Ambient Ground-Water Monitoring in the West Valley area, Yakima County, Washington

Quality Assurance Project Plan

By
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Approvals

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Project Description

The Environmental Assessment Program (EAP) was asked, by Robert Raforth of Ecology's Water Quality Program, to establish an ambient groundwater monitoring network for the West Valley area of Yakima County. The West Valley encompasses highly urbanized rapidly developing land adjacent to the western city limits of Yakima. The project area includes the proposed service area and the urban growth area for the City of Yakima. The study area is loosely bounded by the city of Yakima to the East, the Yakima Nation Reservation to the south, and a mixture of private orchard/ranchland and public forest lands to the West and North. The primary surface water drainages within the area include Ahtanum, Hatton, Bachelor, Spring, and Wide Hollow creeks (Figure1).

Only small pockets of the West Valley are served by sanitary sewers. Accordingly, individual septic systems are the primary means of domestic wastewater disposal. Groundwater from individual or public supply wells is the primary source of potable water for area residents. A 1973 sampling of 100 West Valley wells by the WA Department of Social and Health Services (DSHS) revealed that 23 percent of the wells sampled contained coliform bacteria (DSHS, 1973). Nitrate (as N) concentrations for these wells varied from a low of 0.01 to a high of 1.2 mg/L. Larson (1993) sampled 16 West Valley wells during pesticide screening evaluations of the Ahtanum Creek drainage. For the wells sampled, nitrate+nitrite (N) concentrations ranged from 0.41 to 5.19 mg/L and averaged 2.03 mg/L.

This study will evaluate water quality in approximately 20 private domestic wells and two surface water stations within the West Valley area over a two year period. The surface water stations, one each on Wide Hollow and Ahtanum creeks will be installed and monitored by staff from EAP's Environmental Monitoring and Trends Section (EMTS). The monitoring protocols for these gages are described in a separate study proposal (Plotnikoff, 2000).

Project Objectives

The objective of this study is to establish an ambient groundwater monitoring network in the West Valley area of Yakima County. The network will be used to update past monitoring results, to expand upon past groundwater quality monitoring in the area, and to determine if the concentration of target parameters varies seasonally in area groundwater.

A secondary objective of this study is to determine whether surface water samples, collected during baseflow conditions, provide a reasonable approximation of average ground-water quality conditions within the study area. The results of this study will be used by Ecology and County staff to develop mitigation measures to alleviate groundwater contamination problems in the West Valley area.

Project Organization and Responsibility

Clients: *Robert Raforth*, Project client, Ecology CRO WQ program (509) 457-7113: Responsible for coordinating with other agency staff and reviewing drafts of the project QAPP and final data report.

Elaine Taylor, Yakima County (509) 574-2230: Responsible for coordinating county activities related to this project and reviewing drafts of the project QAPP and final data report.

Project Lead: *Kirk Sinclair*, Ecology (360) 459-7469: Responsible for managing the project, preparing the project Quality Assurance Project Plan (QAPP), coordinating and completing sampling activities, analyzing project data, and preparing the draft and final data reports. Serves as the principal public contact for the technical aspects of the study.

Project Assistants: Present and future EAP interns: Responsible for assisting with sampling activities.

Laboratory Services: *Karin Feddersen*, MEL (MEL) (360) 871-8829: Responsible for coordinating requests for analysis, scheduling sample processing, and providing access to project data.

Study Approach

The objectives of this study will be met through a combination of fieldwork and in-office evaluations of historic water quality and groundwater level data. The following criteria will be used to select the domestic wells that will comprise the monitoring network for this study.

1) A well drillers report (well log) must be available for the well
2) The well should be completed within the upper most aquifer that is commonly used for domestic water supply within the area
3) The well must be easily accessed for water level and water quality sampling
4) The current well owner must grant access to the well
5) The well must be located in the West Valley area
6) The well was preferably monitored during at least one previous investigation (DSHS, 1973, Larson, 1993).
7) The well should not have a water treatment device (such as a water softener or iron treatment system) or a large storage tank that can not be bypassed during well purging and sampling
8) The study wells, in total, should be distributed to provide a representative coverage of the study area.

Shallow wells are preferred for this study since they are the most likely wells to be impacted by increased septic discharges, changing agricultural practices, or other land use activities that may adversely affect groundwater quality.

The well network established for this study will be monitored quarterly for two years. Wells selected for monitoring will be field located on 1/24k quad maps for subsequent analysis and plotting via Arcview GIS software. Network wells will be sampled for the following field parameters: temperature, electrical conductivity, pH, dissolved oxygen, ferrous iron (using the 2-2' dipyridyl method), and water level. The following laboratory parameters will also be analyzed: total persulfate nitrogen (TPN), nitrate + nitrite (N), total coliform, fecal coliform, chloride, total dissolved solids, total iron, and total manganese. These parameters were chosen because they provide a good indication of overall water quality and are typically present in a number of contaminant sources.

