006 [amended by 453/2010]
According to: EU Directive 67/548/EEC (DSD) or 1999/45/EC (DPD)

2.1 Classification of the substance or mixture

CLP • Not classified

DSD/DPD • Not classified

2.2 Label Elements

CLP

Hazard statements • No label element(s) required

DSD/DPD

Risk phrases • No label element(s) required

2.3 Other Hazards

CLP • According to Regulation (EC) No. 1272/2008 (CLP) this material is not considered hazardous.

DSD/DPD • This product is not considered dangerous under the European Directive67/548/EEC

United States (US)

According to: OSHA 29 CFR 1910.1200 HCS

2.1 Classification of the substance or mixture

OSHA HCS 2012 • Not classified

2.2 Label elements

OSHA HCS 2012

Hazard statements • No label element(s) required

2.3 Other hazards

OSHA HCS 2012 • This product is not considered hazardous under the U.S. OSHA 29 CFR 1910.1200 Hazard Communication Standard.

Canada

According to: WHMIS

2.1 Classification of the substance or mixture

WHMIS • Not classified

2.2 Label elements

WHMIS • No label element(s) required.

2.3 Other hazards

WHMIS • In Canada, the product mentioned above is not considered hazardous under the Workplace Hazardous Materials Information System (WHMIS).

Section 3 - Composition/Information on Ingredients

3.1 Substances

Composition					
Chemical Name	**Identifiers**	**%**	**LD50/LC50**	**Classifications According to Regulation/Directive**	**Comments**
Carbonic acid sodium salt (1:1)	**CAS:**144-55-8 **EC Number:**205-633-8	100%	Ingestion/Oral-Rat LD50 • 4220 mg/kg	**EU DSD/DPD:** Not Classified **EU CLP:** Not Classified **OSHA HCS 2012:** Not Classified	NDA

3.2 Mixtures

• Material does not meet the criteria of a mixture in accordance with Regulation (EC) No 1272/2008.

Section 4 - First Aid Measures

4.1 Description of first aid measures

Inhalation
- Move victim to fresh air. If signs/symptoms continue, get medical attention.

Skin
- IF ON SKIN: Wash with plenty of soap and water. Remove clothing and wash thoroughly before use. If skin irritation occurs: Get medical advice/attention.

Eye
- In case of contact with substance, immediately flush eyes with running water for at least 20 minutes. If eye irritation persists: Get medical advice/attention.

Ingestion
- Do not induce vomiting unless instructed to do so by a physician. If swallowed give 2-3 glasses of water if victim is conscious and alert. Do not give anything by mouth to an unconscious person. Do not leave victim unattended.

4.2 Most important symptoms and effects, both acute and delayed

- Refer to Section 11 - Toxicological Information.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to Physician
- All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this product may have occurred.

4.4 Other information

- Call 911 or emergency medical service. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Section 5 - Firefighting Measures

5.1 Extinguishing media

Suitable Extinguishing Media
- Not combustible. Use extinguishing media suitable for surrounding fire.

Unsuitable Extinguishing Media
- No data available.

5.2 Special hazards arising from the substance or mixture

Unusual Fire and Explosion Hazards
- Non-combustible.

Hazardous Combustion Products
- Oxides of carbon.

5.3 Advice for firefighters

- Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing will only provide limited protection. Keep unauthorized personnel away.

Section 6 - Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal Precautions
- Ventilate enclosed areas. Do not touch or walk through spilled material.

Emergency Procedures
- Keep unauthorized personnel away.

6.2 Environmental precautions

- Do not flush to drain. Spills may be reportable to the National Response Center (800-424-8802) and to state and/or local agencies.

6.3 Methods and material for containment and cleaning up

Containment/Clean-up Measures
- Sweep or vacuum up and place in an appropriate closed container. Avoid generating dust.

Sodium Bicarbonate	
	Clean up residual material by washing area with water. Collect washings for disposal.

6.4 Reference to other sections

- Refer to Section 8 - Exposure Controls/Personal Protection and Section 13 - Disposal Considerations.

Section 7 - Handling and Storage

7.1 Precautions for safe handling

Handling

- Avoid direct or prolonged contact with skin and eyes. Avoid breathing dust.

7.2 Conditions for safe storage, including any incompatibilities

Storage

- Store in a tightly closed container. Store in a cool/low-temperature, well-ventilated, dry place.

7.3 Specific end use(s)

- Refer to Section 1.2 - Relevant identified uses.

Section 8 - Exposure Controls/Personal Protection

8.1 Control parameters

Exposure Limits/Guidelines		
	Result	Czech Republic
Carbonic acid sodium salt (1:1) (144-55-8)	Ceilings	10 mg/m3 Ceiling
	TWAs	5 mg/m3 TWA

8.2 Exposure controls

Engineering Measures/Controls

- Dilution ventilation. Adequate ventilation systems as needed to control concentrations of airborne contaminants below applicable threshold limit values.

Personal Protective Equipment

Respiratory

- For limited exposure use an N95 dust mask. For prolonged exposure use an air-purifying respirator with high efficiency particulate air (HEPA) filters. Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or symptoms are experienced.

Eye/Face

- Wear safety goggles.

Hands

- Wear appropriate gloves.

Skin/Body

- Wear long sleeves and/or protective coveralls.

General Industrial Hygiene Considerations

- Wash hands before eating.

Environmental Exposure Controls

- Follow best practice for site management and disposal of waste.

Key to abbreviations

TWA = Time-Weighted Averages are based on 8h/day, 40h/week exposures

Section 9 - Physical and Chemical Properties

9.1 Information on Physical and Chemical Properties

Sodium Bicarbonate

Material Description			
Physical Form	Solid	Appearance/Description	White crystalline or powdered solid with no odor.

Color	White	Odor	Odorless
Odor Threshold	Data lacking		
General Properties			
Boiling Point	Data lacking	Melting Point	Data lacking
Decomposition Temperature	Data lacking	pH	8.5 (@ 1 wt/wt%)
Specific Gravity/Relative Density	1.19 to 2.22	Density	74.2915 to 138.5943 lb(s)/ft³
Bulk Density	0.98 g/cm³	Water Solubility	Hydrolyzes
Viscosity	Data lacking	Explosive Properties	Data lacking
Oxidizing Properties:	Data lacking		
Volatility			
Vapor Pressure	Data lacking	Vapor Density	Data lacking
Evaporation Rate	Data lacking		
Flammability			
Flash Point	Not relevant	UEL	Not relevant
LEL	Not relevant	Autoignition	Data lacking
Flammability (solid, gas)	Data lacking		
Environmental			
Octanol/Water Partition coefficient	Data lacking		

9.2 Other Information

- No additional physical and chemical parameters noted.

Section 10: Stability and Reactivity

10.1 Reactivity

- No dangerous reaction known under conditions of normal use.

10.2 Chemical stability

- Stable under normal temperatures and pressures.

10.3 Possibility of hazardous reactions

- Hazardous polymerization not indicated.

10.4 Conditions to avoid

- Dusting conditions. Elevated temperatures. Extreme humidity. Heat Moisture.

10.5 Incompatible materials

- Strong acids, strong oxidizing agents.

10.6 Hazardous decomposition products

- Oxides of carbon. Carbon dioxide.

Section 11 - Toxicological Information

11.1 Information on toxicological effects

	CAS	
Sodium Bicarbonate	144-55-8	**Acute Toxicity:** Ingestion/Oral-Rat LD50 • 4220 mg/kg; Ingestion/Oral-Man TDLo • 20 mg/kg 5 Day(s)-Intermittent; *Gastrointestinal:***Nausea or vomiting**; *Nutritional and Gross Metabolic:Changes in Chemistry or Temperature:***K**; *Nutritional and Gross Metabolic:Changes in Chemistry or Temperature:***Metabolic acidosis**; Inhalation-Rat LC50 • >4.74 mg/L; **Irritation:** Eye-Rabbit • 100 mg 30 Second(s) • Mild irritation; Skin-Human • 30 mg 3 Day(s)-Intermittent • Mild

Sodium Bicarbonate

irritation; Skin-Rabbit • Mild irritation

GHS Properties	Classification
Acute toxicity	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Aspiration Hazard	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Carcinogenicity	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Germ Cell Mutagenicity	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Skin corrosion/Irritation	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Skin sensitization	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
STOT-RE	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
STOT-SE	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Toxicity for Reproduction	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Respiratory sensitization	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met
Serious eye damage/Irritation	**EU/CLP** • Classification criteria not met **OSHA HCS 2012** • Classification criteria not met

Potential Health Effects

Inhalation

Acute (Immediate) • May cause mild irritation.

Chronic (Delayed) • No data available.

Skin

Acute (Immediate) • May cause mild irritation.

Chronic (Delayed) • No data available.

Eye

Acute (Immediate) • May cause mild irritation.

Chronic (Delayed) • No data available.

Ingestion

Acute (Immediate) • Low acute oral toxicity. May cause nausea, vomiting, abdominal pain and diarrhea.

Chronic (Delayed) • No data available.

Key to abbreviations
LD = Lethal Dose
TD = Toxic Dose

Section 12 - Ecological Information

12.1 Toxicity

Sodium Bicarbonate			144-55-8		
Dosage	Species	Duration	Results	Exposure Conditions	Comments
7700 mg/L	**Fish:** Rainbow Trout	95 Hour(s)	LC50	NDA	NDA
7100 mg/L	**Fish:** Bluegill Sunfish	95 Hour(s)	LC50	NDA	NDA
4100 mg/L	**Water Flea:** Daphnia magna	48 Hour(s)	EC50	NDA	NDA

12.2 Persistence and degradability

- No data available.

12.3 Bioaccumulative potential

- No data available.

12.4 Mobility in Soil

- No data available.

12.5 Results of PBT and vPvB assessment

- PBT and vPvB assessment has not been carried out.

12.6 Other adverse effects

Ecological Fate

- Product decomposes rapidly on contact with moisture to form the corresponding acid.

Section 13 - Disposal Considerations

13.1 Waste treatment methods

Product waste

- Dispose of content and/or container in accordance with local, regional, national, and/or international regulations.

Packaging waste

- Dispose of content and/or container in accordance with local, regional, national, and/or international regulations.

Section 14 - Transport Information

	14.1 UN number	14.2 UN proper shipping name	14.3 Transport hazard class(es)	14.4 Packing group	14.5 Environmental hazards
DOT	NDA	Not Regulated	NDA	NDA	NDA
TDG	NDA	Not Regulated	NDA	NDA	NDA
IMO/IMDG	NDA	Not Regulated	NDA	NDA	NDA
IATA/ICAO	NDA	Not Regulated	NDA	NDA	NDA

14.6 Special precautions for user

- None specified.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

- Data lacking.

Section 15 - Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

SARA Hazard Classifications • None

Inventory						
Component	**CAS**	**Canada DSL**	**Canada NDSL**	**China**	**EU EINECS**	**EU ELNICS**
Carbonic acid sodium salt (1:1)	144-55-8	Yes	No	Yes	Yes	No

Inventory (Con't.)				
Component	**CAS**	**New Zealand**	**Philippines PICCS**	**TSCA**
Carbonic acid sodium salt (1:1)	144-55-8	Yes	Yes	Yes

Canada

Labor

Canada - WHMIS - Classifications of Substances

• Carbonic acid sodium salt (1:1)	144-55-8	Uncontrolled product according to WHMIS classification criteria

Canada - WHMIS - Ingredient Disclosure List

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

Environment

Canada - CEPA - Priority Substances List

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

Germany

Environment

Germany - TA Luft - Types and Classes

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

Germany - Water Classification (VwVwS) - Annex 1

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

Germany - Water Classification (VwVwS) - Annex 2 - Water Hazard Classes

• Carbonic acid sodium salt (1:1)	144-55-8	ID Number 374, hazard class 1 - low hazard to waters

Germany - Water Classification (VwVwS) - Annex 3

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

Philippines

Other

Philippines - Priority Chemical List

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

Singapore

Other

Singapore - Corrosive and Explosive Substances - Corrosive Substances

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

United States

Labor

U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - OSHA - Specifically Regulated Chemicals

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

Environment

U.S. - CAA (Clean Air Act) - 1990 Hazardous Air Pollutants

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - CAA (Clean Air Act) - Class II Ozone Depletors

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - CERCLA/SARA - Hazardous Substances and their Reportable Quantities

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - CERCLA/SARA - Radionuclides and Their Reportable Quantities

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - CERCLA/SARA - Section 302 Extremely Hazardous Substances EPCRA RQs

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - CERCLA/SARA - Section 302 Extremely Hazardous Substances TPQs

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - CERCLA/SARA - Section 313 - Emission Reporting

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - CERCLA/SARA - Section 313 - PBT Chemical Listing

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

United States - California

Environment

U.S. - California - Proposition 65 - Carcinogens List

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - California - Proposition 65 - Developmental Toxicity

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - California - Proposition 65 - Maximum Allowable Dose Levels (MADL)

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - California - Proposition 65 - No Significant Risk Levels (NSRL)

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - California - Proposition 65 - Reproductive Toxicity - Female

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

U.S. - California - Proposition 65 - Reproductive Toxicity - Male

• Carbonic acid sodium salt (1:1)	144-55-8	Not Listed

15.2 Chemical Safety Assessment

- No Chemical Safety Assessment has been carried out.

15.3 Other Information

- FDA Status: This product meets the compositional requirements of: 21 CFR 184.1736 SODIUM BICARBONATE

Section 16 - Other Information

Last Revision Date	• 30/March/2015
Preparation Date	• 30/March/2015
Disclaimer/Statement of Liability	• The information herein is given in good faith but no warranty, expressed or implied, is made.

Key to abbreviations
NDA = No Data Available

APPENDIX B

SCDHEC Approval of Changes to Underground Injection Control Permit to Operate, #SCHE03020559M1

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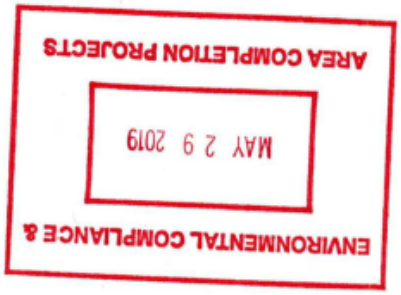
SRNS-OS-2019-00159 110384

dhec
Healthy People. Healthy Communities.

May 20, 2019



Ms. Amy J. Meyer
US DOE - Savannah River Nuclear Solutions, LLC
Building 7230-4B
Aiken, SC 29808

Re: Underground Injection Control Permit #SCHE03020559M1
Savannah River Site - C Area Groundwater Operable Unit Site

Dear Ms. Meyer:

Enclosed is a Permit to Operate fifteen (15) as Class VA-I (Aquifer Remediation) injection wells at the Savannah River Site - C Area Groundwater Operable Unit Site, Aiken County, SC.

South Carolina Board of Health and Environmental Control
Guide to Board Review
Pursuant to S.C. Code Ann. § 44-1-60
Effective April 1, 2013

The decision of the South Carolina Department of Health and Environmental Control (Department) becomes the final agency decision fifteen (15) calendar days after notice of the decision has been mailed to the applicant, permittee, licensee and affected persons who have requested in writing to be notified, unless a written request for final review accompanied by a filing fee in the amount of $100 is filed with Department by the applicant, permittee, licensee or affected person.

Applicants, permittees, licensees, and affected parties are encouraged to engage in mediation during the final review process.

If the Board declines in writing to schedule a final review conference, the Department's decision becomes the final agency decision and an applicant, permittee, licensee, or affected person may request a contested case hearing before the Administrative Law Court within thirty (30) calendar days after notice is mailed that the Board declined to hold a final review conference.

I. **Filing of Request for Final Review**

1. A written Request for Final Review (RFR)and the required filing fee of one hundred dollars ($100) must be received by Clerk of the Board within fifteen (15)calendar days after notice of the staff decision has been mailed to the applicant, permittee, licensee, or affected persons. If the 15th day occurs on a weekend or State holiday, the RFR must be received by the Clerk on the next working day. RFRs will not be accepted after 5:00 p.m.
2. RFRs shall be in writing and should include, at a minimum, the following information:
   - The grounds for amending, modifying, or rescinding the staff decision;
   - a statement of any significant issues or factors the Board should consider in deciding how to handle the matter;
   - the relief requested; and
   - a copy of the decision for which review is requested.

S.C. Department of Health and Environmental Control
2600 Bull Street Columbia, SC 29201 (803) 898-3432 www.scdhec.gov

3. RFRs should be filed in person or by mail at the following address:

   South Carolina Board of Health and Environmental Control

   Attention: Clerk of the Board

   2600 Bull Street

   Columbia, South Carolina 29201

   Alternatively, RFR's may be filed with the Clerk by facsimile (803-898-3393) or by electronic mail (boardclerk@dhec.sc.gov).
4. The filing fee maybe paid by cash, certified check or credit card. If a RFR is filed by facsimile or electronic mail, the filing fee may be mailed to the Clerk of the Board and the envelope must be postmarked within the time allowed for filing a RFR.

5. If there is any perceived discrepancy in compliance with this RFR filing procedure, the Clerk should consult with the Chairman or, if the Chairman is unavailable, the Vice-Chairman. The Chairman or the Vice-Chairman will determine whether the RFR is timely and properly filed and direct the Clerk to (1) process the RFR for consideration by the Board or (2) return the RFR and filing fee to the requestor with a cover letter explaining why the RFR was not timely or properly filed. Processing an RFR for consideration by the Board shall not be interpreted as a waiver of any claim or defense by the agency in subsequent proceedings concerning the RFR.

6. If the RFR will be processed for Board consideration, the Clerk will send an Acknowledgement of RFR to the Requestor and the applicant, permittee, or licensee, if other than the Requestor.

7. The Clerk will email the RFR to all Board members for review, and all Board members will confirm receipt of the RFR to the Clerk by email. If a Board member does not confirm receipt of the RFR within twenty-four (24) hour period, the Clerk will contact the Board member and confirm receipt. If a Board member believes the RFR should be considered by the RFR Committee, he or she will respond to the Clerk's email within forty-eight (48) hours and will request further review. If no Board member requests further review of the RFR within the forty-eight (48) hour period, the Clerk will send a letter by certified mail to the Requestor, with copy by regular mail to the applicant, permittee, or licensee, if not the Requestor, stating the Board will not hold a Final Review Conference. A copy of the Notice of Appeal Procedure will be included with the letter.

   NOTE: If the time periods described above end on a weekend or State holiday, the time is automatically extended to 5:00 p.m. on the next business day.

8. If the RFR is to be considered by the RFR Committee, the Clerk will forward a copy of the RFR to Department staff and Office of General Counsel. A Department response to the RFR should be provided by Department staff to the Clerk within eight (8) working days after the RFR is forwarded.

II. Final Review Conference Scheduling

1. If a Conference will be held, the Clerk will send a letter by certified mail to the Requestor, with copy by regular mail to the applicant, permittee, or licensee, if not the Requestor, informing the Requestor of the determination.

2. The Clerk will request Department staff provide the Administrative Record.

3. The Clerk will send Notice of Final Review Conference to the parties at least ten (10) days before the Conference. The Conference will be publicly noticed and should:

   - include the place, date and time of the Conference;
   - state the presentation times allowed in the Conference;
   - state evidence may be presented at the Conference;
   - if the conference will be held by committee, include a copy of the Chairman's order appointing the committee; and
   - inform the Requestor of his or her right to request a transcript of the proceedings of the Conference prepared at Requestor's expense.

4. If a party requests a transcript of the proceedings of the Conference and agrees to pay all related costs in writing, including costs for the transcript, the Clerk will schedule a court reporter for the Conference.

III. **Final Review Conference and Decision**

1. The order of presentation in the Conference will, subject to the presiding officer's discretion, be as follows:
   - Department staff will provide an overview of the staff decision and the applicable law to include [10 minutes]:
     - Type of decision (permit, enforcement, etc.) and description of the program.
     - Parties
     - Description of facility/site
     - Applicable statutes and regulations
     - Decision and materials relied upon in the administrative record to support the staff decision.
   - Requestor(s) will state the reasons for protesting the staff decision and may provide evidence to support amending, modifying, or rescinding the staff decision. [15 minutes] *NOTE: The burden of proof is on the Requestor(s)*
   - Rebuttal by Department staff[15 minutes]
   - Rebuttal by Requestor(s)[10 minutes]

     Note: Times noted in brackets are for information only and are superseded by times stated in the Notice of Final Review Conference or by the presiding officer.
2. Parties may present evidence during the conference; however, the rules of evidence do not apply.
3. At any time during the conference, the officers conducting the conference may request additional information and may question the Requestor, the staff, and anyone else providing information at the conference.
4. The presiding officer, in his or her sole discretion, may allow additional time for presentations and may impose time limits on the Conference.
5. All Conferences are open to the public.
6. The officers may deliberate in closed session.
7. The officers may announce the decision at conclusion of the Conference or it may be reserved for consideration.
8. The Clerk will mail the written final agency decision (FAD) to parties within 30 days after the Conference. The written decision must explain the basis for the decision and inform the parties of their right to request a contested case hearing before the Administrative Law Court. The FAD will be sent by certified mail, return receipt requested.
9. Communications may also be sent by electronic mail, in addition to the forms stated herein, when electronic mail addresses are provided to the Clerk.

The above information is provided as a courtesy; parties are responsible for complying with all applicable legal requirements.

If you have any questions, please call Bruce Crawford at (803) 898-4177.

Sincerely,

Bruce Crawford, Hydrogeologist
Water Monitoring Assessment and Protection Division
SCDHEC - Bureau of Water

cc: Heather Cathcart, SCDHEC-BLWM

dhec
Healthy People. Healthy Communities.

WATER MONITORING ASSESSMENT & PROTECTION DIVISION

Injection Well Operating Approval

for

Class II, III, and V.A. Injection Well(s)

Permit #SCHE03020559 Date of Issue: May 20, 2019

In accordance with R.61-72 this permit will become final unless it is appealed within fifteen (15) days of the issuance date.

In accordance with the provisions of Title 48, Chapter 1, South Carolina Code of Laws, 1976, as amended, and pursuant to receiving a Permit to Operate fifteen (15) Class VA-I (Aquifer Remediation) injection wells, authorization is granted to United States Department of Energy (DOE) to operate fifteen (15) Class VA-I (Aquifer Remediation) injection wells located at the Savannah River Site - C Area Groundwater Operable Unit Site, Aiken County, SC, and are subject to the attached provisos noted for the operator.

The Class VA-I injection wells are one (1) to three (3) inches in diameter and approximately thirty-three (33) to forty-four (44) and sixty-five (65) to seventy-five (75) feet deep.

Pursuant to Title 48, Chapter 1, South Carolina Code of Laws, 1976, as amended, this authorization may be rescinded if these injection wells should, at any time, contaminate, pollute, or otherwise adversely affect other water in the vicinity or for any other conditions contained in R61-87, Title 48, Chapter 1, South Carolina Code of Laws, 1976, as amended.

Expires: April 4, 2020

Alex Butler, Manager
Water Monitoring Assessment and Protection Division
SCDHEC - Bureau of Water

Date May 20, 2019

S.C. Department of Health and Environmental Control
2600 Bull Street, Columbia, SC 29201 (803) 898-3432 www.scdhec.gov

Provisions to the Injection Well Operating Approval
for
Underground Injection Well Permit #SCHE03020559
Savannah River Site - C Area Groundwater Operable Unit
Aiken County, S.C.
May 20, 2019

1) Construction of new or abandonment of existing wells must be reported to the Department within thirty (30) days of completion.

2) Only EOS BAC-9, EOS-100(emulsified oil with vitamin B-12), dechlorinated water and pH buffer (CoBupHmg), sodium bicarbonate, ascorbic acid and potable water as described in the corrective action plan may be injected into the subsurface at the fifteen (15) Class VA-I (Aquifer Remediation) injection wells. Any changes in the system operation other than as presented in the UIC Permit Application must be reported to the Department prior to implementation.

3) **Permit must be maintained as an active Permit to Operate. Failure to renew a Permit within 30 days of expiration will result in automatic closure of the Permit to Operate. Reactivation of an expired Permit to Operate will be considered after a letter of request to reactivate UIC Permit #SCHE03020559M1 is received and reviewed.**

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APPENDIX C

Notification of Start of Injection Activities

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110513

Shelia Mcfalls

From:	Shelia Mcfalls
Sent:	Thursday, June 27, 2019 1:14 PM
To:	Crawford, Bruce
Cc:	Rob Pope (pope.robert@epa.gov); Jon Richards (richards.jon@epa.gov); Tufts, Jennifer (Tufts.Jennifer@epa.gov); Fulmer, Susan; Heather Cathcart (cathcahe@dhec.sc.gov); HENNESSEY, BRIAN; Karen Adams; HAMMETT, AVERY G; Chris Bergren; Mike Griffith; Thomas Kmetz; Thomas Gaughan; J Ross; Amy Meyer; Thelesia Oliver; Susan Cornwell; Sandra Smith; Terry Killeen; Joseph Burch; Robert Vanpelt; Lew Williams; Travis R. Fuss; O'Quinn, Gregory; Beatty, K. Leigh; Barbara Harris; Bethany Cameron
Subject:	Notification for the C-Area Groundwater Operable Unit Edible Oil Injections - Underground Injection Control Permit #SCHE03020559M1

SRNS-J2000-2019-00498

Bruce,

References:

1) Letter, Amy J. Meyer (SRNS) to B. Crawford (SCDHEC), *Request for Approval of the Savannah River Site Underground Injection Control Permit Application for the Implementation of the Non-Time Critical Removal Action at the C-Area Groundwater Operable Unit (U) (SRNS-RP-2019-00030, Revision 0, March 2019)*, SRNS-J2000-2019-00171, dated March 19, 2019
2) Letter, B, Crawford (SCDHEC) to Amy J. Meyer (SRNS), *Re: Underground Injection Control Permit #SCHE03020559 Savannah River Site – C-Area Groundwater Operable Unit Site Aiken County*, dated April 4, 2019 (Permit to Construct) (SRNS-OS-2019-00107)
3) Letter, B, Crawford (SCDHEC) to Amy J. Meyer (SRNS), *Re: Underground Injection Control Permit #SCHE03020559 Savannah River Site – C-Area Groundwater Operable Unit Site Aiken County*, dated April 8, 2019 (Permit to Operate) (SRNS-OS-2019-00108)
4) E-mail, S. McFalls (SRNS) to B. Crawford (SCDHEC), *Request for Approval: Changes to the Underground Injection Control Permit for the C-Area Groundwater Operable Unit (Permit #SCHE03020559)*, SRNS-J2000-2019-00368, dated May 15, 2019
5) Letter, B, Crawford (SCDHEC) to Amy J. Meyer (SRNS), *Re: Underground Injection Control Permit #SCHE03020559M1 Savannah River Site – C-Area Groundwater Operable Unit Site*, dated May 20, 2019 (Permit to Operate) (SRNS-OS-2019-00159)

The Savannah River Site (SRS) requested approval to install fifteen direst push technology injection points (CCIW-01, CCIW-02, CCIW-03, CCIW-04, CCIW-05, CCIW-06, CCIW-07, CCIW-08, CCIW-09, CCIW-10, CCIW-11, CCIW-12, CCIW-13, CCIW-14 and CCIW-15) at the C-Area Groundwater Operable Unit to create two edible oil treatment barrier areas (Oil Injection Area 1 and Oil Injection Area 2) in the Middle Aquifer Zone to treat a volatile organic compound groundwater plume containing primarily trichloroethylene with minor quantities of tetrachloroethylene (Reference 1). The South Carolina Department of Health and Environmental Control (SCDHEC) approved the request and issued the Underground Injection Control (UIC) Permit to Construct and UIC Permit to Operate (References 2 and 3, respectively). After an independent review of the project to ensure that the appropriate quantities of the injectates would be used, SRS requested approval to modify the quantity and injectates for the edible oil injections (Reference 4). SCDHEC approved the request and issued a modified UIC Permit to Operate (Reference 5). A modified UIC Permit to Construct was not required because there were no changes to the number of injection points. The UIC Permit to Construct requested that SCDHEC be notified at least 24 hours prior to installing the injection wells. This email serves as notification that

1

mobilization and leak testing of the equipment is expected to start on Wednesday, July 10, 2019 and be performed through Monday, July 15, 2019. Injection activities are planned to begin on Tuesday, July 16, 2019.

Please contact me if you have any questions, comments, or concerns.

Thanks

Shelia L. McFalls | **Savannah River Nuclear Solutions, LLC** | Environmental Compliance & Area Completion Projects | shelia.mcfalls@srs.gov | 1.803.952.6819 office | 1.803.725.7243, #19367 pager |1.803.952.6403 fax |Savannah River Site | Building 730-4B, 3134 | Aiken, SC 29808



APPENDIX D

Groundwater Monitoring Well Records
and Injection Point Soil Boring Installation Reports

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Page 1 of 4

Monitoring Well Installation Report

Driller Name/Company	Driller Cert. No.	Tech Oversight Name/Company	Well Number
Jimmy Hall Jr./Cascade Drilling	1398 B	Matt Malin/North Wind	CRW023C

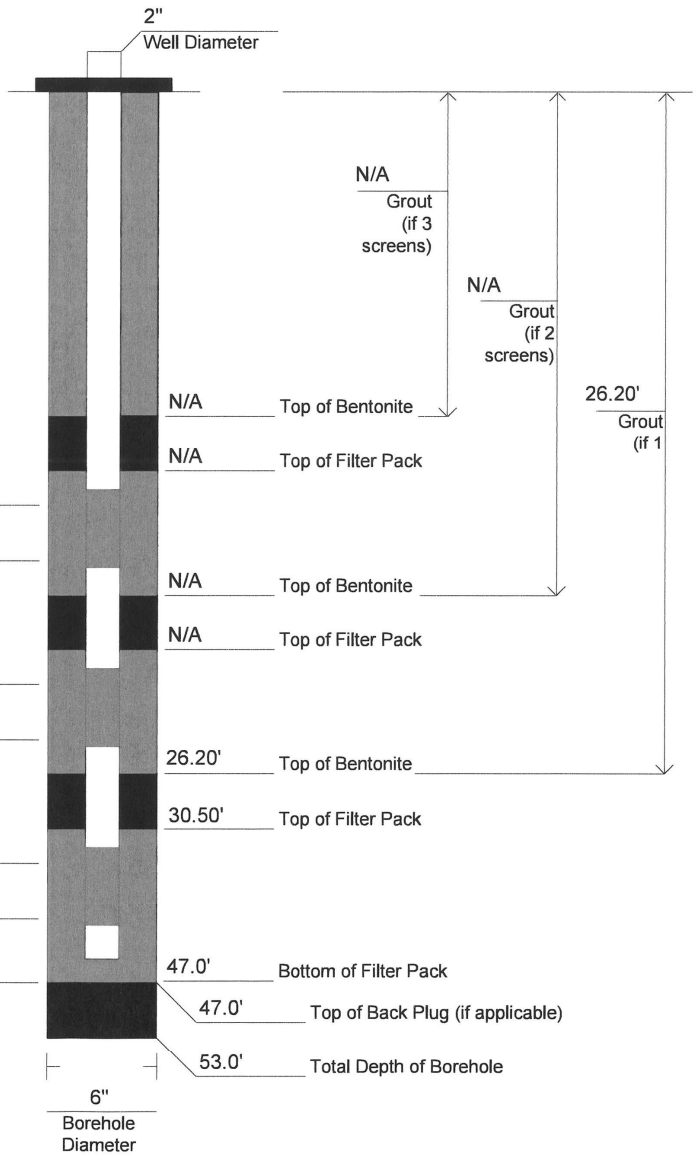
Well Installation Date	SC DHEC Well Approval Number	Drilling Method (Auger Mud Rotary, Rotosonic, etc)	
3/1/18	SRNS-OS-2017-00102	Rotosonic	
SRS North Grid Coordinate (as built)	**SRS East Grid Coordinate (as built)**	**Latitude (deg/min/sec - as built) (NAD 27)**	**Longitude (deg/min/sec - as built) (NAD 27)**
65307.40756	41002.63946	33° 14' 7.3716"	-81° 41' 8.444"
Top of Pad Elevation (as built)	**Water Level Reference Point Elevation (as built)**	**Survey Point**	
197.44	200.36	☒ Top of Casing ☐ Top of Stand Pipe ☐ Ground Surface	

Surface Casing (if installed) Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing N/A

Casing Material/Diameter N/A

Grout Quantity N/A



Screen Zone	Top of Screen	N/A
N/A	Bottom of Screen	N/A
Screen Zone	Top of Screen	N/A
N/A	Bottom of Screen	N/A
Screen Zone	Top of Screen	33.65'
C	Bottom of Screen	43.68'
	Total Depth of Well	46.0'

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Page 2 of 4

Monitoring Well Installation Report (Continued)

Well Number
CRW023C

Program Plan Name	Location Description	Site ID	Project Manager
CAGW OU CPT, DPT and Wells FY2018	S1 W3, south of 3-Road	C-Area Groundwater OU	Mike Grifffith

Station Type (Monitoring Well, Piezometer, etc.)
Monitoring Well

Drilling and Sampling

Drilling Start Date	Drilling Completion Date	Total Drilled Depth
3/1/18	3/1/18	53'

Drilling Sampling Method	Top Depth	Bottom Depth	Diameter
Rotosonic coring	33'	53'	4"
Rotosonic	0'	53'	6"

Drilling and Sampling Comments (lost circulation zones, drilling problems, etc.)

Geophysical Logging

Date Logged	Logging Top Depth	Logging Bottom Depth	Logging Contractor	Logging Truck Operator
N/A	N/A	N/A	N/A	N/A

Geophysical Logs

☐ Caliper ☐ Natural Gamma ☐ Neutron Density ☐ Resistivity ☐ Single Pt. Resistivity ☐ L & S Normal Resistivity ☐ Spontaneous Potential

☐ Other (List)

Backfill Top Depth	Backfill Bottom Depth	Backfill Material (Include Type, Quantity)
47.0'	53.0	1.75 - 50 lb bags of Holeplug

Depths measured from ground surface to nearest 0.1 ft.

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Page 3 of 4

Monitoring Well Installation Report (Continued)

Well Number: CRW023C

	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	+##'	33.65'	PVC/40	2"		
Screen	33.65'	44.67"	PVC/40	2"	0.010	Slot'd Screen
Sump	43.68	45.67'	PVC/40	2"		
Sump Cap	45.67'	46.00'	PVC/40	2"		

Filter Pack	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name
	30.5'	47'	5 - 50 lb bags	Southern Products Filter Media #1A

Bentonite Seal	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)
	26.2'	30.5'	1 - 5 gallon (50 lb) bucket 3/8" pellets

Grout	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight
	0'	26.2'	8 46.2 lb bags	3/1/18	Type I Portland
☒ Neat Cement					
☐ Bentonite Cement					
☐ High Solids Bentonite					

Well Installation Comments

Pump Installation Information ☒ Pump Not Installed

Installation Date	Installer/Company	Model/Manufacturer	Diameter
N/A	N/A	N/A	N/A

☐ Single Speed ☐ Variable Speed — Depth from Top of Casing to Top of Pump: N/A

Report Prepared By: Matt Malin — Date: 3/19/18

Depths measured from ground surface to nearest 0.1 ft.

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Page 4 of 4

Well Development Data Field Parameters

Well Number: CRW023C

Well Developed By: Cascade Drilling | Development Oversight: Matt Malin | Development Method: submersible pump. | Final Yield (gpm): 0.75 gpm

Date	Time	pH	Conductivity	Turbidity	Temperature	Comments (additives, problems, etc.)
3/7/18	0955					WL = 25.97 (TOC) 23.03 (TOG) TD = 48.66 (TOC) 45.85 (TOG)
	1053					start pump - rate 2.5 gpm
	1056	6.44	136.4	999	18.1	turbid water battery goes
	1134	5.95	59.74	—	18.2	water visually clear
	1136	swab + surge				pump rate 2.25 gpm
	1139	5.92	80.45	—	18.2	visually turbid
	1149	5.74	56.46	—	18.7	visually clear
	1152	5.62	55.92	—	18.8	visually clear.
	1155	5.60	53.94	—	18.8	visually clear
	1157	swab and surge				
	1200	5.87	74.62	—	18.8	visually very turbid
	1204	5.58	51.84	—	18.9	cleaning up, some turbidity
	1209	5.56	51.74	—	18.9	cleaning up. slightly turbid, visually
	1213	5.52	49.87	—	18.7	cleaning up
	1215	swab + surge screen				
	1219	5.61	48.49	—	18.3	
	1275					stop pump. new batteries in turbid meter
	1300	swab + surge screen				have new turbid meter.
	1305	5.91	66.58	####	19.0	detector signal too low pump rate 1.75 spm
	1313	5.57	51.42	154	19.1	
	1318	5.50	47.62	71.4	19.0	
	1323	5.48	46.70	31.1	19.2	
	1329	5.48	44.80	26.9	19.3	
	1338	5.36	44.29	19.8	19.0	
↓	1339	swab + surge screen				set lower screen
3/7/18	1343	5.43	46.20	####	18.8	detector signal too low

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Well Development Data Field Parameters

Well Number: CRW025C

Well Developed By	Development Oversight	Development Method	Final Yield (gpm)
Cascade Drilling	Matt Malin	submersible pump	0.75 gpm

Date	Time	pH	Conductivity	Turbidity	Temperature	Comments (additives, problems, etc.)
3/7/18	1346	5.38	43.83	154	18.6	pump rate 1.75 gpm
	1352	5.41	43.88	50.0	18.3	
	1401	5.32	42.85	25.0	18.4	
	1408	5.40	42.12	20.7	18.3	
	1413	5.41	41.69	12.3	18.2	
	1415	swab + surge	screen			set lower screen
	1419	5.53	52.42	####	18.5	
	1423	5.26	41.15	228	18.4	
	1428	5.43	40.47	113	18.2	
	1433	5.26	40.38	74.9	18.6	
	1442	5.31	39.90	35.1	18.5	
	1446	5.20	39.49	29.6	18.5	
	1448	swab + surge	screen			set mid screen
	1452	5.18	39.49	####	18.6	
	1455	5.23	39.46	577	18.7	
	1505	5.12	38.07	78.5	19.0	
	1510	5.19	38.44	44.3	18.7	
	1520	5.22	38.53	29.6	18.5	
	1524	5.17	38.14	22.6	18.5	
	1525	swab + surge	screen			set lower screen
	1529	5.54	49.58	####	18.4	
	1532	5.15	38.28	181	18.6	
	1540	5.15	37.95	69.2	18.2	
	1551	5.10	37.39	37.1	18.3	
	1558	5.15	37.28	28.2	18.1	
3/7/18	1600	shut	off	pump.		

