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Proposed Monitoring and Test Plan, Locher Road SAR Test Site, Walla Walla County, Washington
Revision 3

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Prepared for

EES/HDR
Pasco, Washington
and Walla Walla County

K/J Project No. 0492001*00

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Section 1: Introduction

The Walla Walla Watershed (WRIA 32) planning unit, in Washington, Walla Walla Basin Watershed Council in Oregon, and the Walla Walla Watershed Alliance (both in Washington and Oregon), have expressed concern about the relationship between potentially declining shallow aquifer water levels and diminished spring creek and Walla Walla River flows. Based on this concern, the Washington Department of Ecology (Ecology) provided Walla Walla County with a grant to test the feasibility of shallow aquifer recharge (SAR) at two sites in the Walla Walla Basin in 2004 and 2005.

The objective of feasibility testing (this project) is to evaluate the response of the shallow aquifer to the infiltration into the ground (e.g., recharge) of a measured quantity of water at specific points on the Earth's surface. This evaluation will examine changes, if any, in shallow aquifer water level and water quality as a result of recharge. Potential future uses of shallow aquifer recharge feasibility test results include guiding additional testing at the Site described in this document, evaluation of other Sites, and/or supporting analysis of possible, larger scale, aquifer recharge activities.

This document presents the proposed SAR monitoring and test plan for one of the two Sites Ecology funding is being used for. This Site is known as the Locher Road Site. This monitoring and test plan is based on preliminary hydrogeologic assessment information presented in, Kennedy/Jenks Consultants (2003), and ongoing site-specific hydrogeologic characterization work. If this monitoring and test plan needs to be modified as a result of findings from the characterization work, these modifications will be presented to Ecology for review and concurrence.

This proposed monitoring and test plan (the Plan) provides guidance for the project team during the execution of the test, including monitoring SAR test impacts on area groundwater. This Plan also provides area land owners and stakeholders with an understanding of project activities, and provides information useful for regulator oversight and approvals. Permitting and land owner approvals are not covered in this Plan. This Plan also describes general site setting and provides a basic overview of the proposed project.

For this project, Walla Walla County contracted to Economic and Engineering Services, Inc., to gather a project team and oversee the project. Project team members, roles, and responsibilities are generally as follows:

- *Economic and Engineering Services, Inc. (EES)* - which recently merged with HDR Inc. is the project manager for the project. In addition EES/HDR has the role of gaining final land owner access agreements, permits, and preparing periodic reports to and for the County.

- *Kennedy/Jenks Consultants* – Kennedy/Jenks Consultants focus is Site hydrogeologic characterization, design of SAR test layout, observation of any construction activity, preparation of the monitoring and test plan (e.g. this document), interpreting pre-test, test and post-test monitoring data, and final reporting.

- *Fountainhead Irrigation, Inc.* - Fountainhead Irrigation focuses primarily on public outreach, land owner contact, and limited technical support for testing.

- *Gordon, Thomas, and Honeywell, LLC (GTH)* - GTH's primary role is to provide regulatory support and research.

There are two basic objectives for this proposed Plan. One objective is to define sampling locations, list constituents for sampling, present sampling procedures, and define reporting activities for monitoring to be conducted before, during, and after the SAR test at the Site. Monitoring data will be used to evaluate pre-test (background) groundwater and surface water conditions and assess the impact of SAR testing on area groundwater, including unwanted impacts that may require changes to the SAR test. The second objective of the Plan is to describe the proposed layout of the Site, basic testing activities, and Site operation.

The results of the monitoring and testing described in this proposed plan will be combined with site specific hydrogeologic characterization data to produce a report in June 2005. This report will discuss the results of SAR testing and present recommendations for future SAR activities. Potential recommendations may include additional testing needs at this site and/or other sites, expanding recharge activities here and/or elsewhere, and changes in operation, monitoring, or testing, to name a few examples.

Note: The testing described in this Plan is not intended to immediately lead to recharge of the shallow aquifer to levels sufficient to support increased pumping by permitted groundwater users and/or increased stream flows. The testing is designed to produce fundamental hydrogeologic data that can be used to scope and design subsequent small and large scale shallow aquifer recharge operations. Goals of such future recharge operations may include elevated groundwater levels to support well pumping by permitted users and/or increased base flow to springs and streams.

Section 2: Site Setting

This section briefly introduces the physical setting of the Site, including location and geologic and hydrogeologic setting. The description of the geologic and hydrogeologic setting of the Site is based on Kennedy/Jenks Consultants (2003,*)* initial reconnaissance of several possible SAR sites in the Walla Walla Basin.

2.1 Location and Physical Description

The Site is in a gravel pit located at the intersection of Locher and Stateline Roads (in the NE1/4, NE1/4, Section 18, T 6N, R35E) approximately 4.5 miles west-southwest of College Place, Washington (Figure 1). This location is immediately north of the Oregon-Washington border. The Site is owned by Mrs. Patricia Case and leased for intermittent gravel production. Testing will be conducted in such a manner as to not interfere with gravel mining.

The gravel pit is approximately 800 feet long (north-south) and 300 feet wide (east-west). The gravel pit is estimated to range between 15 and 20 feet deep. The north end of the gravel pit is less than 200 feet from the Burlingame Ditch. Farming and low density rural residential landuses predominate in the areas to the west, northwest, and southwest of the Site. Higher density rural residential and irrigated farming landuses predominate to the east of the Site.

2.2 Geology and Hydrogeology

The gravel pit is excavated into a thin (less than 5 feet thick) layer of uncemented gravel overlying red-brown (iron?) stained, partially cemented and indurated gravel assigned to the Mio-Pliocene conglomerate unit. Except for a thin (<3 feet thick) layer of topsoil, Touchet Beds, loess, and other fine-grained deposits are not found in the immediate vicinity of the Site. Based on outcrops in the gravel pit and interpretations of well logs in the area, the Quaternary alluvial gravel unit which normally overlies Mio-Pliocene conglomerate is interpreted to be relatively thin (<10-15 feet-thick) in the gravel pit area. Within the confines of the gravel pit, the alluvial gravel unit has been removed and the Miocene-Pliocene conglomerate unit extends from the gravel pit floor to an estimated depth of approximately 260 feet. Site geologic conditions will be further investigated during Site-specific characterization. A more comprehensive description of the geology of this Site is found in Kennedy/Jenks (2003).

