NYE COUNTY NUCLEAR WASTE REPOSITORY PROJECT OFFICE

TEST PLAN

TITLE: **Single-Well Push/Pull Tracer Tests at Well NC-EWDP-22S**	REVISION: **0** DATE: **11-18-04** PAGE: **1 of 17**
TEST PLAN NUMBER: **TPN-9.2**	SUPERSEDES: **None**
APPROVAL 11-22-04 Project Manager Date	CONCURRENCE Dale Hammerstrom 11/23/04 On-Site Geotechnical Representative Date Dale Hammerstrom for John Campanella 11/23/04 Principal Investigator Date 11/23/04 Quality Assurance Officer Date

1.0 INTRODUCTION

This test plan (TPN) provides detailed instructions for two Nye County Nuclear Waste Repository Project Office (NWRPO) gravity-fed push/pull tracer injection tests to be conducted in Fall 2004 in Early Warning Drilling Program (EWDP) well NC-EWDP-22S. This TPN supplements work plan WP-9, *Work Plan for Tracer Testing*, which provides the background, purpose, and objectives of the test.

Wells NC-EWDP-22S, -22PA, -22PB and –22PC shall be referred to in this TPN as 22S, 22PA, 22PB and 22PC.

2.0 WELL INFORMATION

Table 1 lists well casing and water level information for well 22S.

Table 1
Well Information

Description	Elevation	
	feet above mean sea level (amsl)	feet below ground surface (bgs)
Measuring point	2,851.51	
Static water level in Screen 2 (472.94 feet to fluid)	2378.57	
6⅝-inch outside diameter (OD) steel casing (6.05-inch inside diameter [ID])		1,190.1
5-inch Schedule 80 PVC pipe (4.768-inch ID)		515
MP55 casing (2.25-inch ID)		1,185.81
Connection between 5-inch PVC pipe and MP55 casing		515

3.0 COMPLETION INFORMATION

Table 2 summarizes well screen intervals and Westbay port depths for well 22S. A well completion diagram for 22S is shown on Figure 1.

Table 2
Westbay Completion Information

Screen	Screen Interval (feet bgs)	Measurement Port (feet bgs)	Pumping Port (feet bgs)
1	521.5 – 581.3	559.6	569.8
2	661.2 – 760.6	742.6	752.9
3	880.2 – 980.0	960.1	970.4
4	1140 – 1180	1148.0	1158.3

Source: Westbay completion report.

4.0 EQUIPMENT LIST

Table 3 lists the equipment required for the single-well tracer test and the amount specified for each item.

Table 3
Single-Well Tracer Test Equipment

Item (In Alphabetical Order)	Amount
Barrel (50-gallon)	1
Carboy (5-gallon, empty)	8
Carboy (containing concentrated pentafluorobenzoate tracer)	1+
Carboy (containing concentrated 2345- Tetrafluorobenzoate tracer)	1+
Carboy (containing concentrated sodium iodide tracer)	1+
Chase-water tank (21,000-gallon internally-painted or epoxy-lined steel; rented)	2
Cone-bottom water tank (1,500-gallon)	2
Datalogger with cable (for SAMs and MOSDAX probes)	2 or 3
Flat-bottom water tank (1,550-gallon)	2
Flat-bottom water tank (305-gallon)	1
Fittings and nipples for surface equipment (2- and 1.25-inch)	Assorted
Galvanized steel pipe and associated pup joints (2-inch, galvanized)	510 feet
Gate valve (2-inch)	2
Generator	1
Hand sprayer (1- or 2-gallon capacity)	1
ISCO Autosampler® and associated sample pump on loan from Los Alamos National Laboratory (LANL)	1
Motor for submersible pump (4-inch 10-horsepower (hp) Franklin®, or alternative)	1
Personal protective equipment	2 sets
Portable staircase	1
Pressure gauge (160 pounds-per-square-inch-gauge [psig])	1
PVC hose (1.25-inch, braided, flexible)	100 feet
PVC pipe (2-inch)	50 feet
Quarter-turn ball valve (2-inch)	4
SAM - 250-psia (with spider centralizer provided by rig contractor)	1
Sample bottles (240-milliliter [ml] amber glass bottles)	~450
Scientific notebook	1
Stand-alone module (SAM) and MOSDAX pressure transducer probes (30 pounds-per-square-inch-absolute [psia])	6
Stopwatch (for barrel flow rate test)	1
Submersible pump (Myers® S100-40, or alternative)	1
Variable-speed pump	1
Water meter (1-inch Turbine, with totalizer, on loan from USGS)	1
Well sounder (500-foot minimum)	2
Westbay MOSDAX™ probe with centralizer	4

5.0 PROCESS

5.1 Borehole Equipment and Instrument Installation for Test 1 and Test 2

5.1.1 Sounders

1. Measure water levels with a sounder (i.e., 500-foot or greater) in all screens of wells 22S, 22PA, 22PB, and 22PC, referring to technical procedure TP-9.9, *Measurement of Groundwater Levels Using Electric Well Sounders*. Record the measurements in the scientific notebook.

5.1.2 30-psia SAMs and MOSDAX Probes

1. Install the six 30-psia pressure transducer probes in the upper and lower piezometer screens of wells 22PA, 22PB and 22PC, referring to TP-9.2, *Operation of Westbay MOSDAX® Groundwater Monitoring Equipment In Nye County Wells*. These probes generate temperature as well as pressure data. Run the probes approximately 25 feet below the water table (i.e., approximately 500 feet bgs) in each piezometer. Gauges should read approximately 24 psia.