Instream piezometers will be used to define the vertical hydraulic gradient between surface water and groundwater at selected locations within the study area. At a minimum, instream piezometers will be co-located with soon to be activated ambient SW monitoring stations on Ahtanum and Wide Hollow Creeks.

The piezometers consist of a seven foot length of ½ inch diameter galvanized pipe, one end of which is crimped and slotted. The piezometers will be hand driven into the stream bed to a maximum depth of approximately 5 feet. The head difference between the internal piezometer water level and the external creek stage, provides an indication of the hydraulic gradient and the direction of flow between the creek and groundwater within the hyporheic zone of the stream bed. When the piezometer head exceeds (is higher than) the creek stage, ground water discharge into the creek can be inferred. Similarly, when creek stage exceeds the head in the piezometer, loss of water from the creek to ground water storage can be inferred.

The instream piezometers will be measured, by staff from EAP's EMTS section, during the monthly surface-water sampling events. The measurements will define both the direction and the relative magnitude of surface water/groundwater exchange between Wide Hollow Creek, Ahtanum Creek, and area groundwater. The piezometer measurements will be used during subsequent data analysis to identify the surface water sampling events where groundwater discharge comprised a significant (relative to other events) portion of total streamflow.

Data Quality Objectives

This section describes the data quality objectives for the groundwater aspects of this study. Data quality objectives for the surface water portion of the study are described in a separate study plan (Plotnikoff, 2000).

EAP Watershed Assessment Section (WAS) protocols will be followed when measuring water quality field parameters (Ecology, 1992). The data quality objectives for this project are presented in Table 1. The expected detection or reporting limits for field parameters and laboratory analyses are listed in Table 2 along with the anticipated analytical method. To enable the data to be used for water quality trend analysis, an overall accuracy of ± 20 to 30 percent is warranted for all parameters except coliform bacteria, for which an accuracy of ±100 percent is acceptable. The total accuracy figures are reflective of the reported precision and bias limitations of the respective analytical methods (Ecology, 1991).

Analytical and Sampling Procedures

Standard MEL laboratory methods are appropriate for this study and should enable us to meet the project data quality objectives (see tables 1 and 2). "Clean" techniques or low-detection limit methods are not warranted for this study.

Ground-water levels will be measured at each of the study wells prior to sampling. Water level measurements will be made using a calibrated electric well probe or steel tape in accordance with standard USGS methodology (Stallman, 1983).

We will use a flow through sampling cell to ensure a consistent purging and sampling procedure. At the start of each sampling day field meters will be calibrated, with known standards, in accordance with the manufacturers instructions. Wells will be purged at a rate of approximately 3 gallons per minute, the maximum flow rate for the sampling cell. Ground-water temperature, electrical conductivity, pH, and dissolved oxygen concentration will be measured at three minute intervals during well purging. Samples for laboratory analysis will be collected (using MEL supplied bottles) when a minimum of three casing volumes of water have been purged from the well and all field parameters have stabilized. Stabilization has occurred when there is less than a five percent difference, between successive three-minute measurements, for all parameters. All bottled samples will be stored on ice pending their arrival at the laboratory.

Each of the quarterly sampling events will take two days to complete. In order to meet established holding times for total and fecal coliform bacteria, it will be necessary to "air freight" bacteria samples, collected on day one, to the laboratory.

Quality Control Procedures

Standard USGS protocols for groundwater level data collection will be followed throughout this study (Stallman, 1983). The equipment used to measure ground-water levels (electric tape or steel tape) will be inspected prior to use to verify that it is working properly. Steel tapes will be checked for bends or twists that might result in inaccurate readings. Electric tapes will be checked to confirm they have fresh batteries and will be calibrated with a steel tape of known accuracy prior to initial use.

Water levels will be measured to the nearest 0.01 foot, with two successive measurements being made at each well. The difference between measurements should not exceed 0.01 feet.

All meters used to measure water quality field parameters (water temperature, electrical conductivity, pH and dissolved oxygen concentration) will be checked and calibrated as appropriate against known standards at the start of each sampling day. Meter calibration will be done in accordance with the manufacturer directions. Field duplicate samples will be used to assess the variability in laboratory sample analyses. Blind duplicate samples, comprising approximately 10 percent of total samples, will be submitted to the laboratory during each sampling event.

Representativeness

The sampling design is intended to ensure the data are representative. Duplicate groundwater level measurements will be made at each well site to assure that the measured water level represents static conditions and is not recovering from recent pumping.