The uppermost aquifer beneath the Site is hosted by the Mio-Pliocene conglomerate. This aquifer is unconfined and is referred to as the suprabasalt aquifer. Ecology has been measuring water levels in the suprabasalt aquifer in a well (commonly referred to as the “Ecology well”) found immediately adjacent to the Site located between the Site and Burlingame Ditch. This data indicates the suprabasalt aquifer water table lies between approximately 25 to 41 feet below the ground surface and its depth varies with the use of the nearby Burlingame Ditch. Anecdotal comments of people familiar with gravel pit history indicate that when water has been discharged into this gravel pit, it rapidly infiltrates into the pit’s floor. Based on such comments and Ecology well records, it appears possible that the Mio-Pliocene conglomerate unit exposed the gravel pit floor is very permeable and may have good potential for infiltration.

Groundwater gradient and flow direction beneath the Site is unknown, but groundwater flow is inferred to be to the north and west. If this is the case, water introduced into the ground at the Site would probably move in a generally westerly to northerly direction. If recharge water moves north, our current subsurface geologic interpretation suggests it may flow towards a low area in the top of the Mio-Pliocene conglomerate unit, possibly increasing potential recharge deeper within these older strata. If recharge water flows to the north-northwest away from the Site, it will move towards topographic low areas along Mud Creek approximately ¼ to ½ mile north and northwest of the Site. This could potentially result in increased groundwater discharge into Mud Creek. Site-specific hydrogeologic conditions will be further investigated during upcoming proposed Site-specific characterization.

Section 3: Project Description

This section presents a general overview of the proposed project. This overview includes a narrative description of likely project activities and factors that may influence project activities and operation.

3.1 General Project Narrative

The basic layout of the Site is shown on Figure 2. The Site will likely consist of one or more ditches or ponds excavated at least 2 feet into the gravel pit floor. The proposed source of recharge water for the test is Walla Walla River water delivered to the site via Burlingame Ditch (the Ditch). Water would be diverted from the Ditch, which lies a few hundred feet north of the Site, and gravity fed into the gravel pit where it will be allowed to infiltrate into the ground. Potential Site modifications for this basic testing scenario include:

- Construction of a turn out structure and delivery pipe or ditch from the Ditch to the gravel pit, structure will include controls to limit the amount of water diverted from the Ditch.
- Work as needed to mitigate against erosion where the diverted water enters the gravel pit.
- Excavation of one or more trenches and/or ponds to aid in distributing water across the gravel pit floor and facilitating infiltration.
- Grading of the gravel pit floor as needed to promote drainage.
- Removal of trash and debris from the portion of the gravel pit used for testing.
- Fencing as needed to restrict access.
- Re-excavation of ponds and trenches as needed during testing if mud deposition hinders recharge.

Gardena Farms Irrigation District (under contract to the project team) will oversee construction of the turn out structure and control delivery of recharge water to the Site.

Contingent on water availability, testing will be done in February through April 2005. Based on potential water availability, regulator approvals, Site access agreements, and Gardena Farms operations the proposed project schedule is as follows:

1. Preliminary planning – Summer 2004.
2. Site characterization – October through December 2004 and January through February 2005.
3. Finalization of monitoring plan – January 2005.

4. Pre-test monitoring and Site preparation – October through December 2004 and January through February 2005. *Note: Turn out structure will be constructed during Gardena Farms normal January/February shut down.*

5. Recharge testing – February through April 2005 (as water is available).

6. Final reporting – May through June 2005.

This schedule assumes all site access agreements and regulatory acceptances are in place prior to project activities requiring them.

Testing generally will be conducted, pending Ecology approval of a temporary water permit, when excess capacity is available in Burlingame Ditch (e.g., there is water in the Ditch in excess of system user needs). Based on existing water rights and typical usage by Ditch customers during the planned test window, the total volumes potentially available are less than 5 cubic feet per second (cfs) up to approximately 15 cfs. Excess capacity is generally absent after early to mid May. Based on the potential quantity of available water during the proposed test period, the temporary water permit for this project should be for a maximum use of 20 cfs, with the total use at any one time, to not exceed the total capacity of the Ditch less calls for water by Ditch users.

In the event of prolonged freezing weather, Site operation may be temporally suspended to avoid ice damage to the Ditch diversion on the Walla Walla River, the Ditch itself, and/or the Site. Water quantities delivered to the Site will be monitored via a gauge/meter at the diversion from the Ditch into the Site. Based on this monitoring data, water quantities discharged to the ground will be calculated. Section 5.0 presents additional proposed test plans.

Groundwater levels in the immediate vicinity of the Site will be monitored before, during, and following all testing. This will be done by three (at a minimum) observation wells that will potentially be constructed during pre-test characterization and by existing water wells in the area if any can be found that are suitable for shallow aquifer water level monitoring. Water quality data also will be collected before, during, and following testing, primarily from onsite wells and from the Ditch at the diversion onto the Site. Parameters to be collected, sampling timing, and other water quality monitoring information are presented in Section 4.

3.2 Outside Influences

Currently identified primary outside influences on testing are water availability from the Ditch, Walla Walla River flow levels, freezing conditions, and undesirable impacts on area groundwater resulting from testing. The probable effects of these influences on testing, and possible mitigation actions to be implemented during testing, are as follows:

- Flow in the Ditch will be a limiting factor for the test. Assuming a valid water permit is granted, water will only be diverted onto the Site when excess capacity exists in the Ditch. Excess capacity is defined as:
    - Total ditch flow – total user demand = excess capacity potentially available for testing.
- Low flows in the Walla Walla River will impact testing because the use of Walla Walla River water for recharge will be conditional based on river flows needed to maintain a

healthy river. Given this, when river flow does not exceed a certain threshold, water will not be delivered to the test Site and testing will not occur. The project team recommends a threshold minimum flow of 150 cfs, at Peppers Bridge, before testing can be done.