2. Set the dataloggers to obtain readings from the probes every 60 seconds. Monitor background readings overnight.

5.1.3 MOSDAX Probes in 22S

1. Open the pumping port for Screen 2 in well 22S. Install the MOSDAX probes in Screens 1, 3, and 4, removing the centralizer from the probe used in Screen 1. If deemed appropriate by the PI, install a probe, without a centralizer, in Screen 2.

2. Ensure that all probes and dataloggers are synchronized.

3. Set the dataloggers to obtain probe readings every 10 seconds. 10-second readings shall be taken immediately prior, during, and immediately after pumping. Monitor background readings overnight. Readings shall be taken at 60-second intervals at all other times to avoid datalogger memory overflow.

5.1.4 250-psia SAM

1. Direct the pumping contractor to lift the submersible pump and motor with the pumping rig.

2. Tape the 250-psia SAM as close as physically possible to the top of the 5-foot-long pump. The SAM must be less than 7 feet above the pump intake. Protect the SAM with the spider centralizer.

3. Record the distance between the midpoints of the pump intake and gauge in the scientific notebook.

4. Run the submersible pump into well 22S on the 2-inch galvanized steel pipe, taking care to avoid damaging the probe cable. As it is being fed into the hole, tape the SAM

cable to the pipe above and below each collar. Set the bottom of the pump 3 feet above the top of the existing PVC pipe/MP55 casing connection to maximize the available drawdown for the pump. Cap the pipe at the wellhead.

5. Record all depth control information on a Tubing and Casing Record (TP-7.0, *Drill Site Management*).

6. Ensure that the pumping contractor remains onsite until the submersible pump has been started in 22S.

5.2 Site, Plumbing, Chase-Water, and Tracer Preparation for Test 1 and Test 2

5.2.1 Site Preparation

1. Prepare the site by installing the two 1,500-gallon cone-bottom tanks, two 1,550 gallon flat-bottom tanks, one 305 gallon flat-bottom tank, and two 21,000-gallon chase-water tanks (Figure 2).

2. Set up the portable staircase, which will be used to unload carboys into the cone-bottom tanks.

5.2.2 Carboys

1. Obtain carboys filled with the concentrated tracers listed in Table 4 and Material Safety Data Sheets (MSDSs) for each tracer from the University of Nevada, Las Vegas, Harry Reid Center (UNLV/HRC).

Table 4
Tracer Names and Types

Tracer Name	Tracer Test Number	Abbreviation	Tracer Mass (kg)	Tracer Injection Concentration Target (mg/l)	Type
Pentafluorobenzoate	1	PFBA	1	250	Quantitative
Sodium Iodide	1	NaI	3	750	
2,3,4,5 Tetrafluorobenzoate	2	2345-TeFBA	1	250	
Sodium Iodide	2	NaI	3	750	

5.2.3 Chase-Water Tanks

1. Connect a 21,000-gallon chase-water tank and 2-inch gate valve to the submersible pump using a combination of 2-inch galvanized steel and 2-inch PVC pipe as shown on Figure 2. Ensure that the water meter is in a straight run of the galvanized steel pipe at least 3 feet from any upstream or downstream flow disturbance, such as bends or valves, and upstream from the control gate valve. Place the 160-psig pressure gauge upstream from the gate valve.

2. Record the water meter total in the scientific notebook. Start the submersible pump and begin filling the tank.

3. Monitor the water level in the tank. When the tank is full, after approximately 8 to 9 hours, simultaneously close the tank gate valve and turn off the submersible pump. Record the water meter total in the scientific notebook. Disconnect the water tank from the submersible pump.

4. Repeat steps 1 through 3 to fill the second 21,000-gallon chase-water tank with water.

5.2.4 Cone-Bottom Tanks

1. Connect a cone-bottom tank to the submersible pump with the same pipe system used to connect the submersible pump to the chase-water tank. (Figure 3).

2. Record the water meter reading in the scientific notebook. Start the submersible pump and begin filling the tank.

3. Record the water meter total again when water first enters the tank.

4. Fill the tank with produced water until the water meter reading equals the volume recorded in step 3 plus 1050 gallons.

5. Simultaneously close the tank valve and turn off the submersible pump. Record both the water meter total and the tank water level in the scientific notebook.

6. Repeat steps 1 through 5 to fill the second cone-bottom tank.

5.2.5 305-Gallon Flat-Bottom Tank

1. Connect the 305-gallon flat-bottom tank to the submersible pump with the same pipe system used to connect the submersible pump to the chase-water tank. (Figure 3).

2. Record the water meter reading in the scientific notebook. Start the submersible pump and begin filling the tank.

3. Record the water meter total again when water first enters the tank.

4. Fill the tank with produced water until the water meter reading equals the volume recorded in step 3 plus 253 gallons.

5. Simultaneously close the tank valve and turn off the submersible pump. Record both the water meter total and the tank water level in the scientific notebook.

5.2.6. 1,550-Gallon Flat-Bottom Tanks

1. Connect the first flat-bottom tank to the submersible pump with the same pipe system used to connect the submersible pump to the chase-water tank (Figure 3).