Completeness

To maximize the amount of usable data collected during this study, we will follow accepted USGS protocols for ground-water level data acquisition. Only appropriately calibrated and maintained field equipment will be used.

Comparability

Data comparability between this study and others will be assured by following standard USGS protocols for ground-water level data acquisition, (Stallman, 1983) and Watershed Assessment Section protocols for water quality field parameters (Ecology, 1992).

Data Assessment and Reporting

At the completion of each sampling event all field and laboratory analytical data will be compiled and evaluated against the project data quality objectives. Data reduction, review, and reporting will follow the procedures outlined in MEL's lab users manual (MEL, 1999). Lab results will be checked for improbable or missing data. Analytical precision will be evaluated using standard statistical techniques (relative percent difference (RPD), standard deviation (s), pooled standard deviation (sp) or percent relative standard deviation (%RSD)) as appropriate. The %RSD for field and laboratory duplicates will be used to assess data quality relative to that listed in Table 1.

Once verified project results will be transitioned to the EIM data repository. The project lead will forward all ground-water level and quarterly sampling results to the project clients upon completing the first year of sampling (following sample event four). A draft data report summarizing monitoring results for years 1 and 2 of the project will be forwarded to the clients within four months of receiving the final round of sample results from MEL. The study report will include all field data, a map (showing well, instream piezometer, and surface water sampling sites), interpretive results, and study conclusions and recommendations. The final data report should be ready for publication within three months of receiving review comments on the draft data report.

Project Budget

Laboratory analytical costs: Project total: $25,696 (see Table 3 for details)

Estimated infrastructure cost:

Install 6 instream piezometers: $240.00 start card fees
$250.00 pipe and piezometer labor cost

Project Schedule

July 2000 through April 2003 (see Table 4 for details)

Table 1 - Data Quality Objectives

Parameter	Accuracy (2*precision + bias)	Precision (%RSD)	Bias	Lowest level of interest
pH (field)	± 0.1 pH units	NA	NA	NA
Conductivity (field)	± 5 %	NA	NA	25 umhos/cm @ 25 C
Temperature (field)	± 0.1 C	NA	NA	NA
Dissolved Oxygen (field)	± 30 %	10	10	0.5 mg/L
Ferrous Iron (2-2' dipyridyl)	± 30 %	10	10	Unknown
TPN	± 30 %	10	10	0.1 mg/L
Nitrate + Nitrite as N	± 20 %	5	10	0.1 mg/L
Coliform, total (MF)	± 100 %	40	20	1 CFU
Coliform, fecal (MF)	± 100 %	40	20	1 CFU
Chloride	± 25 %	5	15	1 mg/L
TDS	± 30 %	10	10	1 mg/L
Iron (total)	± 30 %	10	10	20 ug/L
Manganese (total)	± 30 %	10	10	1 ug/L

Table 2 - Summary of field and laboratory measurements, methods, target detection limits and expected ranges for groundwater samples^

Parameter	Method	Reporting Limit	Expected Range*
Field Measurements			
pH	Field Meter	+/- 0.1 SU	6.5-8.5 standard units
Conductivity	Field Meter	+/- 5%	100-700 umhos/cm @ 25 C
Temperature	Field Meter	+/- 0.2 C	8-14 C
Dissolved Oxygen	Field Meter	+/- 0.2 mg/L	unknown
Ferrous Iron	2-2' dipyridyl	unknown	unknown
Laboratory Parameters			
Total persulfate nitrogen	SM 4500-N C	0.10 mg/L	unknown
Nitrate + Nitrite as N	SM 4500NO3I	0.01 mg/l	<0.1-12 mg/L
Coliform, total (MF)	SM 9222B	1 CFU	0-TNTC
Coliform, fecal (MF)	SM 9222D	1 CFU	unknown
Chloride	EPA 300.0	0.1 mg/L	3-20 mg/L
TDS	EPA 160.1	1 mg/L	100-500 mg/L
Iron (total)	SW 6010	20 ug/L	<20-5000 ug/L
Manganese (total)	EPA 200.7	1 ug/L	<1-5000 ug/L

^ The summary of surface water parameters, methods, reporting limit, and expected range are contained in a separate study proposal (Plotnikoff, 2000)
* Expected range determined from prior investigations by Foxworthy (1962), Van Denburgh and Santos (1965), and DSHS (1973)

Table 3 - Estimated Laboratory Cost by Parameter (8 samplings of 20 wells)

Parameter	Number of Samples*	Cost per sample	Cost per Parameter
TPN	176	$16	$2,816
Nitrate + Nitrite (N)	176	$21	$3,696
Coliform, total (mf)	176	$25	$4,400
Coliform, fecal (mf)	176	$20	$3,520
Chloride	176	$12	$2,112
TDS	176	$10	$1,760
Iron (total)	176	$21	$3,696
Manganese (total)	176	$21	$3,696
TOTAL LAB COST			$25,696

* Includes two sets of field duplicate samples (10% duplicate rate) for each of the 8 groundwater sampling events. The anticipated laboratory analytical costs for the surface water aspects of this study are contained in a separate study proposal (Plotnikoff, 2000).