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Well Development Data Field Parameters

Well Number: CRW023C

Well Developed By: Cascade Drilling | Development Oversight: Matt Malin | Development Method: submersible pump | Final Yield (gpm): 0.75 gpm

Date	Time	pH	Conductivity	Turbidity	Temperature	Comments (additives, problems, etc.)
3/8/18	0845	swab + surge				
	0847					start pump 1 gpm
	0849	5.88	54.82	++++	16.8	overrange
	0854	6.11	59.42	795	18.0	
	0900	5.83	42.28	49.1	18.1	
	0907	6.15	41.46	42.9	17.7	
	0915	5.87	39.59	20.8	18.2	
	0922	5.78	38.69	14.9	18.2	
	0923	swab + surge		++		
	0926	6.26	55.84	++++	18.4	over range
	0929	5.88	38.61	622	18.5	
	0949	5.84	37.16	29.3	17.2	
	0957	5.76	36.38	17.7	17.5	
	1005	5.84	36.10	13.1	17.3	
	1004	swab + surge	screen			
	1008	5.91	42.03	####	18.1	
	1011	5.79	37.17	513	18.2	
	1017	5.72	35.85	123	18.2	
	1027	5.75	35.95	49.6	17.8	
	1037	5.83	35.05	25.0	16.9	
	1038	pumping stops- no water				
	1049	restart pump				pump rate 0.75 gpm
	1052	5.71	36.27	94.9	17.9	
	1055	5.63	35.62	18.3	17.9	
	1059	pumping stops- no water				
mm	~~3/8/18~~ 3/8/18	1121	start pumping			pump rate 0.5 gpm

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Page 4 of 4

Well Development Data Field Parameters

Well Number: CRW 023C

Well Developed By	Development Oversight	Development Method	Final Yield (gpm)
Cascade Drilling	Matt Malin	submersible pump	0.75 gpm

Date	Time	pH	Conductivity	Turbidity	Temperature	Comments (additives, problems, etc.)
3/8/18	1123	5.81	39.62	39.4	17.7	
	1128	5.68	37.19	20.0	17.8	
	1129	Pump goes dry - no water coming out				
	Call	Terry Killeen for direction - w/n make sample delivery				
		Receive direction to attempt to collect sample				
		after 1408.				
	1406	restart pump				rate = 0.375 gpm
	1407	6.10	51.53	12.8	18.3	
	1412	pump goes dry - stop pump				
	1510	5.87	42.99	43.0	18.0	start pump 1.5 gpm
	1515	5.76	37.22	7.81	18.2	
	1518	5.79	35.65	3.83	18.4	
	1521	5.66	35.60	3.02	18.5	
	1524	5.64	35.09	2.28	18.4	
	1527	5.66	35.14	2.25	18.4	
↓	1530	5.73	35.45	2.07	17.9	stabilized - lower flow
3/8/18	1536	Turn pump off				flow rate 0.75
	Sample ID =	CRXWAC-000069				

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Page 1 of 4

Monitoring Well Installation Report

Driller Name/Company	Driller Cert. No.	Tech Oversight Name/Company	Well Number
Jimmy Hall Jr./Cascade Drilling	1398 B	Matt Malin/North Wind Inc	CRW024C

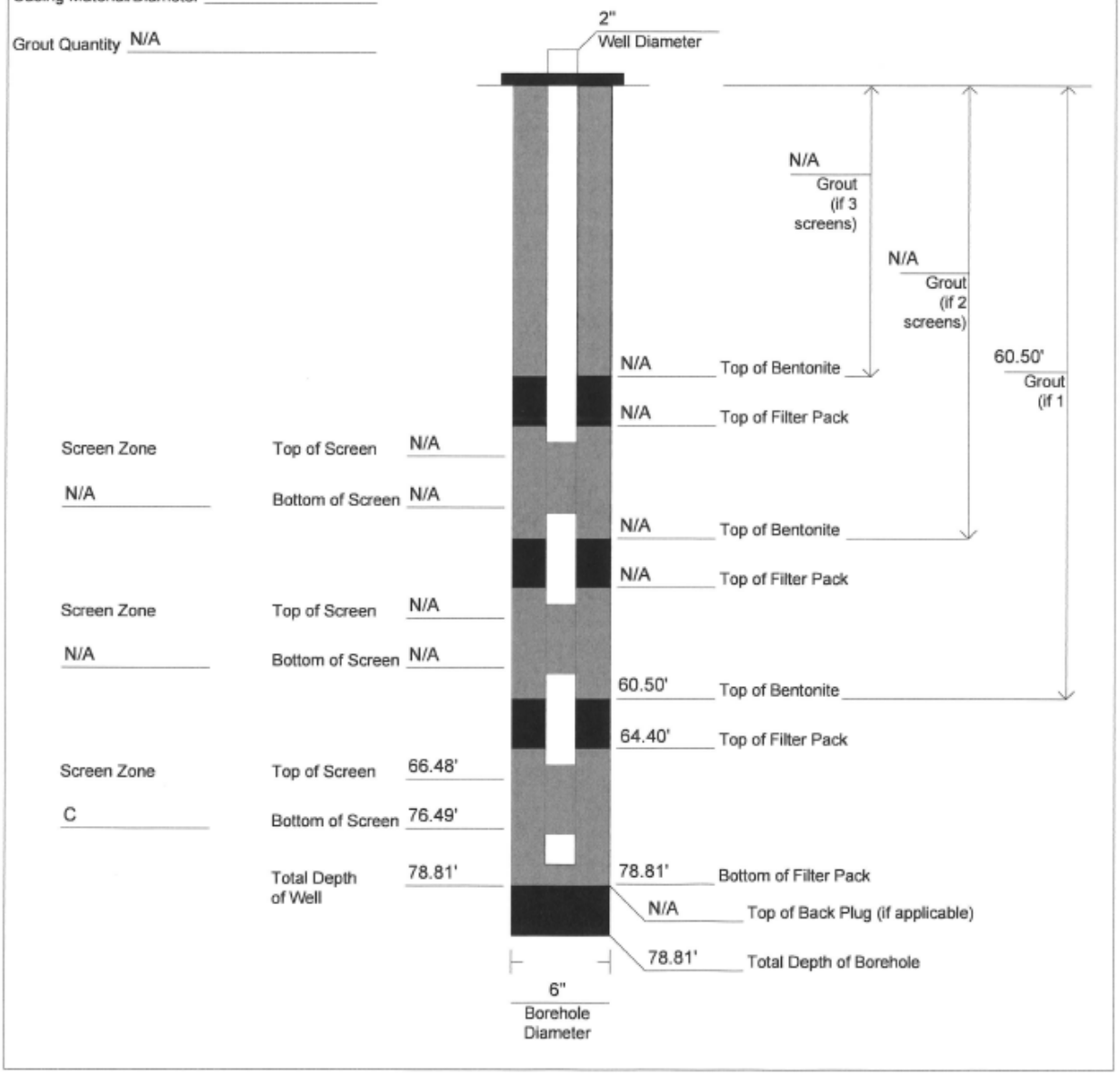
Well Installation Date	SC DHEC Well Approval Number	Drilling Method (Auger Mud Rotary, Rotosonic, etc)	
2/28/18	SRNS-OS-2017-00102	Rotosonic	
SRS North Grid Coordinate (as built)	**SRS East Grid Coordinate (as built)**	**Latitude (deg/min/sec - as built) (NAD 27)**	**Longitude (deg/min/sec - as built) (NAD 27)**
65511.46097	41129.68461	33° 14' 9.744"	-81° 41' 8.668"
Top of Pad Elevation (as built)	**Water Level Reference Point Elevation (as built)**	**Survey Point**	
215.23	217.41	☒ Top of Casing ☐ Top of Stand Pipe ☐ Ground Surface	

Surface Casing (if installed) — Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing: N/A

Casing Material/Diameter: N/A

Grout Quantity: N/A



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Page 2 of 4

Monitoring Well Installation Report (Continued)

Well Number
CRW024C

Program Plan Name	Location Description	Site ID	Project Manager
CAGW OU CPT, DPT and Wells FY2018	S1 W3, south of 3-Road	C-Area Groundwater OU	Mike Grifffith

Station Type (Monitoring Well, Piezometer, etc.)
Monitoring Well

Drilling and Sampling

Drilling Start Date	Drilling Completion Date	Total Drilled Depth
2/28/18	2/28/18	78.5'

Drilling Sampling Method	Top Depth	Bottom Depth	Diameter
Rotosonic coring	48.5'	78.5'	4"
Rotosonic	0'	78.5'	6"

Drilling and Sampling Comments (lost circulation zones, drilling problems, etc.)

Geophysical Logging

Date Logged	Logging Top Depth	Logging Bottom Depth	Logging Contractor	Logging Truck Operator
N/A	N/A	N/A	N/A	N/A

Geophysical Logs

☐ Caliper ☐ Natural Gamma ☐ Neutron Density ☐ Resistivity ☐ Single Pt. Resis-tivity ☐ L & S Normal Resistivity ☐ Spontaneous Potential

☐ Other (List)

Backfill Top Depth	Backfill Bottom Depth	Backfill Material (Include Type, Quantity)
N/A	N/A	N/A

Depths measured from ground surface to nearest 0.1 ft.

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Page 3 of 4

Monitoring Well Installation Report (Continued)

Well Number: CRW024C

	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	+##'	66.48'	PVC/40	2"		
Screen	66.48'	76.49'	PVC/40	2"	0.010	Slot'd Screen
Sump	76.49'	78.48'	PVC/40	2"		
Sump Cap	78.48'	78.81'	PVC/40	2"		

	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name
Filter Pack	64.40'	78.81'	4.5 - 50 lb bags	Southern Products Filter Media #1A

	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)
Bentonite Seal	60.50'	64.40'	1 - 5 gallon (50 lb) bucket 3/8" pellets

	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight
Grout	0'	60.50'	16 46.2 lb bags	2/28/18	Type I Portland
☒ Neat Cement					
☐ Bentonite Cement					
☐ High Solids Bentonite					

Well Installation Comments

Pump Installation Information ☒ Pump Not Installed

Installation Date	Installer/Company	Model/Manufacturer	Diameter
N/A	N/A	N/A	N/A

☐ Single Speed ☐ Variable Speed — Depth from Top of Casing to Top of Pump: N/A

Report Prepared By: Matt Malin — Date: 3/19/18

Depths measured from ground surface to nearest 0.1 ft.

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Page 4 of 4

Well Development Data Field Parameters

Well Number: CRW024C

Well Developed By: Joshua Justice/Jared Matt — Development Oversight: Matt Matin — Development Method: submersible pump — Final Yield (gpm): 1 gpm

Date	Time	pH	Conductivity	Turbidity	Temperature	Comments (additives, problems, etc.)
3/5/18			µS	NTU	°C	WL=39.17 TOC/37.15 TOG
	0933					TD= 79.47 TOC/77.45 TOG pump 1 gpm
	0939					adjust into to 2 gpm
	0945					shut down pump
	1023	swab + surge				
	1025	restart pump				pump rate 2 gpm
	1028	12.17	309.0	E3	18.7	@ top of screen
	1039	9.87	127.4	45.9	18.8	
	1045	8.56	104.1	14.9	18.8	
	1050	swab + surge	screen			dark brn sediment slug in surging.
	1054	8.32	118.2	E3	18.8	
	1101	7.51	94.62	112	18.9	
	1109	7.19	84,100	16.3	19.0	
	1114	7.17	80.33	13.6	19.0	
	1116	swab + surge				turbid, but no sediment slug while surging.
	1121	12.86	150.05	1000+	19.0	pump rate 2 gpm
	1127	8.25	71.25	85.3	19.0	
	1134	7.08	67.72	10.5	18.9	
	1139	6.88	67.36	13.5	19.0	
	1140	swab + surge				
	1145	7.01	73.24	594	19.0	
	1154	6.89	61.74	12.9	18.9	
	1200	6.73	61.42	10.4	19.0	
	1205	swab + surge	after increasing rate			increase pump rate-2.75 gpm
↓	1209	6.60	55.94	912	19.0	moved to bottom of screen
3/5/18	1213	6.52	56.17	27.1	19.0	

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Well Development Data Field Parameters

Well Number: CRW024C

Well Developed By: Joshua Justice/Cascade | Development Oversight: Matt Malin | Development Method: submersible pump | Final Yield (gpm): 1 gpm

Date	Time	pH	Conductivity	Turbidity	Temperature	Comments (additives, problems, etc.)
3/5/18	1218	6.54	55.27	6.53	19.0	
	1224	6.45	54.99	8.95	19.0	
	1229	Swab + surge screen				
	1233	6.42	50.83	599	19.1	
	1236	6.23	50.83	15.4	19.1	
	1244	6.21	49.92	2.48	19.1	pump rate 2.75 gpm
	1250	swab + surge screen				
	1254	6.03	42.96	628	19.1	
	1256	6.11	46.34	22.9	19.2	
	1302	6.12	46.38	3.02	19.2	
	1306	6.14	45.42	1.97	19.1	
	1309	swab + surge - move to mid screen				
	1312	6.06	39.81	300	19.0	
	1315	5.95	44.33	27.0	19.1	pump rate = 2.75 gpm
	1324	6.09	43.28	1.90	19.1	
	1331	6.08	43.81	2.96	18.9	
	1336	swab + surge screen				
	1340	5.91	38.26	246	18.9	
	1346	5.97	41.64	4.20	18.9	
	1354	5.92	41.58	1.31	18.8	
	1401	5.87	41.26	1.59	18.9	
	1403	swab + surge				
	1407	5.78	36.18	196	18.9	pumping rate = 2.5 gpm
	1413	5.86	39.64	3.62	18.9	
	1426	5.93	39.51	1.49	18.9	
3/5/18	1428	swab + surge				

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Well Development Data Field Parameters

Well Number

Well Developed By	Development Oversight	Development Method	Final Yield (gpm)
Cascade/Josh Justice	Matt Malin	submersible pump	1 gpm

Date	Time	pH	Conductivity	Turbidity	Temperature	Comments (additives, problems, etc.)
3/5/18	1434	6.55	41.31	430	18.6	pump rate 1.0 gpm
	1439	5.93	41.37	17.0	18.8	
	1444	6.01	43.01	5.06	18.7	
	1447	5.91	42.15	3.37	18.8	
	1450	5.94	43.44	2.97	18.9	
	1453	5.97	43.75	3.34	18.9	
	1456	6.09	43.91	3.40	18.7	
	1500	6.07	43.69	4.97	18.8	
	1504	6.03	44.21	6.46	18.9	
	1507	5.98	44.03	6.23	18.9	
	1510	6.30	45.37	7.76	18.5	
	1513	6.07	45.15	7.98	18.8	
	1516	6.04	45.75	9.03	18.8	
	1519	6.11	45.10	8.31	18.8	
3/5/18	1522	6.12	46.68	8.33	18.7	
3/15/18	1550	turn off pump				
	Sample ID: CRXWAC-000070					

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Monitoring Well Installation Report

Driller Name/Company	Driller Cert. No.	Tech Oversight Name/Company	Well Number
J. Justice/Cascade	2232	M. Sheehan/Navarro	CRW025C

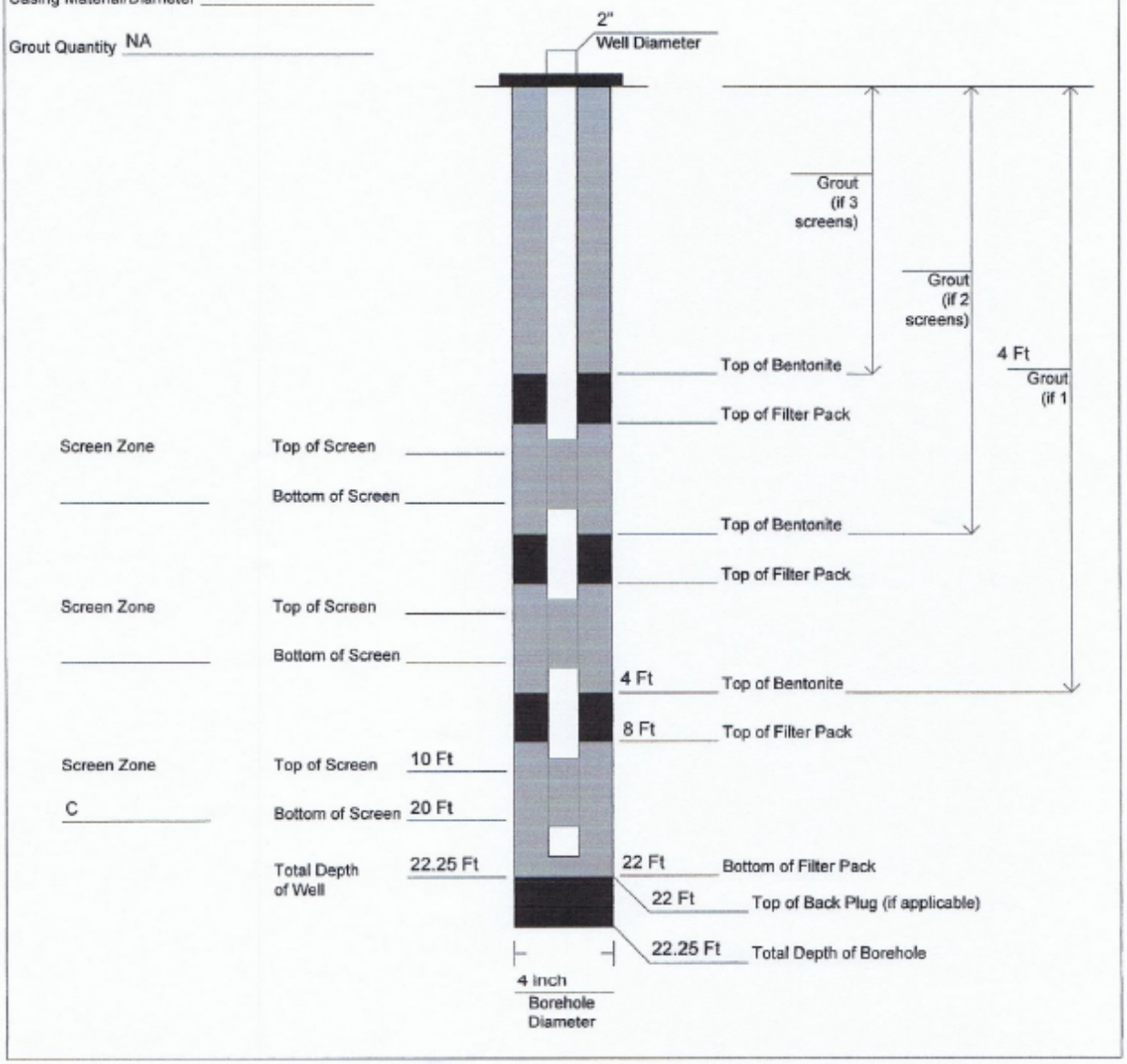
Well Installation Date	SC DHEC Well Approval Number	Drilling Method (Auger Mud Rotary, Rotosonic, etc)	
11/27/18	MW-11705	Diect Push Technology	
SRS North Grid Coordinate (as built)	**SRS East Grid Coordinate (as built)**	**Latitude (deg/min/sec - as built) (NAD 27)**	**Longitude (deg/min/sec - as built) (NAD 27)**
65087.61	40799.08	33°14'10.66"	-81°41'8.83"
Top of Pad Elevation (as built)	**Water Level Reference Point Elevation (as built)**	**Survey Point**	
178.59 TOC	Static water level 9.80 ft BGS on 12/3//18	☒ Top of Casing ☐ Top of Stand Pipe ☒ Ground Surface	

Surface Casing (if installed) Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing NA

Casing Material/Diameter NA

Grout Quantity NA



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Monitoring Well Installation Report (Continued)

Well Number
CRW025C

Program Plan Name	Location Description	Site ID	Project Manager
CAGW:OU-3 Monitoring Wells	C-Area	Caster Creek	Sandra Smith

Station Type (Monitoring Well, Piezometer, etc.)
Monitoring Wells

Drilling and Sampling

Drilling Start Date	Drilling Completion Date	Total Drilled Depth
11/21/18	11/27/19	22 Ft

Drilling Sampling Method	Top Depth	Bottom Depth	Diameter
Hand Auger	0	6	4 Inch
Continous DPT Cores	6	22	4 Inch

Drilling and Sampling Comments (lost circulation zones, drilling problems, etc.)

Geophysical Logging

Date Logged	Logging Top Depth	Logging Bottom Depth	Logging Contractor	Logging Truck Operator

Geophysical Logs

☐ Caliper ☐ Natural Gamma ☐ Neutron Density ☐ Resistivity ☐ Single Pt. Resis-tivity ☐ L & S Normal Resistivity ☐ Spontaneous Potential

☐ Other (List)

Backfill Top Depth	Backfill Bottom Depth	Backfill Material (Include Type, Quantity)

Depths measured from ground surface to nearest 0.1 ft.

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Monitoring Well Installation Report (Continued)

Well Number: CRW025C

	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	0	10	Schedule 40 PVC	2-Inch		
Screen	10	20	Schedule 40 PVC	2-Inch	0.10	Pre-Packed
Sump	20	22	Schedule 40 PVC	2-Inch		
Sump Cap	22	22.25	Schedule 40 PVC	2-Inch		

	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name
Filter Pack	8 Ft	20 Ft	Pre Packed Screen	1 Add. Bag of #1A Southern Prod. Filter

	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)
Bentonite Seal	4 Ft	8 Ft	1.5 bag 3/8" Bentonite Pellet (allowed to hydrate 2 hours)

	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight
Grout	0	4 Ft	1-50lb bags	11/28/18	appx 15 lb/gal
☒ Neat Cement					
☐ Bentonite Cement					
☐ High Solids Bentonite					

Well Installation Comments

Pump Installation Information ☒ Pump Not Installed

Installation Date	Installer/Company	Model/Manufacturer	Diameter

☐ Single Speed ☐ Variable Speed — Depth from Top of Casing to Top of Pump

Report Prepared By: Gregg Stephens — Date: 11/30/18

Depths measured from ground surface to nearest 0.1 ft.

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Monitoring Well Installation Report

Driller Name/Company	Driller Cert. No.	Tech Oversight Name/Company	Well Number
J. Justice/Cascade	2232	M. Sheehan/Navarro	CRW026C

Well Installation Date	SC DHEC Well Approval Number	Drilling Method (Auger Mud Rotary, Rotosonic, etc)	
11/28/18	MW-11705	Diect Push Technology	
SRS North Grid Coordinate (as built)	**SRS East Grid Coordinate (as built)**	**Latitude (deg/min/sec - as built) (NAD 27)**	**Longitude (deg/min/sec - as built) (NAD 27)**
65126.58	40933.00	33°14'11.76"	-81°41'7.83"

Top of Pad Elevation (as built)	Water Level Reference Point Elevation (as built)	Survey Point
176.95 TOC	Static water level 5.35 ft BGS on 12/3//18	☒ Top of Casing ☐ Top of Stand Pipe ☒ Ground Surface

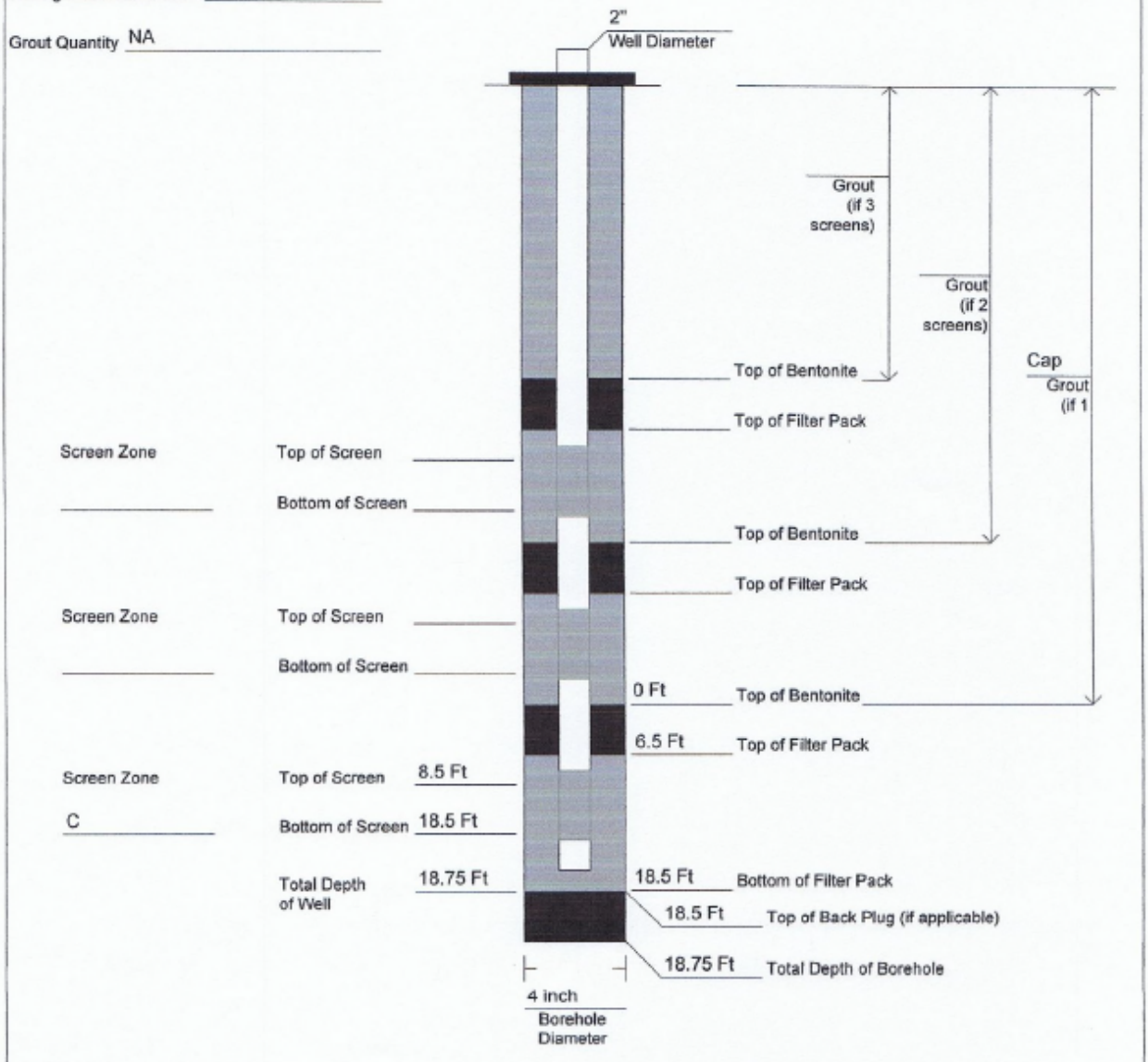
Surface Casing (if installed)

Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing NA

Casing Material/Diameter NA

Grout Quantity NA



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Monitoring Well Installation Report (Continued)

Well Number
CRW026C

Program Plan Name	Location Description	Site ID	Project Manager
CAGW:OU-3 Monitoring Wells	C-Area	Caster Creek	Sandra Smith

Station Type (Monitoring Well, Piezometer, etc.)
Monitoring Wells

Drilling and Sampling

Drilling Start Date	Drilling Completion Date	Total Drilled Depth
11/28/18	11/28/19	18.5 Ft

Drilling Sampling Method	Top Depth	Bottom Depth	Diameter
Hand Auger	0	6	4 Inch
Continous DPT Cores	6	18.5	4 Inch

Drilling and Sampling Comments (lost circulation zones, drilling problems, etc.)
Hit Refusal 18.5 Ft

Geophysical Logging

Date Logged	Logging Top Depth	Logging Bottom Depth	Logging Contractor	Logging Truck Operator

Geophysical Logs

☐ Caliper ☐ Natural Gamma ☐ Neutron Density ☐ Resistivity ☐ Single Pt. Resistivity ☐ L & S Normal Resistivity ☐ Spontaneous Potential

☐ Other (List)

Backfill Top Depth	Backfill Bottom Depth	Backfill Material (Include Type, Quantity)

Depths measured from ground surface to nearest 0.1 ft.

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Monitoring Well Installation Report (Continued)

Well Number
CRW026C

Program Plan Name	Location Description	Site ID	Project Manager
CAGW:OU-3 Monitoring Wells	C-Area	Caster Creek	Sandra Smith

Station Type (Monitoring Well, Piezometer, etc.)
Monitoring Wells

Drilling and Sampling

Drilling Start Date	Drilling Completion Date	Total Drilled Depth
11/28/18	11/28/19	18.5 Ft

Drilling Sampling Method	Top Depth	Bottom Depth	Diameter
Hand Auger	0	6	4 Inch
Continous DPT Cores	6	18.5	4 Inch

Drilling and Sampling Comments (lost circulation zones, drilling problems, etc.)
Hit Refusal 18.5 Ft

Geophysical Logging

Date Logged	Logging Top Depth	Logging Bottom Depth	Logging Contractor	Logging Truck Operator

Geophysical Logs

☐ Caliper ☐ Natural Gamma ☐ Neutron Density ☐ Resistivity ☐ Single Pt. Resistivity ☐ L & S Normal Resistivity ☐ Spontaneous Potential

☐ Other (List)

Backfill Top Depth	Backfill Bottom Depth	Backfill Material (Include Type, Quantity)

Depths measured from ground surface to nearest 0.1 ft.

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Monitoring Well Installation Report

Driller Name/Company	Driller Cert. No.	Tech Oversight Name/Company	Well Number
J. Justice/Cascade	2232	M. Sheehan/Navarro	CRW027C

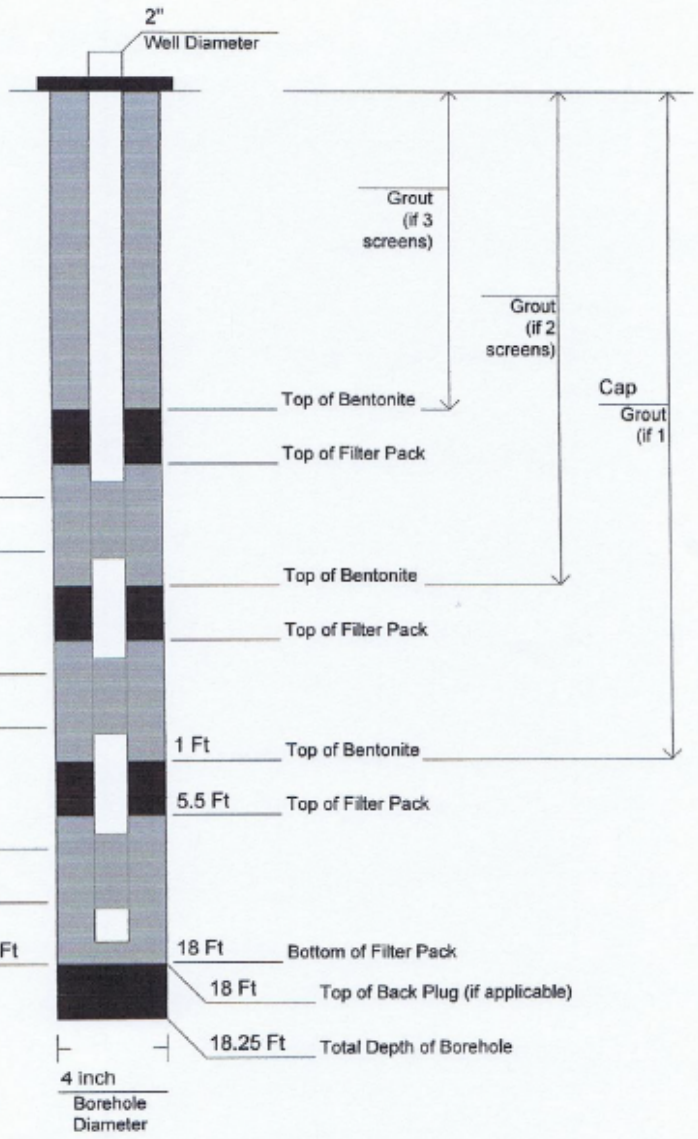
Well Installation Date	SC DHEC Well Approval Number	Drilling Method (Auger Mud Rotary, Rotosonic, etc)	
11/28/18	MW-11705	Diect Push Technology	
SRS North Grid Coordinate (as built)	**SRS East Grid Coordinate (as built)**	**Latitude (deg/min/sec - as built) (NAD 27)**	**Longitude (deg/min/sec - as built) (NAD 27)**
65165.83	41004.41	33°14'12.49"	-81°41'7.43"
Top of Pad Elevation (as built)	**Water Level Reference Point Elevation (as built)**	**Survey Point**	
177.41 TOC	Static water level 1.17 ft BGS on 12/3//18	☒ Top of Casing ☐ Top of Stand Pipe ☒ Ground Surface	

Surface Casing (if installed) Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing NA

Casing Material/Diameter NA

Grout Quantity NA



Screen Zone	Top of Screen	
	Bottom of Screen	
Screen Zone	Top of Screen	
	Bottom of Screen	
Screen Zone	Top of Screen	8 Ft
C	Bottom of Screen	18 Ft
	Total Depth of Well	18.25 Ft

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Monitoring Well Installation Report (Continued)

Well Number
CRW027C

Program Plan Name	Location Description	Site ID	Project Manager
CAGW:OU-3 Monitoring Wells	C-Area	Caster Creek	Sandra Smith

Station Type (Monitoring Well, Piezometer, etc.)
Monitoring Wells

Drilling and Sampling

Drilling Start Date	Drilling Completion Date	Total Drilled Depth
11/28/18	11/28/19	18.5 Ft

Drilling Sampling Method	Top Depth	Bottom Depth	Diameter
Hand Auger	0	6	4 Inch
Continous DPT Cores	6	18.5	4 Inch

Drilling and Sampling Comments (lost circulation zones, drilling problems, etc.)
Hit Refusal 18 Ft

Geophysical Logging

Date Logged	Logging Top Depth	Logging Bottom Depth	Logging Contractor	Logging Truck Operator

Geophysical Logs

☐ Caliper ☐ Natural Gamma ☐ Neutron Density ☐ Resistivity ☐ Single Pt. Resis-tivity ☐ L & S Normal Resistivity ☐ Spontaneous Potential

☐ Other (List)

Backfill Top Depth	Backfill Bottom Depth	Backfill Material (Include Type, Quantity)

Depths measured from ground surface to nearest 0.1 ft.

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Monitoring Well Installation Report (Continued)

Well Number: CRW027C

	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	0	8	Schedule 40 PVC	2-Inch		
Screen	8	18	Schedule 40 PVC	2-Inch	0.10	Pre-Packed
Sump	NA	NA				
Sump Cap	18	18.25	Schedule 40 PVC	2-Inch		

	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name
Filter Pack	5.5 Ft	18. Ft	Pre Packed Screen	1 Add. Bag of #1A Southern Prod. Filter

	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)
Bentonite Seal	5.5 Ft	1 Ft	1.5 bag 3/8" Bentonite Pellet (allowed to hydrate 2 hours)

	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight
Grout	CAP	CAP			

☒ Neat Cement
☐ Bentonite Cement
☐ High Solids Bentonite

Well Installation Comments

Pump Installation Information ☒ Pump Not Installed

Installation Date	Installer/Company	Model/Manufacturer	Diameter

☐ Single Speed ☐ Variable Speed — Depth from Top of Casing to Top of Pump

Report Prepared By: Gregg Stephens — Date: 11/30/18

Depths measured from ground surface to nearest 0.1 ft.

