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7. Abstract

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1.0 INTRODUCTION

This test plan directs hydrologic testing activities planned at three existing *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) wells in the 100-HR-3 Operable Unit of the Hanford Site. Three additional wells will be installed near these existing wells and used as additional testing and observation points during the field activities. Figure 1 shows the locations of the three test sites.

A primary objective of the testing program is to provide more detailed hydraulic characterization information for the unconfined aquifer and targeted test sites than provided by the initial reconnaissance-level slug testing of Vukelich (1992). A second objective is to evaluate the applicability of slug interference and dipole flow tests for detailed hydraulic characterization in an unconfined aquifer. This aquifer testing program will also be useful for substantiating hydraulic conductivities reported from previous slug tests (Vukelich 1992) and evaluating the effects of filter pack volume/configuration on slug test data. Vukelich (1992) recommended additional testing to address the latter two issues.

1.1 SCOPE

This test plan provides technical and administrative guidance for performing a series of aquifer tests in the 100-HR-3 Operable Unit at wells 699-91-46, 699-93-48, and 199-H5-1. Three additional wells will be installed prior to testing: 699-93-48B, 699-91-46B, and 199-H5-1B (Figure 1). Each of the latter wells will be located near its associated existing well and used as an observation well.

Specific items included in this test plan are test and well design requirements, field operational requirements, implementation requirements, and data collection guidelines for the aquifer testing. The test plan was prepared in accordance with Environmental Investigations Instruction (EII) 10.1, "Aquifer Testing" (WHC 1988a).

Field testing is expected to be under way in April of fiscal year 1994. After field testing, a report will be issued summarizing the test results. Field testing will consist of the following types of tests:

- Instantaneous slug injection and withdrawal tests (Papadopoulos and Cooper 1967, Bouwer and Rice 1976)
- Constant rate discharge drawdown and recovery tests (Neuman 1975)
- Slug interference tests (Spaine 1992)
- Dipole flow tests (Kabala 1993).

Figure 1. Location Map of the Proposed Aquifer Test Site.

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1.2 AQUIFER TESTING OBJECTIVES

A primary objective of the testing program is to assess the usefulness of slug tests, slug interference tests, and dipole tests to estimate aquifer properties at the Hanford Site. If these tests prove to produce reliable aquifer properties, these methods may provide adequate aquifer properties for modeling and even remediation, such as for the chromium treatability study in the 100-H Area. Recent aquifer testing in the 100-HR-3 Operable Unit consisted of reconnaissance-level slug tests (Vukelich 1992). This proposed testing program is expected to provide additional estimates of aquifer parameters including vertical hydraulic conductivity and storativity, and to substantiate previously estimated values of horizontal hydraulic conductivity.

A second objective of the testing is to evaluate the applicability of slug interference (Spane 1992) and dipole flow tests (Kabala 1993) for hydraulic characterization in an unconfined aquifer. The interference test method is performed by inducing an "instantaneous" water-level change in one well and measuring the transient wave response in an adjacent observation well. Past slug interference testing at the Hanford Site was performed in semiconfining aquifers (Spane 1992). Under the current testing program, this method will be employed in an unconfined aquifer.

The dipole flow test consists of a dual screened well, where water is pumped from one screened section across a packer to the other screened section where it flows back into the aquifer. The pumping creates a three-dimensional recirculation cell in the aquifer. Aquifer hydraulic parameters can then be estimated after near steady-state flow conditions are achieved, based on drawdown in one of the screen sections.

Aquifer test data from the proposed program will also be used to corroborate previously determined values of hydraulic conductivity in the 100-HR-3 Operable Unit. Vukelich (1992) conducted instantaneous slug injection and withdrawal tests in 1992 at 21 wells. He noted a discrepancy between the geologic descriptions of the tested aquifer materials and the estimated hydraulic conductivities. Vukelich therefore recommended additional testing to substantiate the test results.

To achieve these objectives, slug tests, slug interference tests, dipole flow tests, and constant discharge tests will be performed at each site. The test results for the first three methods will be compared to the conventional pumping test results (constant rate discharge test). Each method will be evaluated for its applicability to the hydrogeology of the 100 Area and possibly more broadly to the Hanford Site.

Table 1 compares the four different testing methodologies in terms of purgewater production, hydraulic parameters that can be calculated, and the need for observation wells. This comparison suggests that the slug interference and the dipole flow tests could be very useful hydrologic tools under certain hydrologic contaminant-specific conditions. Aquifer testing is sometimes needed in areas of contaminated groundwater and near hydrologic boundaries (e.g., the Columbia River). Because these two tests would not produce contaminated purgewater and are relatively unaffected by most hydrologic boundaries, they could be the test method of choice. They also have the advantage over the traditional slug tests by providing a hydraulic conductivity value that is areally more representative of the aquifer.

Table 1. Comparison of the Four Proposed Testing Methods.

Test type ^a	Instantaneous slug withdrawal/injection test	Slug interference test	Dipole flow test	Constant rate discharge test
Calculated aquifer parameters ^b	K ^a	K, Sy ^b	K, Kv ^c , Sy	K, Kv, Se ^d , Sy
Approximate area of influence	<10 ft, three-dimensional	<100 ft, unidirectional	<100 ft, three-dimensional	100-1,000 ft, three-dimensional
Purgewater production	None	None	None	Yes
Relative length of test	Short term (<10 min)	Short term (<10 min)	Moderate term (<400 min)	Long term (usually >1,000 min)
Boundary effects ^e	Near borehole heterogeneity, skin effects	Relatively ^f unaffected	Relatively ^f unaffected	Large-scale heterogeneity, recharge
Requires observation wells	No	Yes	No	Yes (for full range of parameters)
Relative cost to perform	Least	Intermediate	Intermediate	Highest

^aK = Horizontal hydraulic conductivity.

^bSy = Specific yield.

^cKv = Vertical hydraulic conductivity.

^dSe = Elastic storage coefficient.

^eBoundary effects--Several types can be encountered: smaller scale formational or drilling induced heterogeneities (minor gradational or semi-abrupt changes in lithology, a "skin" created while drilling); larger "macro" changes (river/aquifer interconnection, stratigraphic unit pinches out, faults, etc.). The smaller changes affect slug test results most, while the other tests "average" these effects over the entire aquifer.

^fThese tests are relatively unaffected because the small radius of influence (dipole flow test) or the short-term nature of the test (interference slug test) prevents intersection of the larger scale feature. Yet, because these two tests cover a significant portion of the aquifer, small-scale heterogeneities are usually "averaged" out over the aquifer.