2. Record the water meter reading in the scientific notebook. Start the submersible pump and begin filling the tank.

3. Record the water meter total again when water first enters the tank.
4. Fill the tank with produced water until the tank is full. The water meter reading should equal the volume recorded in step 3 plus approximately 1,550 gallons.
5. Simultaneously close the tank valve and turn off the submersible pump. Record both the water meter total and the tank water level in the scientific notebook.
6. Repeat steps 1 through 5 to fill the second flat-bottom tank.
7. Calculate the gallons per inch from the data gathered above for the flat-bottom tanks and verify the calculation using the following formula:

$$\text{gallons} = \frac{3.14 \times \text{diameter}^2}{4}\left(\text{ft}^2\right) \times \text{height}(\text{ft}) \times 7.48\left(\text{gallons} / \text{ft}^3\right)$$

5.2.7 Tracer Dilution

1. Contact UNLV/HRC at 702 895-4450 before diluting the tracers so an analyst can be on location when the initial diluted tracer sample is taken (step 8).
2. Connect the variable-speed pump inlet to a cone-bottom tank outlet (Figure 4). Attach the 1.25-inch braided PVC hose to the pump outlet. Place one end of the hose inside the tank through the access hole in the top. Tape the hose to the portable staircase for support.
3. Open the valve on the tank and start the pump. Repair any leaks. Roll the tank with the pump.
4. Fill the four empty carboys with produced water from the tank using the PVC hose and set them aside. This water will be used for rinsing.
5. Put on personal protective equipment (PPE) as specified in the MSDSs.
6. Empty the carboys containing tracers designated for tracer test 1 (i.e., PFBA and NaI, Table 4) into the tank while continuing to roll the tank with the pump. Label the tank with the tracer name.
7. When empty, rinse the tracer carboys using two of the reserved carboys containing the rinse water obtained in step 4.
8. Using the braided PVC hose, fill a labeled sample bottle with diluted tracer from the tank. Seal the bottle and ship sample to UNLV/HRC for immediate analysis.
9. Repeat steps 2 through 8 to dilute the tracers designated for tracer test 2 (i.e., 2345-TeFBA and NaI, Table 4) in the second cone-bottomed tank.
10 UNLV/HRC will contact Nye County personnel immediately after completion of the tracer analyses described in step 8 to report the tracer concentrations. Target tracer concentrations are listed in Table 4 and also found in Attachment F-1 of the Nevada Underground Injection Control Permit UNEV200310.

5.2.8 Injection Line

1. Plumb the injection line as shown on Figure 5. Place a tee in the PVC pipe downstream from the cone-bottom tank, a quarter-turn ball valve between the tank and tee to control flow from the tank, a 1-inch water meter downstream of the tee, and a variable speed pump between the water meter and 22S to aid injection, as necessary. Attach a section of braided PVC hose at the end of the pipe system. This hose will be placed approximately 10 feet into the existing 5-inch PVC casing of the well to inject the tracers.

5.3 Tracer Injection for Test 1

1. Ensure that probes and dataloggers are synchronized and in working order.
2. If necessary, direct the pumping contractor to raise the submersible pump and pipe (i.e., pump string) several feet above the wellhead with the pumping rig.
3. Place the braided PVC hose (i.e., injection hose) approximately 10 feet into the 5-inch PVC well casing.
4. Record the time, water meter cumulative reading, and cone-bottom tank water level in the scientific notebook. Start the gravity feed of the PFBA and NaI tracers, taking care not to exceed the capacity of well. Record the injection rate from the turbine meter on a regular basis.
5. When the tank is nearly empty, rinse and flush the tank into the injection line with the water from the remaining two carboys. Use a hand sprayer to rinse the tank walls.
6. After the rinse water has drained from the tank, turn off the quarter-turn ball valve to isolate the tank. Note the time and cumulative water meter reading.

5.4 Chase-Water Injection for Test 1

1. Record the time and chase-water tank level in the scientific notebook. Open the tank valve slowly and displace (i.e., chase) the tracers into Screen 2, taking care not to exceed the capacity of the well to take water. Periodically calculate and record the injection rate from water meter readings and elapsed time.
2. Empty the tank as completely as possible into the well. After closing the valve, record the time and tank level in the scientific notebook. Record the water meter cumulative volume in the scientific notebook.
3. Remove the injection hose and, if necessary, direct the pumping contractor to lower the pump string to the wellhead.
4. Leave the well shut in overnight.

5.5 Discharge Line Connection for Test 1

1. Connect the 2-inch galvanized steel pipe discharge line at the wellhead as shown on Figure 6. Ensure that the water meter is in a straight run of pipe at least 3 feet from any upstream or downstream flow disturbance, such as bends or valves, and upstream from the control gate valve. Place the 160-psig pressure gauge upstream from the gate valve.
2. Record the water meter volume in the scientific notebook.
3. Photograph the discharge line to comply with permit regulations.
4. Place the 50-gallon barrel near the discharge point for the barrel flow rate test.

5.6 Los Alamos National Laboratory Multiprobe for Test 1

1. Stop recording readings from the 30-psia pressure probe in the lower piezometer in 22PA. Pull the probe out of the well.
2. LANL personnel shall deploy a YSI multiprobe in the lower piezometer in 22PA to a depth of 770 feet bgs and obtain readings for 5 minutes, then pull the probe up 10 feet and again obtain readings for 5 minutes. These readings shall be repeated at 10-foot intervals until probe depth is less than 660 feet bgs, then the probe shall be removed.
3. Re-install the 30-psia pressure probe in the lower piezometer screen of 22PA, referring to TP-9.2. Run the probe approximately 25 feet below the water table (i.e., approximately 500 feet bgs). The gauge should read approximately 24 psia.
4. Set the datalogger to obtain pressure and temperature readings from the pressure probe every 60 seconds.
5. Stop recording readings from the 30-psia pressure probe in the lower piezometer in 22PC. Pull the probe out of the well.
6. LANL personnel shall repeat step 2, obtaining multiprobe readings at 10-foot intervals in 22PC until the probe depth is less than 660 feet bgs.
7. Repeat steps 3 and 4 in 22PC.

5.7 Sampling Preparation for Test 1

Personnel from the U.S. Department of Energy (DOE) Sample Management Facility (SMF) shall work with Nye County personnel to collect water samples for tracer analysis. SMF personnel shall be responsible for supplying correctly labeled bottles to sample collection point(s) and transporting filled bottles to UNLV/HRC for analysis. If samples will not be transported within eight hours after being collected, they will be kept refrigerated. Sample bottle labeling and transport shall be conducted according to DOE quality assurance requirements.