- High Walla Walla River flows also may effect testing. In the event of high flow during a flood or rapid snow melt event, turbidity will generally increase. The repeated delivery of turbid water to the test Site infiltration ponds and/or ditches may eventually lead to plugging of pore space and reduced infiltration capacity. To mitigate against this, delivery of recharge water may be terminated or scaled back during high flow events. Alternatively, the ponds may be periodically re-excavated to remove these fines. The turbidity threshold for operation and preferred mitigation strategy for dealing with this will be based on monitoring and performance data collected during testing.

- In the event of prolonged freezing weather, Site operation may be temporally suspended to avoid ice damage to the Ditch diversion on the Walla Walla River, the Ditch system itself, and/or the recharge ponds and related structures and to avoid the risk of ice jams forming in the Ditch, backing up water in the Ditch, and causing flooding adjacent to the Ditch.

The main purpose of groundwater monitoring is to identify the influence of recharge on area groundwater level and quality. Test monitoring will: (1) Directly observe the effects of recharge on water levels and quality (2) Use these observations (in conjunction with characterization data) to evaluate whether or not recharge is having an impact on groundwater level and quality that could lead to surface problems, and (3) Potentially identify when and where this type of problem may occur.

Section 4: Monitoring Plan

This section outlines the monitoring plan for the proposed project. Monitoring for the proposed testing is designed to meet five basic goals. These are to evaluate: (1) Pre-test surface and shallow aquifer groundwater conditions. (2) Changes in shallow groundwater caused by factors other than those related to testing. (3) Changes in shallow groundwater caused by the testing (track the test performance). (4) Potential problems caused by the testing that may require modification of the test and/or mitigation actions. (5) Events that effect test operations, such as a freezing or a flooding. To meet these objectives, monitoring will track:

- Source-water quality and volume coming onto the Site
- Upgradient groundwater water quality and levels
- Downgradient groundwater quality and levels, both near and distal to the Site
- Upgradient and downgradient surface water discharge and quality

The following sections present proposed monitoring locations, constituents to be sampled, sampling procedures (including QA/QC), and reporting.

4.1 Sampling Parameters

Sampling will focus on two groups of water quality constituents. These are synthetic organic compounds (SOC) and a number of basic water quality constituents. Table 1 lists SOC's that are proposed for water quality monitoring.

Basic water quality constituents proposed for sampling in this Plan are as follows:

- Static water level
- Standard field parameters, including pH, electrical conductivity, temperature, and turbidity
- Total nitrogen as nitrate
- Total dissolved solids (TDS)
- Hardness
- Chloride
- Orthophosphate
- Chemical oxygen demand (COD)
- Total and fecal coliform bacteria

This constituent list was selected to optimize routine sampling to address constituents commonly of concern (nutrients and salt) and provide prompt indication of potential impacts by analyzing for selected constituents (nitrate and chloride) that are typically good indicators of general water quality. Additional constituents may be proposed for future sampling if the results of the initial proposed sampling indicate this is necessary. In addition, if initial sampling suggests it, the project team may propose removal of some constituents from the list proposed here. All constituents will be reported to the method detection limit for each as per normal laboratory reporting procedures.

4.2 Monitoring Locations and Frequency

Based on the work completed to-date, four basic types of monitoring points will be used. These include:

- Source-water monitoring
- Groundwater monitoring at the Site and more distant from the Site (e.g., distal)
- Surface-water monitoring

4.2.1 Source-water Monitoring

Source-water monitoring will be at the point of diversion into the Site. Monitoring will include both water quantity and quality. The volume of water delivered to the Site will be monitored by a gauge at the diversion point. Water quality samples will be collected at the gauge.

Proposed monitoring frequency is as follows:

- Gauge data will be periodically recorded by a continuous data logger. Flow through the diversion initially will be measured in ten-minute increments. As operations proceed, this measurement frequency will be reevaluated. Rating measurements and tables will be generated for flow at the diversion point.
- Water quality sampling proposed for the basic water quality constituents (defined in Section 4.1) are described below. However, the exact timing of these sampling events will be based on predicted Ditch use. Ecology staff will be notified by the project team of pending sampling events at least one week prior to each sampling event, or as is practicable given actual Ditch use. A total of four sampling events are proposed, as follows:
  - One month prior to the projected beginning of the recharge period (assuming the canal is in operation). If the canal isn't operating then a sample will be collected as soon as it is reasonably practicable, prior to the start of testing.
  - Within five days, following the start of testing.
  - Two weeks, following the start of testing.
  - In the final week of testing.

- Two water quality sampling events for SOC's will be done concurrently with the basic constituent water quality sampling event one month before SAR testing and the event within five days of the start of testing.

The results of source-water quality monitoring will be used by project and Ecology staff to determine if modifications to test operations are warranted. During testing different sampling frequencies may be tried to identify those that are most effective.

4.2.2 Groundwater Monitoring

SAR test groundwater monitoring will be done both in offsite wells (if previously constructed wells are available and appropriate for monitoring) and onsite, purpose-built wells. A minimum of three onsite wells will be built. These wells will be generally located in the Southeast (upgradient), Northeast (downgradient), and Northwest (downgradient) corners of the Site, they will be built to, *WAC 173-160* monitoring well standards, and they will be generally open to the upper 30-50 feet of the suprabasalt aquifer.