Print Form | Save Form | E-mail Form

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Monitoring Well Installation Report

Driller Name/Company	Driller Cert. No.	Tech Oversight Name/Company	Well Number
Ray Witt	2223	Terry Killeen / SRNS	CRW028C

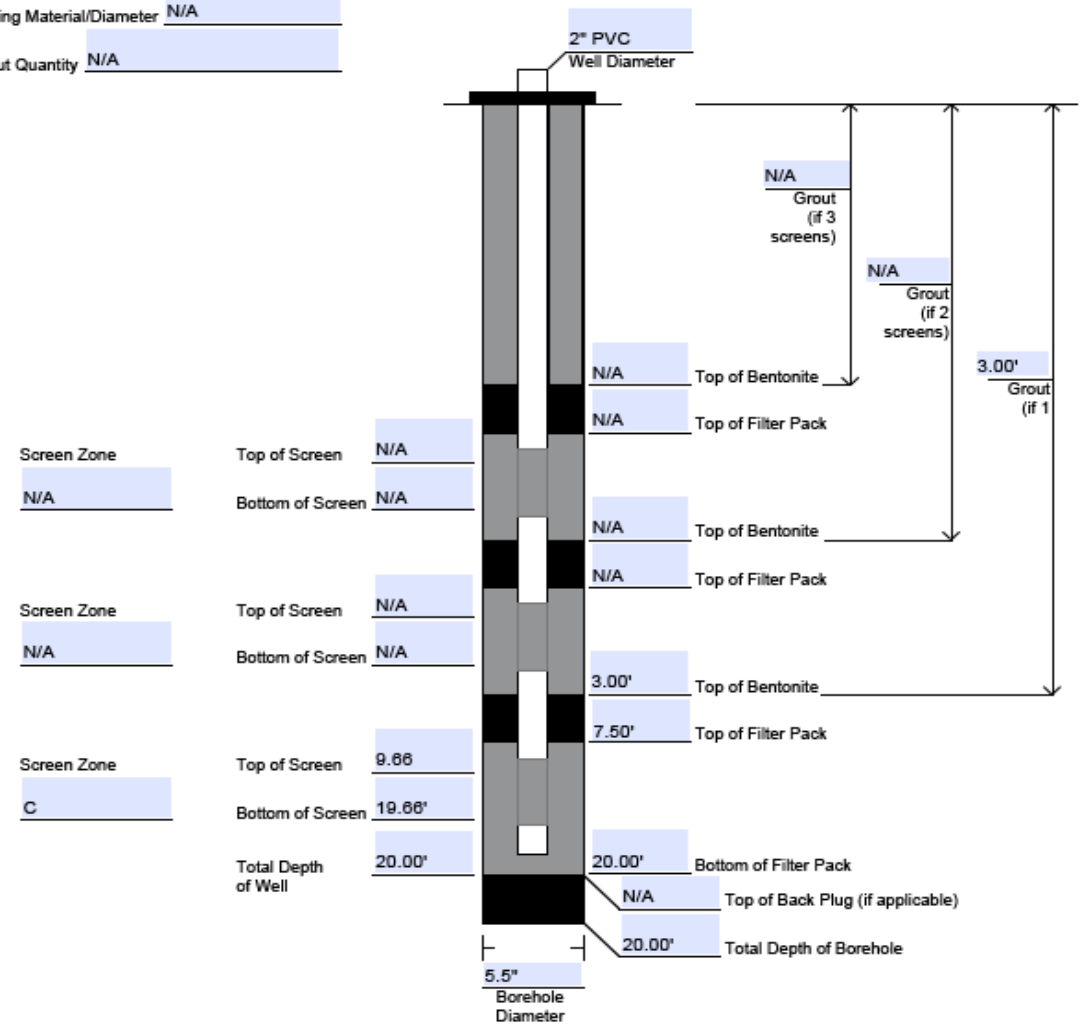
Well Installation Date	SC DHEC Well Approval Number	Drilling Method (Auger Mud Rotary, Rotosonic, etc)	
4/3/19	MW - 11883	Direct Push Technology (DPT	
SRS North Grid Coordinate (as built)	**SRS East Grid Coordinate (as built)**	**Latitude (deg/min/sec - as built) (NAD 27)**	**Longitude (deg/min/sec - as built) (NAD 27)**
65,241.81	41,133.24	33 / 14 / 13.85	-81 / 41 / 6.74
Top of Pad Elevation (as built)	**Water Level Reference Point Elevation (as built)**	**Survey Point**	
177.1 ft-msl	180.44 ft-msl	☒ Top of Casing ☐ Top of Stand Pipe ☐ Ground Surface	

Surface Casing (if installed) — Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing: N/A

Casing Material/Diameter: N/A

Grout Quantity: N/A



Screen Zone: N/A	Top of Screen	N/A
	Bottom of Screen	N/A
Screen Zone: N/A	Top of Screen	N/A
	Bottom of Screen	N/A
Screen Zone: C	Top of Screen	9.66
	Bottom of Screen	19.66'
	Total Depth of Well	20.00'

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Monitoring Well Installation Report (Continued)

Well Number
CRW028C

Program Plan Name	Location Description	Site ID	Project Manager
CAGW OU Emulsified Oil RA Add. Well	South of C-Area at SRS	82	Sandra Smith

Station Type (Monitoring Well, Piezometer, etc.)
Monitoring Well

Drilling and Sampling

Drilling Start Date	Drilling Completion Date	Total Drilled Depth
4/1/19	4/1/19	20'

Drilling Sampling Method	Top Depth	Bottom Depth	Diameter
Hand Auger	0'	6'	4"
DPT	0'	20'	5.5"

Drilling and Sampling Comments (lost circulation zones, drilling problems, etc.)

During the initial installation of the well, flowing sands came into the DPT rods after the expendable tip came off and locked the PVC well to the rods so the well had to be extracted and then reinstalled to depth. Ten gallons of potable water was used to act as counter weight to the flowing sands, but as the DPT rods were extracted natural formation sand collapsed against the pre-packed sand filter of the PVC screen and casing to a depth of 7.5 ft below ground surface. Bentonite seal and grout completed the well to ground surface.

Geophysical Logging

Date Logged	Logging Top Depth	Logging Bottom Depth	Logging Contractor	Logging Truck Operator

Geophysical Logs

☐ Caliper ☐ Natural Gamma ☐ Neutron Density ☐ Resistivity ☐ Single Pt. Resistivity ☐ L & S Normal Resistivity ☐ Spontaneous Potential

☐ Other (List)

Backfill Top Depth	Backfill Bottom Depth	Backfill Material (Include Type, Quantity)

Depths measured from ground surface to nearest 0.1 ft.

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Monitoring Well Installation Report (Continued)

Well Number: CRW028C

	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	-3.00 ft	9.66 ft	Sch 40 PVC	2 in		
Screen	9.66 ft	19.66 ft	Prepack Sch 40 PVC	2 in	0.01 in	Machined
Sump						
Sump Cap	19.66 ft	20.00 ft	Sch 40 PVC	2 in		

	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name
Filter Pack	7.5 ft	20.0 ft		Natural formation sand

	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)
Bentonite Seal	3.0 ft	7.5 ft	1/2 bucket (50lb) 3/8" bentonite pellets

	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight
Grout	0.0	3.0	2 Sacks (50 lb)	4/1/19 & 4/3/19	14 lbs/gal

☐ Neat Cement
☒ Bentonite Cement
☐ High Solids Bentonite

Well Installation Comments

Pump Installation Information ☒ Pump Not Installed

Installation Date	Installer/Company	Model/Manufacturer	Diameter

☐ Single Speed ☐ Variable Speed

Depth from Top of Casing to Top of Pump

Report Prepared By: Terry Killeen

Date: 4/4/19

Depths measured from ground surface to nearest 0.1 ft.

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Well Development Data Field Parameters

Well Number
CRW028C

Well Developed By	Development Oversight	Development Method	Final Yield (gpm)
Ray Witt / Cascade	Terry Killeen	Swab and pump	4 gpm

Date	Time	pH	Conductivity	Turbidity	Temperature	Comments (additives, problems, etc.)
4/3/19	8:45 AM	7.95	47.47	77.0	11.7 C	Water Depth = 2.0 ft. Swabbed well at start, waited for water to clear, then sampled
4/3/19	9:00 AM	8.17	33.20	25.1	14.6 C	
4/3/19	9:05 AM	8.23	32.44	8.38	16.4 C	
4/3/19	9:08 AM	8.29	31.85	5.85	16.7 C	
4/3/19	9:10 AM	8.32	31.36	5.02	16.7 C	
4/3/199	9:15 AM	8.32	31.44	4.28	16.6 C	Paused pumping and contacted sampler. RadCon took sample for rad classification.
4/3/19	11:05 AM	8.2	35	3.0	17.8 C	Classified as non-rad, we can collect the sample, restarted pump ~ 4 gpm.
4/3/19	11:08 AM	8.2	31	2.7	18.7 C	
4/3/19	11:11 AM	8.04	30.73	2.14	19.7 C	Begin collecting WAC sample.

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	01	

GENERAL INFORMATION

Project Name				
CAGW OU NTC Removal Action				
Project Manager			Department	
Sandra Smith & Joao Cardoso-Neto			EC&ACP	
Boring Purpose		County	Location Description	
Oil injection to create a TCE treatment barrier		Barnwell	Savannah River Site, grid S1-W4	
SRS North Grid Coordinate	SRS East Grid Coordinate	Latitude (degrees, minutes, seconds) (NAD 27)	Longitude (degrees, minutes, seconds) (NAD 27)	Ground Elevation
65476.32	41169.49	33°14'15.93"	-81°41'8.04"	212.3 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth	Static Water Level	Drilling Start Date	Drilling Completion Date	Drilling Method
76'	N/A	7/18/19	7/18/19	DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	66-76 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company	Driller (Last Name, First Initial)	Oversight Company	Oversight (Last Name, First Initial)
Cascade Technical Service	Thomas, B.	NorthWind	Malin, M.

Disposition of Samples
N/A

ABANDONMENT

Method of Abandonment	Materials Used in Abandonment
Grouted	4-46.2lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By	Date	Boring Installation Report Prepared By	Date
Matt Malin	7/22/19	Matt Malin	8/15/19

Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	02	

GENERAL INFORMATION

Project Name				
CAGW OU NTC Removal Action				
Project Manager			**Department**	
Sandra Smith & Joao Cardoso-Neto			EC&ACP	
Boring Purpose		**County**	**Location Description**	
Oil injection to create a TCE treatment barrier		Barnwell	Savannah River Site, grid S1-W4	
SRS North Grid Coordinate	**SRS East Grid Coordinate**	**Latitude** (degrees, minutes, seconds) (NAD 27)	**Longitude** (degrees, minutes, seconds) (NAD 27)	**Ground Elevation**
65481.18	41153.95	33° 14' 15.88"	-81° 41' 8.22"	213.9 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth	Static Water Level	Drilling Start Date	Drilling Completion Date	Drilling Method
78'	N/A	7/23/19	7/24/19	DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	66-78 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company	Driller (Last Name, First Initial)	Oversight Company	Oversight (Last Name, First Initial)
Cascade Technical Service	Thomas, B.	NorthWind	Malin, M.

Disposition of Samples
N/A

ABANDONMENT

Method of Abandonment	Materials Used in Abandonment
Grouted	4.5-46.2lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By	Date	Boring Installation Report Prepared By	Date
Matt Malin	7/29/19	Matt Malin	8/15/19

OSR 30-10 (Rev 6-14-2016)

Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	03	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65486.00	SRS East Grid Coordinate: 41138.40	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 15.83"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 8.40"	Ground Elevation: 213.8 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth: 76'	Static Water Level: N/A	Drilling Start Date: 7/18/19	Drilling Completion Date: 7/18/19	Drilling Method: DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	66-76 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company: Cascade Technical Service	Driller (Last Name, First Initial): Thomas, B.	Oversight Company: NorthWind	Oversight (Last Name, First Initial): Malin, M.

Disposition of Samples: N/A

ABANDONMENT

Method of Abandonment: Grouted	Materials Used in Abandonment: 4-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By: Matt Malin	Date: 7/22/19	Boring Installation Report Prepared By: Matt Malin	Date: 8/15/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	04	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65490.97	SRS East Grid Coordinate: 41122.82	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 15.77"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 8.58"	Ground Elevation: 214.1 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth	Static Water Level	Drilling Start Date	Drilling Completion Date	Drilling Method
76'	N/A	7/24/19	7/24/19	DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	66-76 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company	Driller (Last Name, First Initial)	Oversight Company	Oversight (Last Name, First Initial)
Cascade Technical Service	Thomas, B.	NorthWind	Malin, M.

Disposition of Samples: N/A

ABANDONMENT

Method of Abandonment	Materials Used in Abandonment
Grouted	4-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By	Date	Boring Installation Report Prepared By	Date
Matt Malin	7/25/19	Matt Malin	8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	05	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65495.70	SRS East Grid Coordinate: 41107.12	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 15.72"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 8.77"	Ground Elevation: 214.1 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth: 76'	Static Water Level: N/A	Drilling Start Date: 7/23/19	Drilling Completion Date: 7/23/19	Drilling Method: DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	66-76 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company: Cascade Technical Service	Driller (Last Name, First Initial): Thomas, B.	Oversight Company: NorthWind	Oversight (Last Name, First Initial): Malin, M.

Disposition of Samples: N/A

ABANDONMENT

Method of Abandonment: Grouted	Materials Used in Abandonment: 4-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By: Matt Malin	Date: 7/25/19	Boring Installation Report Prepared By: Matt Malin	Date: 8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	06	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65310.67	SRS East Grid Coordinate: 41045.98	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 13.89"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 8.05"	Ground Elevation: 196.9 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth: 43'	Static Water Level: N/A	Drilling Start Date: 8/5/19	Drilling Completion Date: 8/6/19	Drilling Method: DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	33-43 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company: Cascade Technical Service	Driller (Last Name, First Initial): Thomas, B.	Oversight Company: NorthWind	Oversight (Last Name, First Initial): Malin, M.

Disposition of Samples: N/A

ABANDONMENT

Method of Abandonment: Grouted	Materials Used in Abandonment: 2-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By: Matt Malin	Date: 8/7/19	Boring Installation Report Prepared By: Matt Malin	Date: 8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	07	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65301.52	SRS East Grid Coordinate: 41031.94	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 13.73"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 8.12"	Ground Elevation: 195.1 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth: 43'	Static Water Level: N/A	Drilling Start Date: 8/6/19	Drilling Completion Date: 8/6/19	Drilling Method: DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	33-43 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company: Cascade Technical Service	Driller (Last Name, First Initial): Thomas, B.	Oversight Company: NorthWind	Oversight (Last Name, First Initial): Malin, M.

Disposition of Samples: N/A

ABANDONMENT

Method of Abandonment: Grouted	Materials Used in Abandonment: 2-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By: Matt Malin	Date: 8/7/19	Boring Installation Report Prepared By: Matt Malin	Date: 8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	08	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65292.90	SRS East Grid Coordinate: 41018.10	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 13.58"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 8.19"	Ground Elevation: 194.2 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth: 43'	Static Water Level: N/A	Drilling Start Date: 8/5/19	Drilling Completion Date: 8/5/19	Drilling Method: DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	33-43 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company: Cascade Technical Service	Driller (Last Name, First Initial): Thomas, B.	Oversight Company: NorthWind	Oversight (Last Name, First Initial): Malin, M.

Disposition of Samples: N/A

ABANDONMENT

Method of Abandonment: Grouted	Materials Used in Abandonment: 2-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By: Matt Malin	Date: 8/8/19	Boring Installation Report Prepared By: Matt Malin	Date: 8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	09	

GENERAL INFORMATION

Project Name				
CAGW OU NTC Removal Action				
Project Manager			**Department**	
Sandra Smith & Joao Cardoso-Neto			EC&ACP	
Boring Purpose		**County**	**Location Description**	
Oil injection to create a TCE treatment barrier		Barnwell	Savannah River Site, grid S1-W4	
SRS North Grid Coordinate	**SRS East Grid Coordinate**	**Latitude** (degrees, minutes, seconds) (NAD 27)	**Longitude** (degrees, minutes, seconds) (NAD 27)	**Ground Elevation**
65284.99	41003.70	33° 14' 13.43"	-81° 41' 8.27"	194.1 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth	Static Water Level	Drilling Start Date	Drilling Completion Date	Drilling Method
43'	N/A	8/1/19	8/1/19	DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	33-43 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company	Driller (Last Name, First Initial)	Oversight Company	Oversight (Last Name, First Initial)
Cascade Technical Service	Thomas, B.	NorthWind	Malin, M.

Disposition of Samples
N/A

ABANDONMENT

Method of Abandonment	Materials Used in Abandonment
Grouted	2.5-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By	Date	Boring Installation Report Prepared By	Date
Matt Malin	8/6/19	Matt Malin	8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	10	

GENERAL INFORMATION

Project Name				
CAGW OU NTC Removal Action				
Project Manager			Department	
Sandra Smith & Joao Cardoso-Neto			EC&ACP	
Boring Purpose		County	Location Description	
Oil injection to create a TCE treatment barrier		Barnwell	Savannah River Site, grid S1-W4	
SRS North Grid Coordinate	SRS East Grid Coordinate	Latitude (degrees, minutes, seconds) (NAD 27)	Longitude (degrees, minutes, seconds) (NAD 27)	Ground Elevation
65278.46	40987.88	33° 14' 13.29"	-81° 41' 8.38"	194.7 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth	Static Water Level	Drilling Start Date	Drilling Completion Date	Drilling Method
43'	N/A	8/7/19	8/7/19	DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	33-43 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company	Driller (Last Name, First Initial)	Oversight Company	Oversight (Last Name, First Initial)
Cascade Technical Service	Thomas, B.	NorthWind	Malin, M.

Disposition of Samples
N/A

ABANDONMENT

Method of Abandonment	Materials Used in Abandonment
Grouted	2-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By	Date	Boring Installation Report Prepared By	Date
Matt Malin	8/8/19	Matt Malin	8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	11	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65272.56	SRS East Grid Coordinate: 40972.68	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 13.15"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 8.48"	Ground Elevation: 196.5 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth: 43'	Static Water Level: N/A	Drilling Start Date: 7/31/19	Drilling Completion Date: 7/31/19	Drilling Method: DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	33-43 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company: Cascade Technical Service	Driller (Last Name, First Initial): Thomas, B.	Oversight Company: NorthWind	Oversight (Last Name, First Initial): Malin, M.
Disposition of Samples: N/A			

ABANDONMENT

Method of Abandonment: Grouted	Materials Used in Abandonment: 2-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By: Matt Malin	Date: 8/1/19	Boring Installation Report Prepared By: Matt Malin	Date: 8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	12	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65269.40	SRS East Grid Coordinate: 40957.10	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 13.04"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 8.60"	Ground Elevation: 197.8 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth: 43'	Static Water Level: N/A	Drilling Start Date: 8/7/19	Drilling Completion Date: 8/8/19	Drilling Method: DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	33-43 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company: Cascade Technical Service	Driller (Last Name, First Initial): Thomas, B.	Oversight Company: NorthWind	Oversight (Last Name, First Initial): Malin, M.

Disposition of Samples: N/A

ABANDONMENT

Method of Abandonment: Grouted	Materials Used in Abandonment: 2-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By: Matt Malin	Date: 8/8/19	Boring Installation Report Prepared By: Matt Malin	Date: 8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	13	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65266.34	SRS East Grid Coordinate: 40939.21	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 12.91"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 8.75"	Ground Elevation: 199.3 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth	Static Water Level	Drilling Start Date	Drilling Completion Date	Drilling Method
43'	N/A	7/30/19	7/31/19	DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	33-43 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company	Driller (Last Name, First Initial)	Oversight Company	Oversight (Last Name, First Initial)
Cascade Technical Service	Thomas, B.	NorthWind	Malin, M.

Disposition of Samples: N/A

ABANDONMENT

Method of Abandonment	Materials Used in Abandonment
Grouted	2-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By	Date	Boring Installation Report Prepared By	Date
Matt Malin	8/1/19	Matt Malin	8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	14	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65267.05	SRS East Grid Coordinate: 40922.68	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 12.81"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 8.91"	Ground Elevation: 199.5 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth	Static Water Level	Drilling Start Date	Drilling Completion Date	Drilling Method
43'	N/A	8/8/19	8/8/19	DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	33-43 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company	Driller (Last Name, First Initial)	Oversight Company	Oversight (Last Name, First Initial)
Cascade Technical Service	Thomas, B.	NorthWind	Malin, M.

Disposition of Samples: N/A

ABANDONMENT

Method of Abandonment	Materials Used in Abandonment
Grouted	2-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By	Date	Boring Installation Report Prepared By	Date
Matt Malin	8/12/19	Matt Malin	8/19/19

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Soil Boring Installation Report

Boring Number (AAA,NNN,AA)		
CCIW	15	

GENERAL INFORMATION

Project Name: CAGW OU NTC Removal Action				
Project Manager: Sandra Smith & Joao Cardoso-Neto			Department: EC&ACP	
Boring Purpose: Oil injection to create a TCE treatment barrier		County: Barnwell	Location Description: Savannah River Site, grid S1-W4	
SRS North Grid Coordinate: 65268.11	SRS East Grid Coordinate: 40906.62	Latitude (degrees, minutes, seconds) (NAD 27): 33° 14' 12.73"	Longitude (degrees, minutes, seconds) (NAD 27): -81° 41' 9.07"	Ground Elevation: 199.8 ft-msl

DRILLING AND SAMPLING INFORMATION

Total Drilled Depth	Static Water Level	Drilling Start Date	Drilling Completion Date	Drilling Method
43'	N/A	7/30//19	7/30/19	DPT

Sample Type	Sampling Interval	Sample Type	Sampling Interval
Oil Injection	33-43 ft		

Drilling and Sampling Comments (Include drilling muds used, source of water, lost circulation zones, etc.)

Injected 1/2 of an oil mixture consisting of the following:
275 gal EOS100 Emulsified Soybean Oil;
1375 gal water;
2 Lbs Ascorbic Acid;
80 oz. Vitamin B-12; and
300 lbs Sodium Bicarbonate.

Then injected 2 L unconcentrated EOS BAC-9 Microbial Supplement;
Then injected other half of oil mixture;
Then injected 40 gal EOS CoBupH-Mg mixed with 200 gal water;
Lastly injected 300 gal of water.

Drilling Company	Driller (Last Name, First Initial)	Oversight Company	Oversight (Last Name, First Initial)
Cascade Technical Service	Thomas, B.	NorthWind	Malin, M.

Disposition of Samples: N/A

ABANDONMENT

Method of Abandonment	Materials Used in Abandonment
Grouted	2-46.2 lb bags of Holcim Type I Portland Cement

APPROVALS

Abandonment Verified By	Date	Boring Installation Report Prepared By	Date
Matt Malin	8/1/19	Matt Malin	8/19/19

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APPENDIX E

Subcontractor Field Notebook

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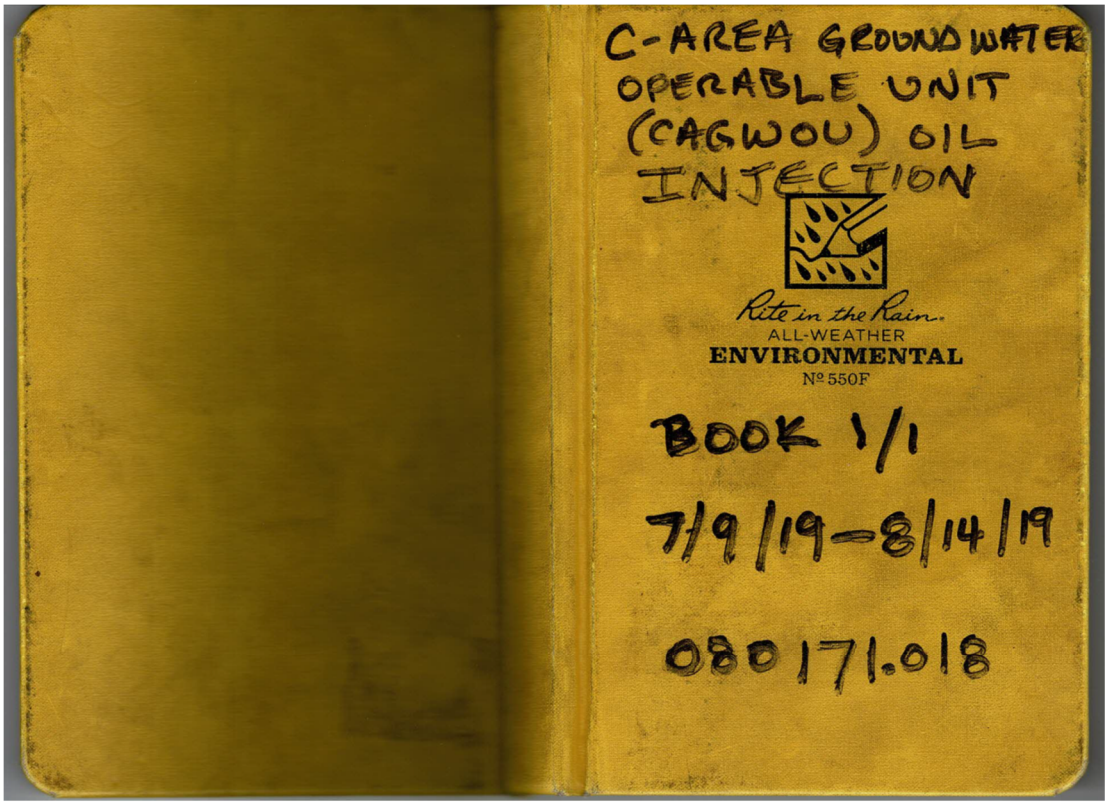
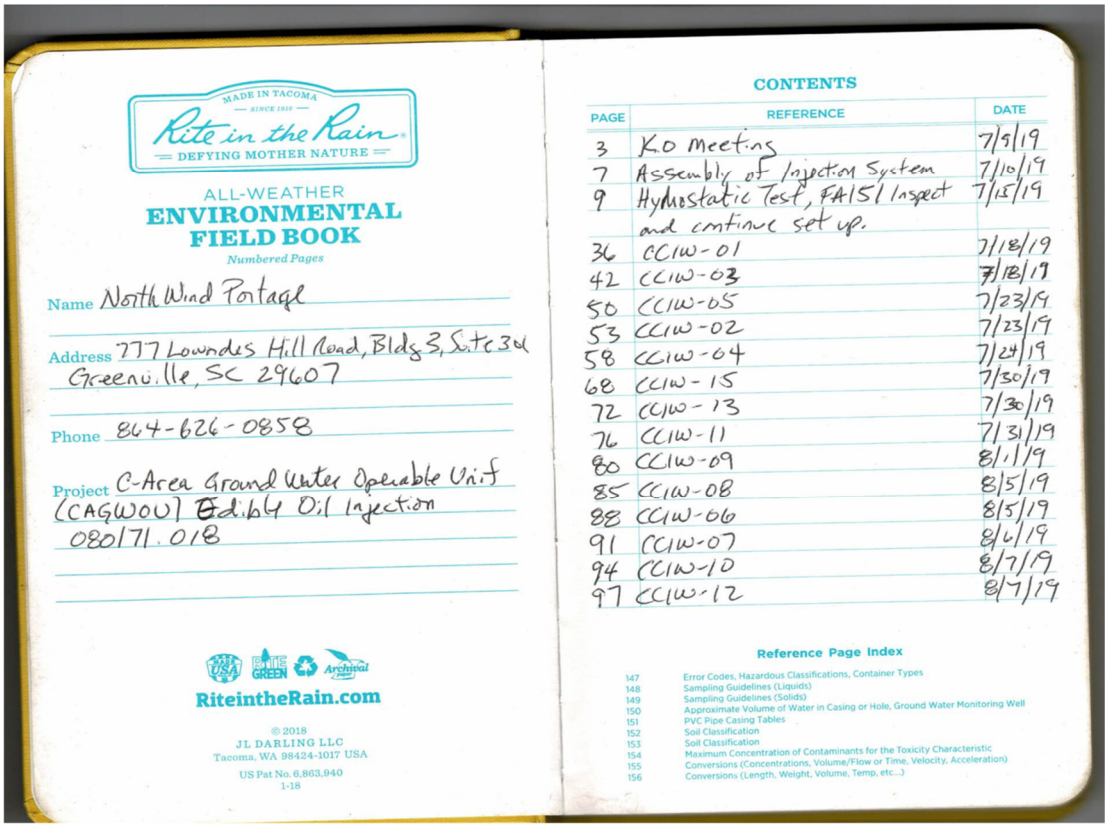

C-AREA GROUNDWATER
OPERABLE UNIT
(CAGWOU) OIL
INJECTION
Rite in the Rain
ALL-WEATHER
ENVIRONMENTAL
Nº 550F
BOOK 1/1
7/9/19-8/14/19
080171.018


MADE IN TACOMA
Rite in the Rain
DEFYING MOTHER NATURE
ALL-WEATHER
ENVIRONMENTAL
FIELD BOOK
Numbered Pages
Name North Wind Portage
Address 777 Lowndes Hill Road, Bldg 3, Ste 3A
Greenville, SC 29607
Phone 864-626-0858
Project C-Area Ground Water Operable Unit
(CAGWOU) Edible Oil Injection
080171.018
RiteintheRain.com
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JL DARLING LLC
Tacoma, WA 98424-1017 USA
US Pat No. 6,863,940
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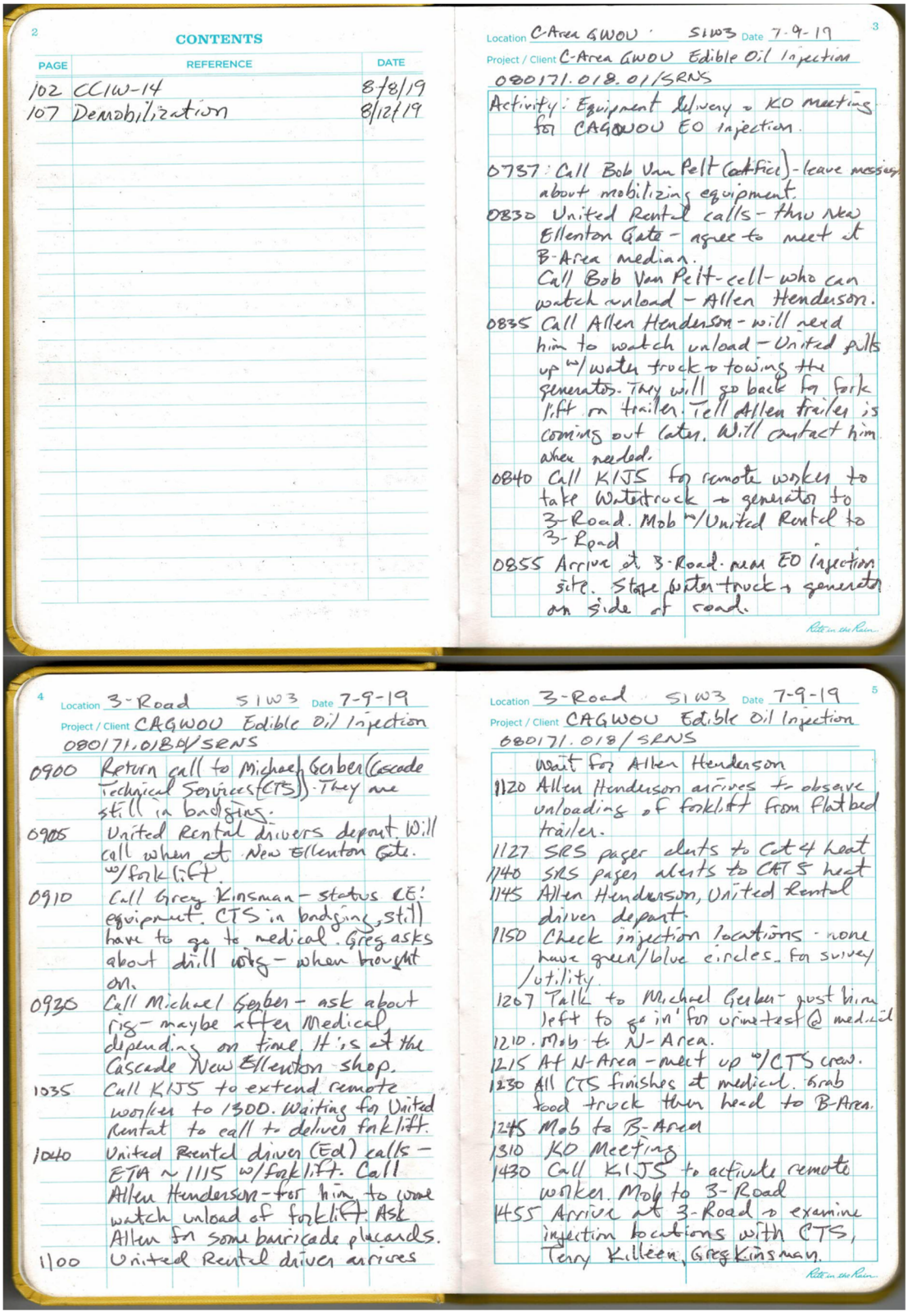

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Location C-Area GWOU · S1W3 Date 7-9-19
Project / Client C-Area GWOU Edible Oil Injection
080171.018.01/SRNS

Activity: Equipment delivery + KO meeting for CAGWOU EO injection.

0737 Call Bob Van Pelt (office) - leave message about mobilizing equipment.
0830 United Rental calls - thru New Ellenton Gate - agree to meet at B-Area median.
Call Bob Van Pelt-cell- who can watch unload - Allen Henderson.
0835 Call Allen Henderson - will need him to watch unload - United pulls up w/ water truck + towing the generator. They will go back for fork lift on trailer. Tell Allen trailer is coming out later. Will contact him when needed.
0840 Call KIJS for remote worker to take Watertruck + generator to 3-Road. Mob w/ United Rental to 3-Road
0855 Arrive at 3-Road. near EO injection site. Stage water truck + generator on side of road.

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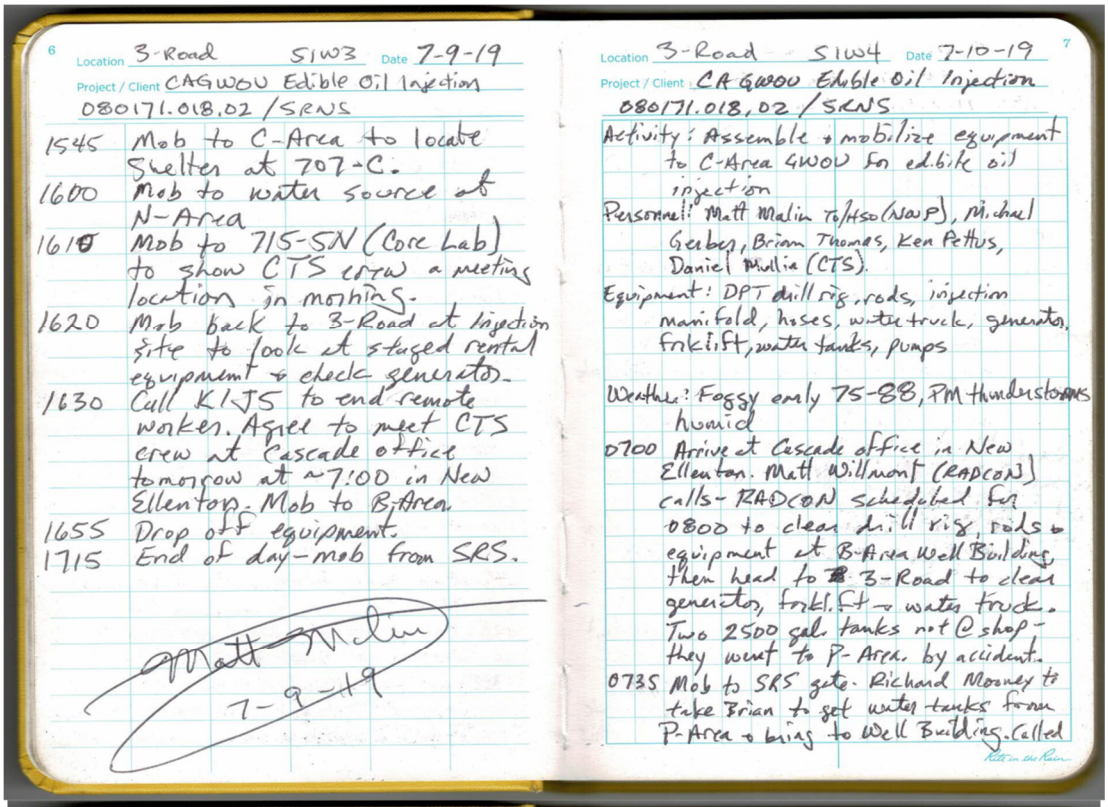
Location 3-Road S1W3 Date 7-9-19
Project / Client CAGWOU Edible Oil Injection
080171.018/SRNS

0900 Return call to Michael Gerber (Cascade Technical Services (CTS)). They are still in badging.
0905 United Rental drivers depart. Will call when at New Ellenton Gate. w/ forklift.
0910 Call Greg Kinsman - status CE: equipment. CTS in badging, still have to go to medical. Greg asks about drill rig - when brought on.
0930 Call Michael Gerber - ask about rig - maybe after Medical depending on time. It is at the Cascade New Ellenton shop.
1035 Call KIJS to extend remote worker to 1300. Waiting for United Rental to call + deliver forklift.
1040 United Rental driver (Ed) calls - ETA ~ 1115 w/ forklift. Call Allen Henderson - for him to come watch unload of forklift. Ask Allen for some barricade placards.
1100 United Rental driver arrives

5

Location 3-Road S1W3 Date 7-9-19
Project / Client CAGWOU Edible Oil Injection
080171.018/SRNS

Wait for Allen Henderson
1120 Allen Henderson arrives to observe unloading of forklift from flatbed trailer.
1127 SRS pager alerts to Cat 4 heat
1140 SRS pager alerts to CAT 5 heat
1145 Allen Henderson, United Rental driver depart.
1150 Check injection locations - none have green/blue circles. For survey/utility.
1207 Talk to Michael Gerber - just him left to go in for urine test @ med. aid
1210 Mob to N-Area.
1215 At N-Area - meet up w/ CTS crew.
1230 All CTS finishes at medical. Grab food truck then head to B-Area.
1245 Mob to B-Area
1310 KO Meeting
1430 Call KIJS to activate remote worker. Mob to 3-Road
1455 Arrive at 3-Road + examine injection locations with CTS, Terry Killeen, Greg Kinsman.



6 Location 3-Road S1W3 Date 7-9-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

1545 Mob to C-Area to locate Shelter at 707-C.
1600 Mob to water source at N-Area
1610 Mob to 715-5N (Core Lab) to show CTS crew a meeting location in morning.
1620 Mob back to 3-Road at injection site to look at staged rental equipment & check generator.
1630 Call KIJS to end remote worker. Agree to meet CTS crew at Cascade office tomorrow at ~7:00 in New Ellenton. Mob to B-Area.
1655 Drop off equipment.
1715 End of day - mob from SRS.