1. Ensure that probes and dataloggers are synchronized and that the generator is fueled and running properly.

2. Connect the Los Alamos National Laboratory ISCO Autosampler® to the discharge line (Figure 6).

3. Fill the Autosampler® with clean, labeled bottles. Program the Autosampler® to obtain samples as soon as pumping starts according to the schedule in Table 5. Ensure that it is in working order.

4. The minimum number of samples to be analyzed by UNLV/HRC are also listed in Table 5. Turnaround time for UNLV/HRC sample analyses (i.e., time from receipt of samples to delivery of preliminary results to Nye County) should be 2 to 3 days, when possible. Analyzed samples should be approximately equally spaced with regards to time in order to generate a useable tracer concentration versus time curve.

Table 5
Autosampler® Sampling Schedule

Elapsed Time	Frequency	Total Number of Samples	Minimum Number of Analyses
Hours 0 – 24	Every 10 minutes	144	12
Days 1 – 3	Every 30 minutes	96	6
Days 3 – 6	Every hour	72	9
Days 6 – 15	Every 3 hours	72	12

5. Manual samples shall be taken for replication and quality control according to the schedule in Table 6. If the Autosampler® is offline for any reason, a manual sample shall be taken at the frequency stated in Table 6.

Table 6
Manual Sampling Schedule

Elapsed Time	Frequency	Total Number of Samples
Hours 0 – 5	Every 20 minutes	15
Hours 5 – 12	Every hour	7
Hours 12 – 24	Every 2 hours	6
Days 1 – 6	Every 8 hours	15
Days 6 – 15	Twice a day	18

5.8 Tracer Recovery and Sample Collection for Test 1

1. Set datalogger frequency to 10-second intervals.

2. Open the control gate valve fully and start the pump. The pump rate should be approximately 40 to 50 gpm. Monitor the drawdown and pinch back with the gate valve, if required. Record the time in the scientific notebook.

3. Start the Autosampler® as soon as pumping begins. Collect groundwater samples from the discharge line according to Tables 5 and 6.
4. Allow the pumping contractor to leave the site.
5. Record water meter readings in the scientific notebook once per shift, or a minimum of twice per day.
6. If discoloration or excessive sediment in the produced water is noted at any time during pumping, take a manual sample for analysis.
7. Pump the well until tracer levels are at or below the requirements determined by the state of Nevada (Nevada Underground Injection Control Permit UNEV200310), which is anticipated to take from 7 to 15 days.
8. Take barrel flow rate measurements daily. Use the stopwatch to determine the time required to fill the barrel. Record the measurements in the scientific notebook.
9. Check pressure probes and dataloggers daily. Download the datalogger to clear its memory as often as necessary. If probes are non-functioning, take manual water levels daily.
10. If the pump accidentally shuts down, restart it, record the time in scientific notebook, and notify the PI.
11. Monitor recovery with probes for a minimum of 4 hours at a 10-second frequency. The PI may specify a longer monitoring period.

5.9 Tracer Injection for Test 2

Upon completion of injection and recovery steps for tracer test 1 (Sections 5.3 through 5.8), repeat the steps in Sections 5.3 and 5.4, with the following changes:

1. In step 4 of Section 5.3, inject the tracers designated for test 2 (i.e., 2345-TeFBA and NaI, Table 4) instead of those designated for test 1.
2. In step 4 of Section 5.4, leave the well shut in for approximately 3 to 4 weeks, instead of overnight.

5.10 Tracer Recovery and Sample Collection for Test 2

Test 2 tracers shall be recovered as described in TPN-9.3, *Cross-Hole, Multiple Well Tracer Test at Site 22*. That is, samples shall be collected and analyzed as part of the cross-hole test according to schedules in Tables 5 and 6 in TPN-9.3. The same water sample and sample bottle will be used to monitor tracer recovery from both test 2 injection and the cross-hole test injections. It is likely that samples for the test 2 analyses shall not be collected beyond the 5- to 14-day interval shown in these tables.

Sample collection procedures shall follow the steps listed in Section 5.4 and 5.9 of TPN-9.3, which are equivalent to Sections 5.7 and 5.8 herein.

