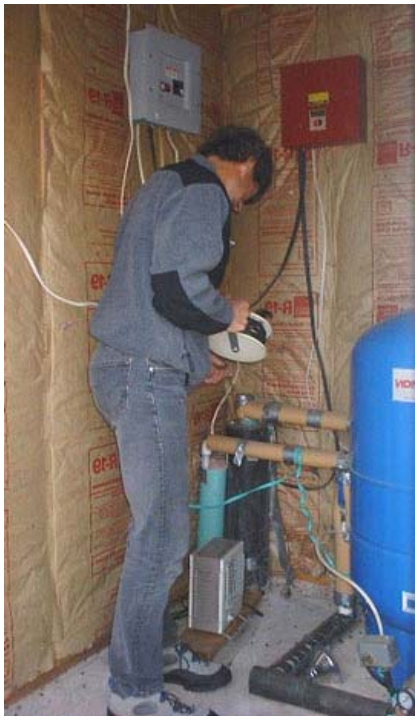
Strategic Recommendations for ***Groundwater Assessment Efforts*** of the Environmental Assessment Program



by
Charles F. Pitz

Environmental Assessment Program
Washington State Department of Ecology

May 2003

Publication No. 03-03-009

Publication Information

This report is available on the Department of Ecology home page on the World Wide Web at http://www.ecy.wa.gov/biblio/0303009.html

For a printed copy of this report, contact:

Department of Ecology Publications Distributions Office
Address: PO Box 47600, Olympia WA 98504-7600
E-mail: ecypub@ecy.wa.gov
Phone: (360) 407-7472

Refer to Publication Number 03-03-009

Groundwater Website

The Environmental Assessment Program's Groundwater website is at www.ecy.wa.gov/programs/eap/groundwater/index.html

Table of Contents

Acknowledgements

The author benefited from insights and ideas from many professionals. People who most actively participated in discussions regarding this evaluation include:

- Staff with the Washington State Department of Ecology
  - Barb Carey, Denis Erickson, Pam Marti, and Kirk Sinclair of the Environmental Assessment Program
  - Susan Braley, Diane Dent, Melanie Kimsey, Laurie Morgan, and Megan White of the Water Quality Program
  - Tom Culhane, John Kirk, Doug McChesney, and Joe Stohr of the Water Resources Program
  - Dan Alexanian, Jim Pendowski, and Charles San Juan of the Toxics Cleanup Program
  - Gale Blomstrom and Victoria Leuba of the Shorelands and Environmental Assistance Program
  - Russ Darr, retired
  - Dick Wallace, Executive
- Contributors from outside the Department of Ecology
  - Jalyn Cummings, Snohomish County
  - Ken Johnson, King County
  - Kirk Cook and Rod Baker, Washington State Department of Agriculture
  - David Jennings, Washington State Department of Health
  - Jennifer Parker, U.S. Environmental Protection Agency Region 10
  - Cindi Barton, and Gary Turney, U.S. Geological Survey
  - Douglas Towne, Arizona Department of Environmental Quality

I would like to thank Darrel Anderson, Bill Backous, Will Kendra, and Dale Norton of Ecology's Environmental Assessment Program for supporting this project, allowing me the time to work with the complex issues, and recognizing the need for thoughtful attention to the groundwater resources of the state. Jennifer Parker and Tim Hamlin of the Region 10 USEPA Ground Water Protection Unit arranged additional financial support for the completion of this report; their assistance is greatly appreciated.

Finally, acknowledgement and thanks go to Joan LeTourneau for her editorial assistance in preparing this report.

Introduction

Although unseen, groundwater is a vital source of water supply for Washington State's citizens and economy. More than 65% of the state's nearly six million residents depend on groundwater for their drinking-water needs, and groundwater currently supports approximately one-quarter of the total water demand in the state (including for irrigation and industrial uses). It is clear that as our population expands, and efforts to restore and preserve our surface water resources continue, growth in public and private water use will be supported by significant increases in groundwater withdrawals.

As a fundamental component of the hydrologic cycle, groundwater also plays an important role in our state's environmental quality. Discharge from groundwater systems sustains stream and river baseflow, and directly influences the quality of riparian and wetland ecosystems. The close interconnection and routine water exchange between aquifer systems and surface water means that groundwater can be a factor in many of Washington's most significant environmental management issues. Examples include water allocation permitting, salmon recovery and watershed planning efforts, wastewater discharge permitting decisions, aquifer storage and recovery projects, and Total Maximum Daily Load (TMDL) studies. While the ultimate goal of many of these efforts is to protect surface water quality and habitat, they cannot be implemented effectively without an informed understanding of groundwater conditions and influence.