Offsite wells used for SAR test monitoring probably will be previously constructed water supply wells that project staff are allowed access to, are usable for sampling, and are open to the upper part of the suprabasalt aquifer. Three offsite, previously constructed, water supply wells are currently being evaluated for possible use (all are east of Locher Road with two south of Mud Creek and one north of Mud Creek). A fourth well, located in Oregon, directly south of the Site may also be monitored if access can be obtained. Based on construction information available for these wells, sampling may be restricted to selected water quality parameters.

Onsite monitoring wells will be used to monitor water quantity and quality impacts from SAR testing in the immediate vicinity of the Site. Offsite, downgradient monitoring will also be used to evaluate distal affects of SAR testing on the suprabasalt aquifer, including migration of the recharge groundwater mound and plume away from the Site. In addition, upgradient onsite and offsite monitoring will be used to differentiate test impacts from those caused by other, offsite effects on groundwater.

Proposed monitoring frequency is as follows:

- Water levels will be measured weekly (at a minimum) in all wells prior to the start of recharge testing. This frequency will be used in distal wells throughout and following testing.

- In the month prior to, during, and the month following the test, water level data will be collected (at a minimum) daily in Site wells.

- Six water quality monitoring events for the basic constituents defined in Section 4.1 are proposed for onsite wells as follows:

  - Two groundwater quality sampling events are proposed prior to the test for basic water quality parameters. They are proposed for each of the two months preceding the proposed test.

- During testing, three sampling events are proposed, one within five days following the start of testing, a second two weeks following that event, a third in the final week of testing.

- A final groundwater quality sampling event will be done approximately four weeks following the end of the test in all previously sampled wells.

- In addition, concurrent with the aforementioned sampling events, field parameters will be collected from offsite distal wells if any are identified that the project team can have access to and from which a representative sample can be retrieved.

- Concurrent with onsite well sampling, the offsite wells will be sampled. Sampling of these wells will focus on standard field parameters.

- Two SOC sampling events are proposed as follows:

  - Prior to testing, one SOC sample will be collected from the upgradient monitoring well concurrently with the basic constituent sampling event held one month before the start of testing.

  - During testing, one SOC sample will be collected from the upgradient monitoring well concurrently with the basic constituent sampling event held within five days of the start of testing.

The results of groundwater quality and level monitoring will be used by project and Ecology staff to determine if modifications to test operations are warranted.

4.2.3 Surface Water and Springs

Surface water and spring monitoring will be done to evaluate the potential effects of testing on spring and/or creek flow. This monitoring will include the collection of both water quality and flow parameters. As with groundwater monitoring, surface water monitoring will need upgradient monitoring information so that effects un-related to Site operations/testing can be differentiated from those due to testing. Three probable surface water monitoring locations are currently being evaluated for use during testing. These are located as follows:

- Mud Creek at or near the State Line Road crossing (for up gradient control).

- Mud Creek in the pasture ground north of the Test Site (for nearby down gradient effects, if any).

- Mud Creek at or near the Frog Hollow Road crossing (for more distal down gradient effects, if any).

These locations, or alternatives, will be verified during pre-test characterization and background data collection.

Proposed monitoring frequency is as follows:

- Flow data will be collected weekly, at a minimum, prior to the start of recharge testing. One week prior to testing, during testing, and one week following testing flow data will be collected daily, at a minimum. Sampling methodology has yet to be determined.

- Water quality sampling will focus on the standard field water quality parameters (defined in Section 4.1). The exact timing of sampling events for these parameters will be based on predicted Ditch use (and test activity). Ecology staff will be notified by the project team of pending sampling events at least one week prior to each sampling event, or as is practicable given actual Ditch use. A total of four sampling events are proposed, as follows:

  - One month prior to the projected beginning of the recharge period (assuming the canal is in operation). If the canal isn't operating than a sample will be collected as soon as is reasonably practicable prior to the start of testing.

  - Within five days following the start of testing.

  - Two weeks following the start of testing.

  - In the final week of testing.

At this time, the project team does not anticipate the need to collect basic and SOC water quality parameters. The need for collecting samples for these parameters will be revisited if characterization and background data collected prior to the start of testing suggests the need. The project team will review this pre-test data prior to the start of testing to confirm such a need.

4.3 Sampling Procedures

Equipment and sampling procedures proposed for recharge test monitoring are provided in the following sections.

This section lists the equipment for groundwater monitoring:

- Submersible pump (Grundfos or similar) or dedicated bailers/sampling line.

- Temperature measuring instrument.

- pH and conductivity meter(s) with calibration reagents.

- Water level meter (0.01 foot resolution required).

- Shipping cooler with ice packs or ice.

- Five gallon pail marked at the five gallon level, stopwatch.

- Laboratory supplied sample containers with appropriate preservatives.

- Tap water, deionized water, phosphate-free soap, cleaning brushes, field note book, and log sheets.

4.3.1 Water Level

An electronic water level meter will be used to measure the depth to groundwater in each observation well to the nearest 0.01 foot. Static water levels will be measured at an indicated reference point prior to purging any water from the well. The reference points will be on the top of the well casings. Static water levels in all wells should be measured on the same day. Accumulation of sediment in the well should also be checked by lowering a weighted tape to the bottom of the well, reading the depth at the well casing's reference point, and comparing this value to the as-built well depth.

4.3.2 Decontamination

All non-disposable field equipment that may potentially come in contact with any soil or water sample shall be decontaminated in order to minimize the potential for cross-contamination between sampling locations. Thorough decontamination of all sampling equipment shall be conducted prior to each sampling event. In addition, the sampling technician shall decontaminate all equipment in the field as required to prevent cross-contamination of samples collected in the field.

4.3.3 Purging and Field Parameters

Sufficient water will be purged to ensure that the sample collected represents water from the geological formation. Borehole volumes are calculated as the volume of water in the casing and the volume of water in the filter pack.

During purging, measure pH, temperature, and electrical conductivity of the water removed. At a minimum, these parameters are measured at the start of purging and after each successive borehole volume is removed. Temperature should be measured first because it changes most rapidly. Purging continues until at least three borehole volumes have been purged and the field parameters are established to within ± 10 percent over three consecutive measurements. At this point, the observation well is considered adequately purged and can be sampled.

