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SUBMITTAL OF ADDENDUM TO PROJECT SPECIFIC PLAN AND RESPONSE TO COMMENTS ON SOUTHFIELD INJECTION TEST REPORT

03/25/96

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DOE-FN EPAS
17
RESPONSES

RESPONSES TO U.S. EPA COMMENTS ON THE SOUTH FIELD INJECTION TEST REPORT OF DECEMBER 1995

1. Commenting Organization: U.S. EPA Commentor: Saric
Section#: 7.0 Pg.#: 24 Line #: 8 Code:
Original Specific Comment #: 1
Comment: The work plan states that two vacuum slug tests and two pneumatic slug tests will be conducted each test session before and after injection testing; however, because of problems encountered in the field, only the vacuum slug test was conducted. An explanation should be provided explaining how this change in the amount and type of data collected will affect the results.
Response: Aborting the pneumatic tests had a negligible impact on the results of the slug testing. A minor objective for conducting the slug tests was to determine if the pneumatic test and vacuum test would yield similar results. The main purpose for conducting a slug test was to compare preinjection slug test data with postinjection slug test data to determine if the injection process affected the relative efficiency of the well. Data collected using the vacuum slug test were adequate for this purpose.
Action: The following text will be added to pg. 24, line 8 of the report: "Not collecting pneumatic slug test data did not effect the outcome of the injection test. The objective of the slug testing was to determine if the injection process affected the efficiency of the well being used for injection. Slug test data collected using vacuum methods were adequate for this purpose."

2. Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.0 Pg #: 26 Line #: 11 & 12 Code:
Original Specific Comment #: 2
Comment: The text states that the aquifer can accept water at injection rates of 450 gallons per minute (gpm) or more. The highest injection rate used for the test was 450 gpm; this rate was only used during the step test. During the constant rate test, 300 gpm was used as the injection rate. Without running injection tests at higher rates the report cannot claim that the aquifer can accept injection rates exceeding 450 gpm. The test should be revised accordingly.
Response: Agree, the text will be corrected.
Action: The text will be revised to read; "....at injection rates up to 450 gallons per minute (gpm)."

3. Commenting Organization: U.S. EPA Commentor: Saric
Section#: 5.0 Pg.#: 14 Line#: 28 to 32 Code:
Original Specific Comment #: 3
Comment: The text is unclear about what a "shut-in line pressure" is. The text should explain shut-in line pressure or use different clearer terms.
Response: With the valves in the downcomers closed and the valve leading to the South Plume force main open, the pressure in the injection line was 15 psi.
Action: The sentence in question will be revised to read as follows: "With the valves on the downcomers closed and the valve leading to the South Plume force main open, the pressure in the injection line was 15 psi."

4. Commenting Organization: U.S. EPA Commentor: Saric
Section #: 8.1 Pg #: 26 Line #: 18 Code:
Original Specific Comment #: 4

Comment: The report states that actual field conditions and modified predictions of the water table rise are in closely agree. The water level rise of 1.0 foot in well 31550 does not seem to match any data presented for well 31550 in the report. The report should clarify where a 1.0 foot water level rise in well 31550 was measured. Additionally, before stating conclusions based on the model's ability to predict aquifer response to injection, the test should present a more rigorous model validation. This validation should use all data from all the wells affected in the test and calibration targets.

Response: The water table around the injection well rose approximately 1 foot. The data used for this interpretation was collected from Well 31551 which is located within 25 feet of the injection well. The data for Well 31551 are presented in Table A-6. The mounding that resulted from the injection test is illustrated in Figure 6-13. The figure incorrectly shows a 1-foot water table rise for the injection well, 31550). When the figure is corrected the text on line 18 of pg. 26 will make sense.

Action: Figure 6-13 will be corrected by deleting Well 31550 from the figure, and revising the notation for Wells 31551 and 31556 to read 1.081 feet and 0.59 feet, respectively.

RESPONSES TO OEPA COMMENTS ON THE SOUTH FIELD INJECTION TEST REPORT OF DECEMBER 1995

5. Commenting Organization: OEPA Commentor: GeoTrans. Inc.
Section#: General Comment Pg.#: Line #: Code: C
Original Comment# 1
Comment: We concur that the results of the injection test indicate that injection can potentially be a viable supplement to extraction for the remediation of the GMA if the geochemical problems and limitations can be overcome. The work performed and interpretation provided are generally satisfactory.
Response: Acknowledged
Action: None

6. Commenting Organization: OEPA Commentor: DDAGW
Section #: 1.0 Pg #: Line #: Code:
Original Comment # 2
Comment: Well/Bore logs for all observation, pumping, and injection wells should be included in the site wide data base. The updated file should then be sent to Ohio EPA.
Response: Well/Boring logs of all the observation, pumping, and injection wells will be included in the site-wide database.
Action: Updated files with the requested information will be sent to the OEPA as soon as data entry and QA/QC requirements have been completed.

7. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section#: 2.0 Pg.#: 2 Line#: 4 Code: C
Original Comment# 3
Comment: The report points out that geochemical issues are not in the scope of work for the injection test. The question arises as to where geochemical considerations are accounted for in the pump and treat system design and what sampling, if any, has been conducted relating to local geochemical conditions.
Response: A team of scientists and engineers, including a geochemist, is working on injection issues. DOE also has the help of private industry through a technology transfer project. Before this test geochemical modeling had been conducted using existing water quality data. Based upon the results of this test it was decided that additional water quality parameters were needed to properly assess the iron situation. As explained in our response to Comment 32, an additional test, which includes a geochemical assessment, is being planned to verify that the iron situation has been properly addressed and to ascertain that no other geochemical issues pose potential problems.
Action: See Comment 32.

8. Commenting Organization: OEPA Commentor: DDAGW
Section #: 2.3 Pg #: 5 Line #: 18 Code:
Original Comment #: 4
Comment: Why is 10 mg/L the cutoff concentration for concern?
Response: The 10 mg/L concentration refers to dissolved oxygen. Air entrainment is a potential plugging mechanism that is caused by the release of dissolved gases within the aquifer formation due to injection. Dissolved oxygen can be used as an indicator of the concentration of gases in solution. The 10 mg/L concentration was reported as a cutoff

concentration to prevent air entrainment as a plugging mechanism by Pyne in a 1995 book titled Groundwater Recharge and Wells, a Guide to Aquifer Storage Recovery.

Action: None.

9. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 2.3 Pg. #: 5 Line #: 25 Code: E
Original Comment # 5

Comment: An explanation of the TDS of the injected water (ranging between 2 and 12 mg/l, Table 4-1) and the formation water (ranging between 2 and 2802 mg/l, Tables 6-6 through 6-11) should be provided.

Response: In responding to this comment it was assumed that TDS (total dissolved solids) was a typographical error and that information regarding TSS (total suspended solids) was being requested by the OEPA.

Action: The following will be added to Tables 6-5 through 6-11 as a footnote to the "Total Suspended Solids" column:

Note: The high variation recorded for TSS is attributed to the sampling technique (boiling) and is not representative of the aquifer. The high TSS measurements were caused by disturbing sediment in the monitoring well with the bailing action of the sampler. If the sampler accidently hit sediment in the bottom of the well screen during the sampling event, the sediment it hit would have been suspended up into the sampler, increasing the TSS concentration of the sample. Given the field constraints and time limitations for the sampling events, bailing was selected as the best method to use.

10. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 2.3 Pg. #: 6 Line #: 5 Code: C
Original Comment # 7

Comment: Was chlorine considered or measured?

Response: Chlorine was not considered or measured. Only chloride is present in the Great Miami Aquifer groundwater and chloride is inert as an oxidizing material.

Action: None.

11. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 4 Pg. #: Figure 4-6 and D-1 Line #: Code: C
Original Comment # 8

Comment: Is there an explanation as to why the water level in well 2387 rose 0.9 ft in response to 3.45 inches of rainfall and the other wells typically rose 0.1 to 0.24 feet?

Response: In reviewing this comment it is not clear where the commentor came up with these numbers. The 3.45 inches of rainfall fell on two different days. On October 3, 0.99 inches fell and on October 5, 2.46 inches fell for a total of 3.45 inches. To determine the rise in water level during this period, the water level measured in Well 2387 on October 2 can be compared to the water level measured on October 6. The water level in Well 2387 at midnight on October 2, 1995 was 518.932 feet amsl. The water level in Well 2387 at noon on October 6, 1995 was 518.971 feet amsl. This calculates out to a rise of 0.039 feet, not 0.9 feet. Using the same dates and times, the water level rise in the other monitoring wells ranged from 0.00 feet to 0.67 feet.

Action: None.

12. Commenting Organization: OEPA Commentor: GeoTrans, inc.
Section #: 4.1 Pg. #: 12 Line #: 2 Code: C
Original Comment # 9

Comment: While we agree that well 31550 is suitable for the purposes of the injection test, the screened interval (upper 30%) of the saturated GMA may not be ideal placement vertically for injection. In fact, the increased head may cause significant downward gradients which may be detrimental of the recovery operations, causing the chemicals to plunge deeper into the formation. There needs to be supporting calculations to demonstrate that the hydraulic efficiency will actually increase with reinjection at 31550.