Groundwater in Washington is a complex, large-scale, three-dimensional resource with a high degree of spatial variability. Groundwater can be difficult and costly to monitor accurately, but is nonetheless vulnerable to a diverse range of external stresses, including chemical contamination and depletion by over-pumping. Time scales of groundwater recharge and contaminant travel in aquifer systems can mean that recognizing and correcting these stresses can require many years. Over two decades of experience in the remediation of contaminated groundwater has shown that the costs to restore a chemically-impacted aquifer system can be extraordinary, and in some cases restoration may even be technically infeasible. Similarly, withdrawals of groundwater beyond the limits of sustainable yield can result in the reduction of critical surface flows or loss of an aquifer for water supply purposes (groundwater mining). Because of the cost and complexity of understanding and repairing the resource, groundwater-related problems are often among the most intractable resource issues to address.

Ensuring the availability of a clean, plentiful supply of groundwater is clearly an essential element of Washington's future. Despite the broad importance of the resource, many areas of the state lack adequate information about the underlying hydrogeologic setting and area-wide groundwater conditions. We still have an incomplete understanding of whether or not state groundwater quality is declining over time on a broad scale, or if the state is experiencing significant large-scale changes in groundwater quantity as a result of reductions in recharge, climate changes, or overdraft.

Limited knowledge about groundwater and its role in the quality and availability of water in state watersheds has hampered the ability of the Washington State Department of Ecology (Ecology) and local governments to make informed environmental and public health management

decisions. This has resulted at times in the need to apply conservative management solutions to problems that involve groundwater, for example the closure of permitting of groundwater withdrawals in watersheds where surface water rights may be impaired, or the use of larger margins of safety in TMDLs.

In response to these concerns, the management team of Ecology's Environmental Assessment (EA) Program, the primary environmental monitoring branch of the agency, requested (1) a review of the current state of affairs for assessment and measurement of state ambient[1] groundwater conditions, and (2) strategic recommendations regarding how the EA Program can best help Ecology and the state meet current and future information needs for the groundwater resource.

To support these objectives, a number of tasks were undertaken, including:

- A review of the existing legal mandates (and resulting available funding) related to groundwater monitoring and assessment.
- A statewide survey to assess the state of affairs for active, long-term monitoring programs for both groundwater quality and water-level conditions.
- A review of the state of affairs for hydrogeologic characterization[2] efforts in Washington.
- A review of ambient groundwater monitoring and characterization programs operated by other states.
- Interviews with local and state-level stakeholders to help identify the common denominator information needs for the groundwater resources of Washington.

This report summarizes the key findings and recommendations resulting from these efforts.

[1] The term "ambient" refers to broad-scale or area-wide conditions, conditions not associated with a specific point source, facility, or property.

[2] The term "characterization" is distinguished from the term "monitoring" in this report. Characterization includes the measurement, description, and interpretation of the hydrogeologic setting that groundwater occurs in; monitoring is the point measurement of water quality or water-level conditions of the groundwater present in such a setting. The term "assessment" is used in this report to describe efforts that combine both characterization and monitoring.

Legal Mandates and Funding

The available statutes and regulations were reviewed for language that directs the ambient monitoring or characterization of the state's groundwater resources. The influence of these legal mandates on the availability of funding for assessment efforts also was evaluated. The Appendix presents detailed information on the applicable statutes and regulations identified during this review.

A key finding of this review is that there are no clearly-articulated legal mandates requiring the state to systematically assess area-wide ambient groundwater or hydrogeologic conditions. A number of state legislatures across the nation have chosen to establish explicit laws requiring (and providing funding for) the *inventory and measurement* of their groundwater resources. In Washington State no equivalent legislation exists.

The principles and goals of groundwater *protection and/or management* are well described in state and federal regulatory acts and policy guidelines. Examples include the Antidegradation Policy described in the state's Water Quality Standards for Ground Water (Chapter 173-200 WAC), the objectives outlined in the Regulation of Public Ground Waters (Chapter 90.44 RCW), and the requirements for Source Water Assessment Programs under the federal Safe Drinking Water Act. However, no regulatory language was identified that directly obligates the state (or parties regulated by the state) to measure aquifer or groundwater conditions to determine compliance with these goals, beyond a site-specific scale.

The need for high quality, accurate assessment of the state's groundwater resource is largely *implied* by the existing legal mandates as a responsibility of Ecology, as a prerequisite of effective management of that resource. The practical result is that efforts to monitor ambient groundwater quality and quantity conditions, or to characterize state aquifers, are largely *discretionary* responsibilities for Ecology. The absence of a clear legal mandate (and associated dedicated funding) requiring the organized cataloguing of the state's groundwater resources is a primary reason Washington lacks a groundwater characterization or ambient monitoring program like those operated by many other states.