Matt Malin
7-9-19

7 Location 3-Road S1W4 Date 7-10-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Assemble & mobilize equipment to C-Area GWOU for edible oil injection
Personnel: Matt Malin TetraTech (NAUP), Michael Gerber, Brian Thomas, Ken Pettus, Daniel Mullis (CTS).
Equipment: DPT drill rig, rods, injection manifold, hoses, water truck, generator, forklift, water tanks, pumps

Weather: Foggy early 75-88, PM thunderstorms humid
0700 Arrive at Cascade office in New Ellenton. Matt Willmont (RADCON) calls - RADCON scheduled for 0800 to clear drill rig, rods & equipment at B-Area Well Building, then head to 3-Road to clear generator, forklift & water truck. Two 2500 gal. tanks not @ shop - they went to P-Area by accident.
0735 Mob to SRS gate. Richard Mooney to take Brian to get water tanks from P-Area & bring to Well Building. Called

8 Location 3-Road S1W4 Date 7-10-19
Project / Client CAGWOU Edible Oil Injection
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Matt Willmont (RADCON) back & pushed the clearing of equipment back to 0830
0820 All of CTS equipment thru low cam at gate. Mob to B-Area.
0830 Arrive at B-Area - RADCON there (Ian Reed, Cory) only need to clear drill rig & rods - anything going into the ground. 2500 gallon water tanks there
0900 RADCON tells us the rig & rods are good to go. Hook up trailer w/ water tanks
~~0915~~ Call Bob VanPelt about unloading drill rig from enclosed trailer. Bob is busy this AM - call Allen Henderson. Call Allen Henderson - leave message.
0915 Call KIJS to activate remote worker. Mob to 3-Road.
0940 Arrive at 3-Road. Conduct daily safety brief -
0955 Allen Henderson calls - he is offsite but will come out this afternoon.
1655 Finish safety brief. Begin unload/setup.
1100 Daniel Wade (S&K Electric) calls to ask when ready - setting up. It will be this

9 Location 3-Road S1W4 Date 7-10-19
Project / Client CAGWOU Edible Oil Injection
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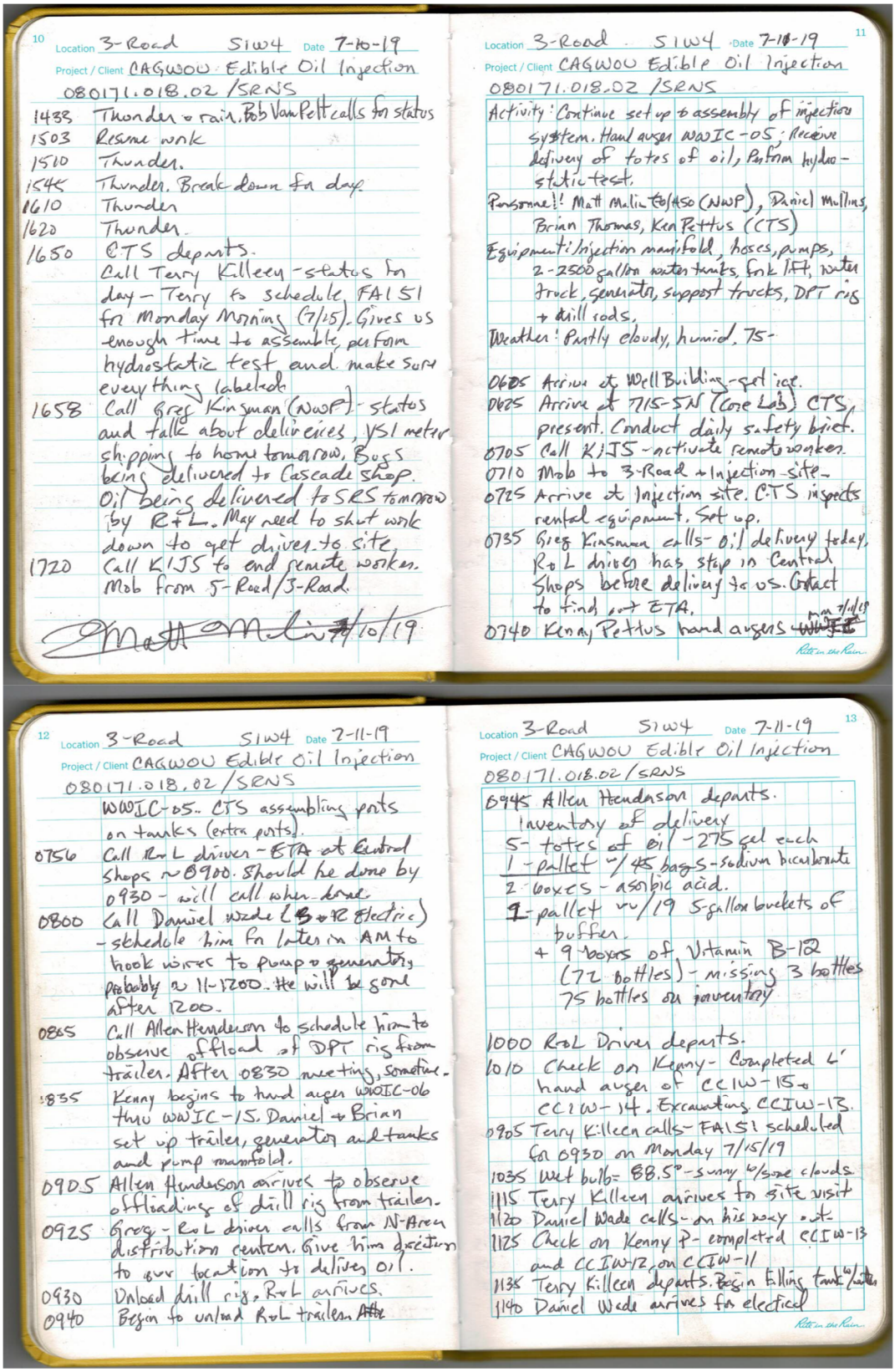
afternoon. Cascade checking equipment rentals.
1130 Brian departs for water. Kenny hand augering 6' for WWIC01 thru WWIC05.
1145 Mobilize water tanks into place (2500 gal each).
1205 Kenny on WWIC03 hand auger. completed WWIC01 & WWIC02.
1122 Terry Killeen calls - asks how things going: Asks to be out for hydrostatic test.
1230 Kenny hand augers WWIC03
1235 Brian returns w/ water truck.
1240 CTS take lunch - cool in trucks
1315 Return to work - Kenny continues hand auger WWIC04. Mobilize trailer w/ equipment/control center in place
1358 Thunder to N - wait 30 min
1400 Thunder.
1405 Thunder
1418 Thunder
1426 Thunder



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Location 3-Road S1W4 Date 7-10-19
Project / Client CAGWOU Edible Oil Injection
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1433 Thunder + rain. Bob VanPelt calls for status
1503 Resume work
1510 Thunder.
1545 Thunder. Break down for day.
1610 Thunder
1620 Thunder.
1650 CTS departs.
Call Terry Killeen - status for day - Terry to schedule FAIS1 for Monday Morning (7/15). Gives us enough time to assemble, perform hydrostatic test and make sure everything labeled.
1658 Call Greg Kinsman (NWP) - status and talk about deliveries, VSI meter shipping to home tomorrow, Bugs being delivered to Cascade shop. Oil being delivered to SRS tomorrow by R+L. May need to shut work down to get drivers to site.
1720 Call KIJS to end remote workers. Mob from 5-Road/3-Road.

Matt Martin 7/10/19

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Location 3-Road S1W4 Date 7-10-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

Activity: Continue set up & assembly of injection system. Haul auger WWIC-05; Receive delivery of totes of oil, Perform hydro-static test.
Personnel: Matt Martin (S&ASO (NWP), Daniel Mullins, Brian Thomas, Ken Pettus (CTS)
Equipment: Injection manifold, hoses, pumps, 2-2500 gallon water tanks, fork lift, water truck, generator, support trucks, DPT rig + drill rods.
Weather: Partly cloudy, humid. 75-

0605 Arrive at Well Building - get ice.
0625 Arrive at 7715-5N (Core Lab) CTS present. Conduct daily safety brief.
0705 Call KIJS - activate remote workers.
0710 Mob to 3-Road + Injection site.
0725 Arrive at Injection site. CTS inspects rental equipment. Set up.
0735 Greg Kinsman calls - Oil delivery today, R+L driver has stop in Central Shops before delivery to us. Contact to find out ETA.
0740 Kenny Pettus hand augers ~~WWIC-05~~ mm 7/11/19

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Location 3-Road S1W4 Date 7-11-19
Project / Client CAGWOU Edible Oil Injection
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WWIC-05. CTS assembling parts on tanks (extra parts).
0756 Call R+L driver - ETA at Central Shops ~0900. Should be done by 0930 - will call when done.
0800 Call Daniel Wade (B&R Electric) - schedule him for later in AM to hook wires to pump & generator, probably ~ 11-1200. He will be gone after 1200.
0805 Call Allen Henderson to schedule him to observe offload of DPT rig from trailer. After 0830 meeting, sometime.
0835 Kenny begins to hand auger WWIC-06 thru WWIC-15. Daniel + Brian set up trailer, generator and tanks and pump manifold.
0905 Allen Henderson arrives to observe offloadings of drill rig from trailer.
0925 Greg - R+L driver calls from N-Area distribution center. Give him directions to our location to deliver oil.
0930 Unload drill rig. R+L arrives.
0940 Begin to unload R+L trailer After

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Location 3-Road S1W4 Date 7-11-19
Project / Client CAGWOU Edible Oil Injection
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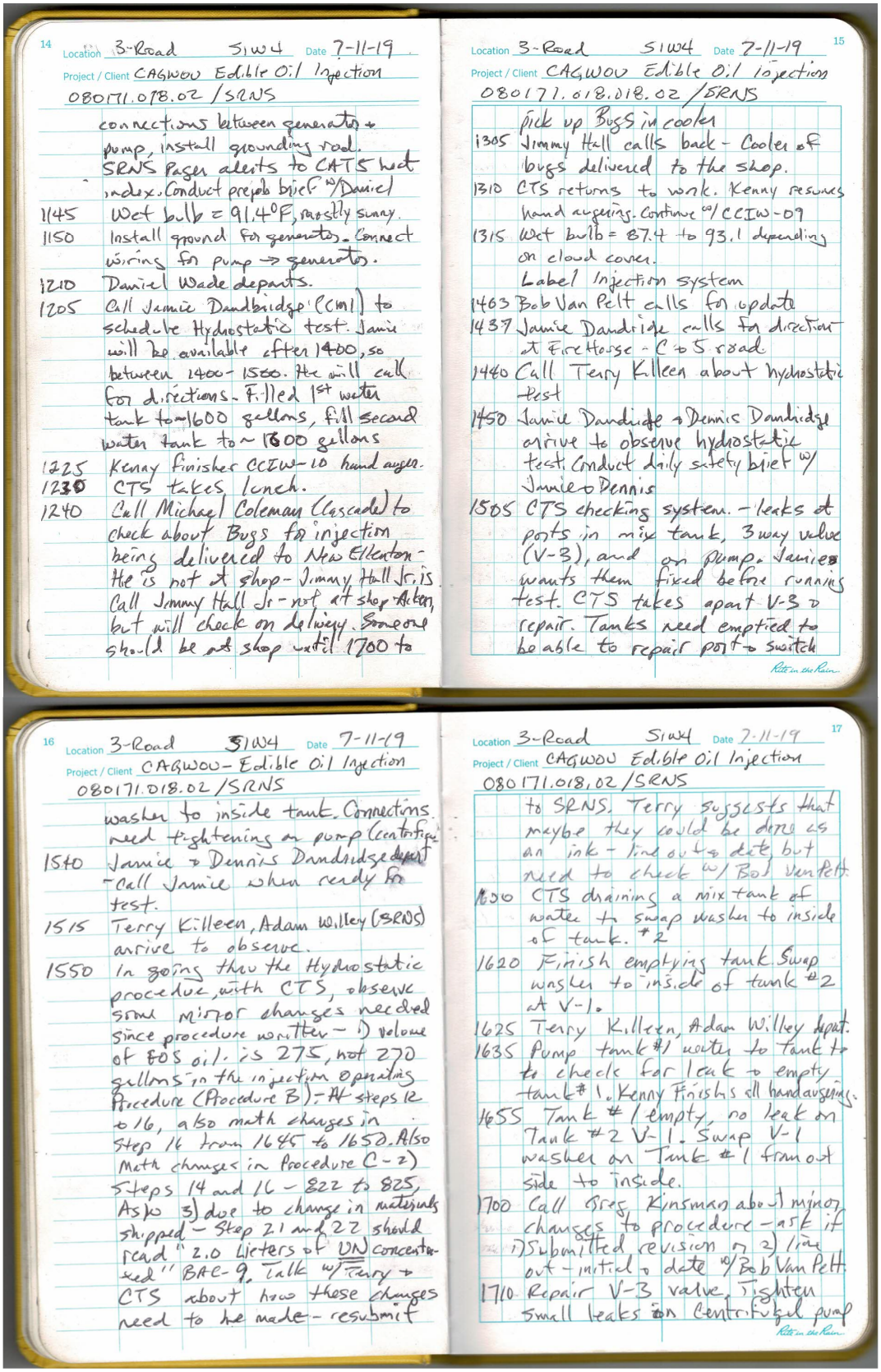
0945 Allen Henderson departs.
Inventory of delivery
5- totes of oil - 275 gal each
1 - pallet w/ 45 bags - sodium bicarbonate
2 boxes - ascorbic acid.
1 - pallet w/ 19 5-gallon buckets of buffer.
+ 9 boxes of Vitamin B-12 (72 bottles) - missing 3 bottles 75 bottles on inventory

1000 R+L Driver departs.
1010 Check on Kenny - Completed 4' hand auger of CCIW-15 + CCIW-14. Excavating CCIW-13.
0905 Terry Killeen calls - FAIS1 scheduled for 0930 on Monday 7/15/19
1035 Wet bulb = 88.5° - sunny w/some clouds
1115 Terry Killeen arrives for site visit
1120 Daniel Wade calls - on his way out.
1125 Check on Kenny P - completed CCIW-13 and CCIW-12, on CCIW-11
1135 Terry Killeen departs. Begin filling tank w/ water
1140 Daniel Wade arrives for electrical



14 Location 3-Road S1W4 Date 7-11-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

connections between generator + pump, install grounding rod. SRNS Pager alerts to CATS hot index. Conduct prepb brief w/ Daniel
1145 Wet bulb = 91.4°F, mostly sunny.
1150 Install ground for generator. Connect wiring for pump → generator.
1210 Daniel Wade departs.
1205 Call Jamie Dandridge (CMI) to schedule Hydrostatic test. Jamie will be available after 1400, so between 1400 - 1500. He will call for directions. Filled 1st water tank to 1600 gallons, fill second water tank to ~ 1800 gallons
1225 Kenny finishes CCIW-10 hand auger.
1230 CTS takes lunch.
1240 Call Michael Coleman (Cascade) to check about Bugs for injection being delivered to New Ellenton - He is not at shop - Jimmy Hall Jr. is. Call Jimmy Hall Jr - not at shop. Left, but will check on delivery. Someone should be at shop until 1700 to

15 Location 3-Road S1W4 Date 7-11-19
Project / Client CAGWOU Edible Oil Injection
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pick up Bugs in cooler
1305 Jimmy Hall calls back - Cooler of bugs delivered to the shop.
1310 CTS returns to work. Kenny resumes hand augering. Continue w/ CCIW-09
1315 Wet bulb = 87.4 to 93.1 depending on cloud cover.
Label injection system
1403 Bob Van Pelt calls for update
1437 Jamie Dandridge calls for direction at Fire House - C to S road.
1440 Call Terry Killeen about hydrostatic test
1450 Jamie Dandridge + Dennis Dandridge arrive to observe hydrostatic test. Conduct daily safety brief w/ Jamie + Dennis
1505 CTS checking system. - leaks at ports in mix tank, 3 way valve (V-3), and on pump. Jamie wants them fixed before running test. CTS takes apart V-3 to repair. Tanks need emptied to be able to repair port + switch

16 Location 3-Road S1W4 Date 7-11-19
Project / Client CAGWOU - Edible Oil Injection
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washer to inside tank. Connections need tightening on pump (centrifu
1510 Jamie + Dennis Dandridge depart - Call Jamie when ready for test.
1515 Terry Killeen, Adam Willey (SRNS) arrive to observe.
1550 In going thru the Hydrostatic procedure, with CTS, observe some minor changes needed since procedure written - i) volume of EOS oil. is 275, not 270 gallons in the injection operating Procedure (Procedure B) - At steps 12 + 16, also math changes in step 14 from 1645 to 1650. Also Math changes in Procedure C - 2) Steps 14 and 16 - 822 to 825, As to 3) due to change in materials shipped - Step 21 and 22 should read "2.0 Liters of UN concentrated" BAC-9. Talk w/ Terry + CTS about how these changes need to be made - resubmit

17 Location 3-Road S1W4 Date 7-11-19
Project / Client CAGWOU Edible Oil Injection
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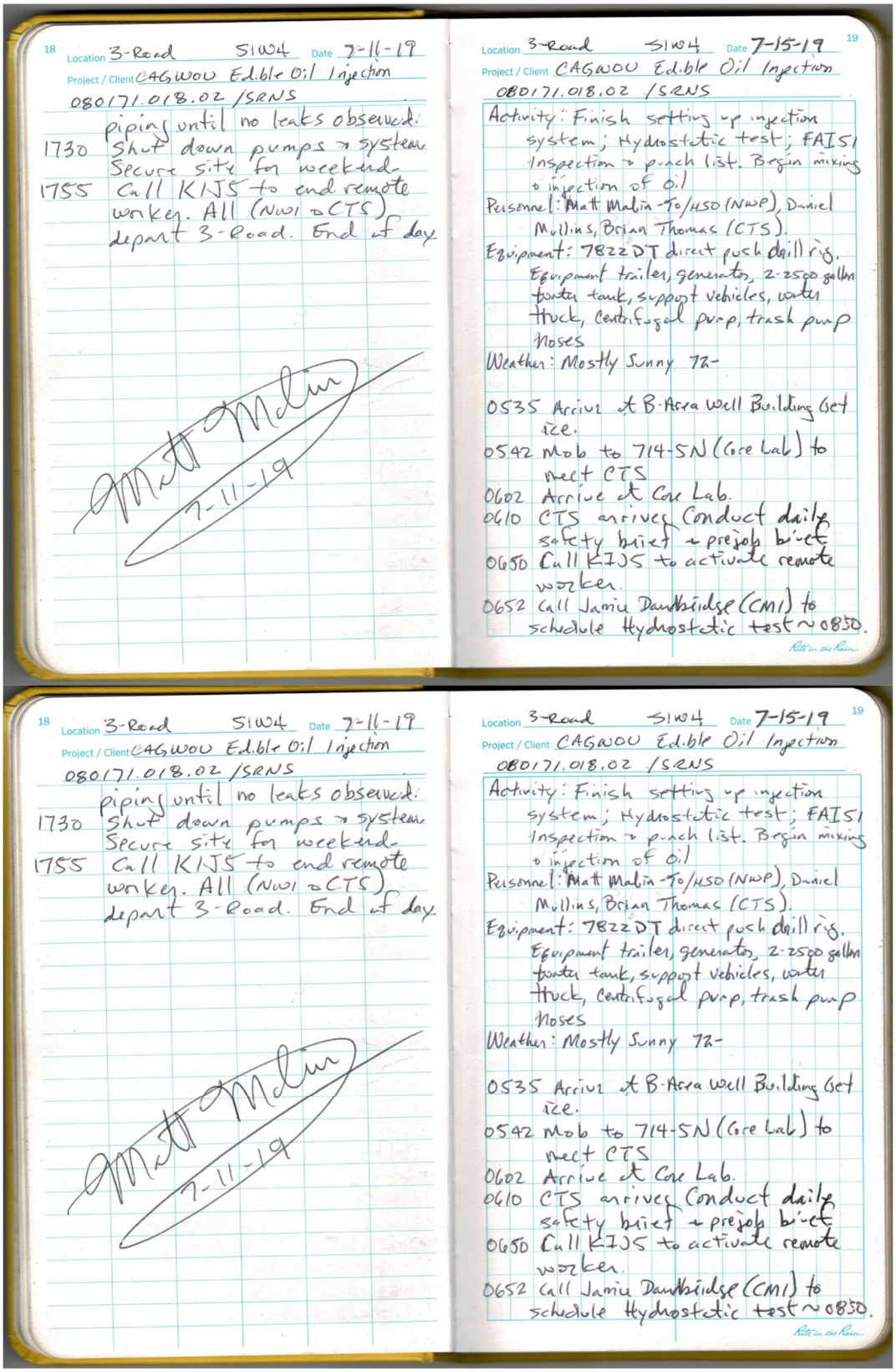
to SRNS. Terry suggests that maybe they could be done as an ink - line out to date, but need to check w/ Bob VanPelt
1600 CTS draining a mix tank of water to swap washer to inside of tank. #2
1620 Finish emptying tank. Swap washer to inside of tank #2 at V-1.
1625 Terry Killeen, Adam Willey depart.
1635 Pump tank #1 water to tank to to check for leak to empty tank #1. Kenny finishes all hand augering.
1655 Tank #1 empty, no leak on Tank #2 V-1. Swap V-1 washer on Tank #1 from out side to inside.
1700 Call Greg Kinsman about minor changes to procedure - ask if i) Submitted revision or 2) line out - initial + date w/ Bob Van Pelt
1710 Repair V-3 valve. Tighten small leaks on Centrifugal pump



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Location 3-Road S1W4 Date 7-11-19
Project / Client CAGWOU Edible Oil Injection
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piping until no leaks observed.
1730 Shut down pumps & system. Secure site for weekend.
1755 Call KIJS to end remote worker. All (NWI & CTS) depart 3-Road. End of day.

Matt Malin 7-11-19

19
Location 3-Road S1W4 Date 7-15-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

Activity: Finish setting up injection system; Hydrostatic test; FAISI Inspection & punch list. Begin mixing & injection of oil
Personnel: Matt Malin-To/HSO (NWP), Daniel Mullins, Brian Thomas (CTS).
Equipment: 7822DT direct push drill rig. Equipment trailer, generator, 2-2500 gallon water tank, support vehicles, water truck, Centrifugal pump, trash pump hoses
Weather: Mostly Sunny 72-

0535 Arrive at B-Area Well Building Get ize.
0542 Mob to 714-5N (Core Lab) to meet CTS
0602 Arrive at Core Lab.
0610 CTS arrives Conduct daily safety brief & prejob brief
0650 Call KIJS to activate remote worker.
0652 Call Jamie Dambridge (CMI) to schedule Hydrostatic test ~0830.

Rite in the Rain

18
Location 3-Road S1W4 Date 7-11-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

piping until no leaks observed.
1730 Shut down pumps & system. Secure site for weekend.
1755 Call KIJS to end remote worker. All (NWI & CTS) depart 3-Road. End of day.

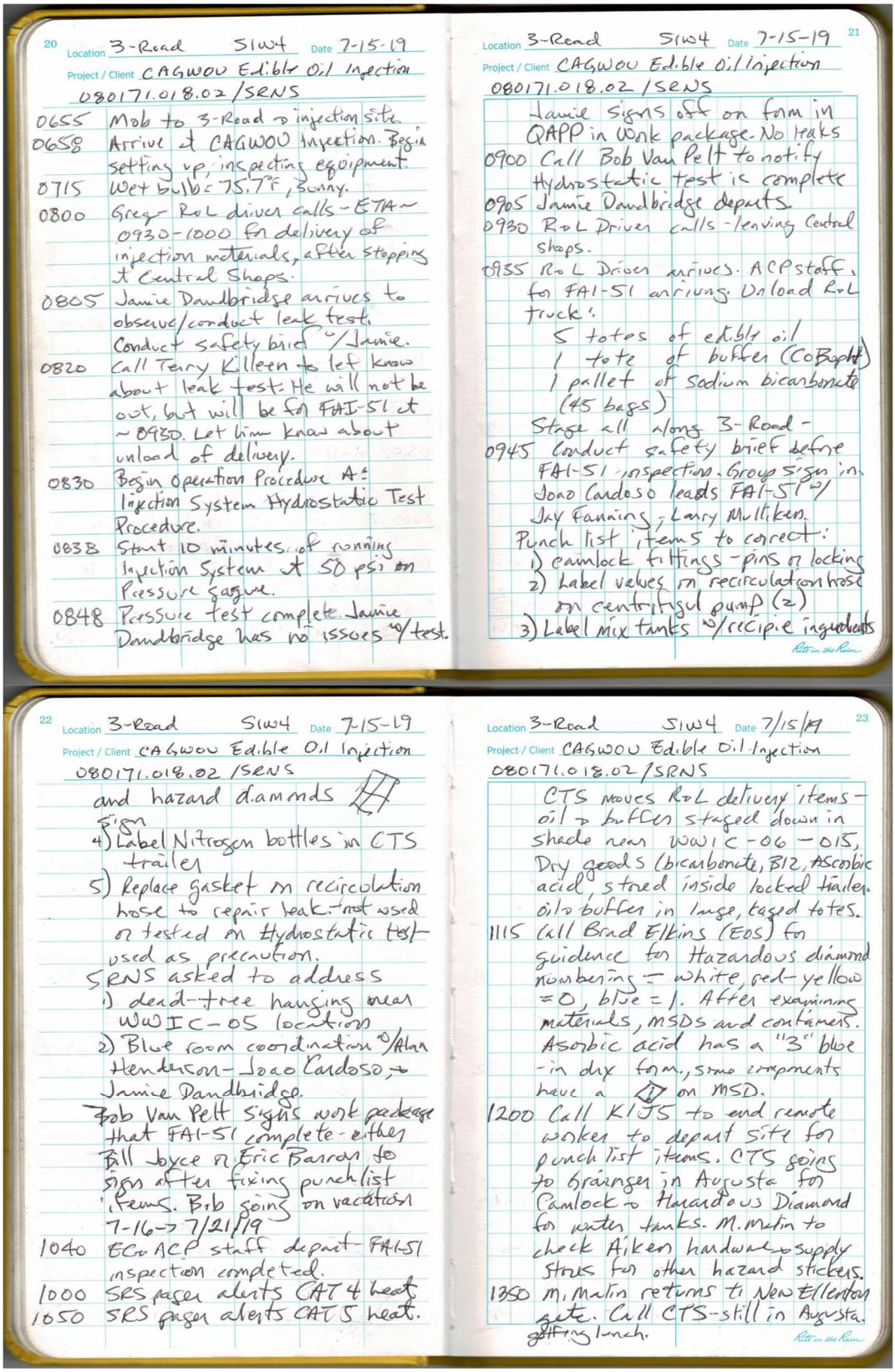
Matt Malin 7-11-19

19
Location 3-Road S1W4 Date 7-15-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

Activity: Finish setting up injection system; Hydrostatic test; FAISI Inspection & punch list. Begin mixing & injection of oil
Personnel: Matt Malin-To/HSO (NWP), Daniel Mullins, Brian Thomas (CTS).
Equipment: 7822DT direct push drill rig. Equipment trailer, generator, 2-2500 gallon water tank, support vehicles, water truck, Centrifugal pump, trash pump hoses
Weather: Mostly Sunny 72-

0535 Arrive at B-Area Well Building Get ize.
0542 Mob to 714-5N (Core Lab) to meet CTS
0602 Arrive at Core Lab.
0610 CTS arrives Conduct daily safety brief & prejob brief
0650 Call KIJS to activate remote worker.
0652 Call Jamie Dambridge (CMI) to schedule Hydrostatic test ~0830.

Rite in the Rain



20 Location 3-Road S1W4 Date 7-15-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

0655 Mob to 3-Road → injection site.
0658 Arrive at CAGWOU injection. Begin setting up, inspecting equipment.
0715 Wet bulb 75.7°F, Sunny.
0800 Greg - RoL driver calls - ETA = 0930-1000 for delivery of injection materials, after stopping at Central Shops.
0805 Jamie Dandbridge arrives to observe/conduct leak test. Conduct safety brief w/ Jamie.
0820 Call Terry Killeen to let know about leak test: He will not be out, but will be for FAI-51 at ~ 0930. Let him know about unload of delivery.
0830 Begin Operation Procedure A: Injection System Hydrostatic Test Procedure.
0838 Start 10 minutes of running Injection System at 50 psi on Pressure gague.
0848 Pressure test complete Jamie Dandbridge has no issues w/ test.

21 Location 3-Road S1W4 Date 7-15-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

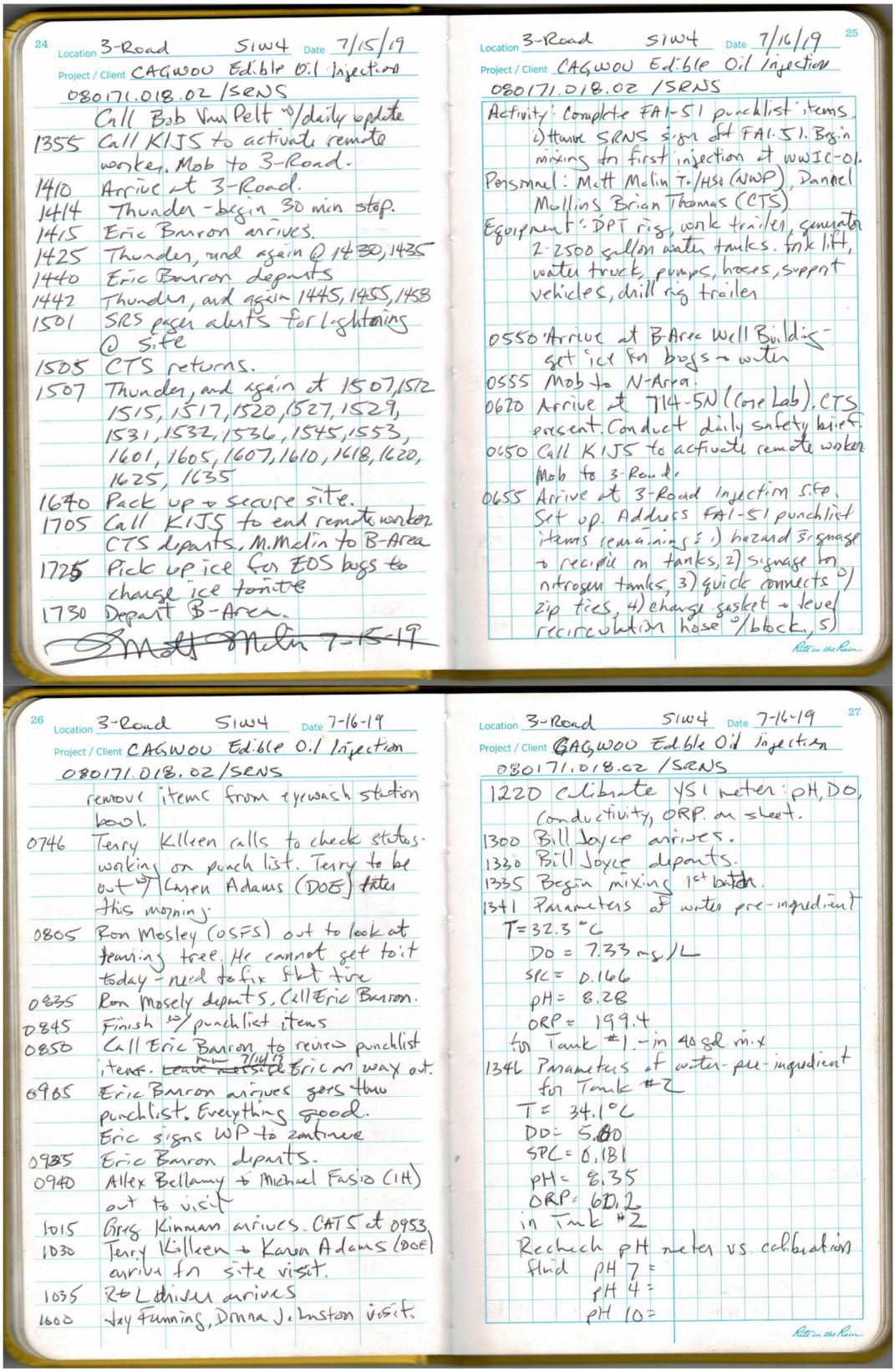
Jamie signs off on form in QAPP in Work package. No leaks
0900 Call Bob Van Pelt to notify Hydrostatic test is complete
0905 Jamie Dandbridge departs.
0930 RoL Driver calls - leaving Central Shops.
0955 RoL Driver arrives. ACP staff, for FAI-51 arriving. Unload RoL truck:
5 totes of edibly oil
1 tote of buffer (CoBaphf)
1 pallet of sodium bicarbonate (45 bags)
Stage all along 3-Road -
0945 Conduct safety brief before FAI-51 inspection. Group sign in. Joao Cardoso leads FAI-51 w/ Jay Fanning, Larry Mulliken.
Punch list items to correct:
1) camlock fittings - pins or locking
2) Label valves on recirculation hose on centrifugal pump (2)
3) Label mix tanks w/ recipie ingredients

22 Location 3-Road S1W4 Date 7-15-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

and hazard diamonds
sign
4) Label Nitrogen bottles in CTS trailer
5) Replace gasket on recirculation hose to repair leak - not used or tested on Hydrostatic test - used as precaution.
SRNS asked to address
1) dead-tree hanging near WWIC-05 location
2) Blue room coordination w/ Alan Henderson - Joao Cardoso, → Jamie Dandbridge.
Bob Van Pelt signs work package that FAI-51 complete - either Bill Joyce or Eric Barron to sign after fixing punchlist items. Bob going on vacation 7-16 → 7/21/19
1040 ECO ACP staff depart - FAI-51 inspection completed.
1000 SRS pager alerts CAT 4 heat.
1050 SRS pager alerts CAT 5 heat.

23 Location 3-Road S1W4 Date 7/15/19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

CTS moves RoL delivery items - oil → buffer staged down in shade near WWIC-06-015, Dry goods (bicarbonate, B12, Ascobic acid, stored inside locked trailer. oil & buffer in large, taged totes.
1115 Call Brad Elkins (EOS) for guidence for Hazardous diamond numbering = white, red - yellow = 0, blue = 1. After examining materials, MSDs and containers. Asorbic acid has a "3" blue - in dry form., some components have a [1] on MSD.
1200 Call KIJS to end remote worker to depart site for punch list items. CTS going to Grainger in Augusta for Camlock & Hazardous Diamond for water tanks. M. Matin to check Aiken hardware → supply stores for other hazard stickers.
1350 M. Matin returns to New Ellenton gate. Call CTS - still in Augusta. getting lunch.



24 Location 3-Road S1W4 Date 7/15/19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Call Bob Van Pelt */daily update
1355 Call KIJS to activate remote worker. Mob to 3-Road.
1410 Arrive at 3-Road.
1414 Thunder - begin 30 min stop.
1415 Eric Barron arrives.
1425 Thunder, and again @ 1430, 1435
1440 Eric Barron departs
1442 Thunder, and again 1445, 1455, 1458
1501 SRS pager alerts for lightening @ site
1505 CTS returns.
1507 Thunder, and again at 1507, 1512, 1515, 1517, 1520, 1527, 1529, 1531, 1532, 1536, 1545, 1553, 1601, 1605, 1607, 1610, 1618, 1620, 1625, 1635
1640 Pack up + secure site.
1705 Call KIJS to end remote worker. CTS departs. M. Medlin to B-Area
1725 Pick up ice for EOS bags to change ice tonite
1730 Depart B-Area.

~~Medlin 7-15-19~~

25 Location 3-Road S1W4 Date 7/16/19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Complete FAI-51 punchlist items, i) have SRNS sign off FAI-51. Begin mixing for first injection at WWIC-01.
Personnel: Matt Medlin T./HSO (WWP), Daniel Mullins, Brian Thomas (CTS)
Equipment: DPT rig, work trailer, generator, 2-2500 gallon water tanks, fork lift, water truck, pumps, hoses, support vehicles, drill rig trailer

0550 Arrive at B-Area Well Building - get ice for bags + water
0555 Mob to N-Area.
0620 Arrive at 714-5N (Core Lab). CTS present. Conduct daily safety brief.
0650 Call KIJS to activate remote worker. Mob to 3-Road.
0655 Arrive at 3-Road injection site. Set up. Address FAI-51 punchlist items remaining: 1) hazard signage + receipt on tanks, 2) signage for nitrogen tanks, 3) quick connects */zip ties, 4) change gasket + level recirculation hose */block, 5)

Rite in the Rain

26 Location 3-Road S1W4 Date 7-16-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

remove items from eyewash station bowl.
0746 Terry Killeen calls to check status - working on punch list. Terry to be out */Layen Adams (DOE) later this morning.
0805 Ron Mosley (USFS) out to look at leaning tree. He cannot get to it today - need to fix flat tire
0835 Ron Mosely departs. Call Eric Barron.
0845 Finish */punchlist items
0850 Call Eric Barron to review punchlist items. ~~Leave message~~ 7/16/19 Eric on way out.
0905 Eric Barron arrives goes thru punchlist. Everything good. Eric signs WP to continue
0935 Eric Barron departs.
0940 Alex Bellamy + Michael Fasig (IH) out to visit
1015 Greg Kinman arrives. CATS at 0953
1030 Terry Killeen + Karen Adams (DOE) arrive for site visit.
1035 R+L driller arrives
1600 Jay Fleming, Donna Johnston visit.