Response: Well 31550 was used for the injection test, but it will not be used as an injection well should the use of injection be approved. Information collected from a pumping test conducted last May indicates that the horizontal hydraulic conductivity for the South Field area of the Great Miami Aquifer is significantly greater than the vertical hydraulic conductivity. The K_h to K_v ratio appears to be 10:1. Injection scenarios were modeled using the 10:1 horizontal to vertical ratio which predicted that groundwater flow from the injection process would be directed principally in the horizontal direction. Because the mounding of the aquifer around the injection well predicted by the modeling was in close agreement with actual mounding observed in the field during the injection test, it is believed that the model realistically represents groundwater flow through the Great Miami Aquifer during injection. Based on the pumping test data and the modeling simulations, the increased head created by injection is not likely to create significant downward gradients, causing contaminants to be transported deeper into the aquifer system.

With regard to the hydraulic efficiency of the injection process, supporting calculations are not possible. Hydraulic efficiencies are likely to decrease over time with injection. This drop in efficiency is an inherent problem with injection and one that can be minimized through proper well installation and treatment of injection waters. Because water is going into the formation, any particulates or solids in the water or chemical precipitates from the injection process tend to clog the formation, resulting in lower efficiency. Routine maintenance is usually required for active injection wells. Modeling is being used to predict the benefits realized by using injection to supplement extraction wells in the cleanup of the Great Miami Aquifer. Efficiency in this regard has been realized through shorter predicted cleanup times.

Action: None.

13. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 4.1 Pg. #: 12 Line #: 14 Code: C
Original Comment # 10

Comment: All of the well screens are essentially at the same elevation. It should be noted that this precludes the interpretation of the vertical hydraulic response.

Response: Agree, but calibrated groundwater model simulations indicate that increased head due to injection is not likely to create significant downward gradients.

Action: The following text will be added to the report. "All of the well screens are at the same elevation. Calibrated groundwater model simulations indicate that increased head due to injection is not likely to create significant downward gradients."

14. Commenting Organization: OEPA Commentor: GeoTrans. Inc.
Section #: 4.1 Pg. #: 12 Line #: 15 Code: C
Original Comment # 11

Comment: In wells 31550-in and 31550-out, the maximum head increase for the step tests are 9.69 and 7.447 feet and in the constant test are 25.7 and 29.18 feet. Given that the transducer range is 20 psi, or 46 feet of head, this choice of transducer appears to be appropriate.

In the other observation wells (31551, 31552, 31553, 31554, 31555, 31556), the head increase is generally less than 1 foot. In hindsight a 5-psi transducer may have been a more appropriate choice. While Insitu offer 10 and 20-psi instruments, other manufacturers such as Instrument Northwest offer 5 psi and less. A 5-psi transducer would provide a range of 11.5 feet which should be sufficient including the submergence depth.

The accuracy of the 20-psi equipment (Insitu PXD-260) is +/- 0.15% or the range at constant temperature and +/- 0.05% using the Hermit 2000 logger. This corresponds to an accuracy range of +/- 0.023 to +/- 0.069 feet. (Data obtained from product specification sheet on file). This can be significant for the constant rate test. It is unclear how greater accuracy was obtained as shown in Figures 6-4 through 6-5. The accuracy of the equipment should be documented because the figure implies a much greater accuracy. The resolution of the Insitu PXD-260 should be provided.

Response: The values reported were read directly from the instruments. The published values of accuracies of Insitu's HERMIT 2000 data logger (± 0.06% of full scale) and PXD-260 pressure transducers (± 0.05% of full scale) cover all Insitu HERMIT 2000s and pressure transducers. Individual HERMITs and pressure transducers usually exhibit better accuracies than the published values.

As groundwater temperature was fairly constant (between 10 and 12°C) during the injection test and the HERMIT was kept in a trailer where the temperature was maintained around 15 to 22°C, we could narrow the accuracy values of the hydrologic instruments used in the injection test. The accuracies were calculated based on the instrument calibrations chart provided by Insitu. The calibration curves developed at the temperatures closest to the field temperatures were used in our calculations.

The attached table shows a summary of the accuracies of instruments used in Wells 31551, 31552, 31554, 31555, and 31556. These are the accuracies for a single water level measurement. The accuracy of water level changes (which are the values of interest in the injection test) is usually much better than that of a single water level measurement because single water level measurement errors are canceled out in the calculation.

The resolution of the HERMIT 2000 is ±0.015%. Based on the information above, during the injection test a 20 psi transducer had a resolution of 0.0069 foot. An accuracy of approximately 1/100th of a foot or approximately ⅛ of an inch is considered accurate enough for the test.

Action: The following text will be added to page 12, line 16 of the report; "The resolution of the measurements is 0.0069 foot."

15. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 4.2 Pg. #: 13 Line #: 13 Code: E
Original Comment # 12
Comment: A reference to Appendix D for slug test data should be provided.
Response: In responding to this comment it was assumed that a typographical error was present: specifically, "Appendix D" should have been "Appendix E." The intent of Section 4 was to give a brief description of the injection test. Specific data from the slug tests is presented in Section 7 where a reference to Appendix E is made on page 24, line 29.
Action: None.

16. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section#: 5.1 Pg.#: 14-16 Line#: Code: C
Original Comment# 13
Comment: Was the transducer inside the pumping well isolated from turbulence by a standpipe?
Response: The transducer located inside the pumping well was not isolated in a standpipe. The transducer located in the filter pack of the pumping well was isolated from turbulence.
Action: None.

17. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 5 Pg. #: Table 5-1 Line #: Code: E
Original Comment # 14
Comment: In step 2 at 0.7 minutes the table reads 521.009 and should read 521.090.
Response: The comment is correct. The table should read 521.090.
Action: A revised table will be prepared and issued.

18. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 5 Pg. #: Table 5-1 Line #: Code: E
Original Comment # 15
Comment: In step 3 at 10.0 minutes the table reads 588.268 and should read 528.268.
Response: The comment is correct. The table should read 528.268.
Action: A revised table will be prepared and issued.

19. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 5 Pg. #: Table 5-1 Line #: Code: E
Original Comment # 16
Comment: In step 2 at 0.0 minutes the table reads 519.954 and should read 518.954.
Response: The comment is correct. The table should read 518.954.
Action: A revised table will be prepared and issued.

20. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 5 Pg. #: Table 5-1 Line #: Code: E
Original Comment # 17
Comment: The water level at time zero is not clear. In step 1, the reference pressures are used in steps 2 and 3. It is not clear as to how these were derived from tables A-2 through A-4.
Response: The water level used for time zero of each step was measured at the start of the test. This number is found in Table A-2 and is indicated as the reference. The data loggers were operated in the "test" mode. This means that they were not turned off between steps. As the injection rate was increased at the start of a step, a new logging cycle was initiated on the data logger using the "step" function. Using the water level measured at the start of the test allows each step to be compared back to a common reference.
Action: None

21. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 5 Pg. #: Table B-2 Line #: Code: C
Original Comment # 18
Comment: There are several instances of unexplained data, such as the value of 22 degrees C water and DO of 8.7 on 10/9. Are these data errors? Were these values checked? An explanation needs to be provided.
Response: The values being questioned were checked and are not considered to be data errors. The water quality parameters in question were affected by sampling events at the well. During a sampling event both the transducer and downhole water quality probe had to be carefully removed from the well to accommodate the sampling bailer. Once the water sample was collected the transducer and downhole water quality probe were carefully returned to the well. The sampling event generally lasted from 30 to 40 minutes. The downhole water quality probes recorded a measurement every hour. An attempt was made to sample each well at a time that would not disturb the downhole measurement, but a few measurements were affected and these are the ones pointed out in the comment. They are considered to be correct readings of disturbed conditions. Because they are disturbed readings they are of no use to the project.
Action: The following text will be added to page 20, line 9: "Some of the readings provided in Appendix B were affected by the sampling events described below. The affected readings are identified by abrupt changes in parameter measurements."

22. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section#: Table 5.3 Pg.#: Line #: Code: C
Original Comment# 19
Comment: Reorganizing Table 5.3 to separate the current injectivity data and previous pump test injectivity data would improve data clarity. Due to the differences in pumping rates, the current presentation of results could be misinterpreted.
Response: Agree, a change in how the data is presented would add clarity.
Action: The table will be revised so that the injectivity data is reported separately from the previous pumping test data.

23. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 5.4 Pg. #: 16 Line #: 17 Code: E
Original Comment # 20
Comment: The specific injectivity should read 46.4, not 46.44.
Response: Agree.
Action: The text will be revised using the correct value of 46.4.

24. Commenting Organization: Commentor: GeoTrans, Inc.
Section #: 5 Pg. #: Figure 5-4 Line #: Code: E
Original Comment # 21
Comment: (1) The initial (10/12) redox of 483 mV for Well 31550 is not shown on Figure 5-4. From Table B-1, the values range from 310 to 340.

(2) Between 10/7 and 10/11, the report should explain why the redox increased from 310 to 500 and the DO decreased from 5.5 to 2.2.
Response: The redox of 483 mV for Well 31550 is found in Table B-5 and was measured at the start of the step test. Table B-5 presents data collected during the step test. Table B-1 presents data collected before the step test. The redox potential recorded before the step test in Well 31550 ranges from 307 mV to 498 mV, with the 498 mV reading being collected on the day before the step test. The reading collected at the start of the step test was 483 mV and appears to be reasonable.

The downhole water quality probes were started just before the beginning of the step test. In preparing Table B-5, the recorded measurement that was taken closest to the start of the step test was the first one reported. The 483 mV measurement was collected just before the start of the test, so was not reported in the table.

The drift in dissolved oxygen and redox potential measurements is believed to be real. It is known that redox probes can foul over time, but the manufacturer believes that more time is usually required before fouling occurs. Work is proceeding to determine if there is a better method for measuring redox potential.