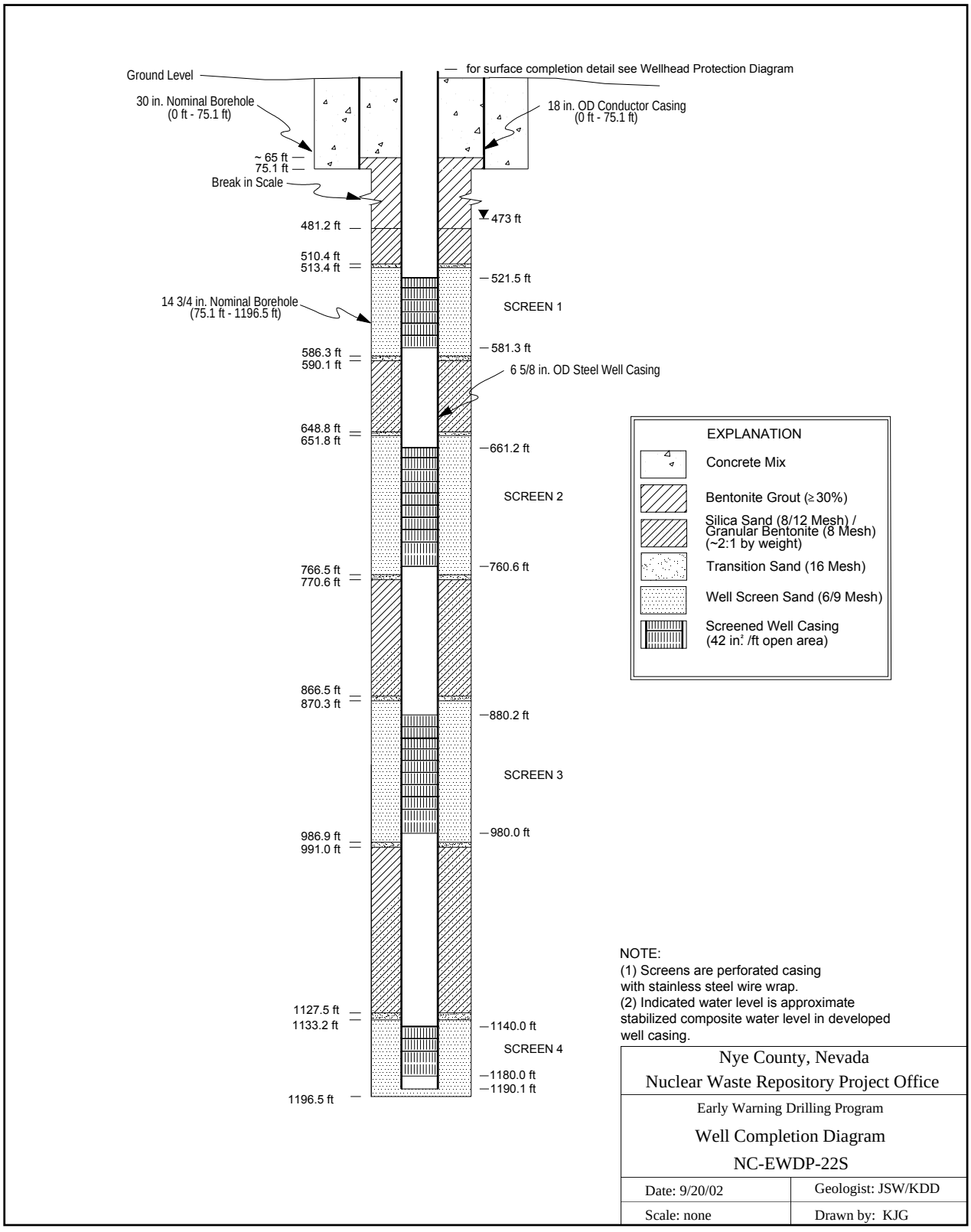

Figure 1
Completion Diagram for Well NC-EWDP-22S

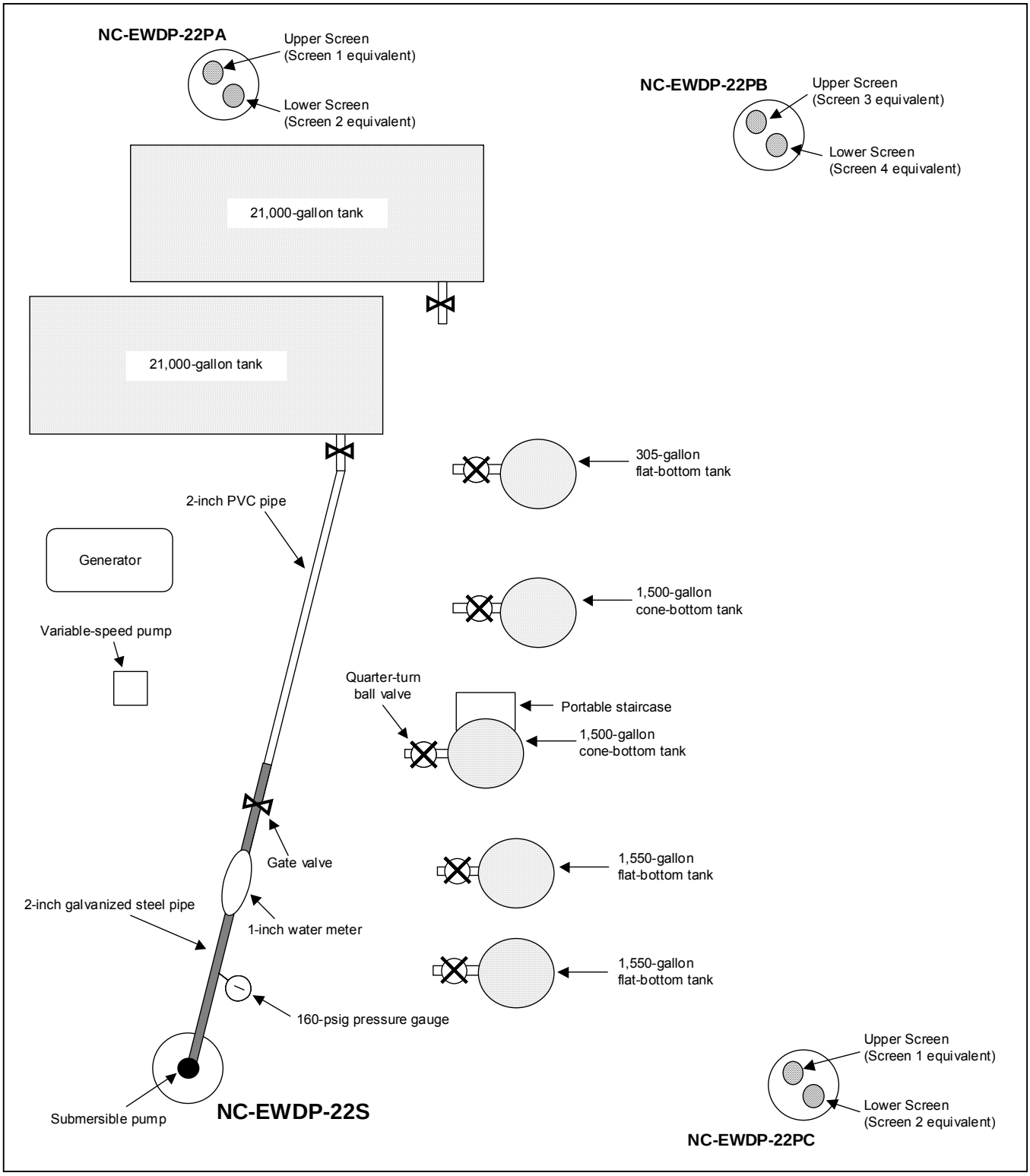

Figure 2
Schematic of Piping for Tracer Injection and Pumping at Well NC-EWDP-22S