1.3 TEST PLAN OBJECTIVES IN RELATION TO PROGRAMMATIC DATA QUALITY OBJECTIVES

This section is intended to integrate the test plan purpose, objectives, and expected results with the programmatic data quality objectives (DQOs). The DQOs for remediation of contamination in the 100 Areas were taken from the draft feasibility study for the 100 Area, *100 Area Feasibility Study Phases 1 and 2* (DOE-RL 1993). Results from the proposed aquifer testing program in the 100-HR-3 Operable Unit will be applicable to other remediation sites in addition to the 100-HR-3 area [e.g., aquifer testing in the 200-UP-1 and 200-ZP-1 Groundwater Operable Units (including slug interference tests)]. Hydrologic testing at these remediation sites will be done in contaminated areas.

The aquifer testing program at 100-HR-3 therefore will be beneficial to other cleanup efforts on the Hanford Site, as well as providing additional characterization information in the 100-HR-3 area. Generally, aquifer testing will be required for the following types of evaluations.

- Risk assessment evaluations--risk assessments are required to consider, in part, the rate of contaminant migration. Such an assessment can only be done using known hydraulic parameters like hydraulic conductivity, hydraulic gradient, and porosity. Estimates of contaminant movement (direction and velocity) are only as good as the input data.
- Evaluation of contaminant plume migration--analytical and numerical computer models are and will be constructed to determine the extent, magnitude, migration rate, and behavior of contaminant plumes (including the site-wide model). Again, models are only as good as the conceptual models on which they are based (i.e., the estimates of hydraulic parameters: e.g., hydraulic conductivity and hydraulic gradient).
- Design of remedial systems--The design of groundwater remedial systems requires accurate data for the hydraulic properties of the aquifer. Sizing of equipment, location of wells, preliminary evaluation of cleanup rates, etc., all depend on part on the hydraulic properties of the aquifer (hydraulic conductivity).

More specific examples where the aquifer test results will be useful are for the proposed remedial alternatives in the 100 Area (see page 5-21 ff in the feasibility study). This plan calls for remediation of groundwater through:

1. Containment Actions--such as vertical barrier walls (slurry walls); and hydraulic control (requiring extraction and injection wells)
2. In Situ Treatment--contamination will be treated in place, for example, fixating (immobilizing) chromium in the soil by reducing the valence state

3. Removal, Treatment, and Disposal for Groundwater--extraction wells or injection wells will be needed for removal of water plus wastes, and for injecting water and other substances.

1.3.1 Application

To design, implement, and model these cleanup methodologies and systems, the hydraulic parameters of the aquifer are an essential requirement. Testing in contaminated zones (which necessitates the disposal of contaminated purge-water) and near hydrologic boundaries (the Columbia River in the 100 Areas) will be significantly simplified if the slug interference and dipole flow tests are validated and can be used. As described above, the testing techniques are preferred over traditional methods in these situations.

1.3.2 Benefits of the Testing Program

The more immediate and direct benefit is to demonstrate or refute that previous slug test results are valid, or can be used with certain qualifications. Slug testing could be shown to be useful under certain well construction and hydrogeologic conditions. Testing will also provide additional aquifer property data in the area of test wells, such as vertical hydraulic conductivity and specific yield.

Additionally, the testing will validate the slug interference and dipole flow test methods. The slug interference testing method is also planned in the 200 West Area, including the 200-UP-1, 200-ZP-1, and the ERDF (macro-landfill) facilities. Therefore, this testing program is beneficial for other cleanup projects.

Testing will be conducted in areas of non-contaminated groundwater. If the test methods are validated, they could be used in areas with contaminated water without creating a purgewater disposal problem. Therefore, these methods will reduce the risk of exposure to hazardous or radioactive groundwater since none will be brought to ground surface. The testing methodologies are consistent with the strong emphasis on worker safety at the Hanford Site.

1.4 TEST PLAN OBJECTIVES

Specific objectives of this test plan are to provide administrative and technical guidance for the field testing, which includes:

- A brief description of the hydrogeology in the area of the test wells
- Well construction and configuration, and equipment requirements
- A discussion of the types of planned tests and their sequencing
- Specific test design, equipment, and data collection requirements
- The disposal of purgewater produced during testing
- Applicable procedures and quality assurance guidelines.

2.0 SITE HYDROGEOLOGY

The geology of the 100-HR-3 Operable Unit includes the unconsolidated sediments of the Hanford and Ringold formations, which are underlain by the Columbia River Basalts (Lindsey and Jaeger 1993). Figure 2 shows a geologic cross section for the 100-HR-3 Operable Unit through two of the proposed test sites. In general, the uppermost aquifer in the 100-H Area is contained in the Hanford formation and is more transmissive than the uppermost aquifer in the 100-D Area (Ringold Formation). The aquifer at the three proposed test sites is contained in the Hanford formation.

The stratigraphy of the 100-D Area includes, from shallowest to deepest, (1) backfill (locally present to depths of 65 ft), (2) Holocene surficial deposits (river and eolian sediments), (3) Hanford formation (sand and gravel), and (4) Ringold Formation (gravel, sand, silt, and clay). The uppermost aquifer is a partially cemented pebble to cobble gravel with a sand matrix, in the Ringold Formation. It is 10 to 25 ft thick and is underlain by a clay-rich unit, which appears to be continuous beneath the 100-D Area.

The stratigraphy of the 100-H Area is similar to the stratigraphy of the 100-D Area. However, the uppermost aquifer includes the bottom portion of the Hanford formation. The uppermost Ringold Formation beneath the 100-H Area is a fine-grained unit, which locally confines the aquifers beneath it.

Previous slug test results for wells 199-H5-1, 699-91-46, and 699-93-48 provided estimates of hydraulic conductivity of 113 ft/d, 50 ft/d, and 790 ft/d, respectively (Vukelich 1992). The specific drawdown for each of the wells was 0.11 ft/gal/min, 0.33 ft/gal/min, and 0.06 ft/gal/min over a time period of about 60 to 90 min. This latter information will be used to estimate the initial rate of discharge for the planned step-drawdown tests. Appendix A contains plots of the development data for each well.

3.0 WELL CONSTRUCTION AND CONFIGURATION

3.1 EXISTING WELLS

All of the existing test wells, 199-H5-1, 699-91-46, and 699-93-48, were drilled with a cable tool rig in 1992. These wells are constructed of 4-in. stainless steel casing with 4-in. continuous wire-wrap 10-slot stainless steel screens 20 ft in length emplaced in a 8-in.-diameter borehole. A 20-40 mesh silica sand pack was placed around the screens, and the annular seals were filled with bentonite chips. Appendix B contains the as-builts for the wells. Table 2 lists construction and related hydrogeologic information for each of these wells.