27 Location 3-Road S1W4 Date 7-16-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

1220 calibrate YSI meter: pH, DO, conductivity, ORP. on sheet.
1300 Bill Joyce arrives.
1330 Bill Joyce departs.
1335 Begin mixing 1st batch.
1341 Parameters of water pre-ingredient
T = 32.3 °C
DO = 7.33 mg/L
SPC = 0.166
pH = 8.28
ORP = 199.4
for Tank #1 - in 40 gal. mix
1346 Parameters of water pre-ingredient for Tank #2
T = 34.1 °C
DO = 5.80
SPC = 0.181
pH = 8.35
ORP = 60.2
in Tank #2
Recheck pH meter vs. calibration fluid
pH 7 =
pH 4 =
pH 10 =

Rite in the Rain



28 Location 3-Road SIW4 Date 7-16-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

1420 CTS repair/replace trash pump.
1455 Begin mixing. Add 5-16oz bottles B-12, 2 lbs ascorbic acid, & 6-50 lb bags of ~~ascorbic~~ 7/16/19 sodium bicarbonate (300 lbs) to declorinated deoxygenated water.
1520 Pump EOS-1 oil into mix tank 1.
1525 Measure parameters of Tank 1 after adding ingredients.
T 32.0
DO 2.50 mg/L
SPC 16160
pH 8.15
ORP 25.5
Begin recirculation of Tank 1
1550 Stop recirculation
1603 Tank #1 parameters after recirc
T = 32.4 °C
DO = 0.55 mg/L
SPC = 18.36 mS/cm
pH = 8.16
ORP = -6.9 mV
1610 Begin mixing batch in tank 2

29 Location 3-Road SIW4 Date 7/16/19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

Add 2 lbs Ascbic acid, 5-bottles of Vitamin B12 (16oz each). Add 6-50lb bags bicarbonate sodium
1628 Add EOS-1 oil. to tank 2.
1650 Finish pumping EOS 1 oil to tank 2.
1653 Measure parameters of Tank #2 after adding ingredients
T = 33.8 °C
DO = 1.84 mg/L
SPC 14.23 mS/cm
pH = 8.17
ORP 48.5 mV
1655 Recirculate Tank #2.
1725 Stop recirculation. Break down Str.
1728 Tank 2 parameters after recirc
T = 34.0
DO = 0.80
SPC = 10.95
pH = 8.18
ORP = 61.5
1740 Call KIJS to end remote workers.
1755 Arrive @ B-Area for ice for Biggs
1805 Depart Well Building

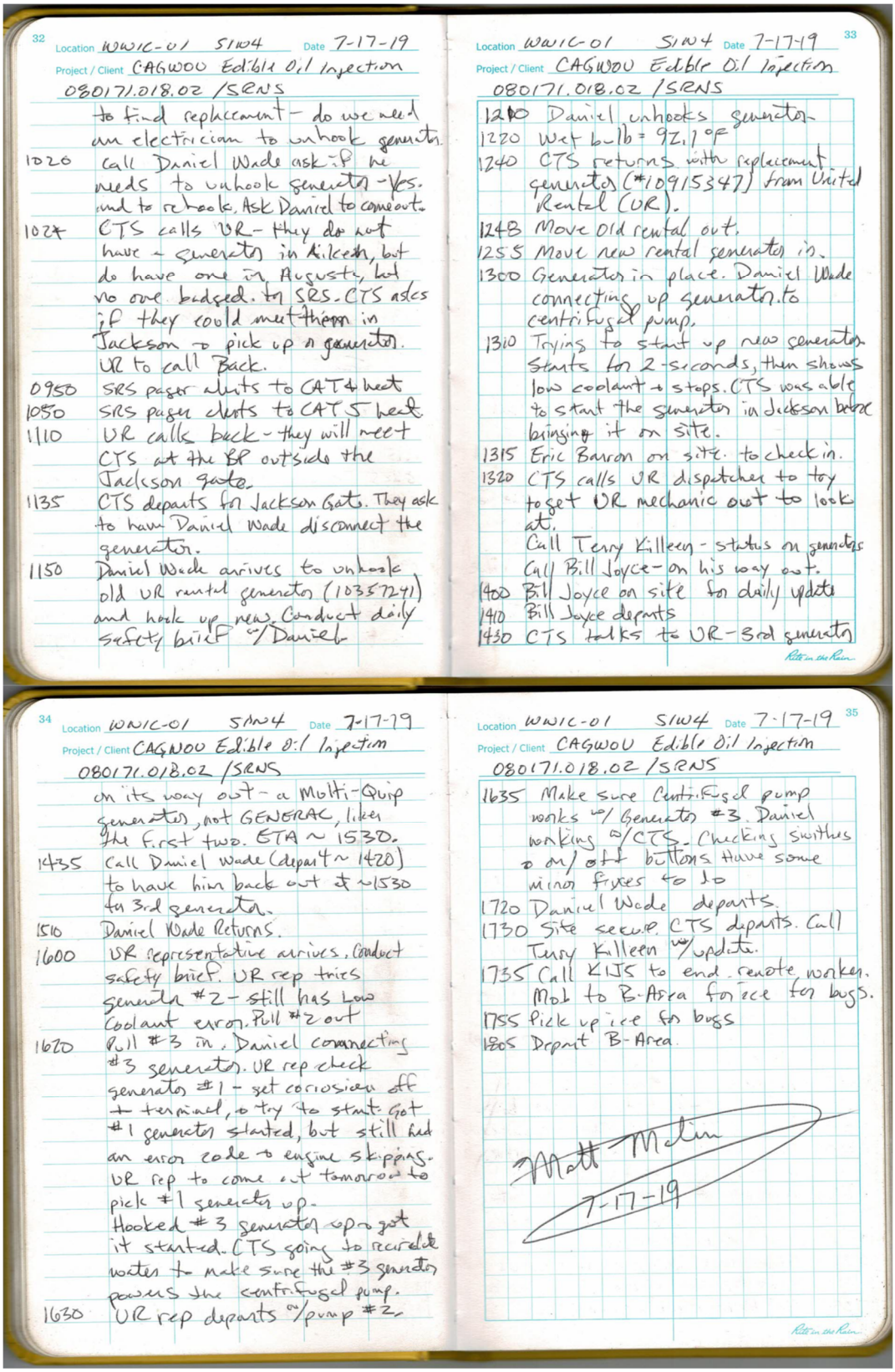
30 Location WNIC-01 SIW4 Date 7-17-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

Activity: Begin injection of edible oil at CAGWOU WBIC-01
Personnel: Matt Malin - 701450 (NAP), Daniel Mullins, Brian Thomas (CTS)
Equipment: DPT drill rig, enclosed trailers (2), 2-2500 gallon mix tanks, centrifugal pump (2), trash pump (2), hoses, support vehicles, fork lift, water truck, generator
Weather: Sunny, clear, HOT 74-99

0535 Arrive at B-Area Well Building. Pick up ice.
0545 Mob to F-Area GW for DI water.
0605 Arrive - wait for staff to finish daily meeting.
0635 Get DI depart F-Area Groundwater
0645 Arrive at 714-5N (Low Lab.). CTS present. Conduct daily safety brief.
0715 Call KIJS to activate remote workers. Mob to 3-Road.
0725 Arrive at 3-Road. Set up.
0800 CTS pushes 10' screen & rods to 76' bgs. Screen interval 66-76
0805 Calibrate YSI meter.

31 Location WNIC-01 SIW4 Date 7-17-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

0835 Terry Killeen arrives. Drilling completed. Adjust barricade for 85 decibles.
0810 Recirculate Tank #2
0855 Rented generator has an issue - ECU error. CTS to contact United Rental.
0900 United Rental contacted. waiting for UR Rep to come out.
0910 Stop recirculation Tank 2
0918 Parameters of Tank #2
T = 33.3 °C
DO = 0.30
SPC = 18.23
pH = 8.04
ORP = -63.4
0925 Terry Killeen departs.
0935 Observe that both tanks the oil separates out on top (8" thick layer)
0938 wet bulb = 80.2 °F
1000 Eric Baron stops by - provides status - generator down. UR mechanic busy until afternoon - CTS calling



32
Location WWIC-01 SIW4 Date 7-17-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

to find replacement - do we need an electrician to unhook generator
1020 call Daniel Wade ask if he needs to unhook generator - Yes. and to rehook. Ask Daniel to come out.
1024 CTS calls UR - they do not have a generator in Aiken, but do have one in Augusta, but no one badged. for SRS. CTS asks if they could meet them in Jackson to pick up a generator. UR to call Back.
0950 SRS pager alerts to CAT 4 heat
1050 SRS pager alerts to CAT 5 heat
1110 UR calls back - they will meet CTS at the BP outside the Jackson gate.
1135 CTS departs for Jackson Gate. They ask to have Daniel Wade disconnect the generator.
1150 Daniel Wade arrives to unhook old UR rental generator (10357241) and hook up new. Conduct daily safety brief w/ Daniel.

33
Location WWIC-01 SIW4 Date 7-17-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

1200 Daniel unhooks generator
1220 Wet bulb = 92.1°F
1240 CTS returns with replacement generator (#10915347) from United Rental (UR).
1248 Move old rental out.
1255 Move new rental generator in.
1300 Generator in place. Daniel Wade connecting up generator to centrifuge pump.
1310 Trying to start up new generator. Starts for 2 seconds, then shows low coolant & stops. CTS was able to start the generator in Jackson before bringing it on site.
1315 Eric Barron on site to check in.
1320 CTS calls UR dispatcher to try to get UR mechanic out to look at.
Call Terry Killeen - status on generators
Call Bill Joyce - on his way out.
1400 Bill Joyce on site for daily update
1410 Bill Joyce departs
1430 CTS talks to UR - 3rd generator

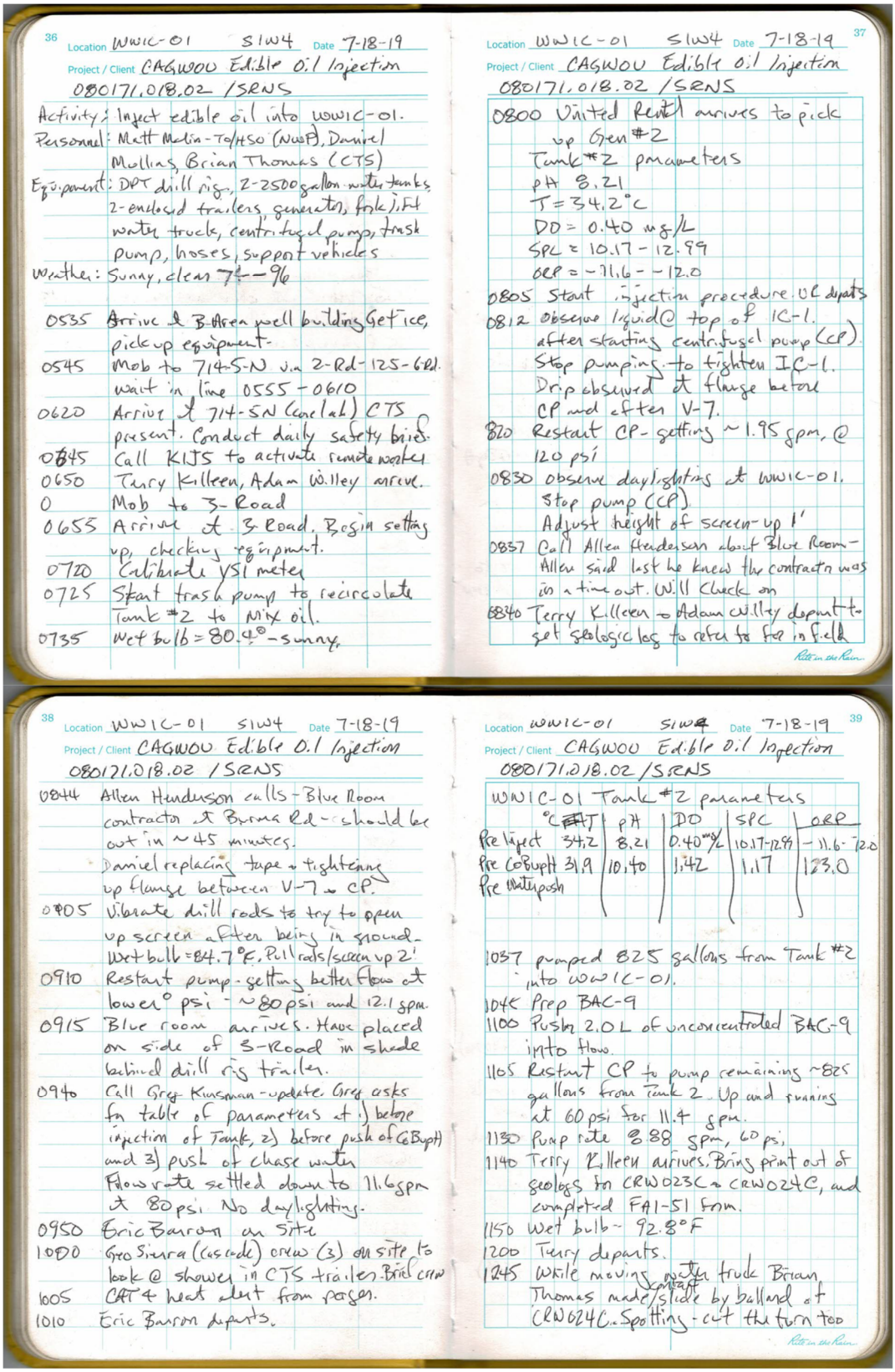
34
Location WWIC-01 SIW4 Date 7-17-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

on its way out - a Multi-Quip generator, not GENERAC, like the first two. ETA ~ 1530.
1435 Call Daniel Wade (depart ~ 1420) to have him back out at ~1530 for 3rd generator.
1510 Daniel Wade Returns.
1600 UR representative arrives. Conduct safety brief. UR rep tries generator #2 - still has Low Coolant error. Pull #2 out
1620 Pull #3 in. Daniel connecting #3 generator. UR rep check generator #1 - set corrosion off + terminal, & try to start. Got #1 generator started, but still had an error code & engine skipping. UR rep to come out tomorrow to pick #1 generator up.
Hooked #3 generator up & got it started. CTS going to recirculate water & make sure the #3 generator powers the centrifuged pump.
1630 UR rep departs w/ pump #2.

35
Location WWIC-01 SIW4 Date 7-17-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

1635 Make sure Centrifuged pump works w/ Generator #3. Daniel working w/ CTS. Checking switches & on/off buttons have some minor fixes to do
1720 Daniel Wade departs.
1730 Site secure. CTS departs. Call Terry Killeen w/ update.
1735 Call KIIS to end remote worker. Mob to B-Area for ice for bags.
1755 Pick up ice for bags
1805 Depart B-Area

Matt Metin
7-17-19



36
Location WWIC-01 S1W4 Date 7-18-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Inject edible oil into WWIC-01.
Personnel: Matt Melin - TO/HSO (NWP), Daniel Mullins, Brian Thomas (CTS)
Equipment: DPT drill rig, 2-2500 gallon water tanks, 2-enclosed trailers, generator, fork lift, water truck, centrifugal pump, trash pump, hoses, support vehicles
Weather: Sunny, clear 7°-9%

0535 Arrive & B-Area well building. Get ice, pick up equipment.
0545 Mob to 714-5N via 2-Rd-125-6Rd. wait in line 0555-0610
0620 Arrive @ 714-5N (Corelab) CTS present. Conduct daily safety brief.
0645 Call KIJS to activate remote worker
0650 Terry Killeen, Adam Willey arrive.
0 Mob to 3-Road
0655 Arrive @ 3-Road. Begin setting up, checking equipment.
0720 Calibrate YSI meter
0725 Start trash pump to recirculate Tank #2 to mix oil.
0735 Wet bulb = 80.4°-sunny.

Location WWIC-01 S1W4 Date 7-18-19 37
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

0800 United Rental arrives to pick up Gen #2
Tank #2 parameters
pH 8.21
T = 34.2°C
DO = 0.40 mg/L
SPC = 10.17 - 12.99
ORP = -71.6 - -12.0
0805 Start injection procedure. UC departs
0812 Observe liquid @ top of IC-1. after starting centrifugal pump (CP). Stop pumping to tighten IC-1. Drip observed at flange before CP and after V-7.
820 Restart CP - getting ~1.95 gpm @ 120 psi
0830 Observe daylighting at WWIC-01. Stop pump (CP). Adjust height of screen - up 1'
0837 Call Allen Henderson about Blue Room - Allen said last he knew the contractor was in a time out. Will check on
0840 Terry Killeen & Adam Willey depart to get geologic log to refer to for in field

38
Location WWIC-01 S1W4 Date 7-18-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

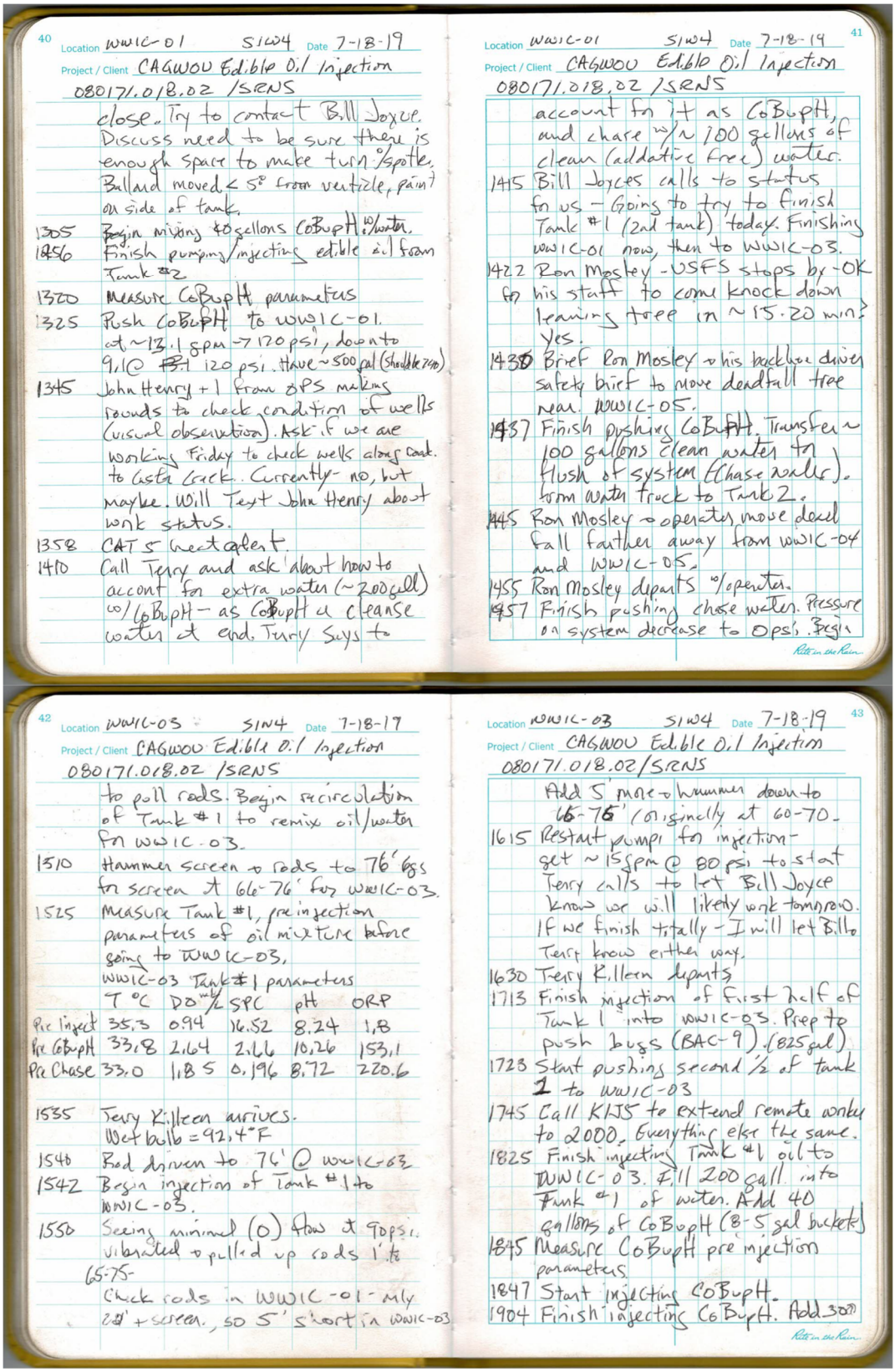
0844 Allen Henderson calls - Blue Room contractor @ Burma Rd - should be out in ~45 minutes.
Daniel replacing tape & tightening up flange between V-7 & CP.
0905 Vibrate drill rods to try to open up screen after being in ground. Wet bulb = 84.7°F. Pull rods/screen up 2'
0910 Restart pump - getting better flow at lower psi - ~80 psi and 12.1 gpm.
0915 Blue room arrives. Have placed on side of 3-Road in shade behind drill rig trailer.
0940 Call Greg Kinsman - update. Greg asks for table of parameters at 1) before injection of Tank, 2) before push of CoBupH and 3) push of chase water. Flow rate settled down to 11.6 gpm @ 80 psi. No daylighting.
0950 Eric Barron on site
1000 Gro Sierra (cascade) crew (3) on site to look @ shower in CTS trailers. Brief crew
1005 CAT 4 heat alert from pagers.
1010 Eric Barron departs.

Location WWIC-01 S1W4 Date 7-18-19 39
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

WWIC-01 Tank #2 parameters

	°C	pH	DO	SPC	ORP
Pre Inject	34.2	8.21	0.40 mg/L	10.17-12.99	-11.6 - 12.0
Pre CoBupH	31.9	10.40	1.42	1.17	123.0
Pre Matrapush					

1037 pumped 825 gallons from Tank #2 into WWIC-01.
1045 Prep BAC-9
1100 Push 2.0 L of unconcentrated BAC-9 into flow.
1105 Restart CP to pump remaining ~825 gallons from Tank 2. Up and running at 60 psi for 11.4 gpm.
1130 Pump rate 8.88 gpm, 60 psi.
1140 Terry Killeen arrives. Bring print out of geologs for CRW023C & CRW024C, and completed FA1-51 form.
1150 Wet bulb - 92.8°F
1200 Terry departs.
1245 While moving water truck Brian Thomas made slide by bollard at CRW024C. Spotting - cut the turn too



40 Location WWIC-01 SIW4 Date 7-18-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

close. Try to contact Bill Joyce. Discuss need to be sure there is enough space to make turn o/spotle. Ballard moved < 5° from verticle, paint on side of tank.

1305 Begin mixing 40 gallons CoBupH w/water.
1456 Finish pumping/injecting edible oil from Tank #2
1320 Measure CoBupH parameters
1325 Push CoBupH to WWIC-01. at ~13.1 gpm → 120 psi, down to 9.1 @ ~~13.1~~ 120 psi. Have ~500 gal (should be 240)
1345 John Henry + 1 from OPS making rounds to check condition of wells (visual observation). Ask if we are working Friday to check wells along road. to Castle Creek. Currently - no, but maybe. Will Text John Henry about work status.
1358 CAT 5 heat alert.
1410 Call Terry and ask about how to account for extra water (~200 gall) w/ CoBupH - as CoBupH a cleanse water at end. Terry says to

41 Location WWIC-01 SIW4 Date 7-18-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

account for it as CoBupH, and chase w/ ~100 gallons of clean (addative free) water.
1415 Bill Joyces calls to status for us - Going to try to finish Tank #1 (2nd tank) today. Finishing WWIC-01 now, then to WWIC-03.
1422 Ron Mosley - USFS stops by - OK for his staff to come knock down leaning tree in ~15-20 min? Yes.
1430 Brief Ron Mosley + his backhoe driver safety brief to move deadfall tree near WWIC-05.
1437 Finish pushing CoBupH. Transfer ~100 gallons clean water for flush of system (Chase water). from water truck to Tank 2.
1445 Ron Mosley + operator move dead fall farther away from WWIC-04 and WWIC-05.
1455 Ron Mosley departs w/operator.
1457 Finish pushing chase water. Pressure on system decrease to 0 psi. Begin

42 Location WWIC-03 SIW4 Date 7-18-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

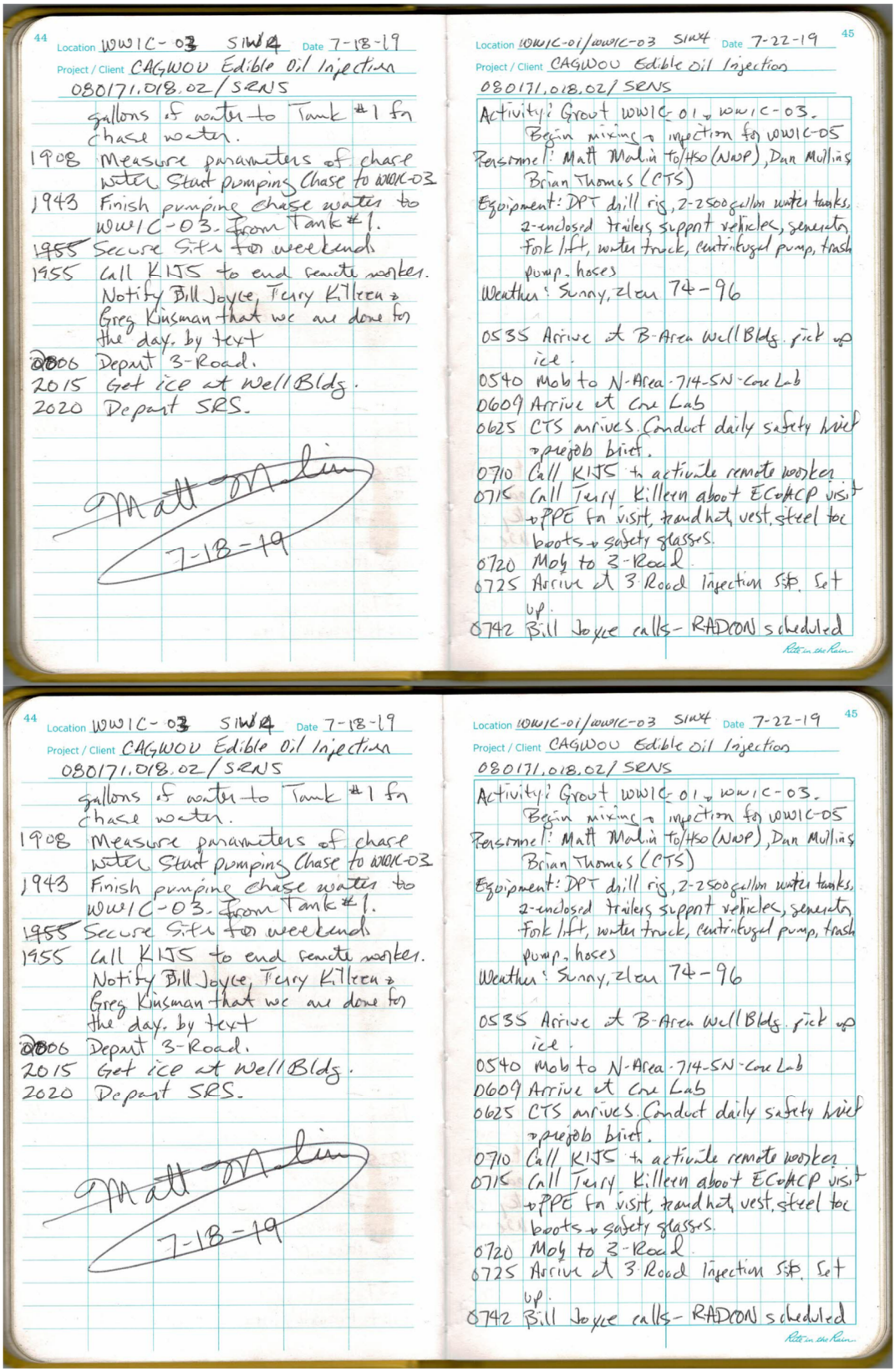
to pull rods. Begin recirculation of Tank #1 to remix oil/water for WWIC-03.
1510 Hammer screen + rods to 76' bgs for screen at 66-76' for WWIC-03.
1525 Measure Tank #1, pre injection parameters of oil mixture before going to WWIC-03.
WWIC-03 Tank #1 parameters

	T °C	DO mg/L	SPC	pH	ORP
Pre Inject	35.3	0.94	16.52	8.24	1.8
Pre CoBupH	33.8	2.64	2.66	10.26	153.1
Pre Chase	33.0	1.85	0.196	8.72	220.6

1535 Terry Killeen arrives. Wet bulb = 92.4°F
1540 Rod driven to 76' @ WWIC-03
1542 Begin injection of Tank #1 to WWIC-03.
1550 Seeing minimal (0) flow at 90 psi. vibrated + pulled up rods 1' to 65-75-
Check rods in WWIC-01 - only 20' + screen, so 5' short in WWIC-03

43 Location WWIC-03 SIW4 Date 7-18-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

Add 5' more + hammer down to 66-76' (originally at 60-70.
1615 Restart pump for injection - get ~15 gpm @ 80 psi to start Terry calls to let Bill Joyce know we will likely work tomorrow. If we finish totally - I will let Bill + Terry know either way.
1630 Terry Killeen departs
1713 Finish injection of first half of Tank 1 into WWIC-03. Prep to push bugs (BAC-9). (825 gal)
1723 Start pushing second ½ of tank 1 to WWIC-03
1745 Call KIJS to extend remote worker to 2000. Everything else the same.
1825 Finish injecting Tank #1 oil to WWIC-03. Fill 200 gall into Tank #1 of water. Add 40 gallons of CoBupH (8-5 gal buckets)
1845 Measure CoBupH pre injection parameters
1847 Start injecting CoBupH.
1904 Finish injecting CoBupH. Add 300



44 Location WW1C-03 SIWR4 Date 7-18-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

gallons of water to Tank #1 for chase water.
1908 Measure parameters of chase water. Start pumping chase to WW1C-03
1943 Finish pumping chase water to WW1C-03. from Tank #1.
~~1955~~ Secure Site for weekend.
1955 Call KIJS to end remote worker. Notify Bill Joyce, Terry Killeen & Greg Kinsman that we are done for the day. by text
~~2000~~ Depart 3-Road.
2015 Get ice at Well Bldg.
2020 Depart SRS.

Matt Malin 7-18-19

45 Location WW1C-01/WW1C-03 SIWR4 Date 7-22-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

Activity: Grout WW1C-01 & WW1C-03. Begin mixing & injection for WW1C-05
Personnel: Matt Malin to/from (WSP), Dan Mullins Brian Thomas (CTS)
Equipment: DPT drill rig, 2-2500 gallon water tanks, 2-enclosed trailers support vehicles, generator, Fork lift, water truck, centrifugal pump, trash pump, hoses
Weather: Sunny, clear 74-96

0535 Arrive at B-Area Well Bldg. pick up ice.
0540 Mob to N-Area-714-5N-Core Lab
0609 Arrive at Core Lab
0625 CTS arrives. Conduct daily safety brief & prejob brief.
0710 Call KIJS to activate remote worker
0715 Call Terry Killeen about ECoACP visit & PPE for visit, hard hat, vest, steel toe boots & safety glasses.
0720 Mob to 3-Road
0725 Arrive at 3 Road Injection Skd. Set up.
0742 Bill Joyce calls - RADCON scheduled

44 Location WW1C-03 SIWR4 Date 7-18-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

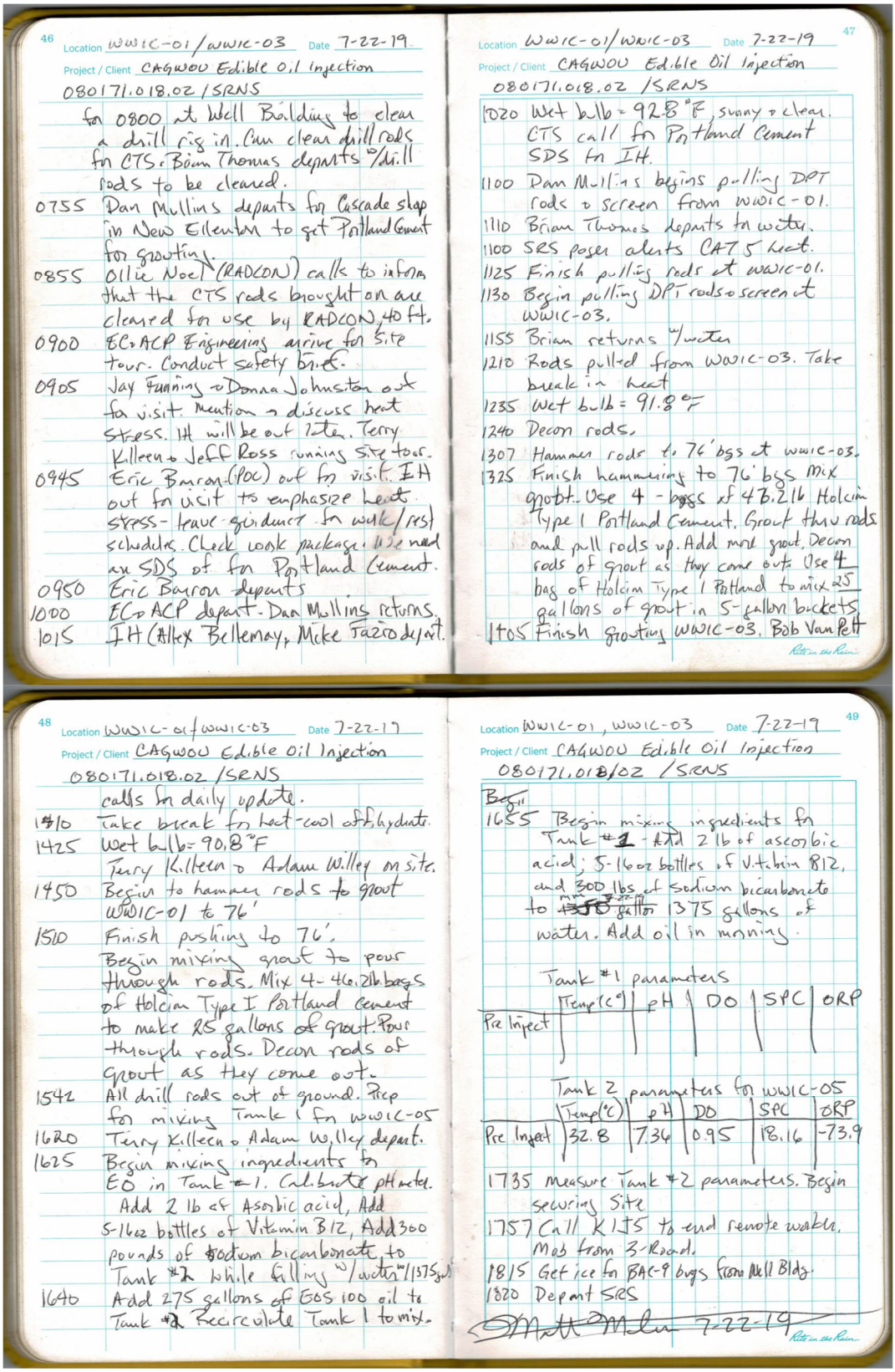
gallons of water to Tank #1 for chase water.
1908 Measure parameters of chase water. Start pumping chase to WW1C-03
1943 Finish pumping chase water to WW1C-03. from Tank #1.
~~1955~~ Secure Site for weekend.
1955 Call KIJS to end remote worker. Notify Bill Joyce, Terry Killeen & Greg Kinsman that we are done for the day. by text
~~2000~~ Depart 3-Road.
2015 Get ice at Well Bldg.
2020 Depart SRS.

Matt Malin 7-18-19

45 Location WW1C-01/WW1C-03 SIWR4 Date 7-22-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

Activity: Grout WW1C-01 & WW1C-03. Begin mixing & injection for WW1C-05
Personnel: Matt Malin to/from (WSP), Dan Mullins Brian Thomas (CTS)
Equipment: DPT drill rig, 2-2500 gallon water tanks, 2-enclosed trailers support vehicles, generator, Fork lift, water truck, centrifugal pump, trash pump, hoses
Weather: Sunny, clear 74-96

0535 Arrive at B-Area Well Bldg. pick up ice.
0540 Mob to N-Area-714-5N-Core Lab
0609 Arrive at Core Lab
0625 CTS arrives. Conduct daily safety brief & prejob brief.
0710 Call KIJS to activate remote worker
0715 Call Terry Killeen about ECoACP visit & PPE for visit, hard hat, vest, steel toe boots & safety glasses.
0720 Mob to 3-Road
0725 Arrive at 3 Road Injection Skd. Set up.
0742 Bill Joyce calls - RADCON scheduled



46
Location WWIC-01/WWIC-03 Date 7-22-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

for 0800 at Well Building to clear a drill rig in. Can clear drill rods for CTS. Brian Thomas departs w/drill rods to be cleared.
0755 Dan Mullins departs for Cascade stop in New Ellenton to get Portland Cement for grouting.
0855 Ollie Noel (RADCON) calls to inform that the CTS rods brought on are cleared for use by RADCON, 40 ft.
0900 EC+ACP Engineering arrive for Site tour. Conduct safety brief.
0905 Jay Fanning + Donna Johnston out for visit. Mention + discuss heat stress. IH will be out later. Terry Killeen + Jeff Ross running site tour.
0945 Eric Barron (POC) out for visit. IH out for visit to emphasize heat stress - leave guidance for work/rest schedule. Check work package. Need an SDS of for Portland Cement.
0950 Eric Barron departs
1000 EC+ACP depart. Dan Mullins returns.
1015 IH (Alex Bellemay, Mike Fazio) depart.

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Location WWIC-01/WWIC-03 Date 7-22-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

1020 Wet bulb = 92.8°F, sunny + clear. CTS call for Portland Cement SDS for IH.
1100 Dan Mullins begins pulling DPT rods + screen from WWIC-01.
1110 Brian Thomas departs for water.
1100 SRS poser alerts CAT 5 heat.
1125 Finish pulling rods at WWIC-01.
1130 Begin pulling DPT rods + screen at WWIC-03.
1155 Brian returns w/water
1210 Rods pulled from WWIC-03. Take break in heat
1235 Wet bulb = 91.8°F
1240 Decon rods.
1307 Hammer rods to 76' bgs at WWIC-03.
1325 Finish hammering to 76' bgs Mix grout. Use 4 - bags of 43.2lb Holcim Type I Portland Cement. Grout thru rods and pull rods up. Add more grout. Decon rods of grout as they come out. Use 4 bag of Holcim Type I Portland to mix 25 gallons of grout in 5-gallon buckets.
1405 Finish grouting WWIC-03. Bob VanPelt

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Location WWIC-01/WWIC-03 Date 7-22-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

calls for daily update.
1410 Take break for heat - cool off, hydrate.
1425 Wet bulb = 90.8°F
Terry Killeen + Adam Willey on site.
1450 Begin to hammer rods to grout WWIC-01 to 76'
1510 Finish pushing to 76'. Begin mixing grout to pour through rods. Mix 4-46.2lb bags of Holcim Type I Portland Cement to make 25 gallons of grout. Pour through rods. Decon rods of grout as they come out.
1542 All drill rods out of ground. Prep for mixing Tank 1 for WWIC-05
1620 Terry Killeen + Adam Willey depart.
1625 Begin mixing ingredients for EO in Tank #1. Calibrate pH meter. Add 2 lb of Asorbic acid, Add 5-16oz bottles of Vitamin B12, Add 300 pounds of Sodium bicarbonate, to Tank #2 while filling w/water w/1375 gal
1640 Add 275 gallons of EOS 100 oil to Tank #2 Recirculate Tank 1 to mix.