With an abundance of important legal mandates and attention focused on surface water (e.g., federally-driven programs addressing surface water quality, endangered-species listings of fish related to declining surface water flows), the bulk of the freshwater-assessment funding spent by Ecology has been directed towards the measurement of conditions in the state's rivers, streams, and lakes. The federal Clean Water Act does assert that states should conduct groundwater water-quality monitoring, but qualifies that these efforts only be done "…to the extent practicable".

These factors have resulted in a noteworthy imbalance in the funding historically available to assess ambient groundwater conditions in Washington. As an outgrowth of the regulatory and funding bias towards surface water, a significant portion of the current EA Program groundwater staff research is conducted on behalf of surface water management efforts. In a broad view, the

funding that is available for groundwater assessment is not commensurate with the relative value of the resource to the state and its citizens.

Under the terms of the Safe Drinking Water Act (SDWA), states are required to conduct periodic compliance monitoring of the quality of the water from public water supply wells. However, a significant proportion of the monitoring activities conducted under the state's drinking water program (overseen by the Washington Department of Health – WDOH) is focused on the analysis of the final or *polished* water quality delivered to users, and is not an accurate measure of in-situ groundwater conditions. Monitoring of the quality of the raw water from individual wells, a better measure of aquifer conditions, is only required for a limited list of parameters. The federal requirements of the SDWA do not explicitly mandate that states monitor area-wide, ambient water-quality conditions in source aquifers (e.g., conditions upgradient of municipal supply wells).

Most of the state's spending for groundwater monitoring or characterization activities has been in support of regulatory-driven, site-scale studies, including compliance evaluations of facilities permitted to discharge to ground, investigations at remediation sites, or permitting of water rights. The majority of Ecology's professional hydrogeologists are employed in this capacity.

The primary examples of discretionary state-level spending on field-based assessment and measurement of larger-scale ambient groundwater conditions include:

- The operation of area-wide groundwater water-level monitoring networks over limited portions of the state by the regional Water Resource Program offices.
- A limited number of groundwater studies conducted by regional or headquarters hydrogeologists outside of the EA Program.
- A portion of the technical studies conducted by groundwater staff in the EA Program.

One notable finding of the review of applicable legal mandates is that directives to monitor the state's ambient groundwater chemical quality (the original bias of this strategic planning effort) are not necessarily any clearer or more compelling than requirements to monitor or characterize physical aspects of the resource (e.g., monitoring of groundwater water levels, the assembly of aquifer yield data, or the assembly of an atlas describing state aquifer systems). Both chemical quality and physical condition are essential and interrelated features of the groundwater environment, and knowledge and description of both are necessary for responsible management decisions.

Until the state legislature provides a direct mandate, opportunities for establishing a state groundwater assessment program will remain at Ecology management's discretion. In the long-term, there is a clear need for the legislature to statutorily recognize the need for, and devote funding to, the assessment of the groundwater resource in a manner equivalent to its value to the citizens.

State of Affairs

Groundwater Monitoring

Many valuable one-time or site-specific groundwater monitoring efforts have been conducted in Washington State over the past decades. However, of particular interest for this evaluation is the state of affairs for groundwater monitoring programs that repetitively measure area-wide, ambient groundwater water-quality or water-level conditions over time. This review, which examined the monitoring efforts that have been conducted by a broad spectrum of organizations involved in groundwater, included a recent survey focused on local government activities[3]. During our evaluations, the EA Program learned that:

Water Quality

- The most extensive ongoing monitoring program involving the collection of groundwater data is overseen by WDOH, under the terms of the SDWA and associated state regulations. Through the WDOH drinking water program, water quality is periodically monitored for a limited list of parameters at approximately 16,000 groundwater-dependent, public water-supply systems throughout the state. While the WDOH program are an important source of groundwater water-quality information (no groundwater water-level data is collected or reported under the WDOH program), *there are significant technical limitations to the usefulness of the data from this program*. In addition, the WDOH program does not provide a routine measure of the quality of the groundwater consumed by nearly one million state residents drawing their drinking water supply from privately owned domestic wells. As a result, the WDOH drinking water monitoring system is unlikely to serve as an effective long-term substitute for a state ambient groundwater quality monitoring program.

- A second important source of monitoring data for groundwater conditions in Washington is the U.S. Geological Survey (USGS). The USGS offices employ a number of groundwater professionals, and have conducted high-quality investigations of ambient groundwater conditions for most of the state's major aquifer systems over the past several decades. Studies by the USGS are traditionally conducted on a large regional scale (meaning the sampling density can be quite low), and focus on issues of national importance. The groundwater water-quality (and water-level) monitoring data collected through these studies is readily available over the internet. Unfortunately, the majority of the studies conducted by the USGS do not involve long-term, ongoing monitoring. Exceptions include the studies conducted under the USGS National Water Quality Assessment (NAWQA) program. The NAWQA program design includes trend monitoring for changes in groundwater quality at a decade interval, although federal funding to maintain the NAWQA program is subject to change. The Puget Sound Basin and the Central Columbia Plateau[4] are the primary NAWQA study areas in Washington.