All field instruments should be calibrated each day prior to sample collection. Instrument calibration and maintenance should precisely follow the manufacturers recommended procedures. Electrical conductivity and pH standards used to calibrate the instruments should be within the range encountered at the monitoring sites. Calibration records should be recorded on the sample collection forms.

4.3.4 Sampling

Samples will be collected after sufficient water has been purged according to the procedure described above. Samples will be collected from the discharge end of the pump hose after the flow rate has been reduced to less than approximately 0.2 gallons per minute. If a bailer is used it will be controlled to minimize agitation and aeration. Sample containers should be sealed with tape, labeled, and immediately placed in a cooler with ice. Sample containers should be filled completely to eliminate head space. Sample containers should be provided by the analytical laboratory and should be requested at least one week in advance of the sampling. The containers should be appropriate for the parameters analyzed and all shipping coolers should have chain-of-custody seals placed on them prior to shipping.

One additional sample should be collected from one of the sample points for quality control purposes. This sample should be evaluated as a "blind duplicate."

Samples should be stored immediately after collection in an ice chest containing sufficient ice to cool the samples to 4 degrees Celsius (°C). Use *"blue ice"* if possible. If water ice must be used, the ice should be sealed in plastic bags, as should the sample bottles. Samples should remain cooled at 4°C and delivered to the laboratory within 24 hours of collection. Sample receipt at the laboratory must be sooner if analysis includes parameters with a shorter holding time. Care should be taken to prevent excessive agitation of samples or breakage/leakage of containers. Samples should be analyzed within the specified holding time for each constituent.

4.3.5 Chain of Custody and Sample Handling

A chain-of-custody form should be completed and signed by the sampler on the day samples are collected. The chain-of-custody form must be signed by laboratory personnel upon receipt and any other individuals that maintain custody of the samples in the interim. Coolers should be sealed and shipped or driven to the lab as soon as possible. The method of shipping, (bus, next day air, etc.) is usually determined by the parameter having the shortest holding time. In any case, shipping times of more than 24-hours should not be used, as the cooler(s) may warm and compromise sample quality.

4.3.6 Field Records and Data Validation

All field notes, analytical results, and other pertinent data associated with the project should be maintained in a secure location and be archived for at least a five year period. Data validation for both field and lab Quality Assurance and Quality Control (QA/QC) will be performed using a checklist. All pertinent information with respect to QA/QC will be checked.

The following items are included on the QA/QC review checklist:

- Field data sheets (or notebooks) and observations (observations are used to check for potentially erroneous data) will be reviewed to make sure they are completely filled out.
- Chain-of-custody forms will be completed, being signed by all sample handlers.
- Holding times for all constituents will be met.
- Field-blind-duplicate results will be evaluated to make sure they are compatible.

Laboratory method blanks, matrix spike, matrix spike duplicates, and surrogate percent recovery data supplied by the analytical laboratory will be evaluated to make sure they are compatible.

4.4 Data Reporting and Analysis

The following procedures for reporting analyses are proposed for this project.

4.4.1 Record Keeping

All field notes, laboratory results, critical calculations, and published reports will be maintained by the project team during the project. Following the project copies of this material will be maintained by Walla Walla County. If possible, both paper and electronic copies will be maintained.

4.4.2 Evaluation

Monitoring data and observations should be evaluated when they are received from the sampler and laboratory. Materials to be received include:

- Field monitoring and sample collection records.
- Original laboratory reporting sheets.

Data evaluation will include:

- Verification of analytical methods and detection limits, along with the date the analysis was performed.
- Review of document handling, sampling and analytical problems, and actions taken to correct any problems.
- Summarizing water level data in tabular and/or graphical form.
- Summarizing water quality analytical results in tabular form and/or graphical form.
- Performing data validation checks, as appropriate to the data set.
- Identifying any significant increases in parameter concentrations.

4.4.3 Reporting

All monitoring activities performed during the project will be included in the final project report completed in the summer of 2005. This report will present the following monitoring information:

- Water quality data, including duplicate sample results in tabular form and time-series plots for specific parameters.
- Water level data, including hydrographs, showing water level changes over time.
- Basic statistical parameters for each parameter of interest: Mean, median, maximum, minimum, standard deviation, number of data points, and number of non-detects.

- Evaluation of field and laboratory data, including observed changes and groundwater flow direction and gradient.

- Discussion and conclusions, including recommended changes to recharge testing.

The methods needed to evaluate water quality and water level data will depend on the objectives of the evaluation. In general, the principal objective is, to evaluate whether or not recharge tests have affected groundwater levels and quality. Evaluation methods include:

- A comparison of water quality data with a concentration limit or with background water quality.

- Comparison of water quality, over time.

- Comparison of water quality between upgradient and downgradient wells.

For the Site, it is anticipated that insufficient data will be available for statistical analysis until late in the project. Until that time, evaluation of data set trends will be solely qualitative, with the data being reevaluated after each sampling event.

Section 5: Test Plan

This section describes basic Plan elements for the proposed SAR test at the Site. These elements include: (1) Site layout, including onsite monitoring locations, (2) Outline of planned recharge test operation and (3) potential locations to be taken if undesirable responses are seen in monitoring.

5.1 Layout

The planned general Site layout is shown on Figure 2. This section briefly describes Site feature, including the turnout structure and conveyance to the Site, location of structures onsite, proposed construction of test ponds/pits/trenches, and location of onsite monitoring.

<u>Turnout structure and Conveyance</u>: Gardena Farms Irrigation District staff will build a turnout structure, which will include controls to regulate water being diverted from the canal, within 15-20 feet upstream of the head board structure. The turnout will be built to meet Gardena Farms ditch operation needs. Water will be delivered through a culvert under the ditch beam to an existing trench. This trench leads to the northernmost end of the gravel pit and will be the conveyance through which water is delivered into the gravel pit.