Filling of Chase-Water Tank

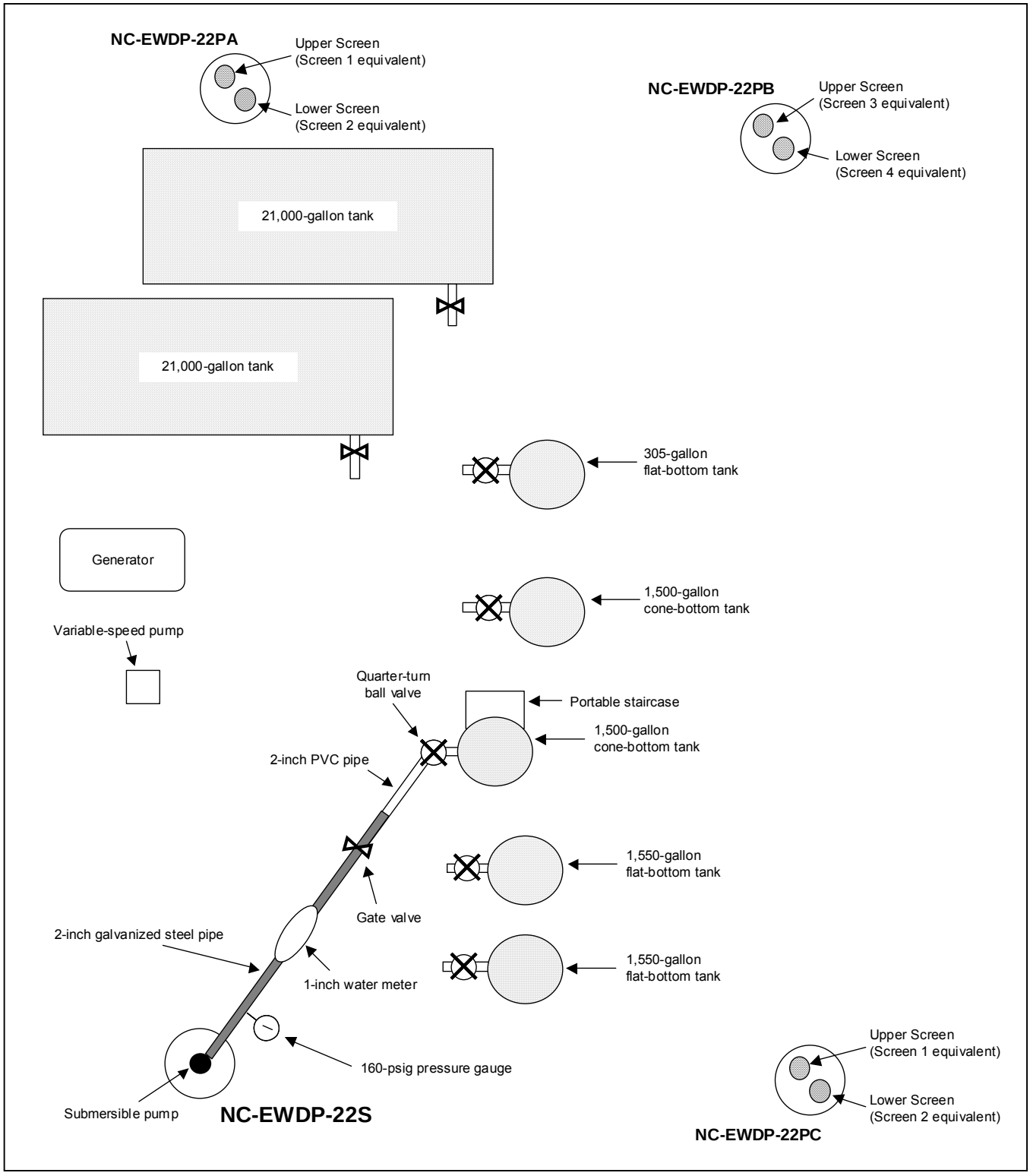

Figure 3
Schematic of Piping for Tracer Injection and Pumping at Well NC-EWDP-22S
Filling of Injection Tank