[3] A complete report of this survey is available at www.ecy.wa.gov/programs/eap/groundwater/survey.html.
[4] The Central Columbia Plateau NAWQA study area was recently modified to include the Yakima River Basin.

- Locally-based, long-term groundwater quality monitoring efforts, including Ground Water Management Area (GWMA)-based programs, cover only a limited portion of the primary aquifers of the state and vary in parameters measured, methods of measurement, data quality and accessibility, and degree of long-term commitment. While there are some well-run programs in areas of high groundwater dependence (e.g., Spokane, Clark, Island, Thurston, and Pierce counties, and the King County and Central Columbia GWMAs), the variability and incomplete coverage of the local information suggests that efforts to synthesize the data to evaluate statewide conditions would be limited in success, and probably not cost-effective.

- While a significant portion of their work is focused on site-scale studies, EA Program groundwater staff have conducted wider-area, ambient groundwater quality monitoring at various locations across the state over the past decade or more. These ambient condition studies have focused largely on nitrate and pesticide conditions in rural and agricultural regions. In only one case has the EA staff returned for follow-up sampling to characterize longer-term water-quality trends (nitrate conditions in the Sumas-Blaine area of Whatcom County). More recently, EA groundwater scientists have been measuring area-wide water-quality conditions for select parameters in support of loading analyses for TMDL studies.

- Additional ambient sampling of groundwater quality also has been conducted by Ecology's regional hydrogeologists (e.g., chloride sampling on Marrowstone and Anderson islands), although this work has traditionally been limited by heavy workloads related to regulatory activities.

- Private consultants conduct extensive water quality (and water-level) monitoring throughout the state. The bulk of this work is conducted in support of site-scale investigations of point-source problems. Consultant monitoring of larger-scale ambient conditions (e.g., measuring background water-quality conditions for a cleanup study, or describing area water-quality or water-level conditions for a municipal well-field investigation) does occur on a more limited basis, often on the behalf of public clients. The data from these investigations can be difficult to access, even in those cases where the information was generated in response to a regulatory requirement from Ecology, or where state grant funding has supported the work. Monitoring of this kind also is commonly not long-term in nature.

Water Levels

- The regional offices of Ecology's Water Resource Program operate the most extensive ambient groundwater water-level monitoring networks in the state. The number and distribution of wells monitored varies significantly by region, with the majority of the measurements occurring in central Washington. Access to the regional water-level databases has generally been limited, although an effort is underway to migrate the information to Ecology's Environmental Information Management (EIM) system. A portion of the studies conducted by EA or regional groundwater staff have included the measurement of groundwater water levels, but little long-term monitoring has been conducted.

- As indicated earlier, the USGS has collected a large data set of groundwater water-level measurements during the course of their regional studies. While many of the wells in the

USGS database have repeated measurements over time, the data have not, to date, been synthesized into a broader state-scale monitoring network.

- Locally-based, groundwater water-level monitoring efforts usually occur in conjunction with water-quality monitoring and therefore cover only a limited portion of the primary aquifers of the state. As with groundwater water-quality data, the technical reliability of the water-level data from local programs is mixed, and the majority of the data currently are not easily accessed electronically.

In summary, a review of the state of affairs for groundwater monitoring efforts in Washington revealed that, while a variety of water-quality and water-level measurements are being made throughout the state, the work is conducted in a poorly coordinated fashion. Two primary data gaps exist for groundwater monitoring in Washington: (1) limited efforts are ongoing to track water-quality and water-level *change over time*, and (2) there remains a gap in the monitoring coverage of ambient conditions between the larger regional USGS studies and the numerous site-scale studies conducted by a variety of public and private organizations.

Hydrogeologic Characterization

The accurate interpretation of groundwater monitoring data can only take place in the context of the hydrogeologic setting. Therefore, in addition to reviewing the monitoring programs active across the state, a review of the status of hydrogeologic characterization efforts also was conducted. The key findings of this review include:

- The majority of the aquifer characterization work conducted in the state beyond the site scale has been performed by the USGS. These characterization studies, which are typically high-quality, federally-funded investigations reporting conditions on a large regional scale, have provided valuable information about the overall hydrogeologic framework of the state (e.g., the Regional Aquifer System Analysis or RASA studies). The USGS has studied, and continues to study, all of the state's major aquifer systems including the Puget Sound Basin, the Central Columbia Plateau, the Yakima River Basin, the Clark County portion of the Portland Basin, and the Spokane River/Rathdrum Prairie Aquifer. Despite the high quality of these studies, the large scale of the information often does not provide the level of detail necessary to support accurate management or regulatory decisions involving groundwater.