At well 199-H5-1 the screen fully penetrates the aquifer. The screens at the other two wells are partially penetrating, with less than 89% of the aquifer screened at well 699-91-46 and only 48% of the aquifer screened at well 699-93-48. Drilling did not reach the top of the lower mud at well 699-91-46, so the true saturated thickness of the aquifer is not known. All of these wells are completed in the Hanford formation.

Figure 2. Geologic Cross Section Across the 100-HR-3 Area.

Table 2. Construction and Relevant Hydrogeologic Information for the Existing Aquifer Test Wells, 100-HR-3 Operable Unit.

Well construction information	Well 199-H5-1	Well 699-91-46	Well 699-93-48
Elevation top of casing	420.16	417.06	437.79
Elevation land surface ^a	417.18	414.19	434.83
Elevation top of screen	382.38	391.19	393.63
Water table elevation ^b	376.6	384.1	383.0
Elevation bottom of screen	366.28	370.39	372.83
Elevation bottom of aquifer	365.18	<368.69 ^c	361.83
Saturated screened thickness (ft)	10.3	13.7	10.2
Aquifer thickness (ft)	11.4	>15.4 ^c	21.2

NOTE: All elevations in feet above National Geodetic Vertical Datum of 1929. Construction information taken from as-built diagrams.

^aElevation of brass disk in concrete pad.

^bAverage of monthly measurements, July 1922 through March 1993.

^cBorehole did not reach clay; aquifer thickness cannot be determined.

3.2 PROPOSED WELLS

One new well will be installed at each site and used as either an observation or test well, depending on the testing requirements (described in a following section). Well 699-93-48B will be completed with a dual screen [two 8-in.-diameter 10-slot stainless steel screens, which are separated by a blank piece of casing (Figure 3)]. This type of construction is needed to conduct the dipole flow test (Figure 4). Well 699-93-48B was selected for the dipole test because the aquifer was thick enough to complete with a dual screen.

The completion configuration for well 699-93-48B (dual screen) was based on the requirements described in Kabala (1993) for performing the dipole flow test. This configuration should also be compatible with the other planned testing methods. Kabala's particular downhole arrangement for the dipole flow test is shown in Figure 4. The additional screened section will also serve as another test interval (in the same well) for the slug and slug interference tests. Wells 699-91-46B and 199-H5-1B will be completed with only one screened section.

Figure 3. Proposed Temporary Well Design for the Proposed Test Wells.

Figure 4. Generalized Diagram Showing the Dipole Flow Test.

Figure 3 also shows the general well construction for wells 699-91-46B and 199-H5-1B. These wells will also be completed with an 8-in.-diameter 10-slot stainless steel screen in a 12-in. borehole. A 10-20 mesh silica sand filter pack will be installed around the screen section and capped by bentonite chunks or pellets, similar to upper screen section in 699-93-48B. Bentonite chunks or pellets will also be placed in the annular space opposite the blank casing of 699-93-48B, hydraulically isolating the screened sections. Table 3 lists the specifications for the screen and blank casing lengths for the three wells.

Table 3. Screen and Casing Information for the Proposed Wells.

Well number	Depth of water table (ft)	Top/bottom of upper screen (ft)	Top/bottom of lower screen (ft)	Length of blank casing (ft)
199-H5-1B	40.6	46/51	N/A	N/A
699-91-46B	30.1	37/42	N/A ^a	N/A ^a
699-93-48B	51.8	55/58	69/72	9

NOTE: See Figure 5 for as-built diagrams.

^aN/A = Well may be configured with a dual screen if the aquifer is thick enough. The final decision will be made after the well is drilled and the depth of the lower mud is determined.

Well 699-91-46B will be drilled to the bottom of the aquifer to determine the aquifer thickness (which is not known at this site). It will then be backfilled with a bentonite material or filter sand to the temporary completion depth.

These wells will be drilled using the Generic Well Specification (WHC-S-014, latest revision) (Reynolds 1992) as the drilling guide. After testing is finished, the wells will be completed either as permanent monitoring structures or abandoned (the final disposition will be determined later). In either case, applicable Washington State water well regulations (WAC 173-160) must be observed.

All three wells will be developed with a submersible pump prior to testing. If significant sand production appears to be a problem, some surge block development may be necessary.

The distance between the two screened sections in well 699-93-48B was kept as large as possible at this location. A large spacing between the screens is advantageous in because (1) it increases the radius of influence of the circulation cell (Figure 4), so the calculated horizontal hydraulic conductivity will represent a larger portion of the aquifer; and (2) the estimated vertical hydraulic conductivity is representative of a larger cross-sectional portion of the aquifer.

Well 699-93-48B will be about 30 ft and wells 699-91-46B and 199-H5-1B will be about 20 ft from their corresponding wells. These distances are adequate for observing responses for each of the testing methodologies.

An estimated drawdown response was calculated for the above well spacing to verify that the 20- and 30-ft distances were reasonable for the constant rate discharge test. Figures 5, 6, and 7 show these distance-drawdown plots after 1 day of pumping. The drawdown will be about 1 ft based on the drawdown responses shown on the plots (reading at 20 and 30 ft). Input parameters were best-guess estimates at these sites based on the previous slug tests and typical hydraulic parameters for unconfined aquifers. The wells were assumed to be fully penetrating.

These wells are temporary installations that will be used as testing and observation points. Whether it is later decided to complete them as permanent structures or to abandon them, they must be constructed or abandoned according to applicable Washington State well construction regulations (WAC 173-160). Generic Well Specification W-014 will be used as the drilling guide for these wells.

4.0 DESCRIPTION OF TEST TYPES AND SEQUENCING

The general sequence of hydrologic testing at each of the three test sites will consist of the following: an instantaneous slug injection/withdrawal test, a slug interference test, a dipole flow test (at well 699-93-48B only), a step-drawdown test, a constant rate discharge test, and a final slug test. The dipole flow test will be run only at well 699-93-48B because of the sufficiently large aquifer thickness at this location. Step-drawdown tests will be used to determine an optimum discharge rate for the constant rate discharge tests.

The pumping wells for the constant rate discharge tests will be 199-H5-1B, 699-91-46B, and 699-93-48B. The B wells were chosen as the pumping wells to provide consistency with the other test methods in which the induced stress will be at the B wells. This approach will help minimize well construction differences and heterogeneities on the test results for each site.