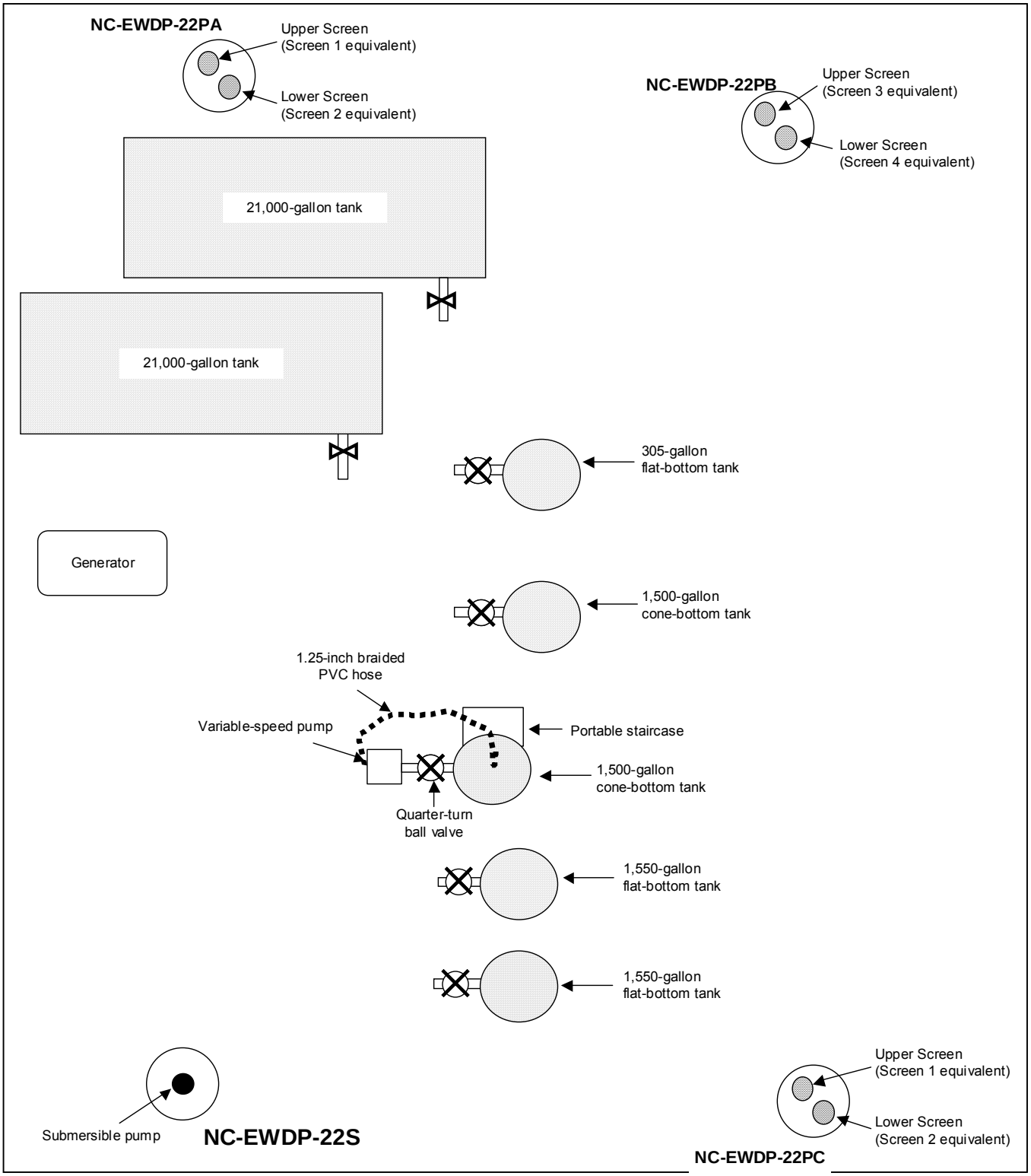

Figure 4
Schematic of Piping for Tracer Injection and Pumping at Well NC-EWDP-22S
Tracer Dilution