<u>Onsite Structures</u>: Water will spill over the edge of the gravel pit into a pond/basin dug in the northernmost end of the gravel pit. This pond will be approximately 50-75 feet in size, and 2-3 feet deep. Given the likely physical properties of the geologic formation underlying the pit floor, (e.g. slightly silty, indurated sandy conglomerate – to be confirmed by upcoming Site characterization) a sand liner or other filtering agent is not currently planned for the pond/basin. Based on guidance in Ecology (2004), the geologic materials comprising the vadose zone under the Site (Mio-Pliocene conglomerate, e.g., indurated sandy gravel to silty sand gravel) should provide adequate filtration for most contaminants we suspect will be found in recharge water used at the Site. One of the objectives of source water and groundwater monitoring is to verify that this is the case. If source water quality is found to be of concern with respect to potentially degrading groundwater quality, the need for sand (or similar filters) in the infiltration pond(s) will be reevaluated by project team staff in consultation with Ecology staff.

If the full 8-10 cfs planned for the 2005 test can not infiltrate into the ground in the first recharge pond, additional ponds will be built. This will be assessed during the planned step increases in recharge water brought onto the Site. If the additional ponds are needed, a trench will be constructed to connect the first pond to these additional ponds. The Ditch connecting the first pond/basin with any additional pond/basin(s) will be unlined, providing additional infiltration capacity.

<u>Onsite Monitoring</u>: Onsite source-water monitoring will be at the turnout structure and culvert. Groundwater monitoring will be done by, (1) a 4’ inch-diameter monitoring well situated approximately 30-40 feet west of the Ecology well, (2) a 2’ inch-diameter monitoring well on the ditch beam adjacent to the northwest corner of the gravel pit and, (3) a 2’ inch-diameter well located adjacent to the gate in the southeast corner of the Site. The 4’ inch well will penetrate approximately 50 feet into the suprabasalt aquifer. The 2’ inch wells will penetrate 30-50 feet into the aquifer. All three wells will be built to basic monitoring well standards as described in.

5.2 Planned Operation

Construction of turnout, conveyance, ponds/basin(s), and ditching will be initially completed during Gardena Farms Irrigation District normally scheduled mid-winter shut down, typically in January and February. With the restart of ditch operation the Site will be ready to accept water for testing (as available). When water first becomes available, initial test volumes will be less a 2-3 cfs, with each successive step this magnitude of changing water level and water quality in cfs increments (as available). Potential impacts on the aquifer will be revaluated with each step. Maximum anticipated test volume in 2005 is 10 cfs.

To evaluate immediate impacts on the suprabasalt aquifer, field parameters and water level measurements will be used extensively. Water level measurements will typically be collected with an electronic water level measuring tape and/or well-dedicated transducers and data loggers. Field water quality parameters will be measured most commonly from samples recovered by bailers.

Turnout operation will most likely be done by Gardena Farms Irrigation District staff. Water will be released to the Site as available in volumes requested by the project team. If undesirable effects on the underlying aquifer are detected, such as increased turbidity or increased TDS, project staff may close the turnout to shut down testing. If this happens, Irrigation District staff will be notified so water is not returned to the Site until the project team determines it is ready to resume the test.

5.3 Mitigation

As stated in the previous section, there is the possibility that undesired impacts on the suprabasalt aquifer could be caused by testing. Examples of these impacts include:

- Water table levels higher than planned, which for this test we define as within five feet of the bottom of test ponds/basin.
- Increases in water quality parameters such as turbidity and TDS which suggests testing is degraded overall area groundwater quality.
- Increased nitrate-N concentrations which indicate testing is violating regulated water quality parameters.
- Changes in upgradient wells suggesting the recharge mound/plume is impacting upgradient areas and masking that monitoring.

If undesirable impacts of testing are observed, the project team plans to take actions that reduce the observed impact. These actions will take two basic forms, (1) reducing test water flow or (2) terminating test. In either case, the project team will assess available monitoring data and determine if testing can resume with increased water volumes or reduces water volumes.

References

Kennedy/Jenks Consultants (2003), Letter report to Economic and Engineering Services, Inc., Portland, Oregon. 30 June 2003.

Ecology (2004), Stormwater Management Manual for Eastern Washington. Washington Department of Ecology Publication Number 04-10-076

Tables

Table 1. Proposed SOC sampling constituents.

DOH#	Compounds	Units	SRL	Trigger	MCL
	Carbamates in Drinking water				
146	Carbofuran	ug/L	1.8	1.8	40.0
148	Oxymal	ug/L	4.0	4.0	200.0
141	3-Hydroxycarbofuran	ug/L	2.0	2.0	
142	Aldicarb	ug/L	1.0	1.0	
143	Aldicarb Sulfone	ug/L	1.6	1.6	
144	Aldicarb Sulfoxide	ug/L	1.0	1.0	
145	Carbaryl	ug/L	2.0	2.0	
147	Methomyl	ug/L	1.0	4.0	
326	Propoxur(Baygon)	ug/L	1.0		
327	Methiocarb	ug/L	4.0		
	Synthetic Organic Compounds				
33	Endrin	ug/L	0.02	0.02	2.0
34	Lindane (BHC-Gamma)	ug/L	0.04	0.04	0.2
35	Methoxychlor	ug/L	0.20	0.20	40.0
117	Alachlor	ug/L	0.40	0.40	2.0
119	Atrazine	ug/L	0.20	0.20	3.0
120	Benzo(a)pyrene	ug/L	0.04	0.04	0.2
122	Chlordane Technical	ug/L	0.40	0.40	2.0
124	Di(ethylhexyl)-Adipate	ug/L	1.30	1.30	400.0
125	Di(ethylhexyl)-phthalate	ug/L	1.30	1.30	6.0
126	Heptachlor	ug/L	0.08	0.08	0.4
127	Heptachlor epoxide (A & B)	ug/L	0.04	0.04	0.2
128	Hexachlorobenzene	ug/L	0.20	0.20	1.0
129	Hexachlorocyclo-Pentadiene	ug/L	0.20	0.20	50.0
133	Simazine	ug/L	0.15	0.15	4.0
118	Aldrin	ug/L	0.20	0.20	
121	Butachlor	ug/L	0.40	0.40	
123	Dieldrin	ug/L	0.20	0.20	
130	Metolachlor	ug/L	1.00	1.00	
131	Metribuzin	ug/L	0.20	0.20	
132	Propachlor	ug/L	0.20	0.20	
179	Bromacil	ug/L	0.20	0.20	
183	Prometon	ug/L	0.20	0.20	
190	Terbacil	ug/L	0.20	0.20	
202	Diazinon	ug/L	0.20	0.20	
208	EPTC	ug/L	0.30	0.30	
232	4,4-DDD	ug/L	0.20	0.20	
233	4,4-DDE	ug/L	0.20	0.20	
234	4,4_DDT	ug/L	0.20	0.20	
236	Cyanazine	ug/L	0.20	0.20	
239	Malathion	ug/L	0.20	0.20	
240	Parathion	ug/L	0.20	0.20	
243	Trifluralin	ug/L	0.20	0.20	
96	Napthalene	ug/L	0.10	0.10	
154	Fluorene	ug/L	0.20	0.20	
244	Acenaphthylene	ug/L	0.20	0.20	
245	Acenaphthene	ug/L	0.20	0.20	
246	Anthracene	ug/L	0.20	0.20	
247	Benz(a)anthracene	ug/L	0.10	0.10	