5.0 DESCRIPTION OF TEST REQUIREMENTS

The following sections describe test design and data collection requirements for each type of aquifer test, including general equipment requirements and pre-test and post-test monitoring. For each specific test type, the following areas are covered as applicable: equipment setup, discharge rates, test length, pump selection, and baseline monitoring.

5.1 GENERAL EQUIPMENT REQUIREMENTS

Calibrated 10-lb/in² (preferred) transducers with an accuracy of $\pm 0.5\%$ of full scale must be used in the pumping and observation wells during all aspects of testing. The transducers should be positioned in the well as stated in EII 10.1, "Aquifer Testing," or as the well configuration warrants (see Figure 4 for 699-93-48B).

Figure 5. Projected Distance Drawdown Curve for Well 199-H5-1.

Projected Distance Drawdown Curve; Neuman Model
 $K=113 \text{ ft/d}$; $K_v=23 \text{ ft/d}$; $S_y=0.25$; $S=0.001$
 $Q=20 \text{ gpm}$; $t=1440 \text{ mins}$

Figure 6. Projected Distance Drawdown Curve for Well 699-91-46.

Figure 7. Projected Distance Drawdown Curve for Well 699-93-48.

The transducers should record at a log-scale recording rate at the start of each test. The maximum recording interval should not exceed 30 min for any of the tests.

Steel tapes and electric tapes used for measuring water-levels must meet the calibration/standardization requirements of EII 10.2 on water-level measurements. Barometric monitoring with a surface pressure transducer will also be conducted during the entire testing sequence, beginning at the start of pre-test monitoring and ending with the termination of post-test monitoring (see Section 5.2).

5.2 PRE-TEST AND POST-TEST MONITORING

Long-term pre-test water-level monitoring is required prior to performing any aquifer testing activities. Monitoring of the existing wells should start about 2 weeks prior to drilling the new B wells and during the drilling and completion of the wells.

Water levels should also be monitored for about 2 weeks after all testing is completed (post-test monitoring), prior to running the final slug test. Recording rates for pre-test monitoring should be set at intervals of 1 h or less. The barometric recording rate must be set at the same recording frequency and time as the pre- and post-test frequencies and times. Full water-level recovery is expected to occur in about 2 or 3 days for a 24-h test.

After pumping is terminated for the drawdown phase of the constant rate discharge test, data collection must continue during the recovery phase of the constant rate discharge test until the water levels have fully recovered. A final slug test should be performed at the pumping well after the recovery period to determine if additional well development occurred during the test period.

5.3 SLUG TESTS

Slug tests will be conducted in the new and existing observation wells and for all screened intervals. The preferred method of displacing the water is with a slug rod. The slug rod volume should be capable of displacing at least 2 to 3 ft of water in the well.

5.3.1 Equipment Setup and Testing Procedure

Slug tests will be conducted in wells 699-91-46B and 199-H5-1B. In the dual screen well (699-93-48B) a slug test will be conducted before setting any downhole packers to provide a composite hydraulic conductivity for both screened sections. After setting a packer between the screens (thus isolating each screen section), a slug test will be run in the annular space to test the upper screened interval. Another slug test will be conducted through the work string to test the lower screened interval.

During the slug tests in the existing wells, a packer should be placed 2 to 5 ft above the top of the screen in the corresponding B well to reduce borehole storage effects. Transducers will monitor the water-level changes in both the existing and B wells during the tests. The recording frequencies and the general procedure for slug testing is covered in EII 10.1, Appendix B.

5.4 SLUG INTERFERENCE TESTS

A slug interference test will be performed in both the upper and lower screens in well 699-93-48B and in the single screened sections of wells 199-H5-1B and 91-46B using the pressurized gas test method (Spane 1992). The existing wells will be used as observation points. An example test configuration for this method is shown in Figure 8. Appendix C contains the procedure for conducting the test.

5.4.1 Equipment Setup

The generalized wellhead diagram for the slug interference pressurized inert gas test method is shown in Figure 8. The upper portion of the casing will be pressurized, reducing the water level to several feet below the static water level, but not below the top of the screen. This depressed state is maintained until any induced pressure transients stabilize (i.e., the downhole pressure should equilibrate to the static water level). The pressure will then be instantaneously released, and the pressure response at the stress well (B well) and the observation well (existing well) will be recorded. It is important that the transducers at the stress and observation wells be synchronized during this test.

A downhole inflatable packer should be installed in well 699-93-48B to isolate each screened interval during the test but still allow transducer access to either of the screen sections. A transducer must be installed in both screened intervals during the slug interference tests. A transducer must also be used to monitor water-level changes during the test in the corresponding monitoring well (e.g., 699-93-48 for 699-93-48B).

An electric water-level tape may be used to determine the depth that the water level is depressed just before release of the pressure. The water level should be depressed close to the top of the well screen (but not below it) to maximize the magnitude of the induced pulse in the nearby observation well.

5.4.2 Length of Test and Baseline Monitoring

The time for the pulse to move to the observation well and then dissipate should be relatively fast (<10 min) because of the moderate to high transmissivities. Baseline monitoring must be initiated 1/2 h to 1 h before the start of the test to establish any short-term trends that may be present, and continue until the water level returns to the pre-test static level.

Figure 8. Generalized Wellhead Configuration for the Slug Interference Test (after Spane 1991).

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5.5 DIPOLE FLOW TEST

A dipole flow test will be conducted in the dual screen well 699-93-48B. During this test, the well will be pumped from one screen section and discharged into the other screen section. Well 699-93-48 will be used as an observation well during the testing. An example test configuration for this method is shown in Figure 4. Appendix D contains the procedure for conducting the test.

5.5.1 Equipment Setup

Well 699-93-48B will be fitted with a downhole packer to isolate the two screen sections. A pump will discharge water from one screen section to the other (the direction of water movement is not important). Transducers will be used to monitor pressure changes in each screened section during the tests.

5.5.2 Discharge Rates

During the dipole flow test the pumping rate should not vary by more than $\pm 10\%$ of the initial stabilized pumping rate. To monitor this, it may be necessary to bring the groundwater to the surface, circulate it through a flow measurement device, and then return the groundwater to the appropriate screened interval. Using this system, the groundwater will move from the aquifer and back to the aquifer through closed-loop piping. Other approaches that could be used to measure the pumping rate include the use of a calibrated downhole weir (a transducer in the weir measures the water level which corresponds to a specific flow rate) (this method is still in the development state), or simply by maintaining constant revolutions-per-minute on the pump.

The actual discharge rate may not be measurable if the water is not discharged to the surface where conventional flow measurement devices can be used. Finding the best tool for measuring the flow rate is still under study. However, an accurate measure of flow measurement is not required to analyze the data for aquifer properties.