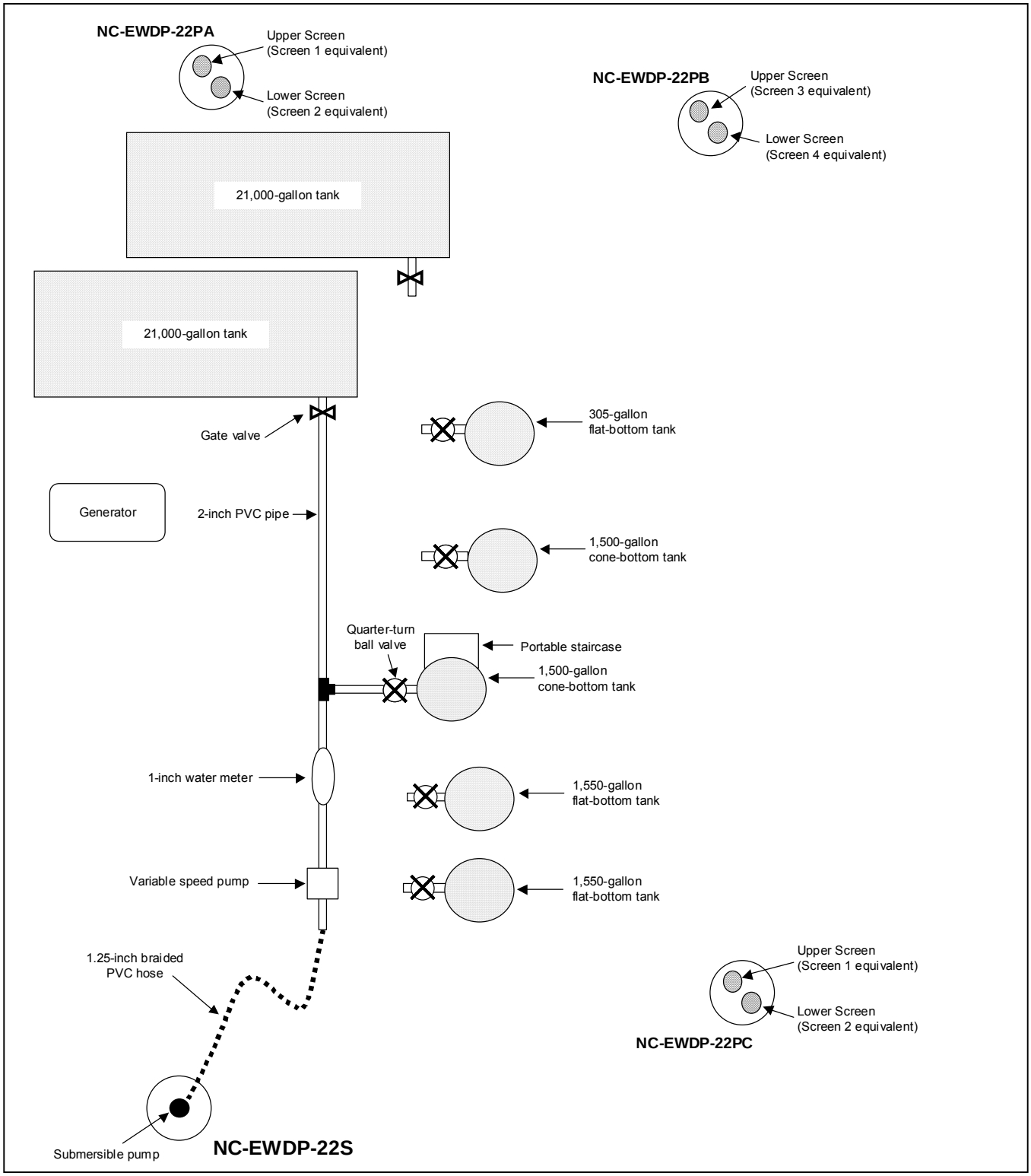

Figure 5
Schematic of Piping for Tracer Injection and Pumping at Well NC-EWDP-22S
Injection Line Connections

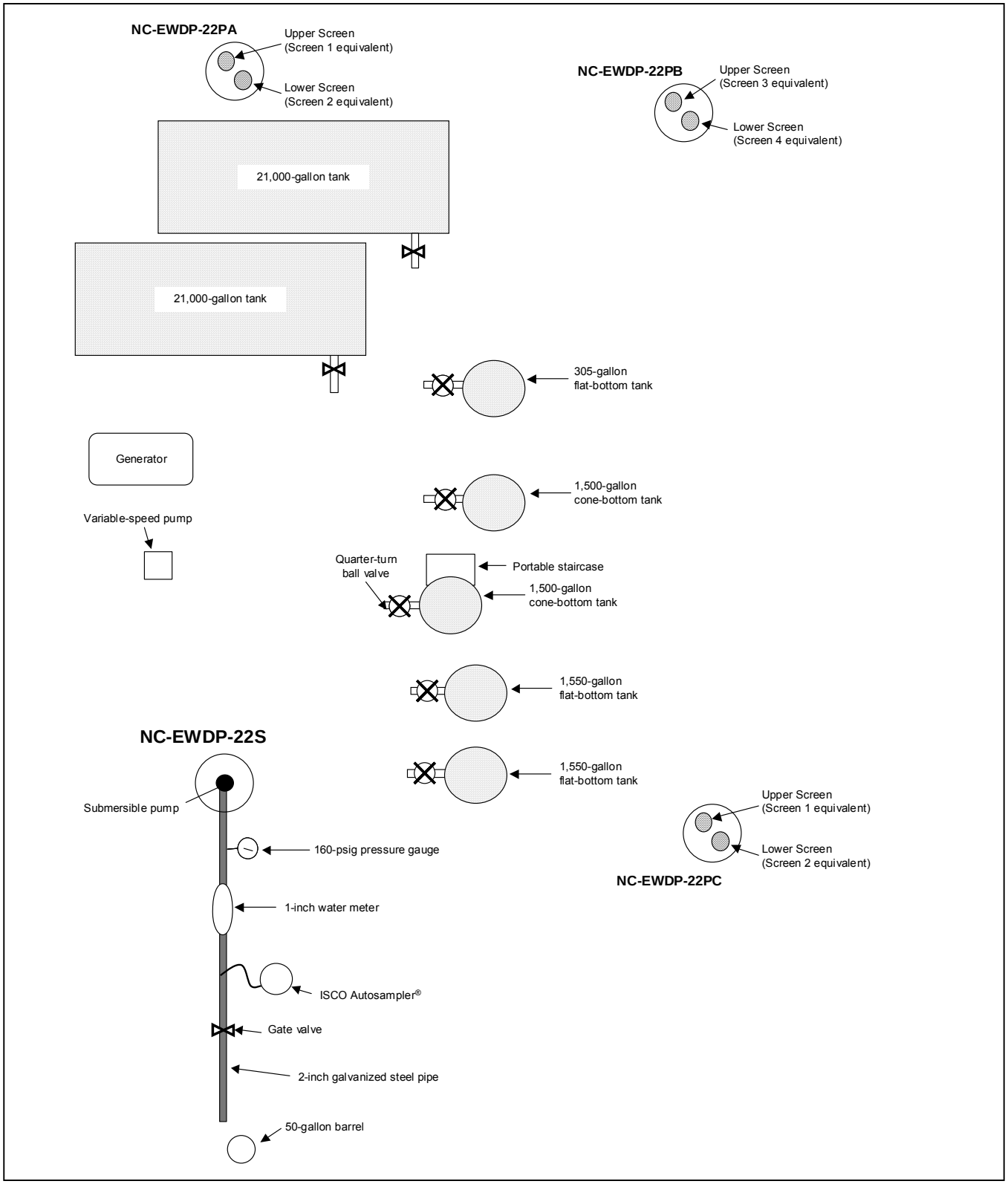

Figure 6
Schematic of Piping for Tracer Injection and Pumping at Well NC-EWDP-22S
Discharge Line Connection