- The USGS also conducts characterization studies at the county or WRIA scale under cooperative agreements arranged with local agencies (including Native American tribes). Cooperative agreements typically involve a match-funding arrangement between the USGS and a local client (i.e., federal matching dollars are contributed by the USGS to help pay for study costs). While these studies are of high quality, they also can be of high cost to the local client. The USGS traditionally enters these agreements when there is some compelling federal-level interest in the results of the study.

- Washington State currently devotes only limited effort to the characterization and cataloging of its aquifer systems, most often relying on the results of efforts by the USGS or private consultants hired on the behalf of a regulated party. Ecology's hydrogeologists employed outside of the EA Program do conduct some field characterization work in support of their

regulatory duties. Unfortunately, access to the information collected during these efforts is often limited (e.g., a portion of the work remains unpublished or is filed as printed reports in regional files; study data are rarely migrated to EIM) and the workload demands posed by staff's regulatory responsibilities restrict the time available for this work.

- The existing EA groundwater group does not *systematically* characterize state hydrogeologic conditions. The groundwater characterization studies that have been conducted by EA have normally been accomplished on the behalf of a regional client facing a specific regulatory or management issue. For the most part, the annual EA project proposal cycle dictates the groundwater staff efforts; as a result, there is no overarching logic or long-term strategy for inventory of the resource. The majority of the historic EA groundwater research efforts have been focused on the monitoring of groundwater quality conditions, which are often interpreted in the context of *existing* published hydrogeologic information. As EA groundwater staff are drawn into increasingly more complex technical studies involving groundwater (e.g., TMDLs), the shortage of background information about the hydrogeologic setting of the study areas makes these efforts progressively more difficult.

- While many states have independent (i.e., separate from the state's environmental quality agency) water resource departments or geologic surveys that assess and report on hydrogeologic conditions, Washington State has no such program. The Washington Division of Geology and Earth Resources program, an office of the Washington State Department of Natural Resources, does not address or report on hydrogeologic conditions, and does not employ professional hydrogeologists.

- Some important larger-scale hydrogeologic characterization work is conducted through local agencies, either by in-house staff or by consultants (including the USGS) hired by those agencies. The majority of these studies are related to investigating water supplies, and these studies may be funded by grant monies received from the state. Examples of such work include characterization studies conducted in Thurston County, and the Central Columbia Basin GWMA. Access to this information, particularly access to electronic versions of the data collected, is varied.

- While an extensive survey of the current status of ESHB 2514 watershed planning unit Level 2 and 3 (long-term) technical assessment efforts was not undertaken, evidence indicates that the amount of new hydrogeologic characterization (and groundwater monitoring) work that has been completed by local planning units is comparatively limited at this time.

- Private consultants conduct the majority of the site-scale characterization work occurring across the state, frequently in support of aquifer remediation or permit actions required by Ecology. The access to and quality of the information generated by these studies is highly varied.

In summary, a review of the state of affairs for characterization of the state's hydrogeologic setting indicates that there remain areas of Washington that lack baseline information, particularly at a scale between the larger regional USGS studies and the site-specific work of private or local public organizations. The lack of information and understanding about the state's hydrogeologic conditions inhibits the interpretation of monitoring results, and impedes Ecology's water management efforts.

Major Issues and Information Needs

Evaluating the status of assessment efforts for a resource as complex and varied as groundwater will inevitably reveal a variety of problems or issues that could benefit from attention. Some of the issues are important systemic problems regarding the state's regulatory priorities, funding choices, and water management organization, that are beyond the capacity of the EA Program to solve alone. During this review, the author focused on identifying key issues or information needs that directly relate to the EA groundwater group efforts, and that represent areas that the EA Program can actively address or improve. These issues, which are informed by the findings summarized above, are broken into three major categories discussed below: *information management and communication, data loss and data mining,* and *monitoring and characterization*.

Information Management and Communication

- *Access to the information generated by the EA groundwater group, and communication by the group with external stakeholders interested in groundwater, is poor.*

A recurrent theme heard from many of the people interviewed during this evaluation is a concern over the lack of coordinated data and information sharing between organizations involved in groundwater assessment. There was a desire expressed by many professionals for a single clearinghouse for groundwater information, allowing 'one-stop shopping' for data, published reports, hydrogeologic maps, etc. These comments describe the need for an independent (ideally, non-regulatory) state office whose defined role is to inventory the water resources of the state, including groundwater. This solution represents an important systemic change in the structure of state government for water management, and will only occur if and when the legislature mandates and funds the concept.