The total drawdown in the screen sections should range between 0.5 to 3 ft. This drawdown range is based on Kabala's recommendation (1993), where the maximum drawdown in an unconfined aquifer during the dipole flow test should meet the criterion of $s/b \ll 1$, where s is the drawdown and b is the saturated thickness of the aquifer.

5.5.3 Length of Test

The test should continue until the rate of change of drawdown approaches a straight line on a semi-log plot for a period of 0.5 to 1 log cycle (time is plotted on the log axis).

5.5.4 Baseline Monitoring

New tests must not be initiated until the water level returns to the estimated static water level that existed prior to being perturbed during the previous testing activities. Baseline monitoring will be used to detect any short- and long-term water-level trends and to remove these extraneous effects from the test data prior to analysis.

5.6 STEP-DRAWDOWN TESTS

A step-drawdown test will be conducted at each of the B wells, following the slug interference test, to determine the optimum pumping rate for the constant rate discharge test. The new B wells will be used as the pumping wells. Only the lower screen section will be step-tested in well 699-93-48B.

5.6.1 Equipment Setup

For the step-drawdown tests and constant rate discharge tests, the pump should be installed 1 to 5 ft from the bottom of the screen. The water level must not be allowed to drawdown to the top of the pump. A shroud may be installed over the pump to promote cooling of the motor during the tests.

Purgewater produced during the constant rate discharge tests should be discharged at least 1,000 ft from the wellhead. The purgewater at all three sites has been designated as "clean" and may be discharged to the ground (see Appendix E).

5.6.2 Discharge Rates and Length of Test

The primary purpose of the step-drawdown testing will be to estimate the optimal discharge rate for the longer term constant rate discharge test. Three to five pumping rate steps at 60 to 90 min each will be necessary to make this determination.

An initial maximum discharge rate was estimated using well development data plots contained in Appendix A. The specific drawdown was 0.11 ft/gal/min, 0.33 ft/gal/min, and 0.06 ft/gal/min at wells 199-H5-1, 699-91-46, and 699-93-48, respectively.

Based on these estimates, the initial discharge rate for the step tests should be about 10 gal/min at well 199-H5-1B, 0.5 gal/min at well 699-91-46B, and about 15 gal/min at 699-93-48B. These discharge rates will produce about 1 ft of drawdown at each well. The flow rate for each step should be increased so that an additional 1 ft of drawdown is produced.

The following maximum drawdown ranges were calculated for each of the respective wells based on the assumption of a maximum drawdown at the pumping well of 3 to 5 ft (not to exceed 50% of the screen length): 10 to 45 gal/min, 0.5 to 15 gal/min, and 15 to 85 gal/min.

A calibrated flow measurement device (including orifice-type devices) must be used to monitor the discharge rates. The orifice device is considered calibrated if it was constructed according to standard industry specifications (e.g., Driscoll 1986). The discharge rate will be confirmed using a stop watch and container of known volume during the testing. The error of the flow measurement device should not exceed $\pm 10\%$ of the flow.

Flow measurement devices must be installed with the correct length of straight run pipe upstream and downstream from the device per the manufacturer's recommendations or standard industry practice (e.g., Driscoll 1986).

If a rotor meter-type flow meter is used for low flow rates (<10 gal/min), the factory calibration is acceptable, provided the flow rate is also confirmed with a stop watch and container of known volume while the test is run.

Flow rates should be recorded at least every 5 min at the start of the test and at a maximum of 30-min intervals after the first 30 min. If a transducer can be used for recording flow rates, the rate should be set to a logarithmic recording frequency at the start of the test with a maximum recording interval of every 30 min.

5.6.3 Baseline Monitoring

New tests must not be initiated until the water level returns to the estimated static water level that existed prior to being perturbed during the slug interference or dipole flow tests. Baseline monitoring will be used to detect any short- and long-term water-level trends and to remove these extraneous effects from the test data prior to analysis.

5.7 CONSTANT RATE DISCHARGE TESTS

A constant rate discharge test will be conducted at each of the B wells after the step-drawdown test. The existing wells will be used as observation wells. At the dual screened well (699-93-48B) this test will be run in the lower screen section. If time and resources permit, an additional test may be run in the upper screen section.

5.7.1 Equipment Setup

The final pump selection for each well will depend on the results of the step-drawdown tests. During the step-drawdown and constant rate discharge tests, the riser pipe from the pump must have a backflow valve or a surface valve installed to prevent water in the pipe from draining back into the aquifer after the pump is shut off.

5.7.2 Discharge Rates

The discharge rate for the pumping test will depend on the results of the step-drawdown test. The aquifer test lead will make the final determination of the flow rate with verbal concurrence from the Site hydrologist. Flow rate measurement requirements and calibration of flow rate measurement devices were covered in Section 5.5.2.

The screen entrance velocities into the well are not expected to produce significant turbulence at the estimated flow rates. For an 8-in. 10 slot continuous wire-wrap screen that is 3 ft long, the entrance velocity at 80 gal/min is about 0.3 ft/s. This velocity is significantly below the upper limit of 2 ft/s given by Roscoe Moss Company (1990). Assuming that 50% of the screen area is blocked, the entrance velocity will still only be 0.6 ft/s.

5.7.3 Length of Test

The constant rate discharge test should run until the effects of delayed yield have dissipated and a straight line is well developed on a semi-log plot of drawdown versus time. It is anticipated that the test will run at least 24 h. Final determination on the length of the test is at the discretion of the aquifer test lead. The rationale for stopping the test will be recorded on the field activity report.

5.7.4 Baseline Monitoring

New tests must not be initiated until the water levels from the step-drawdown tests return to the estimated static water level that existed prior to being perturbed by earlier tests. Baseline monitoring will be used to detect any short- and long-term water-level trends and to remove these extraneous effects from the test data prior to analysis.

6.0 PURGEWATER REQUIREMENTS

Purgewater can be discharged to the ground at all three sites. It should be directed at least 1,000 ft from the wellhead to prevent recharge to the aquifer within the cone of depression created during the constant rate discharge test. Appendix E contains the confirmation letter that designates the groundwater at these wells as disposable to the ground.

A sample of the purgewater will be collected at the end of each constant rate discharge test for information and analyzed in the field for hexavalent chromium per field screening methodology (standard field test kit) and total activity per standard Westinghouse Hanford Company laboratory procedure.

This sampling and analysis is being conducted strictly as a safety precaution and screening method to determine if any unknown contaminant plumes were intercepted and moved to the well during the discharge tests (none are expected). The total volume of purgewater for the constant rate discharge

tests is estimated to be about 151,00 gal assuming three tests for 24 h at an average pumping rate of 35 gal/min.