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Location WWIC-01, WWIC-03 Date 7-22-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

1655 Begin mixing ingredients for Tank #1 - Add 2 lb of ascorbic acid, 5-16oz bottles of Vitamin B12, and 300 lbs of sodium bicarbonate to ~~1350~~ gallon 375 gallons of water. Add oil in morning.

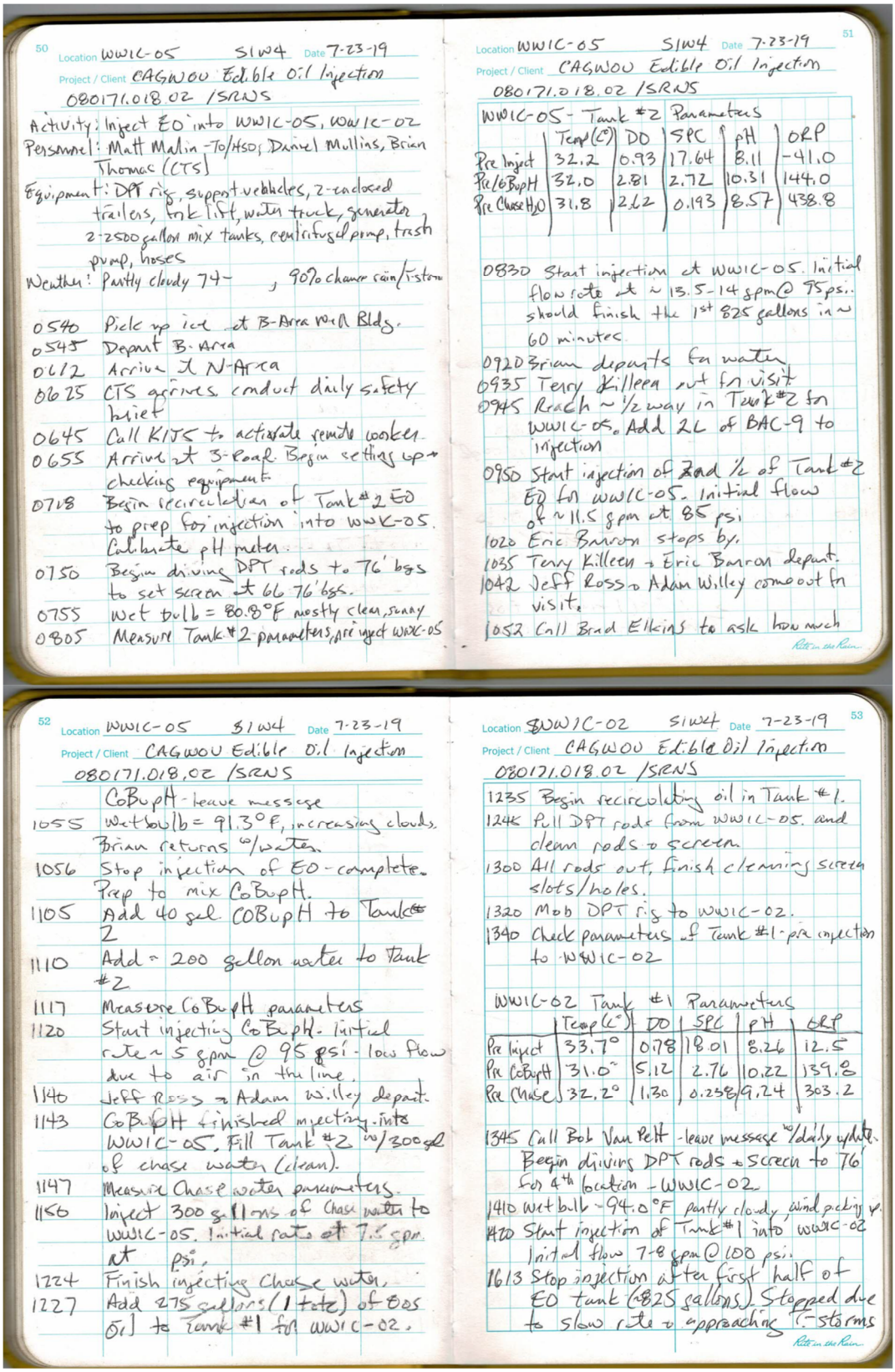
Tank #1 parameters

	Temp (°C)	pH	DO	SPC	ORP
Pre Inject					

Tank 2 parameters for WWIC-05

	Temp (°C)	pH	DO	SPC	ORP
Pre Inject	32.8	7.34	0.95	18.16	-73.9

1735 measure Tank #2 parameters. Begin securing Site
1757 Call KIJS to end remote walkie, Mob from 3-Road.
1815 Get ice for BAC-9 bags from Mill Bldg.
1820 Depart SRS
7-22-19



50
Location WWIC-05 SIW4 Date 7-23-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

Activity: Inject EO into WWIC-05, WWIC-02
Personnel: Matt Malin -To/HSO, Daniel Mullins, Brian Thomas (CTS)
Equipment: DPT rig, support vehicles, 2-enclosed trailers, fork lift, water truck, generator 2-2500 gallon mix tanks, centrifugal pump, trash pump, hoses
Weather: Partly cloudy 74~ , 90% chance rain/storms

0540 Pick up ice at B-Area Well Bldg.
0545 Depart B-Area
0612 Arrive at N-Area
0625 CTS arrives, conduct daily safety brief
0645 Call KIJS to activate remote workers
0655 Arrive at S-Road. Begin setting up + checking equipment
0718 Begin recirculation of Tank #2 EO to prep for injection into WWIC-05. Calibrate pH meter.
0750 Begin driving DPT rods to 76' bgs to set screen at 66-76' bgs.
0755 Wet bulb = 80.8°F mostly clear, sunny
0805 Measure Tank #2 parameters, pre inject WWIC-05

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Location WWIC-05 SIW4 Date 7-23-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

WWIC-05 - Tank #2 Parameters

	Temp (C°)	DO	SPC	pH	ORP
Pre Inject	32.2	0.93	17.64	8.11	-41.0
Pre/CoBupH	32.0	2.81	2.72	10.31	144.0
Pre Chase H_2O	31.8	2.62	0.193	8.57	438.8

0830 Start injection at WWIC-05. Initial flow rate at ~ 13.5-14 gpm @ 75 psi. Should finish the 1st 825 gallons in ~ 60 minutes.
0920 Brian departs for water
0935 Terry Killeen out for visit
0945 Reach ~ ½ way in Tank #2 for WWIC-05. Add 2L of BAC-9 to injection
0950 Start injection of 2nd ½ of Tank #2 EO for WWIC-05. Initial flow of ~ 11.5 gpm at 85 psi
1020 Eric Barron stops by.
1035 Terry Killeen + Eric Barron depart.
1042 Jeff Ross + Adam Willey come out for visit.
1052 Call Brad Elkins to ask how much

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Location WWIC-05 SIW4 Date 7-23-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

CoBupH - leave message
1055 Wet bulb = 91.3°F, increasing clouds. Brian returns w/water.
1056 Stop injection of EO - complete. Prep to mix CoBupH.
1105 Add 40 gal CoBupH to Tank #2
1110 Add ~ 200 gallon water to Tank #2
1117 Measure CoBupH parameters
1120 Start injecting CoBupH. Initial rate ~ 5 gpm @ 95 psi - low flow due to air in the line.
1140 Jeff Ross + Adam Willey depart.
1143 CoBupH finished injecting into WWIC-05. Fill Tank #2 w/ 300 gal of chase water (clean).
1147 Measure Chase water parameters.
1150 Inject 300 gallons of Chase water to WWIC-05. Initial rate at 7.5 gpm at psi.
1224 Finish injecting Chase water.
1227 Add 275 gallons (1 tote) of EOS Oil to Tank #1 for WWIC-02.

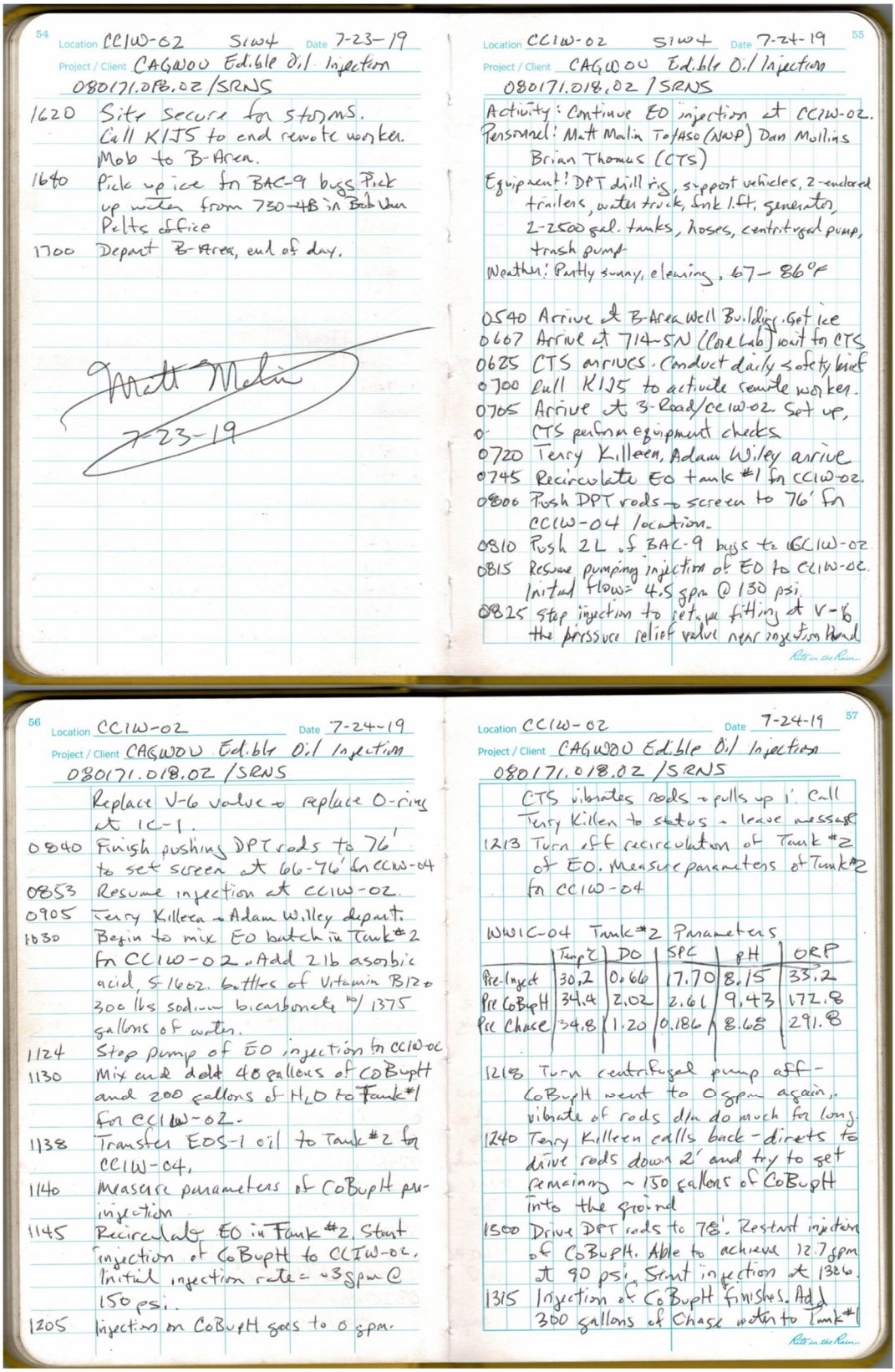
53
Location WWIC-02 SIW4 Date 7-23-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

1235 Begin recirculating oil in Tank #1.
1245 Pull DPT rods from WWIC-05. and clean rods + screen
1300 All rods out, finish cleaning screen slots/holes.
1320 Mob DPT rig to WWIC-02.
1340 Check parameters of Tank #1 pre injection to WWIC-02

WWIC-02 Tank #1 Parameters

	Temp (C°)	DO	SPC	pH	ORP
Pre Inject	33.7°	0.78	18.01	8.26	12.5
Pre CoBupH	31.0°	5.12	2.76	10.22	139.8
Pre Chase	32.2°	1.30	0.258	9.24	303.2

1345 Call Bob Van Pelt - leave message w/ daily update. Begin driving DPT rods + screen to 76' for 4th location - WWIC-02
1410 Wet bulb - 94.0°F partly cloudy, wind picking up.
1420 Start injection of Tank #1 into WWIC-02 Initial flow 7-8 gpm @ 100 psi.
1613 Stop injection after first half of EO tank (~825 gallons). Stopped due to slow rate + approaching T-storms



54
Location CC1W-02 SW4 Date 7-23-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

1620 Site secure for storms. Call KIJS to end remote worker. Mob to B-Area.
1640 Pick up ice for BAC-9 bags. Pick up water from 730-4B in Bob Van Pelt's office
1700 Depart B-Area, end of day.

Matt Malin
7-23-19

55
Location CC1W-02 SW4 Date 7-24-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Continue EO injection at CC1W-02.
Personnel: Matt Malin TetraTech (NWP) Dan Mullins
Brian Thomas (CTS)
Equipment: DPT drill rig, support vehicles, 2-enclosed trailers, water truck, fork lift, generator, 2-2500 gal. tanks, hoses, centrifugal pump, trash pump
Weather: Partly sunny, clearing, 67–86°F

0540 Arrive at B-Area Well Building. Get ice
0607 Arrive at 714-5N (Core Lab) wait for CTS
0625 CTS arrives. Conduct daily safety brief
0700 Call KIJS to activate remote worker.
0705 Arrive at 3-Road/CC1W-02. Set up, CTS perform equipment checks
0720 Terry Killeen, Adam Wiley arrive
0745 Recirculate EO tank #1 for CC1W-02.
0800 Push DPT rods → screen to 76' for CC1W-04 location.
0810 Push 2 L of BAC-9 bugs to CC1W-02
0815 Resume pumping injection of EO to CC1W-02. Initial flow= 4.5 gpm @ 130 psi.
0825 Stop injection to set up fitting at V-6 the pressure relief valve near injection head

56
Location CC1W-02 Date 7-24-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Replace V-6 valve → replace O-ring at IC-1.
0840 Finish pushing DPT rods to 76' to set screen at 66-76' for CC1W-04
0853 Resume injection at CC1W-02.
0905 Terry Killeen + Adam Wiley depart.
1030 Begin to mix EO batch in Tank #2 for CC1W-02. Add 2 lb ascorbic acid, 5-16oz. bottles of Vitamin B12 + 300 lbs sodium bicarbonate to/ 1375 gallons of water.
1124 Stop pump of EO injection to CC1W-02
1130 Mix and add 40 gallons of CoBupH and 200 gallons of H_2O to Tank #1 for CC1W-02.
1138 Transfer EOS-1 oil to Tank #2 for CC1W-04.
1140 Measure parameters of CoBupH pre-injection
1145 Recirculate EO in Tank #2. Start injection of CoBupH to CC1W-02. Initial injection rate = 3 gpm @ 150 psi.
1205 Injection on CoBupH goes to 0 gpm.

57
Location CC1W-02 Date 7-24-19
Project / Client CAGWOU Edible Oil Injection
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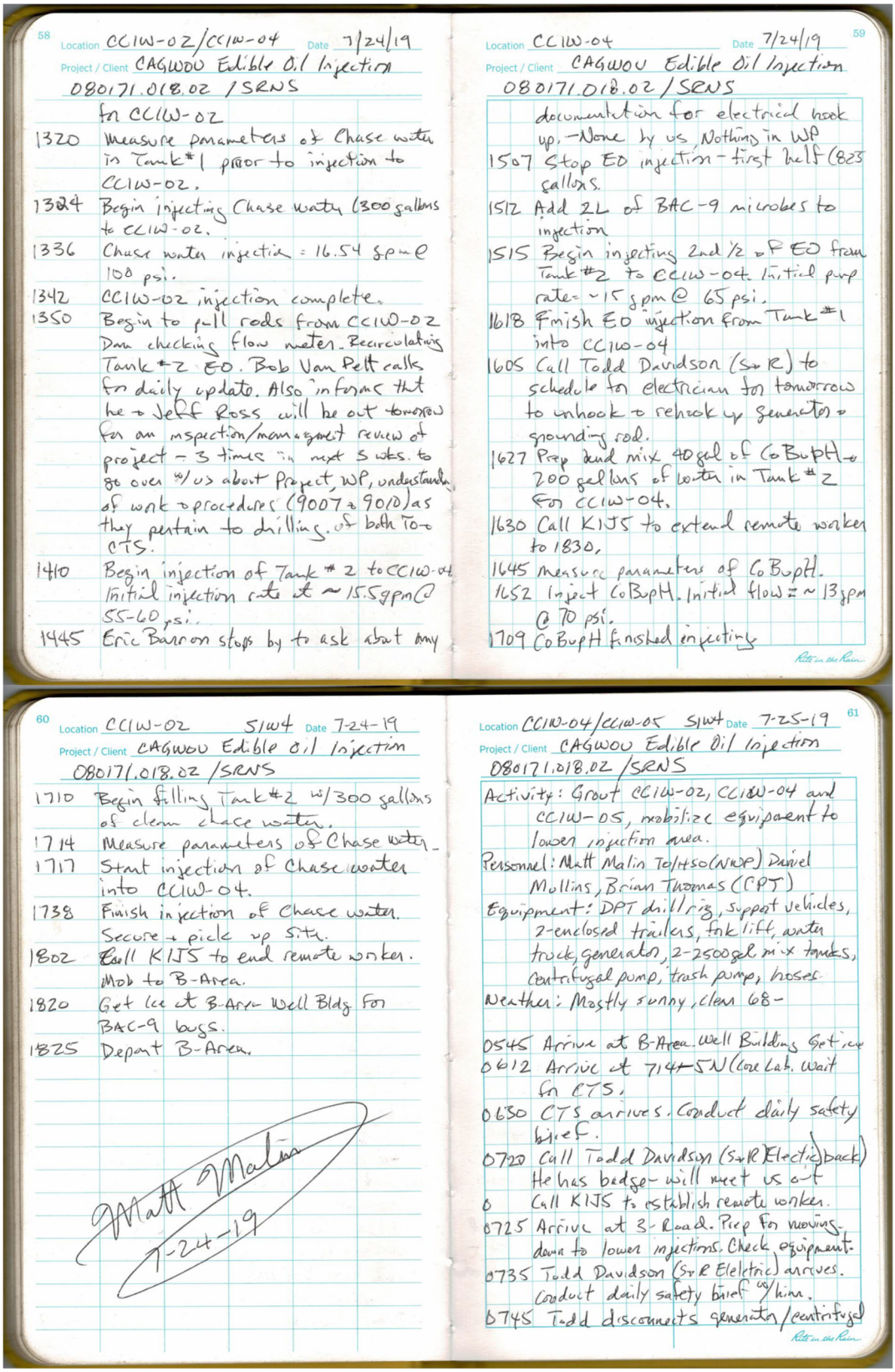
CTS vibrates rods → pulls up 1'. Call Terry Killeen to status → leave message
1213 Turn off recirculation of Tank #2 of EO. Measure parameters of Tank #2 for CC1W-04

WWIC-04 Tank #2 Parameters

	Temp C	DO	SPC	pH	ORP
Pre-Inject	30.2	0.66	17.70	8.15	33.2
Pre CoBupH	34.4	2.02	2.61	9.43	172.8
Pre Chase	34.8	1.20	0.186	8.68	291.8

1218 Turn centrifugal pump off – CoBupH went to 0 gpm again, vibrate of rods d/n do much for long.
1240 Terry Killeen calls back – directs to drive rods down 2' and try to get remaining ~150 gallons of CoBupH into the ground
1500 Drive DPT rods to 78'. Restart injection of CoBupH. Able to achieve 12.7 gpm at 90 psi. Start injection at 1326.
1315 Injection of CoBupH finishes. Add 300 gallons of Chase water to Tank #1



58
Location CC1W-02/CC1W-04 Date 7/24/19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

for CC1W-02

1320 Measure parameters of Chase water in Tank #1 prior to injection to CC1W-02.
1324 Begin injecting Chase water (300 gallons to CC1W-02.
1336 Chase water injection = 16.54 gpm @ 100 psi.
1342 CC1W-02 injection complete.
1350 Begin to pull rods from CC1W-02 Dan checking flow meter. Recirculating Tank #2 EO. Bob Van Pelt calls for daily update. Also informs that he + Jeff Ross will be out tomorrow for an inspection/management review of project - 3 times in next 5 wks. to go over w/ us about Project, WP, understanding of work + procedures (9007 + 9010) as they pertain to drilling of both To + CTS.
1410 Begin injection of Tank #2 to CC1W-04 Initial injection rate at ~ 15.5 gpm @ 55-60 psi.
1445 Eric Barron stops by to ask about any

59
Location CC1W-04 Date 7/24/19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

documentation for electrical hook up, - None by us, Nothing in WP
1507 Stop EO injection - first half (825 gallons.
1512 Add 2L of BAC-9 microbes to injection
1515 Begin injecting 2nd ½ of EO from Tank #2 to CC1W-04. Initial pump rate = ~15 gpm @ 65 psi.
1618 Finish EO injection from Tank #1 into CC1W-04
1605 Call Todd Davidson (S+R) to schedule for electrician for tomorrow to unhook + rehook up generator + grounding rod.
1627 Prep and mix 40 gal of CoBupH + 200 gallons of water in Tank #2 for CC1W-04.
1630 Call KIJS to extend remote worker to 1830.
1645 Measure parameters of CoBupH.
1652 Inject CoBupH. Initial flow = ~ 13 gpm @ 70 psi.
1709 CoBupH finished injecting

60
Location CC1W-02 S1W4 Date 7-24-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

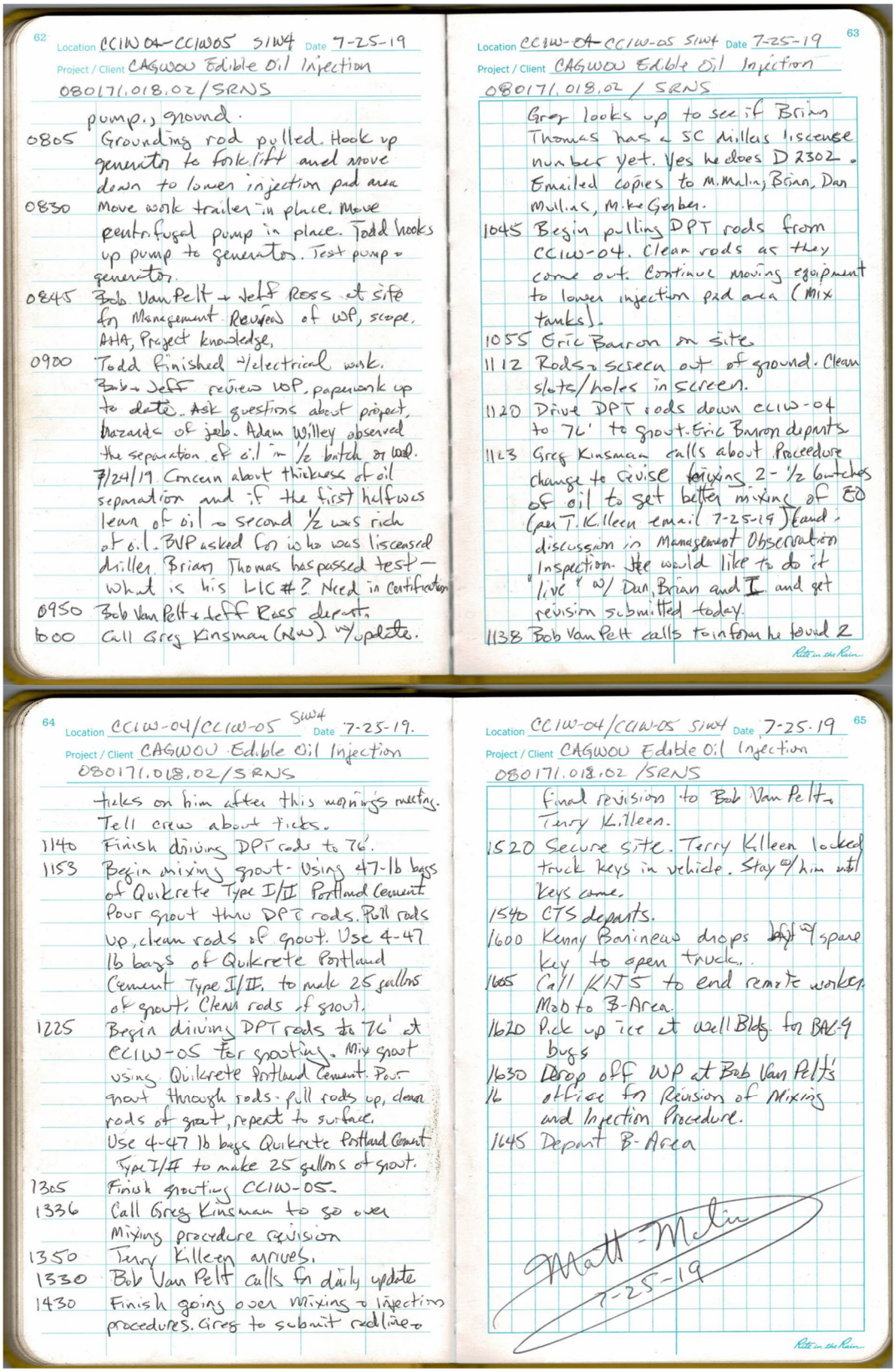
1710 Begin filling Tank #2 w/ 300 gallons of clean chase water.
1714 Measure parameters of Chase water.
1717 Start injection of Chase water into CC1W-04.
1738 Finish injection of Chase water. Secure + pick up Site.
1802 Call KIJS to end remote worker. Mob to B-Area.
1820 Get ice at B-Area Well Bldg for BAC-9 bags.
1825 Depart B-Area.

Matt Malin 7-24-19

61
Location CC1W-04/CC1W-05 S1W4 Date 7-25-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Grout CC1W-02, CC1W-04 and CC1W-05, mobilize equipment to lower injection area.
Personnel: Matt Malin TO/HSO (NRP) Daniel Mullins, Brian Thomas (CPT)
Equipment: DPT drill rig, support vehicles, 2-enclosed trailers, fork lift, water truck, generator, 2-2500 gal mix tanks, centrifugal pump, trash pump, hoses
Weather: Mostly sunny, clear 68-

0545 Arrive at B-Area Well Building Get ice
0612 Arrive at 714-5N (Core Lab. Wait for CTS.
0630 CTS arrives. Conduct daily safety brief.
0720 Call Todd Davidson (S+R Electric) back) He has badge - will meet us out
0 Call KIJS to establish remote worker.
0725 Arrive at S-Road. Prep for moving down to lower injections. Check equipment.
0735 Todd Davidson (S+R Electric) arrives. Conduct daily safety brief w/ him.
0745 Todd disconnects generator/centrifugal



62 Location CCIW-04-CCIW-05 SIW4 Date 7-25-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

pump., ground.
0805 Grounding rod pulled. Hook up generator to fork lift and move down to lower injection pad area
0830 Move work trailer in place. Move centrifugal pump in place. Todd hooks up pump to generator. Test pump + generator.
0845 Bob VanPelt + Jeff Ross at site for Management Review of WP, scope, AHA, Project knowledge,
0900 Todd finished w/electrical work. Bob + Jeff review WP, paperwork up to date. Ask questions about project, hazards of job. Adam Willey observed the separation of oil in ½ batch of Wed. 7/24/19. Concern about thickness of oil separation and if the first half was lean of oil + second ½ was rich of oil. BVP asked for if he was licensed driller. Brian Thomas has passed test — what is his LIC #? Need in certification
0950 Bob VanPelt + Jeff Ross depart.
1000 Call Greg Kinsman (KW) w/update.

63 Location CCIW-04-CCIW-05 SIW4 Date 7-25-19
Project / Client CAGWOU Edible Oil Injection
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Greg looks up to see if Brian Thomas has a SC millers license number yet. Yes he does D 2302. Emailed copies to M. Maling, Brian, Dan Mullins, Mike Gerber.
1045 Begin pulling DPT rods from CCIW-04. Clean rods as they come out. Continue moving equipment to lower injection pad area (Mix tanks).
1055 Eric Barron on site.
1112 Rods + screen out of ground. Clean slots/holes in screen.
1120 Drive DPT rods down CCIW-04 to 76' to grout. Eric Barron departs.
1123 Greg Kinsman calls about Procedure change to revise mixing. 2 - ½ batches of oil to get better mixing of EO (per T. Killeen email 7-25-19) Had discussion in Management Observation / Inspection. He would like to do it "live" w/ Dan, Brian and I and get revision submitted today.
1138 Bob VanPelt calls to inform he found 2

64 Location CCIW-04/CCIW-05 SIW4 Date 7-25-19.
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

tickets on him after this morning's meeting. Tell crew about tickets.
1140 Finish driving DPT rods to 76'.
1153 Begin mixing grout - Using 47-lb bags of Quikrete Type I/II Portland Cement. Pour grout thru DPT rods. Pull rods up, clean rods of grout. Use 4-47 lb bags of Quikrete Portland Cement Type I/II to make 25 gallons of grout. Clean rods of grout.
1225 Begin driving DPT rods to 76' at CCIW-05 for grouting. Mix grout using Quikrete Portland Cement. Pour grout through rods. Pull rods up, clean rods of grout, repeat to surface. Use 4-47 lb bags Quikrete Portland Cement Type I/II to make 25 gallons of grout.
1305 Finish grouting CCIW-05.
1336 Call Greg Kinsman to go over Mixing procedure revision
1350 Terry Killeen arrives.
1330 Bob VanPelt calls for daily update
1430 Finish going over Mixing + Injection procedures. Greg to submit redline +

65 Location CCIW-04/CCIW-05 SIW4 Date 7-25-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

final revisions to Bob VanPelt + Terry Killeen.
1520 Secure site. Terry Killeen locked truck keys in vehicle. Stay w/him until keys come.
1540 CTS departs.
1600 Kenny Barineau drops off w/spare key to open truck.
1605 Call KNTS to end remote worker Mob to B-Area.
1620 Pick up ice at well Bldg. for BAC-9 bugs
1630 Drop off WP at Bob VanPelt's office for Revision of Mixing and Injection Procedure.
1645 Depart B-Area

Matt Maling 7-25-19

66 Location CC1W-02 S1W4 Date 7-29-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Grout CC1W-02, begin EO injection at CC1W-15.
Personnel: Matt Malin TO/HSO (NWP), Dan Mullins, Brian Thomas
Equipment: DPT drill rig, support vehicles, 2 enclosed trailers, fork lift, generator, water truck, 2-2500 gal mix tanks, centrifugal pump, trash pumps, hoses
Weather: Sunny, clear 65+

0640 Arrive at B-Area Well Building - get ice
0704 Arrive at 7145N (core Lab) to meet CTS.
0710 CTS arrives. Conduct daily safety brief. Wait for work package revision
0840 Talk w/ Bob VanPelt about WP. Joao Cardoso is taking it to Lew Williams - check w/ them.
0945 Talk w/ Joao Cardoso - Valerie Whitehead is reviewing the revision of procedure for mixing - update of WP.
1055 Bob Van Pelt calls to inform that the work package is ready to be picked up from Valerie Whitehead in F-Area Groundwater trailers.
1100 Mob to F-Area Groundwater to pick up WP

67 Location CC1W-02 S1W4 Date 7-29-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

1110 Pick up WP from Valerie Whitehead
1130 Return to N-Area at Core Lab
Conduct daily safety brief + pre job brief
1210 Call KIJS to activate remote workers. Mob to 3 Rd.
1215 Arrive at 3-Rd. Check equipment
1240 Begin driving DPT rods to 78' to grout CC1W-02
1255 Begin mixing grout use 3 46.2 lb bags of Holcim Type I Portland Cement + 1.5 bags (47 lb) of Kaiserete Portland Cement (Type I/II) to make 25 gallons of grout. Pour grout through rods.
1325 Finish grouting CC1W-02 to surface.
1330 Brian departs for water. Break down barricade and set up down at lower injection site.
1435 Brian returns from getting water.
1440 Set up + connect all hoses
1530 Mix ½ batch in Tank #1
1545 Mix ½ batch in Tank #2
1600 Add ½ of oil (~137.5 gal) to Tank #2
1609 Recirculate Tank #2
1615 Terry Killen arrives

Rain in the Rain

68 Location CC1W-15 S1W4 Date 7-29-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

CC1W-15 Tank #2 Parameters

	Temp °C	DO	SPC	pH	ORP
Preinject	30.72	0.22	18.21	8.36	22.8

1639 Stop recirculation of Tank #2.
1645 Pump oil (~137.5 gal) to tank #1 rinse EO tank to mix tank #1.
1650 Recirculate Tank #1
Measure parameters in tank #2
1700 Terry Killeen departs

CC1W-15 Tank #1 Parameters

	Temp °C	DO	SPC	pH	ORP
Preinject	31.0	0.43	16.41	8.38	35.0

1720 Stop recirculation on Tank #1
Measure parameters on Tank #1.
1725 Secure Site
1735 Call KIJS - to end remote worker.
1750 Pickup ice for BAC-9 bags.
1800 Depart B-Area Well Building

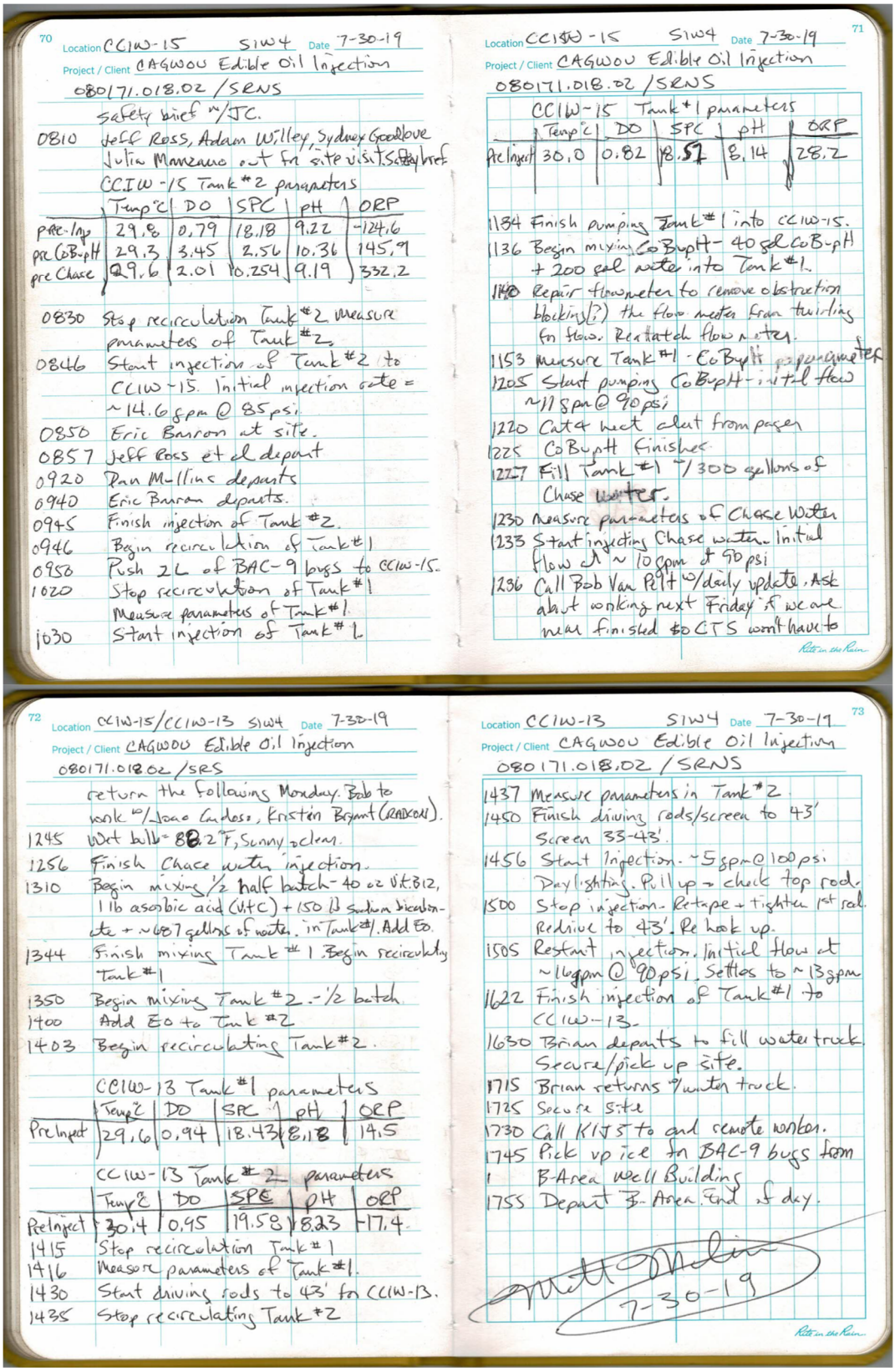
~~Matt Malin 7-29-19~~

69 Location CC1W-15 S1W4 Date 7-30-19
Project / Client ~~CAGWOU~~ CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Inject EO at CC1W-15.
Personnel: Matt Malin - TO/HSO, Daniel Mullins, Brian Thomas (CTS)
Equipment: DPT drill rig, support vehicles, water truck, generator, forklift, 2-2500 gal mix tanks, centrifugal pump, trash pump, hoses, 2-enclosed trailers
Weather: Partly cloudy, 68-96

0550 Arrive at B-Area Well Building get ice
0555 Mob to N-Area
0608 Arrive at 7145N (Core Lab)
0620 CTS arrive - conduct daily safety brief
0645 Call KIJS to activate remote worker. Mob to 3 Road
0650 Arrive at 3-Road / lower injection site
Set up, check equipment
0705 Calibrate pH meter
0720 Begin driving DPT rods to 43' bgs to set injection screen from 33-43' bgs
0737 Recirculate Tank #2 of EO
0742 Finish driving DPT rods
0755 "JC" Jermaine Cook (Cascade) arrives to assist CTS. Conduct prejob brief

Rain in the Rain



70 Location CCIW-15 SIW4 Date 7-30-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

safety brief w/JC.
0810 Jeff Ross, Adam Willey, Sydney Goodlove Julia Manzano out for site visit. Safety brief.