For the purpose of this injection test, however, the readings were considered representative. They indicate that injection water was relatively reduced and low in dissolved oxygen with respect to the in situ water located at the injection site.

Action: None

25. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 5 Pg. #: Figure 5-5 Line #: Code: E
Original Comment # 22
Comment: The initial (10/12) DO of 2.07 mg/L for Well 31550 is not shown on Figure 5-5.
Response: The downhole water quality probes were started just before the beginning of the step test. In preparing data tables the recorded measurement that was taken closest to the start of the step test was the first one reported. The 2.07 mg/L measurement was collected just before the start of the test, so it was not reported in the table.
Action: None

26. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 5 Pg. #: Figure 5-5 Line #: Code: E
Original Comment # 23
Comment: All of the data should be included on Figure 5-5. Specifically, the late time portion for well 31555 and all of the data for 31552 and 31553.
Response: Agree.
Action: A revised Figure 5-5 will be issued that graphically displays the other data.

27. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 6.1 Pg. #: 18 Line #: 4-7 Code: C
Original Comment # 24
Comment: The average rate of water level decline during the pretest period is reported as 0.020 ft/day. The data from Appendix D were independently analyzed and summarized in the following table.

Well Number	Rise in water level (ft) (Interpreted from Figures D-1 to D-5) 10/3-10/5	10/14-10/15	Average rate of decline (ft/day) (Interpreted from Figures D-1 to D-5)	Mound after 2000 minutes (Taken from Figure 6-13)
2387	.12	.90	0.0257	.65
2049	.24	.24	0.0234	.85
2390	.45	.10	0.0271	.03
2434	.21	.20	0.0308	.076
2398	.20	.12	0.0300	.03

From these interpretations, the average water level decline rate is 0.0274 ft/day. This would result in a maximum water level correction after 4.000 minutes (2.77 days on Table 6-4) of 0.076 ft rather than the 0.056 used in Table 6-4.

Response: The average rate of water level decline reported on page 18 (0.020 ft/day) was calculated for the time period September 23, 1995 to October 4, 1995. October 4 was chosen as the cut off for this determination because the water table rose on October 5 in response to 2.46 inches of rain (see page 18 of report). The independent analysis reported above includes October 4, making the results differ by .0074. The rise in water table due to the rainfall event was short and did not appear to have an effect on the long-term trend.

Action: None

28. Commenting Organization: OEPA Commentor: DDAGW
Section #: 6.1 Pg #: 19 Line #: 1-15 Code:
Original Comment #: 25

Comment: This effect is not clear. If biological growth and iron precipitation result in clogging the injection well screen, then the rate that water leaves the well and enters the aquifer is decreased; thus causing the water level in the injection well to rise. If the rate that water enters the aquifer is decreased, the water levels should either decrease or the rate of increase should slow down in the surrounding observation wells..

Response: The rate at which water entered the aquifer remained essentially unchanged during the test with the exception of water supply pressure fluctuations. The clogging of the well screen and filter pack material decreased the efficiency of the well, causing the water to mound in the well. This mounding within the well created additional pressure (or head) needed to overcome the clogging and corresponding loss of well efficiency. In other words, it takes more pressure to move the same amount of water through the screen and into the aquifer. Therefore, water levels in the surrounding observation wells would not have decreased or increased.

Action: None.

29. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 6 Pg. #: Tables 6-5 through 6-11 Line #: Code: E
Original Comment # 26
Comment: On 10/12, these tables show a significantly higher temperature (15 to 17 degree C) as compared to the measurements in Appendix B. The tables are from water samples collected and analyzed either in the field or nearby lab. Values presented in the appendix are from downhole probe measurements. Because the daily temperature at the site on 10/12 ranged from 80 degree F to 39 degree F, it is reasonable that water sampled were warmed to 62 degree F (17 degree C) from the downhole conditions of 52 degree F (11 degree C). The measurement conditions should be noted in the appropriate tables in Section 6.
Response: Agree.
Action: A note will be added to the tables indicating that the measurements were made in the field from samples that had been brought to the surface.

30. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section #: 6 Pg. #: Figure 6-12 Line #: Code: E
Original Comment # 27
Comment: The note indicates that the high DO is temporary and corresponds to sampling events. It should be noted in the report that not all data is plotted in this figure. This still does not explain the elevated levels of DO such as 10.41 in Table B-11, P. 8 of 13 at 194000 on 10/15 in well 31551. This well was sampled at 20:15 on 10/15 (Table 6-6). It would appear as though the time reported on Table 6-6 is when the readings were made and not when the samples were collected. If this is the case, a note should be added to the table to indicate that the samples were collected previously, typically within the previous 10 to 60 minute period.
Response: It took approximately 30 to 40 minutes to complete a sampling event. A sampling event included carefully pulling the transducer and downhole water quality probes from the well, purging the well of three well volumes, immediately collecting water quality parameters, collecting and containerizing the groundwater sample, and replacing the transducer and downhole water quality probes. The variance in time being noted, 19:40 and 20:15 hours, results from different actions being completed during a sampling event.
Action: A note will be added to Figure 6-12 to indicate that not all of the collected data is posted in the figure. The following text will be added to Section 6.2: "Each sampling event took approximately 30 to 40 minutes to complete. A sampling event included carefully pulling the transducer and downhole water quality probe from the well; purging the well of three well volumes while measuring pH, specific conductance, turbidity, dissolved oxygen, and temperature; collecting and containerizing a groundwater sample for laboratory analysis of total uranium and total suspended solids; and gently lowering the transducer and downhole water quality probe back down the well. Tabulated results of the last field readings measured, just before the groundwater sample was collected, are reported in Tables 6-5 through 6-11."

31. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section#: 7 Pg.#:23-25 Line#: Code: C
Original Comment# 28
Comment: Two of the data sets were selected for review because of the obvious different conditions encountered before and after the 72-hour injection test. Both the "PREVAC1" and "POSTVAC2" data were analyzed with both the Bouwer and Rice (1976) and Cooper et al (1967) methods using AQUESOLV™. Both methods yielded similar results to those presented in the report. The Bouwer and Rice analysis of the

"PREVAC1" data yielded a hydraulic conductivity value of 257.2 ft/day, slightly higher then the 241.5 ft/day value reported. The Cooper et al (1967) analysis of the PREVAC1 data yielded a hydraulic conductivity of 260.2 ft/day. The results of Bouwer and Rice (1976) and Cooper et al. (1967) analysis of the "POSTVAC2" data set yielded values of 46.5 ft/d and 27.21 ft/d respectively, again comparable to the 37.3 ft/day value reported. Thus the reviewers concur with reported data interpretation.

References

Bouwer, H. and R. C. Rice, 1976. A slug test for determining hydraulic conductivity of unconfined aquifers with completely of partially penetrating wells. Water Resources Research, v. 12, n. 3, pp 423 - 428.

Cooper, H. H. jr., and J.D. Bredehoeft and S.S. Papadopulos. 1967. Response of a finite-diameter well to an instantaneous charge of water. Water Resources Research, v. 3, n. 1, pp 263 - 269.

Response: Comment acknowledged.
Action: None

32. Commenting Organization: OEPA Commentor: DDAGW
Section #: 8.1 Pg #: 26 Line #: Code:
Original Comment #: 29

Comment: The water chemistry issue should not be trivialized. A process which can reduce hydraulic conductivity 84% within 72 hours is going to have a tremendous impact on a system that is designed to pump over 5.7 million gallons per day for 10 years. The results of this test show that unless DOE can come up with a method of eliminating iron precipitation and controlling biological action, injection cannot be considered a viable option for augmenting ground water remediation.

Response: The water chemistry issue is being given a tremendous amount of attention. It is believed that the cause of the iron problem has been properly identified and that injecting water that has gone through the site treatment system will eliminate iron precipitation. Another short injection test is being designed to field verify that the iron precipitation can be eliminated or satisfactorily controlled.

The next test will inject treated groundwater collected from the South Plume Interim Treatment (SPIT) project effluent into one of the South Field extraction wells. A means of delivering the treated water to Well 18 does not exist so a closer location is being selected. At this point it appears that treated water will be injected into Well 17. Under advisement of the project geochemist, additional water quality data is being collected from both Well 17 and the SPIT project effluent. Test results will be used to conduct geochemical modeling to determine the probability that iron precipitation will occur when the water is mixed. If the water quality results and modeling predictions are favorable, then a short injection test will be conducted to verify the results in the field.

A new injection test work plan has been prepared and is attached to these comment responses. This new work plan is an addendum to the existing Project-Specific Plan for the South Field Injection Test. The plan outlines the water quality test results and the geochemical modeling conducted to predict the outcome of the new verification test.

Action: An additional test will be conducted as outlined in the Addendum to the Project-Specific Plan for the South Field Injection Test, Phase II Injection Test Work Plan.

33. Commenting Organization: OEPA Commentor: DDAGW
Section # 8.1 Pg #: 27 Line #: Code:
Original Comment #: 30
Comment: Was there any injection rate data which could be salvaged to calculate hydraulic conductivity? If the biological action was increasing exponentially at the end of the test, can earlier results be used?
Response: DOE does not believe that data collected from the injection test could or should be used to determine a hydraulic conductivity for the aquifer. It was never an objective of the injection test to do so. A pumping test was conducted at Well 31550 in May of 1995 and data collected were used to calculate hydraulic conductivity. Because partially penetrating wells were used, the equations needed to solve the hydraulic conductivity calculation were very complicated; the use of computers simplified the math portion of the work and produced excellent results. However, not as much work has been done to calculate hydraulic conductivity using partially penetrating wells during an injection test and it is doubtful that results would be defensible.
Action: None

34. Commenting Organization: OEPA Commentor: DDAGW
Section #: 8.1 Pg #: 28 Line #: 1-2 Code:
Original Comment #: 31
Comment: Please quantify "close".
Response: The water level in the immediate vicinity of well 31550 rose approximately 1 foot. The model predicted that the water table would rise approximately 1.275 feet. The difference between actual rise and predicted rise is .275 feet.
Action: The sentence on pg. 28, line 1-2 will be changed to "Actual water level rises produced during the injection test around the injection well (approximately 1 foot) are in close agreement with modeled predictions (approximately 1.275 feet)."

35. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section#: 6.3/8.1 Pg.#: 20-21,26-27 Line#: Code: C
Original Comment #32
Comment: There is little evidence to support the notion that *Gallionella* iron bacteria would not continue to be a problem if more oxidizing water is used in the next injection test. While it is reasonable to assume the changes in Eh during the reinjection test contributed to *Gallionella* bacterial growth, this does not support and address other factors such as ferric hydroxide precipitation, velocity-induced pressure changes and other natural geochemical reactions. It is agreed that further testing is required to examine the iron precipitation problem.
Response: At this time the evidence is strong that *Gallionella* iron bacteria will not continue to be a problem if more oxidizing water that is lower in iron is used. The equation that describes the process is as follows:

$$3H_2O + Fe^{+2} = Fe^{+3} + 3OH + e^- + 3H^+$$

Ferrous iron dissolved in the water is oxidized to ferric iron. The process gives off electrons (Eh dependent) and hydrogen (pH dependent). The *Gallionella* bacteria thrive on the energy released by the electrons. Eliminate the iron and the energy created by the oxidization of the iron and the *Gallionella* bacteria will not thrive. If water rich in ferrous iron is oxidized the iron will precipitate out. Therefore, it is felt that injecting oxidized water with a low iron concentration will eliminate conditions under which *Gallionella* iron bacteria can thrive.

A small-scale injection test is being planned to verify that this process is understood. See response to Comment 32.

Action: None.

36. Commenting Organization: OEPA Commentor: GeoTrans. Inc.
Section#: 8.2 Pg.#: 28 Line#: 13-17 Code: C
Original Comment # 33

Comment: The current level of sampling is not adequate to support geochemical modeling of precipitation of iron hydroxide in the Great Miami Aquifer.

Response: Agree. Upon the advice of the project geochemist, additional water quality parameters such as iron, redox potential and dissolved oxygen will be analyzed for.

Action: Analyze for the additional water quality parameters listed below and conduct geochemical modeling of the injection process.

Aluminum	Chloride	Phosphate (total)
Calcium	Sulfate	Uranium
Iron	TDS	Carbonate
Magnesium	Alkalinity	Bi/carbonate
Manganese	Fluoride	pH (field)
Potassium	Nitrate-nitrogen	Redox (field)
Silicon	Solids	Temperature (field)
Sodium	Ammonia	TDS
		Dissolved oxygen

37. Commenting Organization: OEPA Commentor: GeoTrans, Inc.
Section#: Appendix A & E Pg.#: Line#: Code: C
Original Comment # 34

Comment: The data presented in Appendix E have been reviewed, the details of how the raw data were adjusted and transformed are not presented. The normal format of transducer data is "time of day" and "height of water above the transducer". Data presented in Appendix A indicates that the recorded transducer data could be modified to yield the elevation of the water table based on some measuring point. At some point during the test the value recorded by the data logger is equal to the height of water above the transducer and the amount of pressure or vacuum applied to the well to achieve the desire displacement. It is not clear from the report how the results were modified or what information was used to create the data sets provided. An explanation of what methods were used is necessary as the amount of head increase induced in the well does not correspond to any value presented in the report (10 feet). Instead each data set starts when time and displacement equal zero. For example, for "PREVAC1" the maximum amount of displacement is 7.816 ft, 1.8 seconds into the test. Similar conditions are shown in "POSTVAC2".

Response: The data presented in Appendix E was transformed into a format that would be easily accepted into the AQTESOLV™ software. The raw data from the data logger is recorded as "Time of day" and "height of water above the transducer." However, this data is cumbersome to use without some type of transformation. Before each test, a transducer reading was recorded as a reference point once the transducer lines had time to stabilize. This reference reading was subtracted from each transducer measurement in order to yield a water level displacement value. Time of day readings were converted to elapsed time in seconds, with zero time representing the start of a response test.