7.0 PROCEDURES AND DOCUMENTATION

Testing documentation and procedural control is covered by EII 10.1 and 10.2 (WHC 1988a). Field activity reports will be used to record daily field activities during aquifer testing in accordance with EII 6.7. Standard activities and any unusual observations should be recorded on a daily activity log. Data collected during the testing will be stored according to EII 1.6 and incorporated into the project file after testing is completed. The wells will be installed using the Generic Well Specification (WHC-014, Rev. 7) as a guide and when completed or abandoned will meet the requirements of WAC-173-160 (Ecology 1990).

8.0 QUALITY ASSURANCE

Data quality is controlled by this test plan and EII 10.1, "Aquifer Testing" (WHC 1988a). The data from the test wells can be reproduced by re-running the test if the initial test fails. The test site areas will require an evaluation of the impact to endangered, threatened, and sensitive species because a significant volume of water will be disposed to the ground.

The quality assurance documents that cover the test activities are the Quality Assurance Manual (WHC 1988b) and the *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990). This aquifer test plan and the aquifer testing are assigned an impact level of 3Q.

9.0 RESPONSIBILITIES

Specific responsibilities for the testing activities are contained in EII 10.1. Personnel performing individual test activities will be identified in the daily field activity log. Geotechnical Engineering personnel will be the primary lead for aquifer testing and will direct and schedule field activities.

Subsurface Investigation Support (SIS) will support the testing by operating the slugging rod during slug testing, setting and removing pumps, providing and installing packers, providing equipment for and setting up the wellhead for the slug interference tests, and providing certain other types of equipment required during testing (such as pumps, generators, outdoor lighting, discharge pipe). SIS will also supply a job safety analysis for each of the sites.

SIS or an equivalent organization will determine the potential impact to endangered, threatened, or sensitive plant and animal species where groundwater is planned to be disposed to the ground. A letter of approval will be obtained prior to groundwater discharges to the ground.

10.0 HEALTH AND SAFETY

A job safety analysis or Hazardous Work Permit will be provided for the test sites. The level of protection required by the job safety analysis or Hazardous Work Permit will probably be minimal because no hazardous or radiological constituents are known to be present at the test sites.

11.0 REFERENCES

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APPENDIX A

PLOTS OF THE DEVELOPMENT DATA FOR THE EXISTING WELLS

Development Drawdown Data
Well H5-1; April 17, 1992

Well Development Data
699-91-46; April 27, 1992

A-4

WMC-SD-EN-TP-031, Rev. 0

Development Drawdown Data
699-93-48; April 29, 1992

APPENDIX B
WELL CONSTRUCTION AND COMPLETION SUMMARIES

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91-46

WIC-SD-EN-TP-031, Rev. 0

B
DH
I

Project: 100-HR-3		Well No: 699-93-46		Page 1 of 1	
Drilling Started: 2-10-92		Drilling Completed: 2-19-92		Well Developed: 4/27/92	
Logged By: * See Comments		Checked By: R.F. Raidl		Surface Elevation: 414.19	
Drilling Co: K.E.H.		Driller: J. McKnight		Northing: 495915.43	
Drilling Method: Cable Tool		Drilling Equipment: BE-22		Easting: 1889449.29	
Screen: 23.0 - 43.8' (T-304 Stainless Steel, Wire Wrap, 10 Slot).					
Filter Pack: 19.0 - 44.8' (20-40 Silica Sand).					
Permanent Casing: + 3.0 - 23.0' (T-304 Stainless Steel).					
Comments: G.S. Bumgarner, J.W. Lindemann, R.S. Edrington.					

Elev'n (Feet)	Depth (Feet)	Casing Strings (Inches)	Well Construction	Interval	Remarks	Gross Gamma Log	Lithology	Rad Count/Gross Gamma 1000 counts/min.	Drill Method
410	10	10		4.0 5.0	Start 2/10/92		0.0 - 5.0' Gravelly SAND.		
400	10	10		9.0 10.0			5.0 - 15.0' Silty Sandy GRAVEL.		
390	20	8		14.0 15.0			15.0 - 20.0' Sandy GRAVEL.		
380	30			19.0 20.0			20.0 - 25.0' Gravelly SAND.		
370	40			23.8 24.0	699-93-46 21.8 - 23.8'		25.0 - 35.0' Sandy GRAVEL.		
360	50			25.0 29.0 30.0 32.0	699-93-46 32.0 - 34.0'		35.0 - 41.0' Gravelly SAND.		
	60			34.0 35.0 39.0 40.0 41.0 43.0 44.0 45.0	699-93-46 41.0 - 43.0'		41.0 - 45.5' Sandy GRAVEL.		
Total Depth = 45.5 Feet.									

B-4

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Project: 100-HR-3		Well No: 699-93-005		Page 1 of 2	
Drilling Started: 2-6-92		Drilling Completed: 2-11-92		Well Developed: 4/29/92	
Logged By: * See Comments		Checked By: R.F. Raidl		Casing Elevation: 434.83	
Drilling Co: K.E.H.		Driller: D. StGeorge		Northing: 498010.75	
Drilling Method: Cable Tool		Drilling Equipment:		Easting: 1886769.47	
Screen: 41.2 - 62.0' (T-304 Stainless Steel, Wire Wrap, 10 Slot).					
Filter Pack: 37.4 - 61.3' (20-40 Silica Sand).					
Permanent Casing: + 3.8 - 41.2' (T-304 Stainless Steel).		Temporary Casing: 10" case from 0.0 - 75.1'.			
Comments: J.P. Haney, J.W. Lindemann, G.S. Bumgarner, R.S. Edrington.					