Table 1. Proposed SOC sampling constituents.

248	Benzo(b)fluoranthene	ug/L	0.20	0.20	
249	Benzo(g,h,i)perylene	ug/L	0.20	0.20	
250	Benzo(k)fluoranthene	ug/L	0.20	0.20	
251	Chrysene	ug/L	0.20	0.20	
252	Dibenzo(A,H)anthracene	ug/L	0.20	0.20	
253	Fluoranthene	ug/L	0.20	0.20	
255	Indeno(1,2,3-CD)Pyrene	ug/L	0.20	0.20	
256	Phenanthrene	ug/L	0.20	0.20	
257	Pyrene	ug/L	0.20	0.20	
258	Benzyl Butyl Phthalate	ug/L	0.60	0.60	
259	Di-N-Butyl Phthalate	ug/L	0.60	0.60	
260	Diethyl Phthalate	ug/L	0.60	0.60	
261	Dimethyl Phthalate	ug/L	0.60	0.60	
36	Toxaphene	ug/L	2.0	2.0	3.0
173	Aroclor 1221	ug/L	20.0	20.0	
174	Aroclor 1232	ug/L	0.5	0.5	
175	Aroclor 1242	ug/L	0.5	0.3	
176	Aroclor 1248	ug/L	0.1	0.1	
177	Aroclor 1254	ug/L	0.1	0.1	
178	Aroclor 1260	ug/L	0.2	0.2	
180	Aroclor 1016	ug/L	0.1	0.1	
	Herbicides in Drinking Water				
37	2,4-D	ug/L	0.2	0.2	70.0
38	2,4,5-TP (Silvex)	ug/L	0.4	0.4	50.0
134	Pentachlorophenol	ug/L	0.1	0.1	1.0
137	Dalapon	ug/L	2.0	2.0	200.0
139	Dinoseb	ug/L	0.4	0.4	7.0
140	Picloram	ug/L	0.2	0.2	500.0
138	Dicamba	ug/L	0.2	0.2	
135	2,4 DB	ug/L	1.0	1.0	
136	2,4,5 T	ug/L	0.4	0.4	
220	Bentazon	ug/L	0.5	0.5	
221	Dichloroprop	ug/L	0.5	0.5	
223	Actiflorfin	ug/L	2.0	2.0	
225	Dacthal (DCPA)	ug/L	0.1	0.1	
226	3,5-Dichlorobenzoic Acid	ug/L	0.5	0.5	