It should be pointed out that the water level displaced was 10.0 feet upward in the well casing using a vacuum pump. However, at the start of every test when the vacuum was released, there was a time lag until the entire vacuum was released. This was due to the size of the well casing (12 inches) and the volume held under vacuum conditions. If the vacuum could be released instantaneously, the initial transducer reading would be 10.0 feet. But the first few readings are measuring vacuum effects in which a portion of the elevated water column is being supported by a partial vacuum remaining while at the same time the water column is dropping as the well recovers. As the water column is being held at the 10-foot mark, equilibrium will be attained and the transducer will read at or close to the reference reading due to the fact that the column of water raised in the well is under vacuum and therefore is being supported. The zero reading at time zero is a reflection of this, as the reference value subtracted from the transducer reading results in zero.

As noted in the comment, the maximum amount of displacement appeared to be 7.18 feet at 1.8 seconds in the "PREVAV1" data set. However, it took approximately 1.8 seconds for the vacuum to totally dissipate, at which time the pressure transducer began measuring the true water level displacement. Projecting the recovery line to the "Y" axis yields a value of 10.21 feet, close to the starting displacement value.

Action: Section 7.2 titled "Postinjection Slug Testing" will be replaced with the following text: "After completion of the constant rate injection test, water levels in the injection well and surrounding observation wells were allowed to recover for 24 hours. When full recovery of the aquifer was verified, a series of vacuum slug tests were conducted on October 17, 1995 in the injection well. Three 10-foot vacuum displacement tests were attempted in order to determine reproducibility and compare results with the preinjection slug test results. However, after reviewing the data for the postinjection slug tests, it became apparent that 10-foot vacuum displacements were not achieved. Errant water level indications from the meter stemming from the iron precipitate may have caused the meter to falsely indicate the water was at 10 feet above the static level. Test data showed that the displacement levels were between five and seven feet. Pneumatic tests were not attempted due to the problems encountered during preinjection testing."

Section 7.3 titled "Slug Test Results" will be replaced with the following text: "The data set for each slug test was imported into a computer spreadsheet program for manipulation. Time-of-day measurements collected by the data logger were converted to elapsed time in seconds, starting at zero when the vacuum was released and the test was started. Pressure transducer data were normalized by subtracting the static pressure transducer reading from the data point, resulting in true water level displacement numbers. Early time data (0.0 to 2.0 seconds) from each test were included even though the water level displacement readings were not accurate. The large diameter of Well 31550 required one to two seconds for the vacuum to dissipate, and transducer readings recorded during this period reflected the effects of the partial vacuum.

Once the data were in a proper format, it was imported into AQTESOLV™, a computer program designed to interpret aquifer test data such as slug test data for unconfined aquifers. The method selected was the Bouwer & Rice slug test method to determine hydraulic conductivity of the material immediately surrounding the well bore. Individual data plots created by AQTESOLV™ and their associated data sets are presented in Appendix E. It should be noted that not all the data were able to be imported into AQTESOLV™ due to its limit of 200 data pairs. In order to use each data set, time/water level data were "thinned," selecting the optimum time interval

providing a maximum of 200 data pairs. Results of the vacuum slug testing are summarized in Table 7-1.

As shown in Table 7-1, the hydraulic conductivity value of the well/aquifer system before injection was approximately 240 ft/day. After injection, the well showed a significant drop in hydraulic conductivity, from 240 ft/day to approximately 40 ft/day. This was most likely due to clogging of the well screen and filter pack with ferric iron precipitation and iron bacterial growth."

TABLE 1

SUMMARY OF ACCURACIES OF IN SITU INSTRUMENTS USED IN THE INJECTION TEST

Well No.	Transducer[a] s/n	Transducer[a] Input No.	Depth Below Water Level Where Transducer Was Set psi[b]	%FS[c]	mA[d]	Transducer Accuracy[e] at 15°C	HERMIT Accuracy[f] at 23°C	Combined Accuracy	Deviation psi	Deviation ft.
31551	203947	1	0.892	4.46%	4.71	0.00% to +0.005%	-0.025%	-0.025%	-0.005	-0.0115
31552	205041	2	1.988	9.95%	5.59	-0.002% to +0.005%	-0.03%	-0.032%	-0.0064	-0.0148
31554	201762	4	9.699	48.50%	11.76	-0.01% to +0.005%	-0.035%	-0.045%	-0.009	-0.0201
31555	203660	5	1.486	7.43%	5.19	-0.006% to +0.005%	-0.02%	-0.026%	-0.0052	-0.0120
31556	203951	6	9.730	48.65%	11.78	-0.007% to 0.00%	-0.025%	-0.032%	-0.0064	-0.0148

[a]South Field Injection Test Report, Table A-6.
[b]South Field Injection Test Report, Table A-6, before the start of the 72-hour injection test.
[c]Percent full scale of a 20-psi transducer.
[d]Transducer psi (0 to 20 psi) converted to current (4 to 20 mA).
[e]See In Situ pressure transducer calibration charts (Repeatability Quadratic).
[f]See In Situ HERMIT calibration charts.
Note: Could not locate transducer calibration chart for the transducer used in Well 31553.