Elev'n (Feet)	Casing Strings (Inches)	Well Construction	Sample	Interval	Remarks	Gross Gamma Log	Lithology	Red Count/Gross Gamma 1000 counts/min.	Drill Method
430	10		AR	4.0	Start 2/6/92		0.0 - 6.0' SAND.		WHC-SD-EN-TP-031, Rev. 0 DB
420			AR	6.0			6.0 - 9.8' Silty SAND.		
			AR	9.5			9.8 - 13.8' Gravelly SAND.		
			AR	10.8	No Chemical or Physical Samples Collected.		13.8 - 21.8' Sandy GRAVEL.		
			AR	14.5			21.8 - 25.2' Gravelly SAND.		
			AR	15.5			25.2 - 31.5' SAND / Gravelly SAND.		
			AR	19.1			31.5 - 34.3' Sandy GRAVEL.		
			AR	20.2			34.3 - 38.0' Gravelly SAND.		
			AR	24.0			38.0 - 58.5' Sandy GRAVEL.		
			AR	25.1			58.5 - 61.0' GRAVEL.		
410				30.7					
400				31.7					
				34.8					
				35.8					
				40.0					
				41.7					
				45.2					
				46.7					
				50.8					
				51.9					
				54.5					
				55.5					
60				59.5					

Project: 100-HR-3							Well No: 699-93-000 4B		Page 2 of 2	
Elev'n (Feet)	Depth (Feet)	Casing Strings (Inches)	Well Construction	Sample	Interval	Remarks	Gross Gamma Log	Lithology	Rad Count/Gross Gamma 1000 counts/min.	Drill Method
370					60.5			61.0 - 64.5 Sandy GRAVEL.		DB
					64.9 65.9			64.5 - 66.0' Silty Sandy GRAVEL. 66.0' - 71.5' Sandy GRAVEL.		
70					70.4 71.4 73.5			71.5 - 72.0' SANDY GRAVEL/CLAY. 72.0 - 73.0' SAND. 73.0 - 83.0' CLAY.		HT
					76.2 80.0 83.0					
Total Depth = 83.0 Feet.										

APPENDIX C
PROCEDURE FOR SLUG INTERFERENCE TEST

APPENDIX C SLUG INTERFERENCE TEST PROCEDURE

PREREQUISITE

1. Before installing any calibrated test equipment, verify and record that the equipment will remain in calibration over the period of the test.
2. Pre-test monitoring of water levels at each well must start at least 1 day before the field testing begins to establish water-level trends (although a longer period is optimum). A barometric pressure transducer must be used to monitor atmospheric pressure changes over the same period of time. Both transducers must be set to the same recording rate and time (a maximum of 1-h intervals).

PROCEDURE

1. Install an inflatable packer on a working string in the observation well as close as possible to the top of the well screen. The packer generally should not be seated inside the well screen, but may be if the screen is a louvered or bridge slot type. The packer must be set below the top of the water table. NOTE: The test can still be conducted even if a packer is not set (e.g., testing a well with a wire wrap screen that transects the water table), although this is not the preferred method. Install the observation well transducer within the screened interval of the well.
2. Begin baseline monitoring of water levels and barometric pressures at the observation well(s) at 10-minute intervals.
3. Make up the wellhead assembly to the stress well.
4. Install two pressure transducers in the screen section of the stress well: one at the maximum depth that the water level will be depressed and the other above the water table. An electric tape may be placed at or below the lower transducer as a check to ensure that the water level is not depressed into the well screen. Begin baseline monitoring with the transducer at 10-minute intervals.
5. Connect the gas line from the gas cylinder to the wellhead assembly, and make sure that the ball valves are closed. An inert type of gas must be used such as nitrogen.
6. Set the transducer recording rates to 1 minute for both the observation well and stress well. Make sure that the transducers in both the stress and observation wells are recording at the same rate and at the same time.

7. Pressure the well casing by opening the valve on the gas cylinder, and thereby depress the water level in the well to near the top of the well screen (maximizing the volume displaced), but not below the screen top. The well should be pressurized until the pressure reading on both transducers is about the same. If the water level drops below the electric tape, the tape will no longer buzz when tested. This indicates that the water level has dropped into the screen, and the test must be abandoned (the test can be restarted after the water level restabilizes).
8. Hold the water level at this elevation until the transducers indicate the formation has restabilized (i.e., the pressure readings are relatively constant).
9. Reset the transducer recording rates to the most rapid recording rate (less than 1 second is preferred), making sure that the transducers in the stress and observation wells are synchronized.
10. Open the ball valve on the wellhead assembly to instantaneously release the pressure in the casing, and monitor the water level recovery in both the stress well and the observation wells until they return to static.
11. Repeat the process of pressurizing and depressurizing as many times as desired. At least two cycles are recommended.

VARIATIONS IN STRESS WELL CONFIGURATION

- A. If the stress well has a double screen section, and the upper screen section will be tested, an inflatable packer on a working string must be installed in the blank casing section between the screens. Placement of the packer will isolate the two screen sections. The wellhead assembly is constructed to allow access to the lower screen section, but still allow pressurization and depressurization of the upper screen interval (annular space).

Using this configuration, a third transducer should be installed through the working string to monitor water-level changes in the lower screen section. The recording rate and recording times must be synchronized with the transducer in the upper screen.

- B. If in a double screened well the lower screen section is to be tested, the same packer and transducer configuration can be used as for Variation A above. However, the working string is pressurized and then depressurized instead of the annular space.

APPENDIX D
PROCEDURE FOR DIPOLE FLOW TEST

APPENDIX D
DIPOLE FLOW TEST PROCEDURE

PREREQUISITE

1. Before installing any calibrated test equipment, verify and record that the equipment calibration is valid over the period of the test.
2. Pre-test monitoring of water levels at the test well must start 1 to 5 days before the test begins. These data will be used to establish water-level trends. A barometric pressure transducer must also be used to monitor atmospheric pressure changes over the same period of time. Both transducers must be set to the same recording rate. A recording interval of 1 h is recommended.

PROCEDURE

1. If an observation well is used (it is not a requirement), install a pressure transducer in the screen section of the observation well. Begin baseline monitoring at 10-minute intervals.
2. Remove the pressure transducer used for pre-test monitoring from the stress well. Set an inflatable packer on a working string between the two screen sections to isolate each screened interval. The working string also includes an in-line pump (with a check valve) located just above the packer (Figure 1), and a transducer that monitors the lower screen section.
3. Install a pressure transducer in the upper screen section. Begin baseline monitoring at 10-minute intervals with the transducers in the upper and lower screen sections, and a surface barometric pressure transducer.
4. Make up the recirculation piping at ground surface with the flow measurement device in line, if it is necessary to monitor the flow rate.
5. Allow the water level to re-equilibrate to static level. Set all transducers to a log cycle recording rate, making sure they are all synchronized.
6. Begin pumping at the sustainable flow rate established during well development, or the step-drawdown test, or the constant discharge test. Monitor flow rates every 5 minutes at the start of the test for 30 minutes and then increase to 30-minute intervals.
7. Continue pumping until the effects of delayed yield have dissipated and/or the drawdown data approach a straight line on a semi-log plot of drawdown versus time.
8. Shut off the pump after resetting all transducers to a synchronized log cycle recording rate.

9. Continue monitoring and recording time-drawdown data until the water levels have fully recovered to the pre-pumping level.