Figures

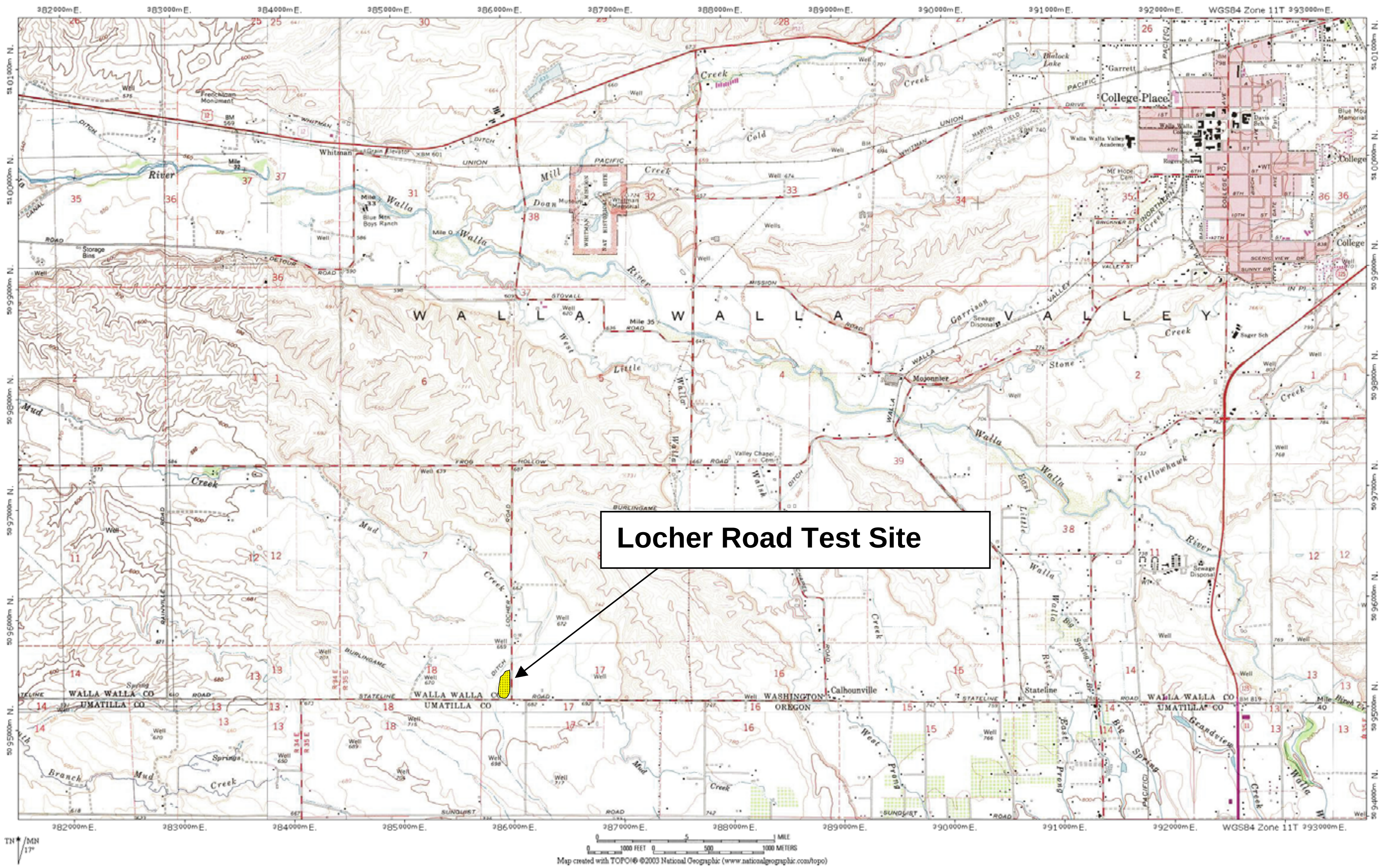

Figure 1. Area location map.

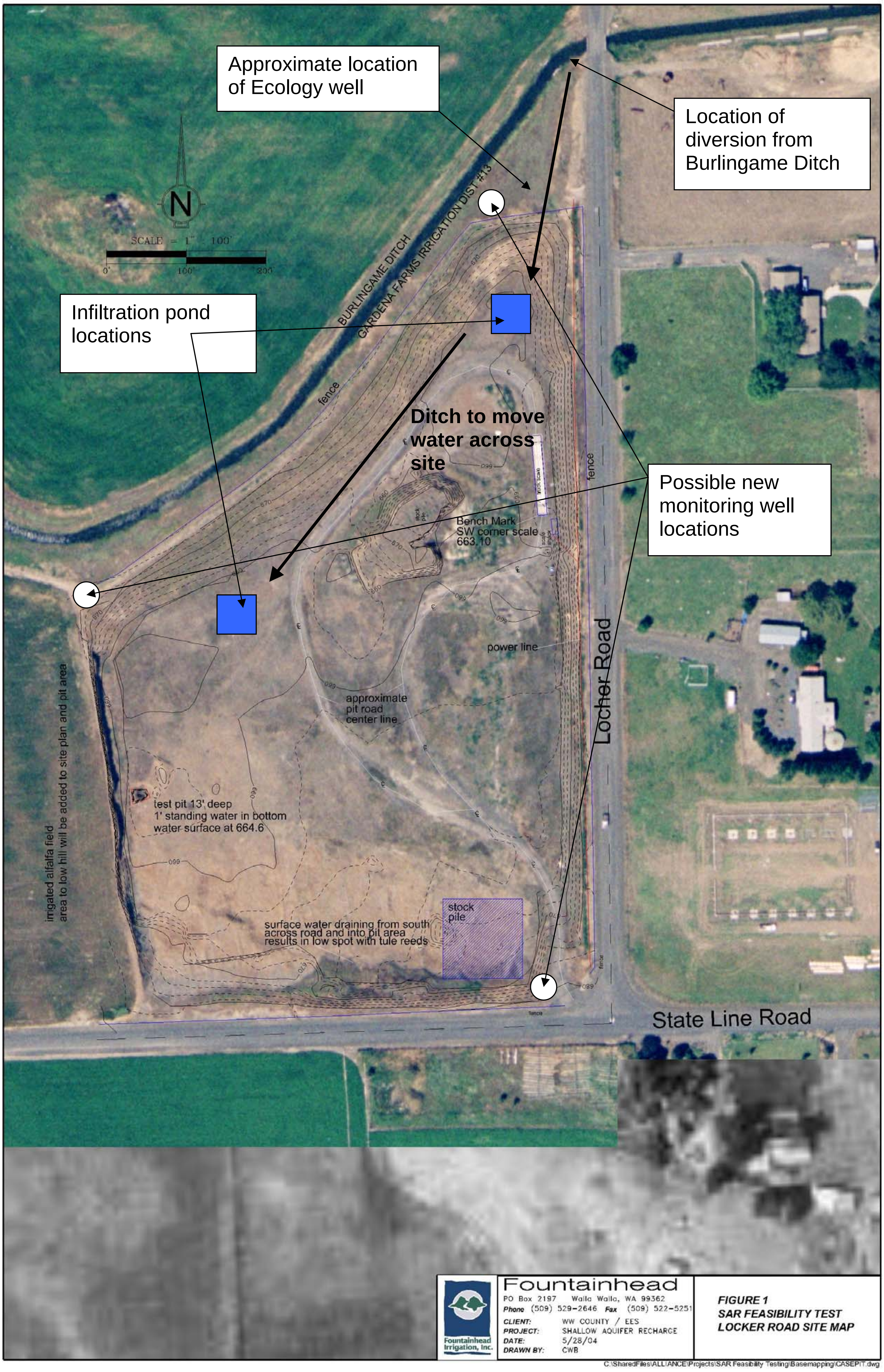

Figure 2. Site Layout.