A more immediate need is an improvement of the coordination between individual organizations. The Interagency Ground Water Committee (IGWC[5]) is currently the main body for coordination on state groundwater issues. While the IGWC provides a valuable forum, it currently has a largely policy-based focus, less frequently addressing technical monitoring and characterization work (the EA groundwater staff historically have not participated as members of the IGWC). As a result, there remains the need for the formation of a state-level groundwater monitoring and characterization council that is specifically focused on issues related to the coordination, standardization, and sharing of technical data[6]. Considering the wide range of organizations

[5] See www.ecy.wa.gov/programs/wq/igwc/index.html for additional information about the IGWC.

[6] This idea has been implemented in a variety of other states, most recently in California. The formation of a statewide groundwater monitoring council in California was an outgrowth of a white paper prepared by the Natural Resources Defense Council, which concluded that the state was negligent in the monitoring and reporting of the state's groundwater quality conditions (see www.nrdc.org/water/pollution/ccg/ccginx.asp). The NRDC white paper was an important factor in the development of state legislation requiring improved coordination between organizations involved in groundwater monitoring.

collecting or generating groundwater information, and the difficult and costly steps required to reach the desired level of coordination, the assembly of such a forum may be unlikely in the foreseeable future.

In the near term, individual public agencies or offices currently involved in groundwater assessment will need to continue to improve access to their information by external parties. In the last several years a number of excellent steps have been taken in this direction. Examples of such progress include the development of a web-based search tool for all groundwater data in the USGS database, a web-based search tool for Ecology's EIM system, a digital bibliography of the WDGER geologic report holdings, Ecology's web-based search tool for the state well-log database, and county-based, web-accessible databases. Collectively, these steps are resulting in the formation of an informal, internet-based 'ring' that can serve many, though not all, of the same functions as a clearinghouse.

These concerns and efforts greatly highlight the need for the EA Program to improve access and sharing of its *own* groundwater information. Only a limited audience appears to be aware of the groundwater work conducted by EA; in certain cases even fellow groundwater professionals have little knowledge of the program's efforts. Some positive steps in this direction have occurred. For example, recent EA technical reports are now posted on the internet, and much of the groundwater monitoring data collected by the program is now migrated to EIM. Nonetheless, the EA groundwater group's management of information, and coordination and communication with parties outside of the program, need to improve significantly.

Data Loss and Data Mining

- *Valuable groundwater information collected using state grant monies is poorly managed, or even lost.*

The high cost of monitoring and characterizing the groundwater resource clearly suggests that whenever data are collected, they should be of high quality and readily accessible to those who need the information. Evidence collected during this evaluation indicates that the state routinely provides grant funding for groundwater data collection efforts by local organizations (or their consultants), but does not *reliably* receive, manage, house, or evaluate that data.

Boilerplate language for the Water Quality Program (Centennial Clean Water program, State Revolving Fund, and Clean Water Act Section 319 grant funds) and Shorelands and Environmental Assistance Program (2514 Watershed) grant agreements does include requirements for the electronic submittal of all environmental monitoring data generated by grant recipients. Grant recipients are directed to format and deliver data according to the standards of the agency's EIM Data Submittal Guide. The oversight of this data transfer is, in practice, a responsibility of a regional hydrogeologist or grant manager. Heavy workloads, and the complexity of and lack of familiarity with the EIM system, can result in the failure to capture these valuable data. Ecology, and the EA Program as the primary data branch of Ecology,

should consider formal steps to prevent loss of valuable groundwater information paid for by state taxpayers[7].

- *Valuable groundwater information housed in regional Ecology databases is difficult to access.*

Knowledge of long-term state groundwater water-level conditions is becoming increasingly important for the effective management of the state's water supplies. While not providing complete coverage of the state's aquifer systems, the regional offices of the Water Resources program have operated independent water-level monitoring networks for many years. The data from these networks, currently stored in databases overseen by each regional office, are difficult to access at this time. While progress has been made in migrating these data to the agency EIM system (notably for the Southwest Region database), workload demands have limited the time available for regional database managers and EIM staff to devote to the effort. Considering the high value of this information, Ecology and the EA Program should consider providing all necessary technical assistance to accelerate this effort.

Monitoring and Characterization

- *Many areas of the state still lack baseline information about the hydrogeologic setting and ambient groundwater conditions of aquifer systems, particularly at a local-basin scale. Washington State does not dedicate funding or staff time to the systematic, baseline description of its groundwater resources commensurate with the value of these resources. The state does not have an adequate infrastructure in place to assess compliance with many of its groundwater protection and management goals.*

Despite the monitoring and characterization efforts described earlier, a number of pressing technical questions about our state groundwater resources remain. Some of the questions identified during interviews with stakeholders include, in no particular order of priority:

- What are ambient groundwater water-level conditions like across the state?
- Are groundwater water-level conditions changing significantly over time, particularly in areas of rapidly expanding groundwater use?
- Where, how, and when is groundwater interacting with surface water?
- How are groundwater discharges influencing surface water-quality and flow conditions?
- How much groundwater can be withdrawn without impairing surface water flows (i.e., are groundwater withdrawal rates sustainable?)
- What are the ambient groundwater quality conditions across the state, particularly for key chemical contaminants like nitrate, pesticides, or arsenic?