CCIW-15 Tank #2 parameters

	Temp °C	DO	SPC	pH	ORP
pre-Inj	29.8	0.79	18.18	9.22	-124.6
pre CoBupH	29.3	3.45	2.56	10.36	145.9
pre Chase	29.6	2.01	0.254	9.19	332.2

0830 Stop recirculation Tank #2 Measure parameters of Tank #2.
0846 Start injection of Tank #2 to CCIW-15. Initial injection rate = ~14.6 gpm @ 85 psi.
0850 Eric Barron at site.
0857 Jeff Ross et al depart
0920 Dan Mullins departs
0940 Eric Barron departs.
0945 Finish injection of Tank #2.
0946 Begin recirculation of Tank #1
0950 Push 2L of BAC-9 bugs to CCIW-15.
1020 Stop recirculation of Tank #1 Measure parameters of Tank #1.
1030 Start injection of Tank #1.

71 Location CCIW-15 SIW4 Date 7-30-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

CCIW-15 Tank #1 parameters

	Temp °C	DO	SPC	pH	ORP
Pre Inject	30.0	0.82	18.57	8.14	28.2

1134 Finish pumping Tank #1 into CCIW-15.
1136 Begin mixing CoBupH - 40 gal CoBupH + 200 gal water into Tank #1.
1140 Repair flowmeter to remove obstruction blocking(?) the flow meter from twirling for flow. Reattach flow meter.
1153 Measure Tank #1 - CoBupH parameter
1205 Start pumping CoBupH - initial flow ~11 gpm @ 90 psi
1220 Cat 4 heat alert from pager
1225 CoBupH finishes
1227 Fill Tank #1 w/ 300 gallons of Chase water.
1230 Measure parameters of Chase Water
1233 Start injecting Chase water. Initial flow at ~10 gpm at 90 psi
1236 Call Bob Van Pelt w/daily update. Ask about working next Friday if we are near finished so CTS won't have to

72 Location CCIW-15/CCIW-13 SIW4 Date 7-30-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRS

return the following Monday. Bob to work w/ Joao Cardoso, Kristin Bryant (RADCON).
1245 Wet bulb = 88.2 °F, Sunny & clear.
1256 Finish Chase water injection.
1310 Begin mixing 1/2 half batch - 40 oz Vit B12, 1 lb ascorbic acid (Vit C) + 150 lb sodium bicarbonate + ~687 gallons of water. in Tank #1. Add EO.
1344 Finish mixing Tank #1. Begin recirculating Tank #1
1350 Begin mixing Tank #2 - 1/2 batch
1400 Add EO to Tank #2
1403 Begin recirculating Tank #2.

CCIW-13 Tank #1 parameters

	Temp °C	DO	SPC	pH	ORP
Pre Inject	29.6	0.94	18.43	8.18	14.5

CCIW-13 Tank #2 parameters

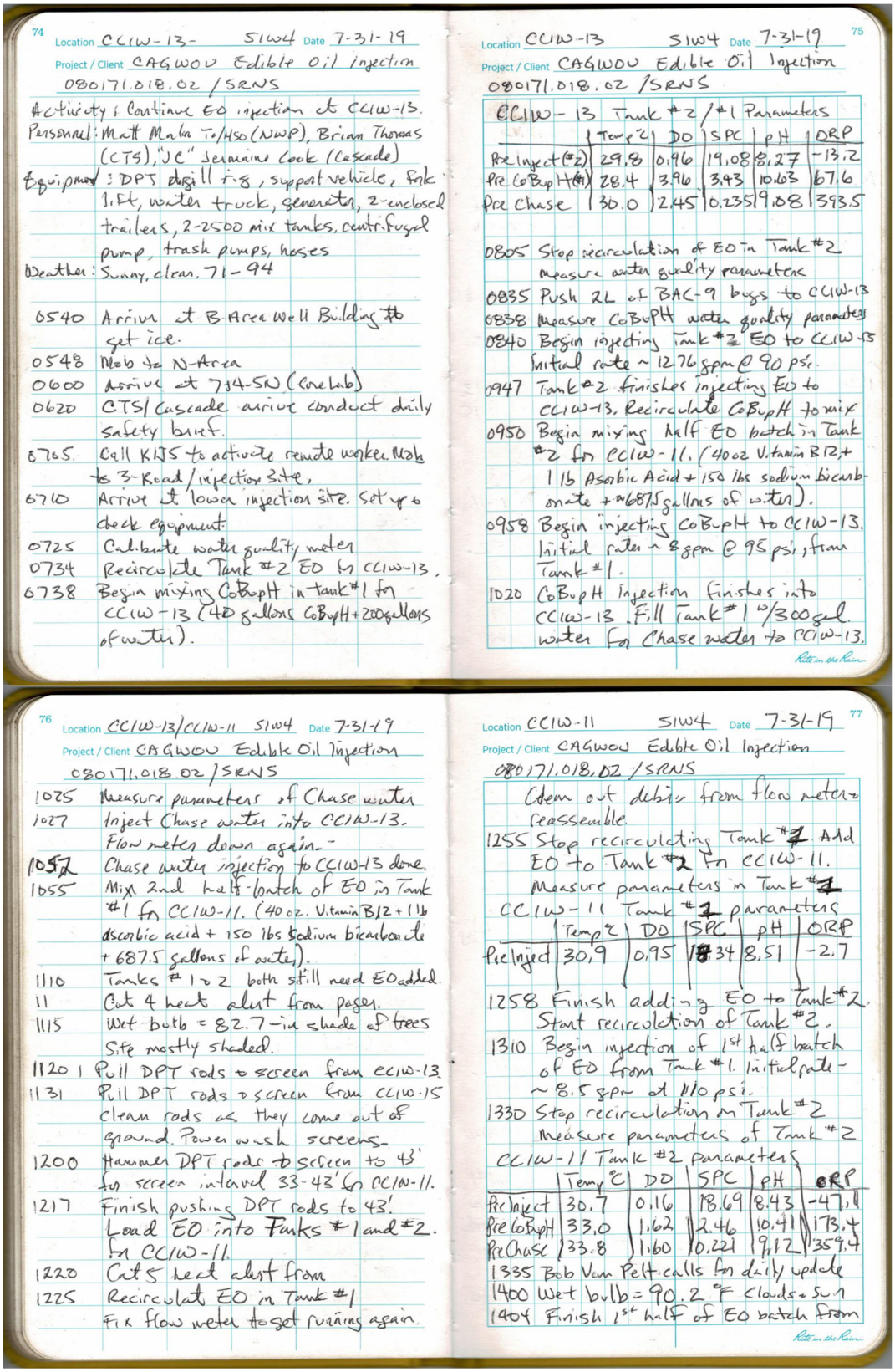
	Temp °C	DO	SPC	pH	ORP
Pre Inject	30.4	0.95	19.58	8.23	-17.4

1415 Stop recirculation Tank #1
1416 Measure parameters of Tank #1.
1430 Start driving rods to 43' for CCIW-13.
1435 Stop recirculating Tank #2

73 Location CCIW-13 SIW4 Date 7-30-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

1437 Measure parameters in Tank #2.
1450 Finish driving rods/screen to 43' Screen 33-43'.
1456 Start Injection. ~5 gpm @ 100 psi Daylighting. Pull up & check top rod.
1500 Stop injection. Retape + tighten 1st rod. Redrive to 43'. Re hook up.
1505 Restart injection. Initial flow at ~16 gpm @ 90 psi. Settles to ~13 gpm
1622 Finish injection of Tank #1 to CCIW-13.
1630 Brian departs to fill water truck. Secure/pick up site.
1715 Brian returns w/water truck.
1725 Secure site
1730 Call KIJ5 to and remote worker.
1745 Pick up ice for BAC-9 bugs from B-Area Well Building
1755 Depart B-Area End of day.

Matt Mullins
7-30-19



74
Location CCIW-13- S1W4 Date 7-31-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Continue EO injection at CCIW-13.
Personnel: Matt Malin TO/HSO (NWP), Brian Thomas (CTS), "JC" Jermaine Cook (Cascade)
Equipment: DPT rig, support vehicle, fork lift, water truck, generator, 2-enclosed trailers, 2-2500 mix tanks, centrifugal pump, trash pumps, hoses
Weather: Sunny, clear, 71-94

0540 Arrive at B-Area Well Building to get ice.
0548 Mob to N-Area
0600 Arrive at 714-5N (Core Lab)
0620 CTS/Cascade arrive conduct daily safety brief.
0705 Call KNS to activate remote worker. Mob to 3-Road / injection site.
0710 Arrive at lower injection site. Set up & check equipment.
0725 Calibrate water quality meter
0734 Recirculate Tank #2 EO to CCIW-13.
0738 Begin mixing CoBupH in tank #1 for CCIW-13 (40 gallons CoBupH + 200 gallons of water).

75
Location CCIW-13 S1W4 Date 7-31-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

CCIW-13 Tank #2 / #1 Parameters

	Temp °C	DO	SPC	pH	ORP
Pre Inject (#2)	29.8	0.96	19.08	8.27	-13.2
Pre CoBupH (#1)	28.4	3.96	3.43	10.03	67.6
Pre Chase	30.0	2.45	0.235	9.08	393.5

0805 Stop recirculation of EO in Tank #2 measure water quality parameters
0835 Push 2L of BAC-9 bugs to CCIW-13
0838 Measure CoBupH water quality parameters
0840 Begin injecting Tank #2 EO to CCIW-13 Initial rate ~ 12.76 gpm @ 90 psi.
0947 Tank #2 finishes injecting EO to CCIW-13. Recirculate CoBupH to mix
0950 Begin mixing half EO batch in Tank #2 for CCIW-11. (40 oz Vitamin B12, + 1 lb Asorbic Acid + 150 lbs sodium bicarbonate + ~687.5 gallons of water).
0958 Begin injecting CoBupH to CCIW-13. Initial rate ~ 8 gpm @ 95 psi, from Tank #1.
1020 CoBupH Injection finishes into CCIW-13. Fill Tank #1 w/ 300 gal. water for Chase water to CCIW-13.

Rite in the Rain

76
Location CCIW-13/CCIW-11 S1W4 Date 7-31-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

1025 Measure parameters of Chase water
1027 Inject Chase water into CCIW-13. Flow meter down again.
1052 Chase water injection to CCIW-13 done.
1055 Mix 2nd half-batch of EO in Tank #1 for CCIW-11. (40 oz. Vitamin B12 + 1 lb ascorbic acid + 150 lbs Sodium bicarbonate + 687.5 gallons of water).
1110 Tanks #1 & 2 both still need EO added.
11 Cut 4 heat alert from pager.
1115 Wet bulb = 82.7 - in shade of trees Site mostly shaded.
1120 Pull DPT rods to screen from CCIW-13
1131 Pull DPT rods to screen from CCIW-15 clean rods as they come out of ground. Power wash screens.
1200 Hammer DPT rods to screen to 43' for screen interval 33-43' for CCIW-11.
1217 Finish pushing DPT rods to 43'. Load EO into Tanks #1 and #2 for CCIW-11.
1220 Cut 5 heat alert from
1225 Recirculate EO in Tank #1 Fix flow meter to get readings again.

77
Location CCIW-11 S1W4 Date 7-31-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Clean out debris from flow meter & reassemble
1255 Stop recirculating Tank #1 Add EO to Tank #2 for CCIW-11. Measure parameters in Tank #1

CCIW-11 Tank #1 parameters

	Temp °C	DO	SPC	pH	ORP
Pre Inject	30.9	0.95	18.34	8.51	-2.7

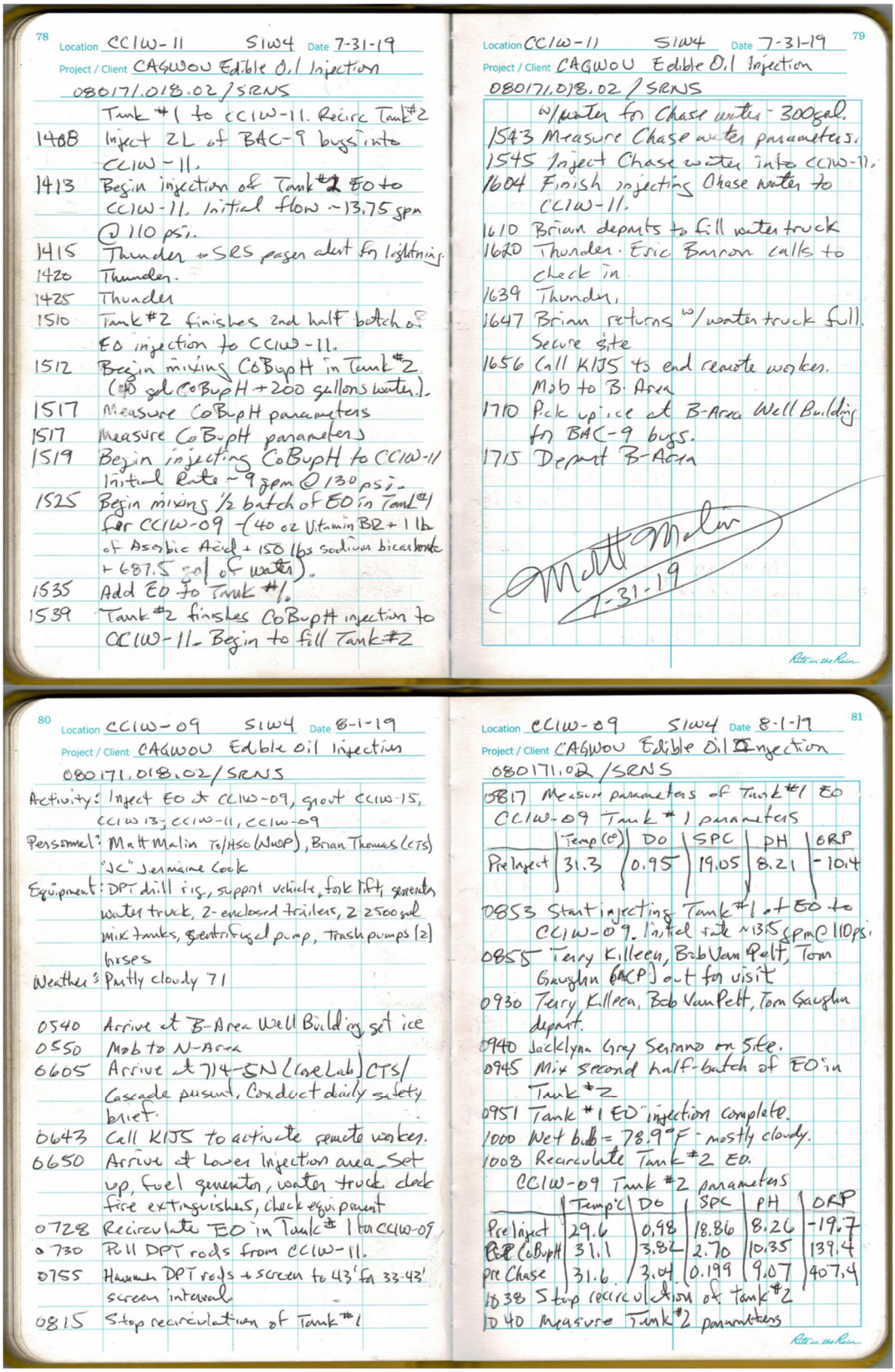
1258 Finish adding EO to Tank #2. Start recirculation of Tank #2.
1310 Begin injection of 1st half batch of EO from Tank #1. Initial rate ~ 8.5 gpm at 110 psi.
1330 Stop recirculation in Tank #2 Measure parameters of Tank #2

CCIW-11 Tank #2 parameters

	Temp °C	DO	SPC	pH	ORP
Pre Inject	30.7	0.16	18.69	8.43	-47.1
Pre CoBupH	33.0	1.62	2.46	10.41	173.4
Pre Chase	33.8	1.60	0.221	9.12	359.4

1335 Bob Van Pelt calls for daily update
1400 Wet bulb = 90.2 °F clouds & sun
1404 Finish 1st half of EO batch from

Rite in the Rain



78
Location CCIW-11 S1W4 Date 7-31-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Tank #1 to CCIW-11. Recirc Tank #2
1408 Inject 2L of BAC-9 buys into CCIW-11.
1413 Begin injection of Tank #2 EO to CCIW-11. Initial flow ~13.75 gpm @ 110 psi.
1415 Thunder - SRS pages alert for lightning.
1420 Thunder.
1425 Thunder
1510 Tank #2 finishes 2nd half batch of EO injection to CCIW-11.
1512 Begin mixing CoBupH in Tank #2 (25 gal CoBupH + 200 gallons water).
1517 Measure CoBupH parameters
1517 Measure CoBupH parameters
1519 Begin injecting CoBupH to CCIW-11 Initial Rate ~9 gpm @ 130 psi.
1525 Begin mixing ½ batch of EO in Tank #1 for CCIW-09 (40 oz Vitamin B12 + 1 lb of Asorbic Acid + 150 lbs sodium bicarbonate + 687.5 gal of water).
1535 Add EO to Tank #1.
1539 Tank #2 finishes CoBupH injection to CCIW-11. Begin to fill Tank #2

79
Location CCIW-11 S1W4 Date 7-31-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

w/water for Chase water - 300gal.
1543 Measure Chase water parameters.
1545 Inject Chase water into CCIW-11.
1604 Finish injecting Chase water to CCIW-11.
1610 Brian departs to fill water truck
1620 Thunder. Eric Barron calls to check in
1639 Thunder.
1647 Brian returns w/water truck full. Secure site
1656 Call KIJS to end remote workers. Mob to B-Area
1710 Pick up ice at B-Area Well Building for BAC-9 buys.
1715 Depart B-Area

Matt Malin 7-31-19

80
Location CCIW-09 S1W4 Date 8-1-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Inject EO at CCIW-09, grout CCIW-15, CCIW-13, CCIW-11, CCIW-09
Personnel: Matt Malin T3/HSO (NWOP), Brian Thomas (CTS) "JC" Jermaine Cook
Equipment: DPT drill rig, support vehicle, fork lift, generator, water truck, 2-enclosed trailers, 2 2500 gal mix tanks, centrifugal pump, trash pumps (2) hoses
Weather: Partly cloudy 71

0540 Arrive at B-Area Well Building set ice
0550 Mob to N-Area
0605 Arrive at 714-5N (Core Lab) CTS/Cascade present, Conduct daily safety brief.
0643 Call KIJS to activate remote workers.
0650 Arrive at Lower Injection area. Set up, fuel generator, water truck, check fire extinguishers, check equipment
0728 Recirculate EO in Tank #1 for CCIW-09
0730 Pull DPT rods from CCIW-11.
0755 Hammer DPT rods + screen to 43' for 33-43' screen interval
0815 Stop recirculation of Tank #1

81
Location CCIW-09 S1W4 Date 8-1-19
Project / Client CAGWOU Edible Oil Injection
080171.02 / SRNS

0817 Measure parameters of Tank #1 EO
CCIW-09 Tank #1 parameters

	Temp (°C)	DO	SPC	pH	ORP
Pre Inject	31.3	0.95	19.05	8.21	-10.4

0853 Start injecting Tank #1 of EO to CCIW-09. Initial rate ~13.5 gpm @ 110 psi.
0855 Terry Killeen, Bob VanPelt, Tom Gaughn (BACP) out for visit
0930 Terry Killeen, Bob VanPelt, Tom Gaughn depart.
0940 Jacklyn Gray Seymour on Site.
0945 Mix second half-batch of EO in Tank #2
0951 Tank #1 EO injection complete.
1000 Wet bulb = 78.9°F - mostly cloudy.
1008 Recirculate Tank #2 EO.
CCIW-09 Tank #2 parameters

	Temp °C	DO	SPC	pH	ORP
Pre Inject	29.6	0.98	18.86	8.26	-19.7
Post CoBupH	31.1	3.82	2.70	10.35	139.4
pre Chase	31.6	3.04	0.199	9.07	407.4

1038 Stop recirculation of Tank #2
1040 Measure Tank #2 parameters

82

Location CC1W-09 S1W4 Date 8-1-19
Project / Client CAGWOU Edible Oil Injection
080171.02 / SRNS

1105 SRNS pager alerts CAT 4 heat.
1110 Push 2L of BAC-9 bugs to CC1W-09
1115 Begin injecting Tank #2 of EO to CC1W-09. Initial flow rate ~14 gpm @ 115 psi.
1205 Cat 5 heat alert from Pager.
1214 Tank #2 Injection to CC1W-09 finishes
1217 Mix CoBupH in Tank #2.
1228 Measure CoBupH parameters
1230 Start injecting CoBupH to CC1W09.
1249 CoBupH injection finishes Fill Tank #2 w/300 gallons of water for Chase water.
1256 Measure Chase water parameters.
1258 Start injecting Chase water into CC1W-09.
1319 Finish injection of Chase water.
1330 Thunder
1340 Thunder
1350 Bob VanPelt calls for daily update
1353 Thunder.
1403 Thunder
1422 Thunder
1438 Thunder
1454 Thunder

83

Location CC1W-15/CC1W-13 S1W4 Date 8-1-19
Project / Client CAGWOU Edible Oil Injection
080171.02 / SRNS

1502 Thunder
1545 Begin prepping to grout CC1W-15 Thunder pulling away a none heard in 40 minutes +.
1555 Begin driving DPT rods to 43' to grout CC1W-15.
1602 Rod driven. Begin to grout through rods. Use 2-46.2 lb bags of Holcim Type I Portland Cement to mix 15 gallons of grout.
1615 Rods out finish grouting
1620 Drive DPT rods to 43' for CC1W-13 to grout.
1625 Begin grouting CC1W-13. Mix 2 bags of 46.2 lb Holcim Type I Portland Cement to make 15 gallons of grout to pour thru rods.
1638 Finish grouting CC1W-13
1640 Drive DPT rods to 43' for CC1W-11 for grouting.
1645 Begin grouting CC1W-11 from bottom up. Mix 2-46.2 lb bags of Holcim Type I portland cement to make 15 gallons

Rite in the Rain

84

Location CC1W-11 S1W4 Date 8-1-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

of grout
1700 Finish grouting CC1W-11. Pick up Site.
1715 Call KNS to end remote worker.
1730 Pick up ice for BAC-9 bugs from B-Area Well Building.
1735 Depart B-Area; end of day

Matt Malin 8-1-19

85

Location CC1W-08 S1W4 Date 8-5-19
Project / Client CAGWOU Ed. Oil Injection
080171.018.02 / SRNS

Activity: Inject EO at CC1W-08
Personnel: Matt Malin FJ/HSO (NOO-P), Dan Mullins, Brian Thomas (CTS)
Equipment: DPT drill rig, support vehicles, fork lift, water truck, generator, 2-enclosed trailers, 2-250 gal. mix tanks, hoses, trash pumps, centrifuged pump
Weather: Foggy/overcast 71-90°F, clearing ~1200.
0545 Pick up ice at B-Area Well Building
0603 Arrive at 714-5N (Core Lab) to meet CTS.
0620 CTS arrives. Conduct daily safety brief and pre-job safety brief
0645 Call KNS to activate remote workers. Mob to Lower injection area.
0653 Arrive at S-Road Lower Injection area.
0700 Set up, check equipment
0805 Calibrate water quality meter. Begin mixing 2-half batches for CC1W-08
0810 Brian Thomas hammers DPT rods to screen to 43' bgs at CC1W-08
0840 Finish mixing both half batches EO. Begin recirculating Tank #2 for CC1W-08.

Rite in the Rain

84

Location CCIW-11 SIW4 Date 8-1-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

of grout
1700 Finish grouting CCIW-11. Pick up Site.
1715 Call KIJS to end remote workers.
1730 Pick up ice for BAC-9 bugs from B-Area Well Building.
1735 Depart B-Area, end of day

Matt Malin 8-1-19

85

Location CCIW-08 SIW4 Date 8-5-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Inject EO at CCIW-08
Personnel: Matt Malin TO/HSO (NAO-P), Dan Mullins, Brian Thomas (CTS)
Equipment: DPT drill rig, support vehicles, fork lift, water truck, generator, 2-enclosed trailers, 2-250 gal. mix tanks, hoses, trash pumps, centrifuged pump
Weather: Foggy/overcast 71-90°F, clearing ~ 1200.
0545 Pick up ice at B-Area Well Building
0603 Arrive at 714-5N (core lab) to meet CTS.
0620 CTS arrives. Conduct daily safety brief and pre-job safety brief
0645 Call KIJS to activate remote workers. Mob to Lower injection area.
0653 Arrive at S-Road Lower Injection area.
0700 Set up, check equipment
0805 Calibrate water quality meter, Begin mixing 2 half batches for CCIW-08
0810 Brian Thomas hammers DPT rods to screen to 43' bgs at CCIW-08
0840 Finish mixing both half batches EO. Begin recirculating Tank #2 for CCIW-08.

Rite in the Rain

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Location CCIW-08 SIW4 Date 8/5/19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

0913 Measure Tank #2 EO parameters

	Temp°C	DO	SPC	pH	ORP
Pre Inje	25.3	0.98	19.06	8.25	+14.8
Pre CoBupH	32.4	2.70	2.181	10.44	183.3
Pre Chase	30.1	4.89	0.243	9.05	290.6

took a while for DO to get below 1.00

0943 Begin injecting Tank #2 EO to CCIW-08. Initial flow = 9.2 gpm @ 120 psi
1005 Jacklynn Gray-Serrato (NAO-P) at site
1010 Terry Killeen & Justin Steadman at Site.
1045 Terry → Justin depart
1055 Jacklynn departs
1105 Finish injecting Tank #2 to CCIW-08
1109 Begin recirculate of Tank #1 EO.
1115 Inject/push 2L of BAC-9 bugs to CCIW-08.
1130 Mix CoBupH (40 gal. + 200 gal water) in Tank #2
1139 Tank #1 finish recirculating. Measure parameters of EO in Tank #1
1156 Measure Tank #1 EO parameters.
1158 Begin Tank #1 EO injection to CCIW-08

87

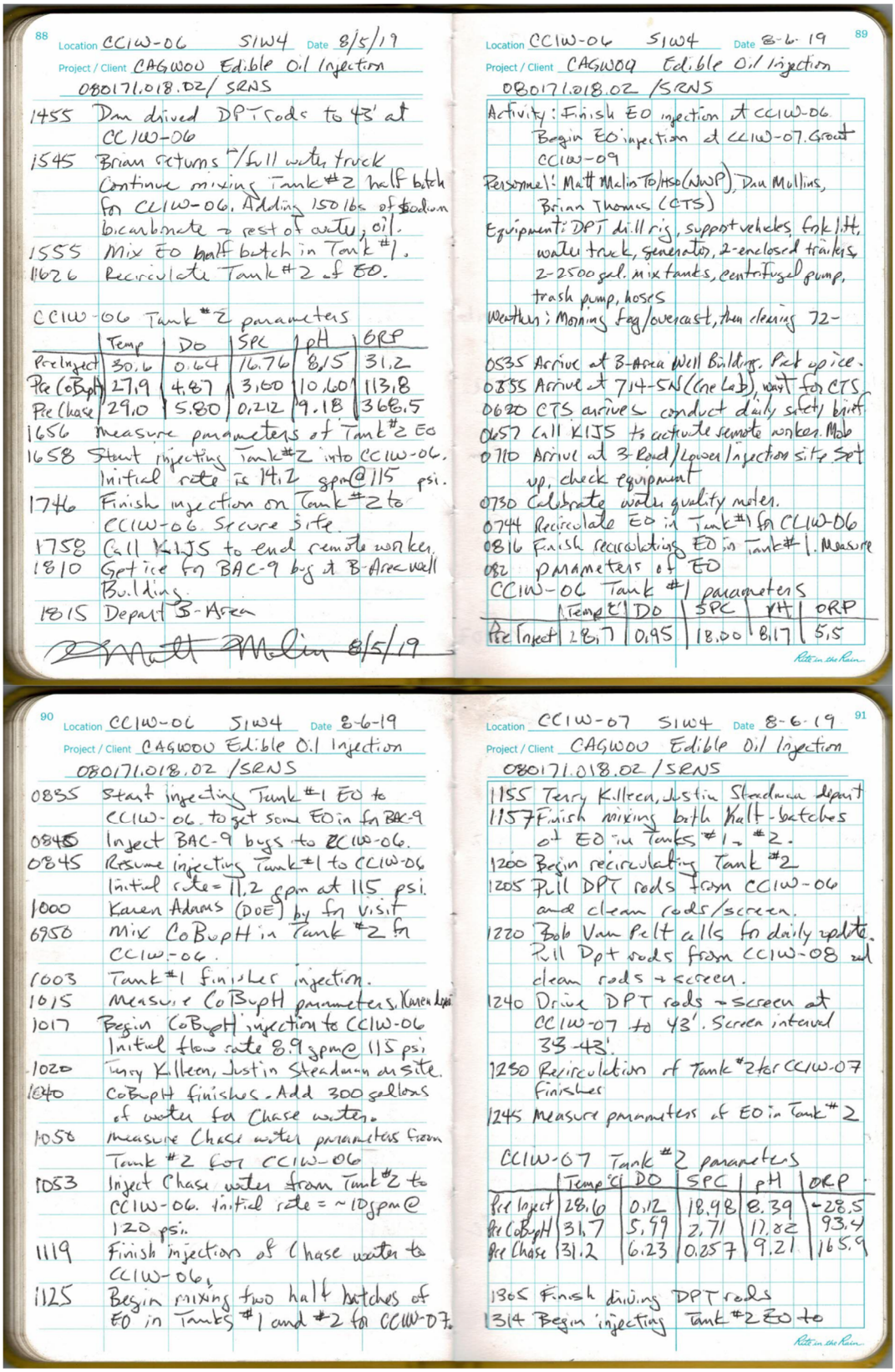
Location CCIW-08 SIW4 Date 8/5/19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

CCIW-08 Tank #1 parameters

	Temp°C	DO	SPC	pH	ORP
Pre Inject	25.7	0.98	18.63	8.05	15.2

1158 - Initial flow rate of ~ 11 gpm @ 110 psi - to CCIW-08.
1250 Pull DPT rods → screen from CCIW-08.
1320 Tank #1 EO finishes injection. Eric Barron stops by
1330 Measure parameters of CoBupH. Start injection of CoBupH to CCIW-08 from Tank #2. Injection rate ~ 9.8 gpm @ 110 psi.
1348 Call Bob Van Pelt w/ daily update
1353 CoBupH finishes pumping to CCIW-08 Fill Tank #2 w/ 300 gal. Chase water.
1400 Measure Chase water parameters
1401 Begin injecting Chase water to CCIW-08 Initial flow rate =
1450 Chase water finishes
1455 Start to mix half batch in Tank #2 - add Vitamin B12 + Asorbic acid - but not enough water for full ½ batch
1450 Brian departs for water

Rite in the Rain



88
Location CC1W-06 S1W4 Date 8/5/19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/ SRNS

1455 Dan drived DPT rods to 43' at CC1W-06
1545 Brian returns w/ full water truck Continue mixing Tank #2 half batch for CC1W-06. Adding 150 lbs of Sodium bicarbonate + rest of water, oil.
1555 Mix EO half batch in Tank #1.
1626 Recirculate Tank #2 of EO.

CC1W-06 Tank #2 parameters

	Temp	DO	SPC	pH	ORP
Pre Inject	30.6	0.64	16.76	8.15	31.2
Pre CoBupH	27.9	4.87	3.100	10.60	113.8
Pre Chase	29.0	5.80	0.212	9.18	368.5

1656 Measure parameters of Tank #2 EO
1658 Start injecting Tank #2 into CC1W-06. Initial rate is 14.2 gpm @ 115 psi.
1746 Finish injection on Tank #2 to CC1W-06. Secure site.
1758 Call KIJS to end remote worker.
1810 Get ice for BAC-9 bags at B-Area well Building.
1815 Depart B-Area

Matt Melin 8/5/19

89
Location CC1W-06 S1W4 Date 8-6-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

Activity: Finish EO injection at CC1W-06 Begin EO injection at CC1W-07. Grout CC1W-09
Personnel: Matt Melin TO/HSO (NWP), Dan Mullins, Brian Thomas (CTS)
Equipment: DPT drill rig, support vehicles, fork lift, water truck, generator, 2-enclosed trailers, 2-2500 gal. mix tanks, centrifugal pump, trash pump, hoses
Weather: Morning fog/overcast, then clearing 72-

0535 Arrive at B-Area Well Building. Pick up ice.
0855 Arrive at 714-5N (Core Lab), wait for CTS
0620 CTS arrives conduct daily safety brief
0657 Call KIJS to activate remote worker. Mob
0710 Arrive at 3-Road/Lower Injection site. Set up, check equipment
0730 Calibrate water quality meter.
0744 Recirculate EO in Tank #1 for CC1W-06
0816 Finish recirculating EO in Tank #1. Measure
082 parameters of EO

CC1W-06 Tank #1 parameters

	Temp C	DO	SPC	pH	ORP
Pre Inject	28.7	0.95	18.00	8.17	5.5

Rite in the Rain

90
Location CC1W-06 S1W4 Date 8-6-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

0855 Start injecting Tank #1 EO to CC1W-06. to get some EO in for BAC-9
0845 Inject BAC-9 bugs to CC1W-06.
0845 Resume injecting Tank #1 to CC1W-06 Initial rate = 11.2 gpm at 115 psi.
1000 Karen Adams (DOE) by for visit
6950 Mix CoBupH in Tank #2 for CC1W-06.
1003 Tank #1 finishes injection.
1015 Measure CoBupH parameters, Karen Lee
1017 Begin CoBupH injection to CC1W-06 Initial flow rate 8.9 gpm @ 115 psi
1020 Terry Killeen, Justin Steadman on site.
1040 CoBupH finishes. Add 300 gallons of water for Chase water.
1058 Measure Chase water parameters from Tank #2 for CC1W-06
1053 Inject Chase water from Tank #2 to CC1W-06. Initial rate = ~10 gpm @ 120 psi.
1119 Finish injection of Chase water to CC1W-06.
1125 Begin mixing two half batches of EO in Tanks #1 and #2 for CC1W-07.

91
Location CC1W-07 S1W4 Date 8-6-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 /SRNS

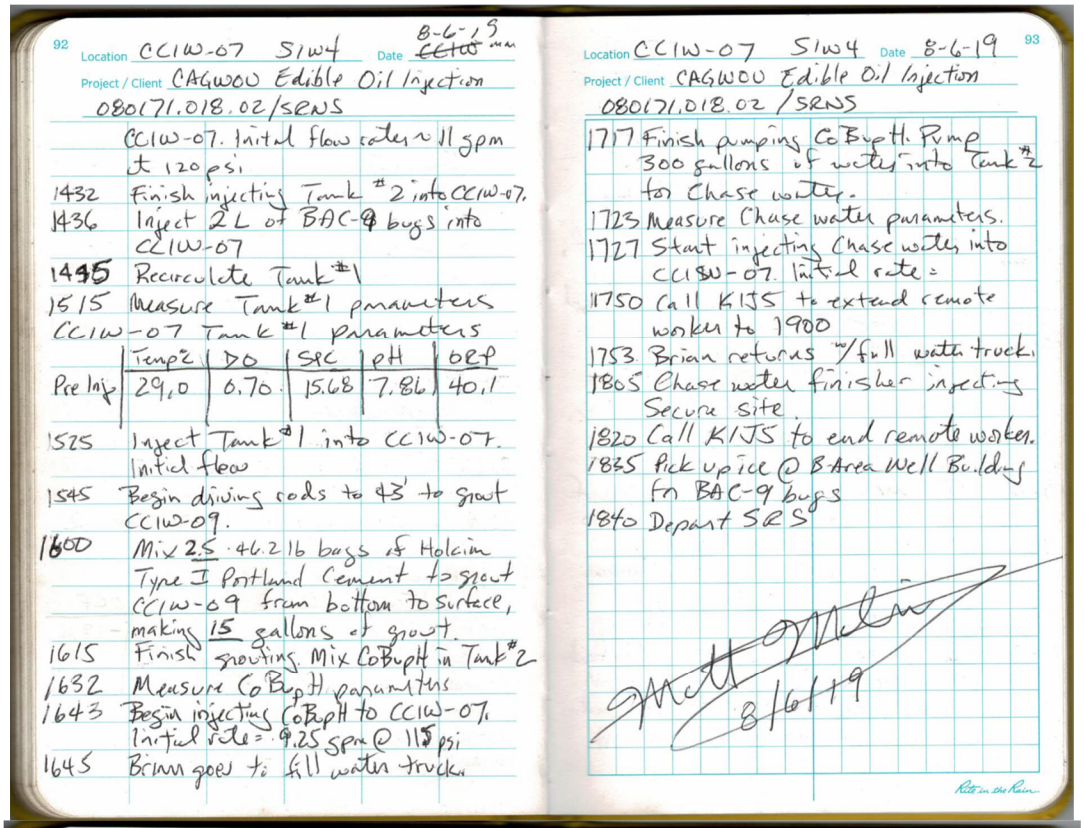
1155 Terry Killeen, Justin Steadman depart
1157 Finish mixing both half-batches of EO in Tanks #1 + #2.
1200 Begin recirculating Tank #2
1205 Pull DPT rods from CC1W-06 and clean rods/screen.
1220 Bob Van Pelt calls for daily update. Pull Dpt rods from CC1W-08 and clean rods + screen.
1240 Drive DPT rods + screen at CC1W-07 to 43'. Screen interval 33-43'.
1250 Recirculation of Tank #2 for CC1W-07 finishes
1245 Measure parameters of EO in Tank #2

CC1W-07 Tank #2 parameters

	Temp °C	DO	SPC	pH	ORP
Pre Inject	28.6	0.12	18.98	8.39	-28.5
Pre CoBupH	31.7	5.99	2.71	11.82	93.4
Pre Chase	31.2	6.23	0.257	9.21	165.9

1305 Finish driving DPT rods
1314 Begin injecting Tank #2 EO to

Rite in the Rain



92 Location CC1W-07 S1W4 Date 8-6-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

CC1W-07. Initial flow rate ~ 11 gpm at 120 psi.
1432 Finish injecting Tank #2 into CC1W-07.
1436 Inject 2L of BAC-9 bugs into CC1W-07
1445 Recirculate Tank #1
1515 Measure Tank #1 parameters
CC1W-07 Tank #1 parameters

	Temp°C	DO	SPC	pH	ORP
Pre Inj	29.0	0.70	15.68	7.86	40.1

1525 Inject Tank #1 into CC1W-07. Initial flow
1545 Begin driving rods to 43' to grout CC1W-09.
1600 Mix 25 · 46.2 lb bags of Holcim Type I Portland Cement to grout CC1W-09 from bottom to surface, making 15 gallons of grout.
1615 Finish grouting. Mix CoBupH in Tank #2
1632 Measure CoBupH parameters
1643 Begin injecting CoBupH to CC1W-07. Initial rate = 9.25 spm @ 115 psi
1645 Brian goes to fill water truck.