Table 4 - Project Timeline (by Task)

TASK	2000 JASOND	2001 JFMAMJJASOND	2002 JFMAMJJASOND	2003 JFMAM
Project Planning	J			
QAPP preparation	ON			
Well selection	ND			
Project setup in EIM	D			
Quarterly sampling	D	M J S D	M J S	
Quarterly LIMS upload to EIM		F M A N	F M A N	
Annual data submittal to Client		D		
Compile project data			OND	
Prepare draft data report			D	J
Incorporate Review Comments and Finalize Report				FMAM

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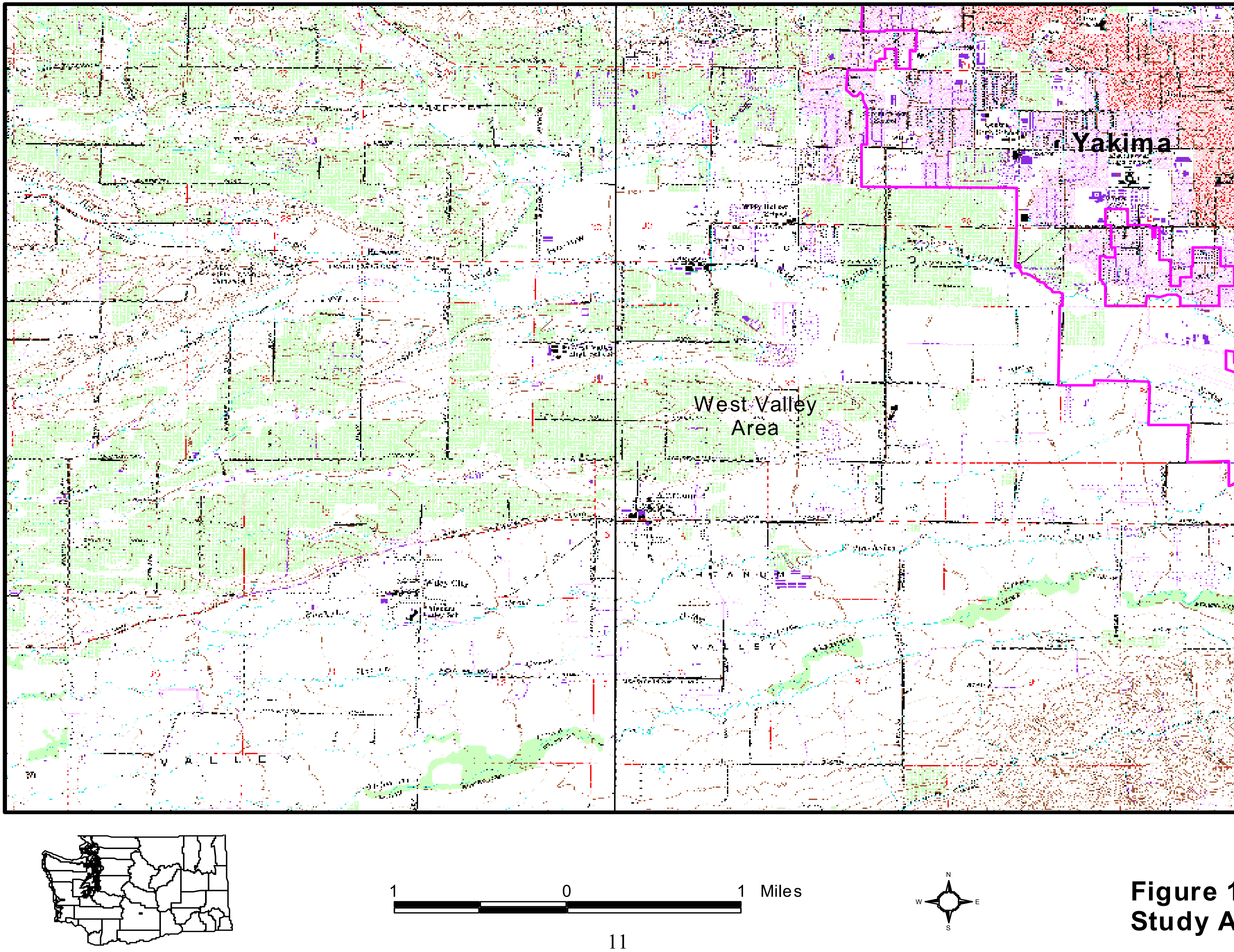

Figure 1
Study Area