VARIATIONS IN EQUIPMENT CONFIGURATION

- A. The flow rate during the test does not need to be measured. But it is important to maintain a constant flow rate (an inherent assumption of the analytical method). Therefore, two alternate methods are proposed for determining if the flow rate is constant. Neither of these methods require circulating groundwater to the surface and back into the well.

One method consists of measuring the flow rate and flow consistency using a downhole weir. A transducer placed in the weir measures water level changes which correspond to flow rates. This technique is still in the development stages.

A second method employs an electronic motor controller to maintain a constant pump speed (revolutions per minute or hertz). The pump will then produce a constant discharge rate because of the constant operating speed.

If either one of these alternate methods is used, Step 4 in the procedure would be eliminated. The downhole equipment would be configured to support these methods prior to installation.

APPENDIX E
PURGEWATER DISPOSAL LETTER

**Westinghouse
Hanford Company****Internal
Memo**

From: Hydrochemistry & Geochemistry Group
Phone: 376-6465 H6-06
Date: March 22, 1994
Subject: PURGEWATER DETERMINATION FOR AQUIFER TEST ACTIVITIES

8C520-94-005

To: R. L. Biggerstaff H6-02
D. G. Horton *[signature]* H6-06
R. L. Jackson H6-06
A. J. Knepp H6-06
K. D. Reynolds H6-06
L. C. Swanson H6-06

cc: W. R. Thackaberry H4-16
BHF File/LB

Attachment 1 contains the purgewater determination for proposed aquifer testing activity in the 100-H Area. The two columns located beneath the general heading "Purgewater Determination" specify the collection requirement for each well for which a determination was requested. The definition for each column is as follows:

Collect/contain. A purgewater designation which is applied to wells which require collection of purgewater in a tank truck and transport of the purgewater to an above-ground storage unit. Three categories of collect/contain requirements are identified in the "Purgewater Strategy Document:"

Category I. A well which is located within the 200 West boundary (except for the expansion area).

Category II. A well which has at least one constituent which exceeds a containment criterion listed in Table 1 of the "Purgewater Strategy Document."

Category III. A well for which there is insufficient analytical information to make a purgewater determination but is located within a purgewater containment plume.

Collect/dispose elsewhere. A purgewater designation which is applied to wells which do not require Category I, II, or III containment but are located in a restricted disposal area. Purgewater from these wells must be collected and transported elsewhere on the Hanford Site for disposal (may use a carbon steel tank truck).

Dispose at well. A purgewater designation which is applied to wells which may have the purgewater disposed to the ground in the immediate vicinity of the well head.

R. L. Biggerstaff, et al.
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Restricted disposal area. A location designated in Section 3.2.2 of the "Purgewater Strategy Document" and categorized as "Collect/dispose elsewhere" per this procedure. Restricted disposal areas are:

- designated RCRA Solid Waste Management Units (SWMUs).
- burial grounds,
- active/inactive liquid effluent disposal sites, or
- known surface or subsurface soil contamination areas.

All wells considered for aquifer testing had recent analytical results in the groundwater database. A list of the wells considered in the evaluation are provided in Attachment 2.

Attachment 3 contains purgewater exceedances from the Groundwater Database. Filtered chromium was reported to exceed the containment criterion in two wells, 199-D2-6 and 699-91-43.

Attachments 4 and 5 contain lists of the most recent tritium, gross alpha, and gross beta results (by well). This information is provided for your own information and evaluation.

This determination is effective for 90 days from issuance. It must be reviewed if additional sampling is scheduled on these wells subsequent to that date or for any wells which are added to the network (on an individual basis).

B. H. Ford, Senior Scientist
Geochemistry & Hydrochemistry Group

kbm

Attachments - 5

Well	Project	Collect/ Contain	Collect/ Dispose to the Ground	Dispose to Ground at Well
199-D2-6	100-H AQTEST	II		
199-H5-1	100-H AQTEST			W
699-91-43	100-H AQTEST	II		
699-93-46*	100-H AQTEST			W
699-93-49B**	100-H AQTEST			W

NOTES:

- I - This well is located within the 200 West boundary (excluding the expansion area).
- II - This well contains one or more results which exceed a purgewater criterion (see Attachment 2 for details).
- III - There is insufficient analytical information to make a purgewater determination for this well. It must be contained until further information is available.
- DE - This well does not require containment but may not be disposed to the ground in the immediate vicinity of the wellhead. The water from this well must be collected and transported elsewhere (a clean area) on the Hanford Site for disposal to the ground.
- W - This well may be disposed to the ground at the wellhead unless it is located in an underground/surface contamination zone. If it is located in one of these zones, the well is to be redesignated in the field as a Collect/Dispose Elsewhere (DE) well and the Geosciences Purgewater Coordinator is to be notified of the change.

*699-93-46 well name was changed to 699-91-46.

**699-93-49B well name was changed to 699-93-48.

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Wells for Purgewater Analysis

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ATTACHMENT 2
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Well	Project
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699-91-43	100-H AQTEST
699-93-46	100-H AQTEST
699-93-49B	100-H AQTEST
199-D2-6	100-H AQTEST
199-H5-1	100-H AQTEST

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Wells Exceeding Purgewater Standards

Page 1

Well	Project	Collect Date	Result	Qualifier	Limit	Constituent Name
199-D2-6	100-H AQTEST	7/30/92	210.00		110.00	Chromium, filtered
699-91-43	100-H AQTEST	7/30/92	156.00		110.00	Chromium, filtered

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ATTACHMENT 3
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Latest Tritium Levels

Page 1

Well	Collect Date	Result	Qualifier	Constituent Name	Project
199-D2-6	3/06/93	2400		Tritium	100-N AQTEST
199-H5-1	8/17/93	7500		Tritium	100-N AQTEST
599-91-43	7/30/92	11000		Tritium	100-N AQTEST
599-93-46	7/29/92	7200		Tritium	100-N AQTEST
599-93-49B	7/31/92	3600		Tritium	100-N AQTEST

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Radiation Screening Data

Page 1

Well	Collect Date	Result	Qualifier	Constituent Name	Project
199-D2-6	7/30/92	0		Gross alpha	100-H AQTEST
199-D2-6	3/06/93	5		Gross beta	100-H AQTEST
199-H5-1	8/17/93	6		Gross alpha	100-H AQTEST
199-H5-1	8/17/93	4		Gross beta	100-H AQTEST
699-91-43	7/30/92	6		Gross beta	100-H AQTEST
699-93-46	7/29/92	6		Gross beta	100-H AQTEST
699-93-49B	7/31/92	5		Gross beta	100-H AQTEST

**DATE
FILMED**

6 / 14 / 94

END