93 Location CC1W-07 S1W4 Date 8-6-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

1717 Finish pumping CoBupH. Pump 300 gallons of water into Tank #2 for Chase water.
1723 Measure Chase water parameters.
1727 Start injecting Chase water into CC1W-07. Initial rate =
1750 Call KIJS to extend remote worker to 1900
1753 Brian returns w/ full water truck.
1805 Chase water finisher injecting. Secure site.
1820 Call KIJS to end remote worker.
1835 Pick up ice @ B-Area Well Building for BAC-9 bugs
1840 Depart SRS

Matt O'Malley 8/6/19

Rite in the Rain

94 Location CC1W-10 S1W4 Date 8-7-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

Activity: Mix 2-half batches of EO and inject into CC1W-10.
Personnel: Matt Malin TO/HSO (NWP) Dan Mullins, Brian Thomas (CTS)
Equipment: DPT drill rig, support vehicles, fork lift, water truck, generator, 2-2500 gallon mix tanks, 2-enclosed trailers, centrifugal pump, trash pumps, hoses
Weather: Mostly sunny, clear 71-

0540 Arrive at B-Area Well Building set ice.
0541 Depart B-Area for N-Area
0600 Arrive at 714-5N to meet CTS.
0625 CTS arrives. Conduct daily safety brief.
0710 Call KIJS to activate remote worker MOB to CC1W-10 @ lower injection area
0718 Arrive at CC1W-10 - lower injection area. Set up. Check equipment.
0745 Calibrate water quality meter.
0817 Bob Van Pelt calls about states to finish up this week - too much coordination. Hope to finish injection this week, and grout, with demob done by next Tuesday.

95 Location CC1W-10 S1W4 Date 8-7-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

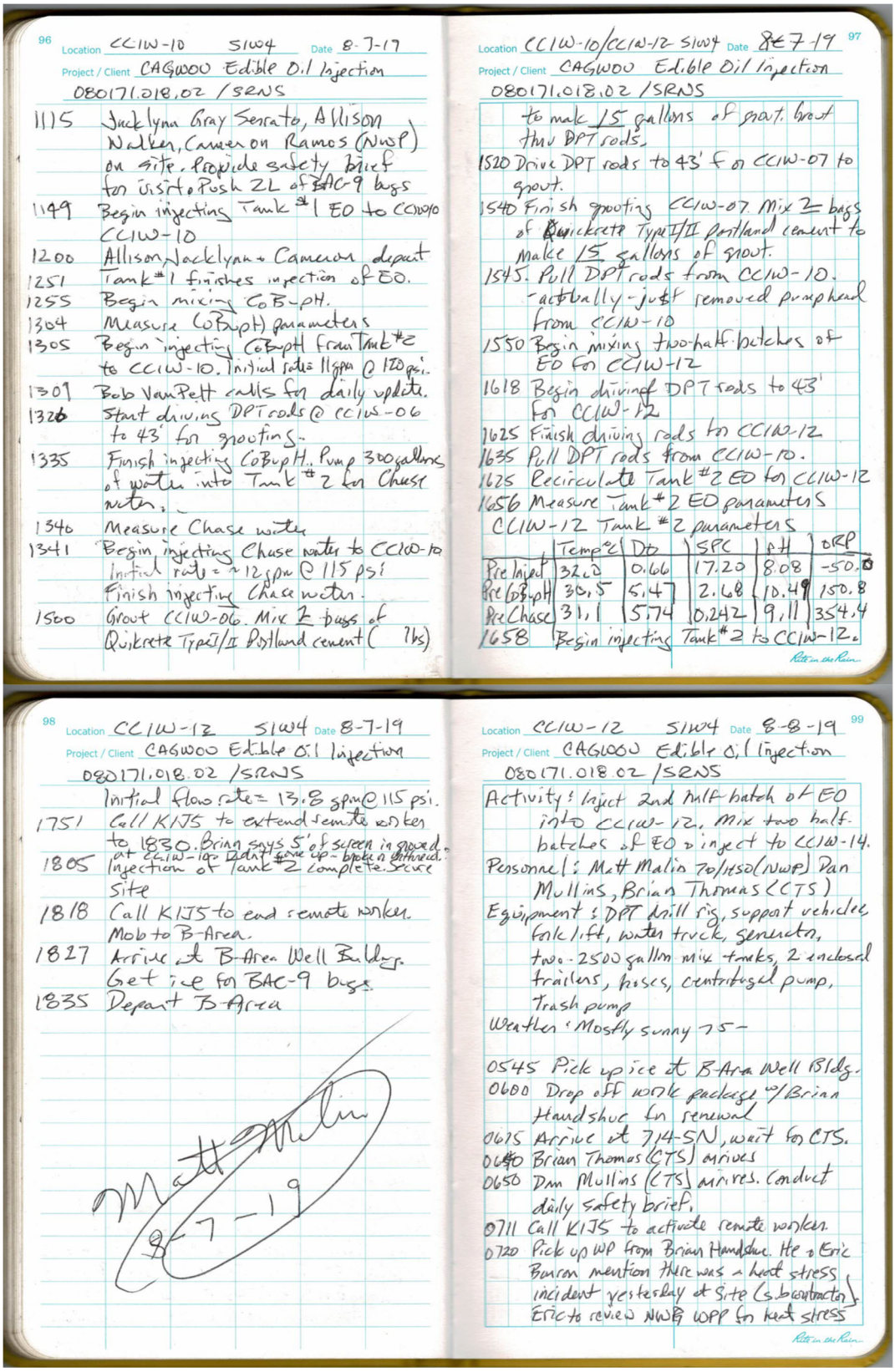
0850 Begin mixing two half batches of EO for CC1W-10
0940 Measure parameter in Tank #2 for CC1W-1
0910 Recirculate Tank #2
CC1W-10 Tank #2 parameters

	Temp°C	DO	SPC	pH	ORP
Pre Inject	28.7	0.91	18.59	8.47	-87.4
Pre CoBupH	30.1	5.23	2.91	10.38	176.4
Pre Chase	31.0	5.10	0.229	9.09	300.6

0915 Pull DPT rods from CC1W-07.
0931 Begin driving DPT rods w screen to 43' @ CC1W-10.
0956 Begin pumping Tank #2 to CC1W-10 Initial flow = ~ 12.6 gpm @ 110 psi.
1109 Finish injecting Tank #2 into CC1W-10. Begin recirculating Tank #1 EO.
1140 Finish recirculating Tank #2. Measure Tank #1 parameters
CC1W-10 Tank #1 parameters

	Temp°C	DO	SPC	pH	ORP
Pre Inject	29.2	0.97	17.67	7.23	-11.8

Rite in the Rain



96 Location CCIW-10 SIW4 Date 8-7-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

1115 Jacklyna Gray Serrato, Allison Walker, Cameron Ramos (NWP) on site. Provide safety brief for visit. Push 2L of BAC-9 bags
1149 Begin injecting Tank #1 EO to CCIW10 CCIW-10
1200 Allison, Jacklyna + Cameron depart
1251 Tank #1 finishes injection of EO.
1255 Begin mixing CoBupH.
1304 Measure CoBupH parameters
1305 Begin injecting CoBupH from Tank #2 to CCIW-10. Initial rate = 11 gpm @ 120 psi.
1309 Bob VanPelt calls for daily update.
1326 Start driving DPT rods @ CCIW-06 to 43' for grouting.
1335 Finish injecting CoBupH. Pump 300 gallons of water into Tank #2 for Chase water.
1340 Measure Chase water
1341 Begin injecting Chase water to CCIW-10 Initial rate = ~12 gpm @ 115 psi
Finish injecting Chase water.
1500 Grout CCIW-06. Mix 2 bags of Quikrete Type I/II Portland cement (lbs)

Location CCIW-10/CCIW-12 SIW4 Date 8-7-19 97
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

to make 15 gallons of grout. Grout thru DPT rods.
1520 Drive DPT rods to 43' for CCIW-07 to grout.
1540 Finish grouting CCIW-07. Mix 2 bags of Quickrete Type I/II Portland cement to make 15 gallons of grout.
1545. Pull DPT rods from CCIW-10. - actually - just removed pump head from CCIW-10
1550 Begin mixing two-half batches of EO for CCIW-12
1618 Begin driving DPT rods to 43' for CCIW-12
1625 Finish driving rods for CCIW-12
1635 Pull DPT rods from CCIW-10.
1625 Recirculate Tank #2 EO for CCIW-12
1656 Measure Tank #2 EO parameters
CCIW-12 Tank #2 parameters

	Temp °C	DO	SPC	pH	ORP
Pre Inject	32.0	0.66	17.20	8.08	-50.0
Pre CoBupH	30.5	5.47	2.68	10.49	150.8
Pre Chase	31.1	5.74	0.242	9.11	354.4

1658 Begin injecting Tank #2 to CCIW-12.

Rite in the Rain

98 Location CCIW-12 SIW4 Date 8-7-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Initial flow rate = 13.8 gpm @ 115 psi.
1751 Call KIJS to extend remote worker to 1830. Brian says 5' of screen in ground at CCIW-10. Didn't come up - broken or bathread.
1805 Injection of Tank #2 complete. Secure site
1818 Call KIJS to end remote worker. Mob to B-Area.
1827 Arrive at B-Area Well Bldg. Get ice for BAC-9 bags.
1835 Depart B-Area

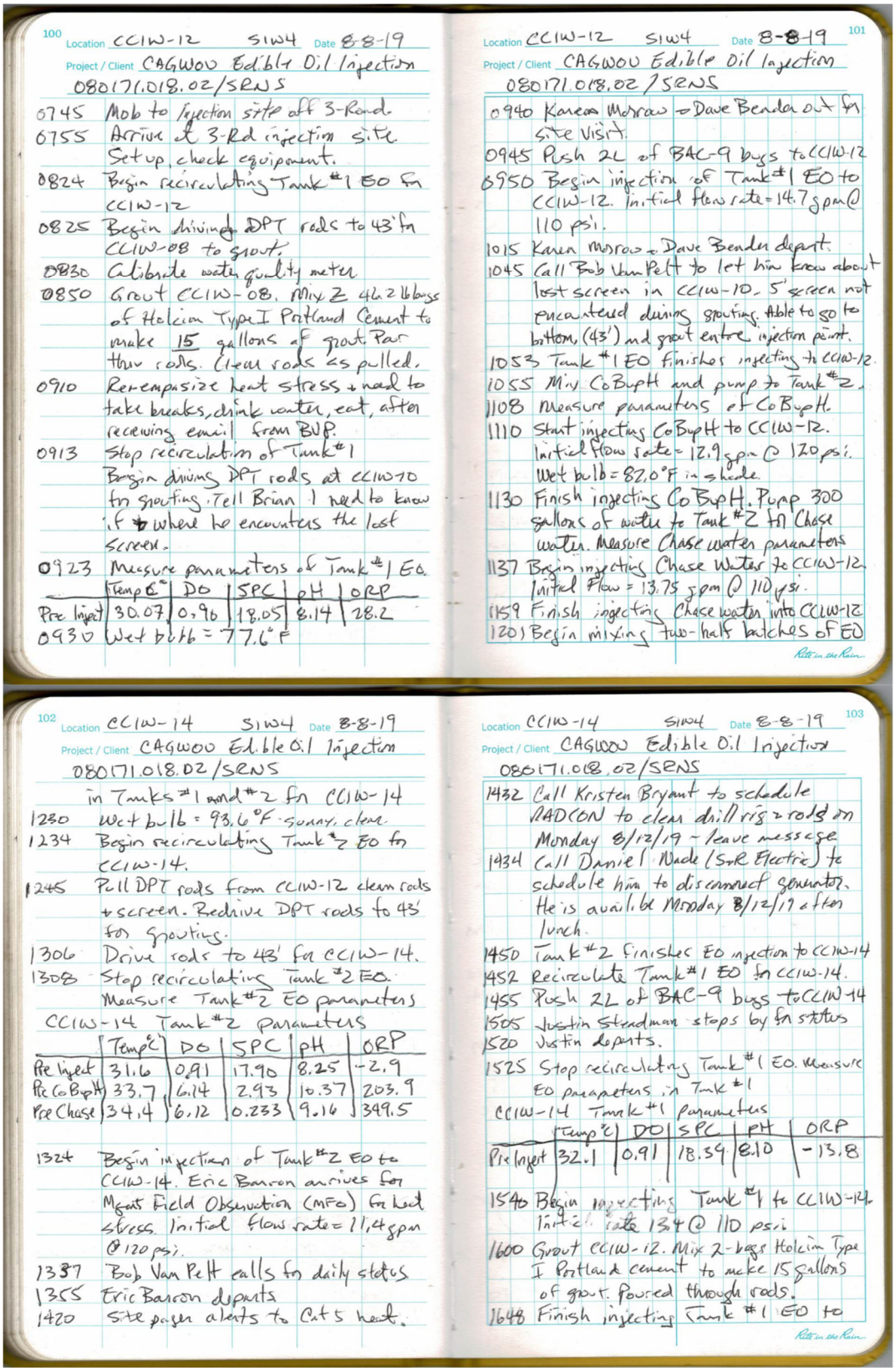
Matt Malin
8-7-19

Location CCIW-12 SIW4 Date 8-8-19 99
Project / Client CAGWOU Edible Oil Injection
080171.018.02 / SRNS

Activity: Inject 2nd half batch of EO into CCIW-12. Mix two half batches of EO & inject to CCIW-14.
Personnel: Matt Malin 70/HSO (NWP) Dan Mullins, Brian Thomas (CTS)
Equipment: DPT drill rig, support vehicles, fork lift, water truck, generator, two - 2500 gallon mix tanks, 2 enclosed trailers, hoses, centrifugal pump, Trash pump
Weather: Mostly sunny 75 -

0545 Pick up ice at B-Area Well Bldg.
0600 Drop off work package w/ Brian Handshue for renewal
0615 Arrive at 714-5N, wait for CTS.
0640 Brian Thomas (CTS) arrives
0650 Dan Mullins (CTS) arrives. Conduct daily safety brief.
0711 Call KIJS to activate remote worker.
0720 Pick up WP from Brian Handshue. He & Eric Barron mention there was a heat stress incident yesterday at site (subcontractor). Eric to review NWP WPP for heat stress

Rite in the Rain



100 Location CCIW-12 SIW4 Date 8-8-19
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

0745 Mob to injection site off 3-Road.
0755 Arrive at 3-Rd injection site. Setup, check equipment.
0824 Begin recirculating Tank #1 EO to CCIW-12
0825 Begin driving DPT rods to 43' to CCIW-08 to grout.
0830 Calibrate water quality meter
0850 Grout CCIW-08. Mix 2 46.2 lb bags of Holcim Type I Portland Cement to make 15 gallons of grout. Pour thru rods. Clean rods as pulled.
0910 Re-emphasize heat stress + need to take breaks, drink water, eat, after receiving email from BWP.
0913 Stop recirculation of Tank #1 Begin driving DPT rods at CCIW-10 for grouting. Tell Brian I need to know if & where he encounters the lost screen.
0923 Measure parameters of Tank #1 EO.

	Temp C°	DO	SPC	pH	ORP
Pre Inject	30.07	0.96	18.05	8.14	28.2

0930 Wet bulb = 77.6°F

101 Location CCIW-12 SIW4 Date 8-8-19
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0940 Karen Morrow + Dave Bender out for site visit.
0945 Push 2L of BAC-9 bugs to CCIW-12
0950 Begin injection of Tank #1 EO to CCIW-12. Initial flow rate = 14.7 gpm @ 110 psi.
1015 Karen Morrow + Dave Bender depart.
1045 Call Bob VanPelt to let him know about lost screen in CCIW-10. 5' screen not encountered during grouting. Able to go to bottom (43') and grout entire injection point.
1053 Tank #1 EO finishes injecting to CCIW-12.
1055 Mix CoBupH and pump to Tank #2.
1108 Measure parameters of CoBupH.
1110 Start injecting CoBupH to CCIW-12. Initial flow rate = 12.9 gpm @ 120 psi. Wet bulb = 82.0°F in shade.
1130 Finish injecting CoBupH. Pump 300 gallons of water to Tank #2 for Chase water. Measure Chase water parameters
1137 Begin injecting Chase Water to CCIW-12. Initial flow = 13.75 gpm @ 110 psi.
1159 Finish injecting Chase water into CCIW-12
1201 Begin mixing two-half batches of EO

102 Location CCIW-14 SIW4 Date 8-8-19
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in Tanks #1 and #2 for CCIW-14
1230 Wet bulb = 93.6°F Sunny, clear.
1234 Begin recirculating Tank #2 EO for CCIW-14.
1245 Pull DPT rods from CCIW-12 clean rods + screen. Redrive DPT rods to 43' for grouting.
1306 Drive rods to 43' for CCIW-14.
1308 Stop recirculating Tank #2 EO. Measure Tank #2 EO parameters

CCIW-14 Tank #2 parameters

	Temp C°	DO	SPC	pH	ORP
Pre Inject	31.6	0.91	17.90	8.25	-2.9
Pre CoBupH	33.7	6.14	2.93	10.37	203.9
Pre Chase	34.4	6.12	0.233	9.16	349.5

1324 Begin injection of Tank #2 EO to CCIW-14. Eric Barron arrives for Mgmt Field Observation (MFO) for heat stress. Initial flow rate = 11.4 gpm @ 120 psi.
1337 Bob VanPelt calls for daily status
1355 Eric Barron departs
1420 Site pager alerts to Cat 5 heat.

103 Location CCIW-14 SIW4 Date 8-8-19
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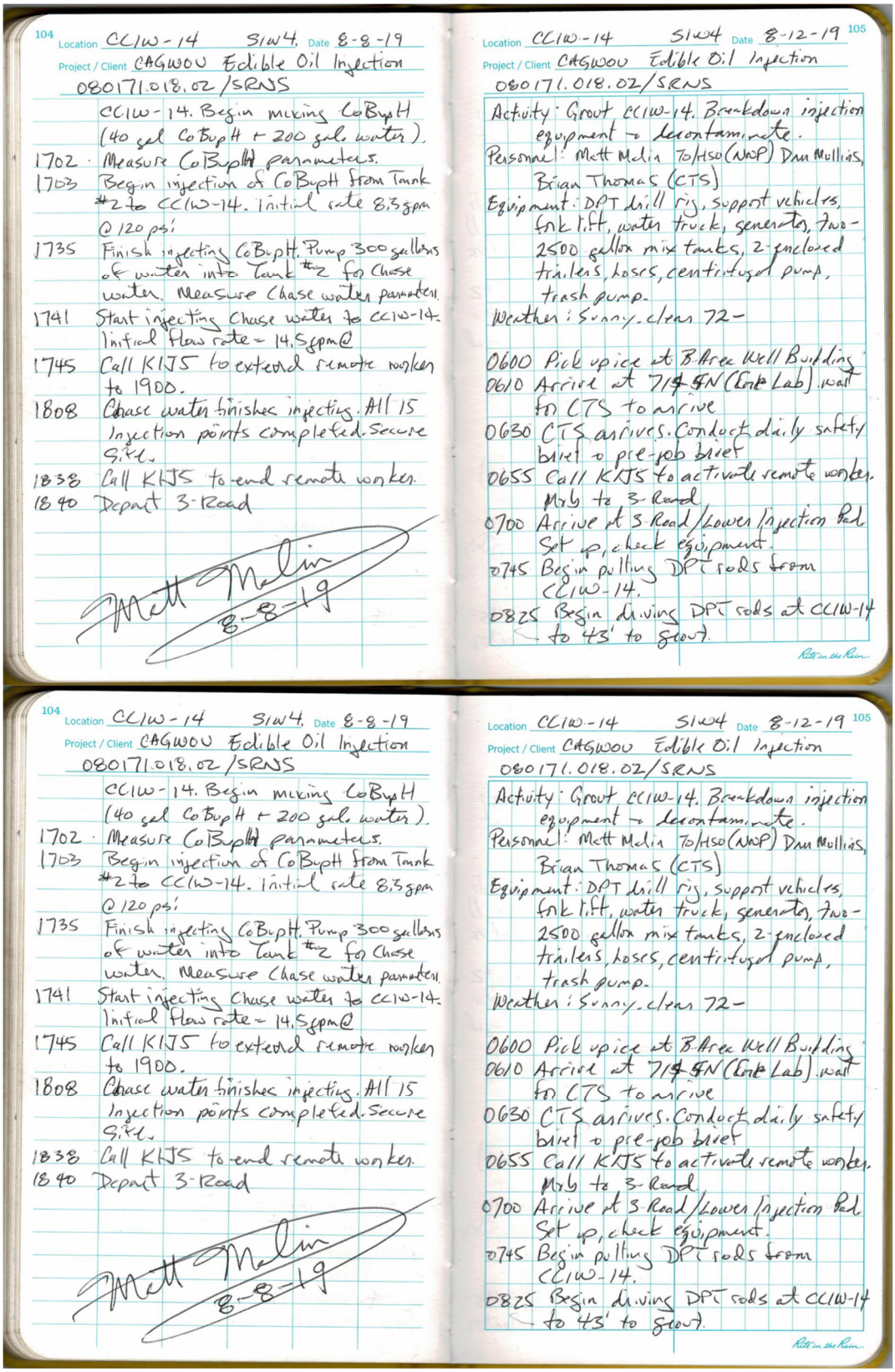
1432 Call Kristen Bryant to schedule RADCON to clear drill rig + rods on Monday 8/12/19 - leave message
1434 Call Daniel Wade (S+R Electric) to schedule him to disconnect generator. He is available Monday 8/12/19 after lunch.
1450 Tank #2 finishes EO injection to CCIW-14
1452 Recirculate Tank #1 EO for CCIW-14.
1455 Push 2L of BAC-9 bugs to CCIW-14
1505 Justin Steadman stops by for status
1520 Justin departs.
1525 Stop recirculating Tank #1 EO. Measure EO parameters in Tank #1

CCIW-14 Tank #1 parameters

	Temp C°	DO	SPC	pH	ORP
Pre Inject	32.1	0.91	18.34	8.10	-13.8

1540 Begin injecting Tank #1 to CCIW-14. Initial rate 13 @ 110 psi
1600 Grout CCIW-12. Mix 2-bags Holcim Type I Portland cement to make 15 gallons of grout. Poured through rods.
1648 Finish injecting Tank #1 EO to



104 Location CCIW-14 SIW4 Date 8-8-19
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CCIW-14. Begin mixing CoBupH (40 gal CoBupH + 200 gal. water).
1702 Measure CoBupH parameters.
1703 Begin injection of CoBupH from Tank #2 to CCIW-14. Initial rate 8.3 gpm @ 120 psi
1735 Finish injecting CoBupH. Pump 300 gallons of water into Tank #2 for Chase water. Measure Chase water parameters.
1741 Start injecting Chase water to CCIW-14. Initial flow rate = 14.5 gpm@
1745 Call KIJS to extend remote worker to 1900.
1808 Chase water finishes injecting. All 15 Injection points completed. Secure Site.
1838 Call KIJS to end remote worker.
1840 Depart 3-Road

Matt Malin
8-8-19

Location CCIW-14 SIW4 Date 8-12-19 105
Project / Client CAGWOU Edible Oil Injection
080171.018.02/SRNS

Activity: Grout CCIW-14. Breakdown injection equipment + decontaminate.
Personnel: Matt Malin To/HSO (NNP) Dan Mullins, Brian Thomas (CTS)
Equipment: DPT drill rig, support vehicles, fork lift, water truck, generator, two-2500 gallon mix tanks, 2-enclosed trailers, hoses, centrifugal pump, trash pump.
Weather: Sunny, clear 72-

0600 Pick up ice at B Area Well Building
0610 Arrive at 714-5N (Cook Lab) wait for CTS to arrive
0630 CTS arrives. Conduct daily safety brief + pre-job brief
0655 Call KIJS to activate remote worker. Mob to 3-Road.
0700 Arrive at 3-Road/Lower Injection Pad. Set up, check equipment.
0745 Begin pulling DPT rods from CCIW-14.
0825 Begin driving DPT rods at CCIW-14 to 43' to grout.

Rite in the Rain

104 Location CCIW-14 SIW4 Date 8-8-19
Project / Client CAGWOU Edible Oil Injection
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Matt Malin
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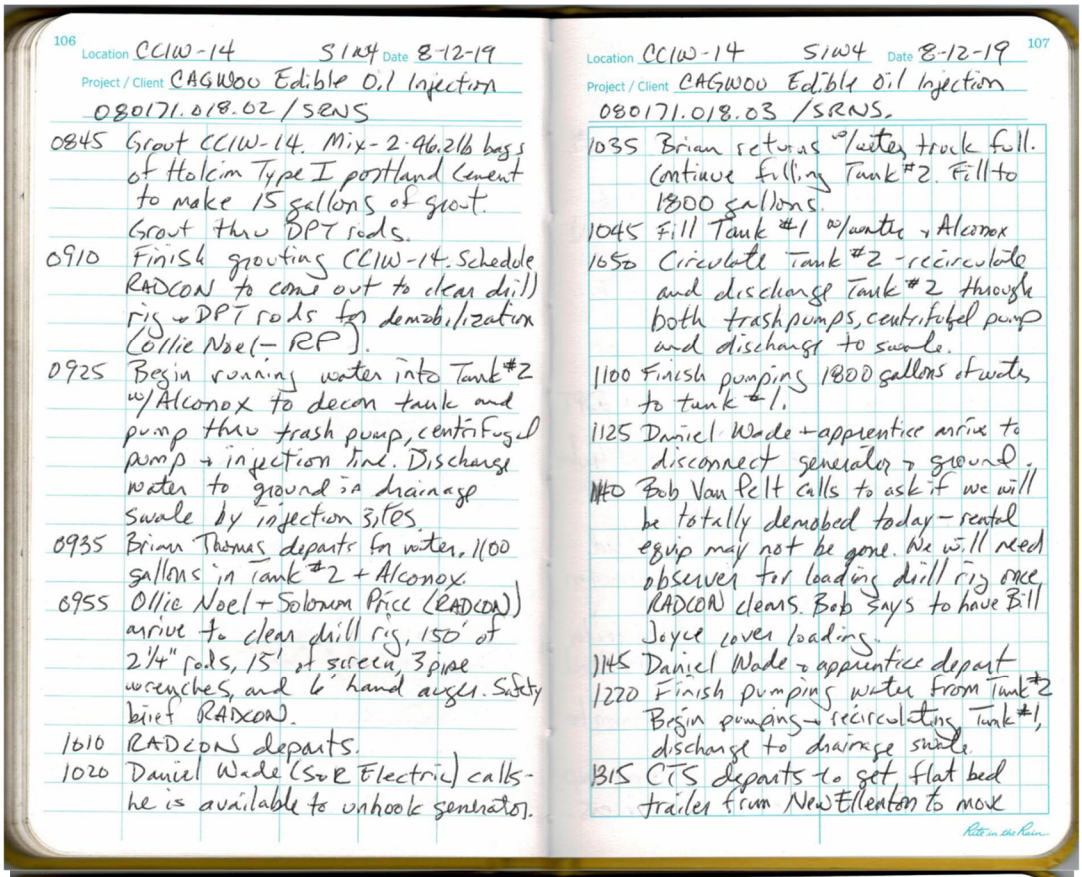
Rite in the Rain



106 Location CCIW-14 S1W4 Date 8-12-19
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0845 Grout CCIW-14. Mix - 2-96.2lb bags of Holcim Type I portland Cement to make 15 gallons of grout. Grout thru DPT rods.
0910 Finish grouting CCIW-14. Schedde RADCON to come out to clear drill rig + DPT rods for demobilization (Ollie Noel - RP).
0925 Begin running water into Tank #2 w/ Alconox to decon tank and pump thru trash pump, centrifugal pump + injection line. Discharge water to ground in drainage swale by injection sites.
0935 Brian Thomas departs for water. 1100 gallons in Tank #2 + Alconox.
0955 Ollie Noel + Solomon Price (RADCON) arrive to clear drill rig, 150' of 2¼" rods, 15' of screen, 3 pipe wrenches, and 6' hand auger. Safety brief RADCON.
1610 RADCON departs.
1020 Daniel Wade (S&R Electric) calls - he is available to unhook generator.

107 Location CCIW-14 S1W4 Date 8-12-19
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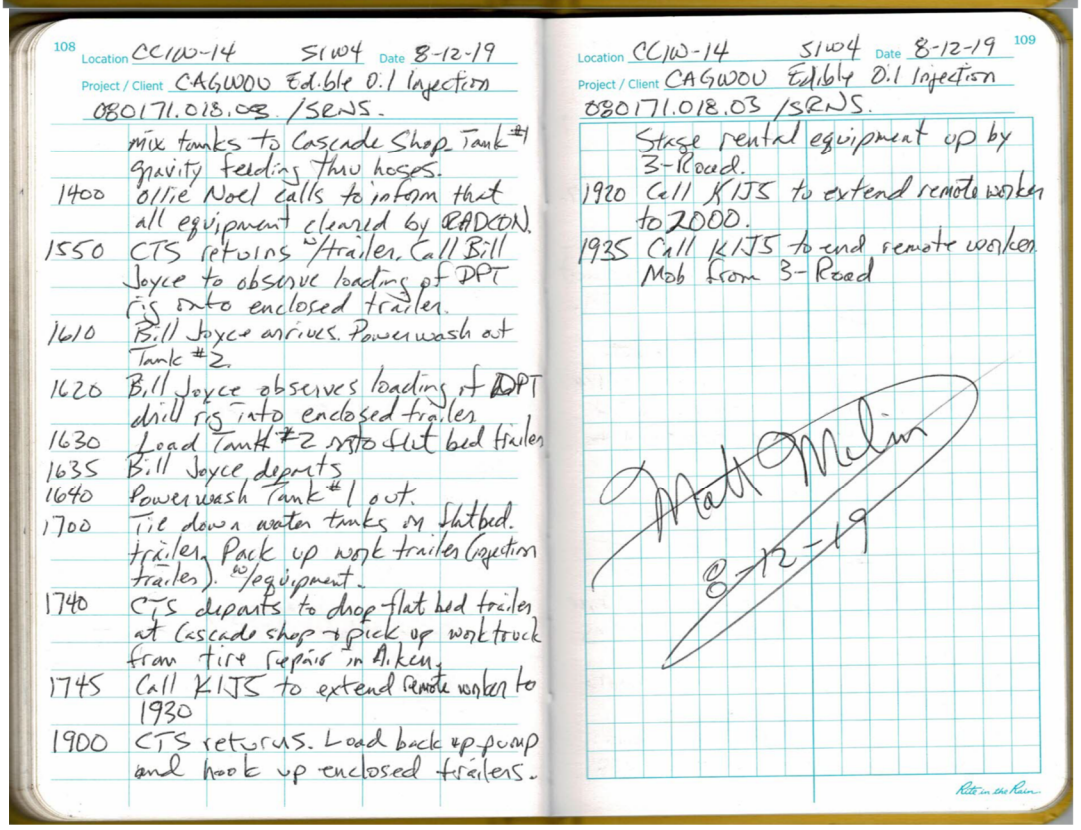
1035 Brian returns w/ water truck full. Continue filling Tank #2. Fill to 1800 gallons.
1045 Fill Tank #1 w/ water + Alconox
1050 Circulate Tank #2 - recirculate and discharge Tank #2 through both trash pumps, centrifugal pump and discharge to swale.
1100 Finish pumping 1800 gallons of water to tank #1.
1125 Daniel Wade + apprentice arrive to disconnect generator + ground.
1140 Bob Van Pelt calls to ask if we will be totally demobed today - rental equip may not be gone. We will need observer for loading drill rig once RADCON clears. Bob says to have Bill Joyce cover loading.
1145 Daniel Wade + apprentice depart
1220 Finish pumping water from Tank #2 Begin pumping + recirculating Tank #1, discharge to drainage swale.
1315 CTS departs to get flat bed trailer from New Ellenton to move



108 Location CCIW-14 S1W4 Date 8-12-19
Project / Client CAGWOU Ed.ble 0.1 Injection
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mix tanks to Cascade Shop. Tank #1 gravity feeding thru hoses.
1400 Ollie Noel calls to inform that all equipment cleared by RADCON.
1550 CTS returns w/ trailer. Call Bill Joyce to observe loading of DPT rig onto enclosed trailer.
1610 Bill Joyce arrives. Powerwash out Tank #2.
1620 Bill Joyce observes loading of DPT drill rig into enclosed trailer.
1630 Load Tank #2 onto flat bed trailer
1635 Bill Joyce departs
1640 Powerwash Tank #1 out.
1700 Tie down water tanks on flatbed trailer. Pack up work trailer (injection trailer). w/ equipment.
1740 CTS departs to drop flat bed trailer at Cascade shop + pick up work truck from tire repair in Aiken.
1745 Call KIJS to extend remote worker to 1930
1900 CTS returns. Load back up pump and hook up enclosed trailers.

109 Location CCIW-14 S1W4 Date 8-12-19
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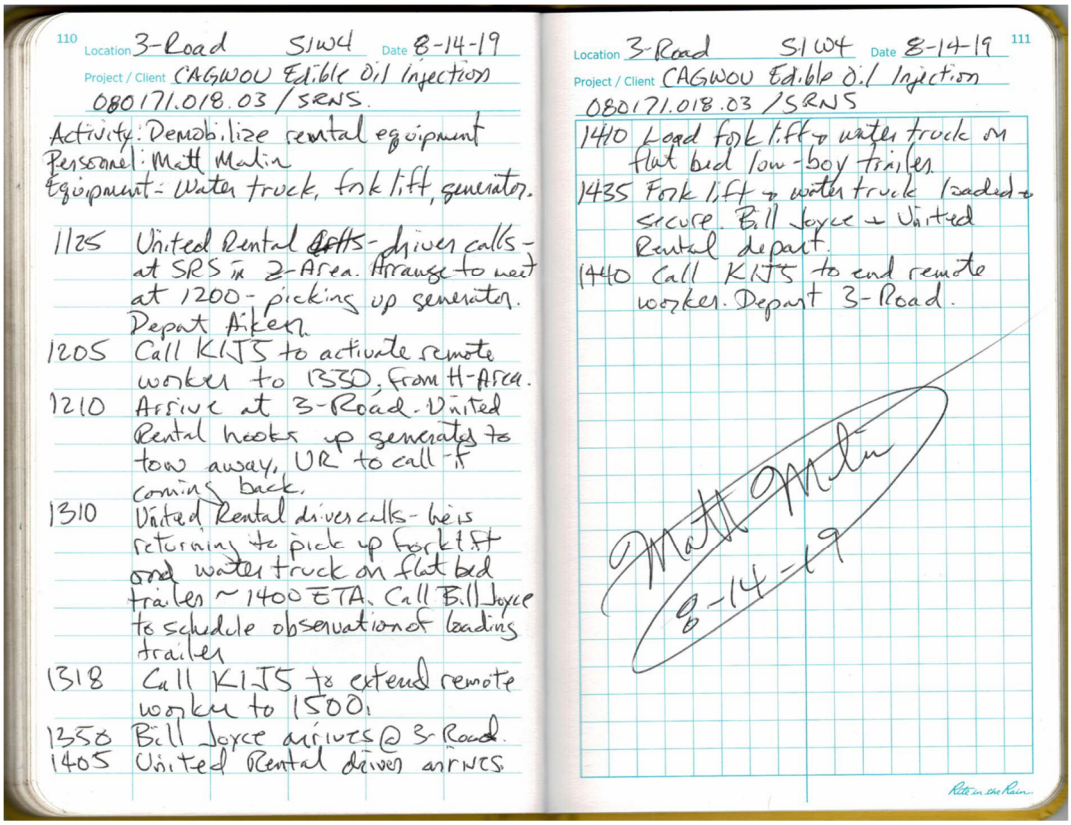
Stage rental equipment up by 3-Road.
1920 Call KIJS to extend remote worker to 2000.
1935 Call KIJS to end remote worker. Mob from 3-Road

Matt Melvin 8-12-19



110 Location 3-Road S1W4 Date 8-14-19
Project / Client CAGWOU Edible Oil Injection
080171.018.03 / SRNS.

Activity: Demobilize rental equipment
Personnel: Matt Malin
Equipment: Water truck, fork lift, generator.

1125 United Rental ~~[illegible]~~ - driver calls - at SRS in Z-Area. Arrange to meet at 1200 - picking up generator. Depart Aiken.
1205 Call KIJ5 to activate remote worker to 1330, from H-Area.
1210 Arrive at 3-Road. United Rental hooks up generator to tow away, UR to call it coming back.
1310 United Rental driver calls - he is returning to pick up fork lift and water truck on flat bed trailer ~1400 ETA. Call Bill Joyce to schedule observation of loading trailer
1318 Call KIJ5 to extend remote worker to 1500.
1350 Bill Joyce arrives @ 3-Road.
1405 United Rental driver arrives

Location 3-Road S1W4 Date 8-14-19 111
Project / Client CAGWOU Edible Oil Injection
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1410 Load fork lift + water truck on flat bed low-boy trailer.
1435 Fork lift + water truck loaded + secure. Bill Joyce + United Rental depart.
1440 Call KIJ5 to end remote worker. Depart 3-Road.

Matt Malin
8-14-19

Rite in the Rain

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