[7] While not a direct responsibility of the EA Program, these problems also highlight the need for improvements in the EIM data submittal interface available to external users.

- Are groundwater water-quality conditions changing significantly over time, particularly in areas undergoing rapid development?
- What is the quality of the groundwater being withdrawn by private domestic wells from shallower aquifer systems that is not routinely monitored by the WDOH Drinking Water Program?
- Are our groundwater protection efforts effective?

As expected, many of these questions are interrelated, although the technical approaches required to answer them may vary significantly. However, above all, two themes stood out as common denominator information needs by nearly all of the professionals interviewed: 1) the continued need for basic hydrogeologic characterization at the local-basin scale, and 2) improved ambient status and *trend* monitoring of water-quality and water-level conditions at the local-basin scale.

In light of all of the information reviewed for this evaluation, there remains a need for a systematic state program to assess and report on groundwater resource conditions at a scale better suited to the evolving business requirements of Ecology.

Recommendations

This section presents recommendations to Ecology managers for EA Program responses to the three key issues identified above. In addition to the information presented earlier, the recommendations are guided by considerations regarding:

- Approaches adopted by other states.
- The appropriate role of state government in comparison to private consultants, universities, and local and federal government.
- Limited funding and staff resources available in both the near term and (potentially) the long term.
- Technical capabilities of the EA groundwater staff.
- The unique character of groundwater, and the cost and complexity of assessing groundwater conditions.

Several of the actions recommended in this report have already been initiated, as described below. Others will require the consideration, approval, and commitment of resources, new or reassigned, by Ecology managers.

Information Management and Communication

The following recommendations are suggested to improve EA groundwater program information management and communication:

1. *Create a publicly-accessible website focused on the activities of the EA groundwater program*.

The website should, at a minimum, include:

- Contact information for all of the EA groundwater staff.
- A geo-referenced bibliography of all completed groundwater studies published by the EA groundwater group, including links to all web-published reports.
- Geo-referenced descriptions of current studies, including links to contact information and study quality-assurance plans.
- Easy access to the EA-generated groundwater data stored electronically in EIM.
- A comprehensive listing of links to other web-based sources of groundwater information for Washington State (i.e., pointers to other parts of an internet ring).

The development of an EA groundwater program website as described above was completed in November 2002 as a part of the strategic planning effort described in this report. The homepage for this website can be viewed at www.ecy.wa.gov/programs/eap/groundwater/index.html

2. *Formally commit resources and EA staff time to the ongoing maintenance and improvement of the website.*

EA Program managers should recognize the significant level of effort required to keep a website current and useful, and specifically allot time for such effort in the workforce plan and staff position descriptions (CQs). While the support of an EA staff expert in website management is available on a restricted basis, much of the day-to-day upkeep of the site lies in the hands of a groundwater staff member.

One example for future improvement of the website is the addition of an annotated, geo-referenced bibliography of all of the reports in the Washington State Water Supply Bulletin series, which often present baseline information regarding the state's hydrogeologic setting. Given the broad value of the water supply reports, there may be cost-sharing opportunities with other Ecology programs for this suggestion. A second possibility is incorporating groundwater open-file technical reports issued by other Ecology programs into the EA website bibliography. These suggestions represent unofficial steps towards the development of a single internet portal for the public to access Ecology-generated technical information about groundwater or hydrogeologic conditions. Recent experience with the new EA groundwater website points to a need for a wider discussion between Ecology's program and website managers to decide if such a portal is an agency goal.

3. *Commit to regularly sending an EA groundwater staff representative to Interagency Ground Water Committee (IGWC) meetings.*

Allot this task in the EA Program workforce plan and staff CQs. Until such time as a state-level groundwater monitoring and characterization council is created, the IGWC is the primary forum for cooperating on, and learning about, state groundwater issues. An EA representative should routinely attend these meetings to keep the program better connected to ongoing issues and to ensure that outside stakeholders are aware of EA groundwater efforts. The IGWC is also an important avenue for identifying potential funding partners.

4. *Consider seeking a legislative mandate for the formation of a state-level groundwater monitoring and characterization council.*

The EA Program should take an active role in spearheading an effort to improve the coordination of data standardization, collection, and sharing among organizations involved in the field assessment of state groundwater.

Data Loss and Data Mining

The following recommendations are suggested to improve the capture of valuable groundwater data that might otherwise be lost, or remain inaccessible to a larger audience. These recommendations are guided by the EA Program expertise in the EIM system in comparison to other Ecology programs:

1. *Devote a portion of EA staff resources to data-mining activities for groundwater monitoring data generated by state grant projects*.

Specifically, the EA Program should consider permanently assigning a portion of a groundwater staff member's time to a technical assistance role involving the oversight of data transfer to EIM from recipients of state grant monies that conduct groundwater monitoring.

Where appropriate, portions of this work could be assigned to an EA staff member directly involved in EIM support. However, a groundwater professional should (1) be involved in the routine tracking of state grant projects involving the collection of groundwater data, (2) coordinate closely with regional hydrogeologists or grant managers responsible for the grants to ensure the transfers occur, and (3) be the final arbiter of the decision to accept or reject the data for inclusion in EIM, as well as assign an EIM quality assurance level to the data. Funding for this work could be cost-shared with the programs providing the grant monies.

2. *Devote a portion of EA groundwater staff time to providing technical assistance for the transfer of the regional Water Resource Program groundwater water-level databases into EIM*.

At this time the rate of transfer of these valuable databases to EIM varies by region, and is greatly influenced by the workloads of regional hydrogeologists. In the near-term EA should more actively support the effort to capture these data for the state's benefit by assigning a portion of an EA groundwater staff FTE to provide technical assistance to this effort.

3. *Once the migration of the regional water-level databases is complete, devote a portion of EA groundwater staff time to a comprehensive, statewide analysis of the database information*.

In the future, tracking of water-level conditions will likely become one of the most pressing monitoring needs for the groundwater resource in Washington. The regional databases house important long-term information about water-level conditions in areas of high demand or vulnerability that would be impossible to re-create. These data sets, however, are difficult to access from outside of the region, and have never been examined on a statewide scale. Evaluating the collective data set may allow the identification of important gaps in the monitoring, and could help to guide the formation and design of a statewide, water-level monitoring system.

Barring the identification of a new source of funding to expand the available EA groundwater staff FTE, the data-mining recommendations listed above would result in a reduction in the effort currently focused on client-specific projects. The high value of the information gained suggests that EA and Ecology managers closely weigh and decide the benefits of these efforts.

Monitoring and Characterization

The following recommendations are presented to help address the monitoring and characterization needs identified for state groundwater resources.

It is clear that the staff time and funding currently available cannot meet all of the state information needs for groundwater. However, it is also clear that the state needs to begin to build a program that more systematically assesses groundwater and aquifer conditions, equivalent to those in place for surface and marine waters. While baseline assessment work cannot immediately solve the many complex groundwater-related management problems faced by Washington, this basic science is unmistakably a fundamental legal responsibility of Ecology, and lays a valuable foundation for future solutions.

EA groundwater staff work on a number of important studies in support of regulatory or permitting activities of the agency, and this demand will likely increase over time. For example, recently there has been a growing recognition of the significant role of groundwater in many of the TMDL studies conducted by EA. However, it is recommended that Ecology managers ensure that at least a portion of the EA groundwater efforts, through new or reassigned funding, is devoted to implementing a permanent, baseline groundwater assessment program.

After evaluating a wide spectrum of possible program designs, the author of this report recommends the following near-term and long-term steps:

Near-term

1. *Pilot test a basin-scale, state groundwater assessment program in the EA Program*.

Select a priority basin according to information needs, and conduct a multidisciplinary, basin-scale, ambient monitoring and hydrogeologic characterization pilot study to refine an assessment approach.

While there are many different technical approaches and program design philosophies to address the needs described earlier, the information synthesized during this evaluation indicates that the most appropriate and effective scale for EA ambient groundwater assessment work lies at the local-basin level. A pilot study initially conducted at a sub-WRIA level is recommended to refine the study scale best suited to EA resources. A multidisciplinary approach is preferred for a variety of technical reasons; more so than surface water, representative groundwater monitoring is difficult to conduct separately from characterization (i.e., groundwater data cannot be reliably interpreted without a reasonable understanding of the hydrogeologic context or setting). A holistic assessment approach also generates the greatest amount of information for the widest audience of stakeholders. The near-term implementation of a large-scale ambient groundwater quality monitoring program similar to that operated by many other states is not considered cost-effective at this time, and was not identified as a high priority by the large majority of the professionals interviewed.

The goal of a groundwater assessment program would be to systematically apply best available scientific methods to gather *baseline* groundwater data in high-priority basins that still lack information. The program objectives for each basin studied would include:

- Characterizing the basic hydrogeologic setting, through assembly of existing and new information.

- Monitoring and describing baseline water-table conditions.
- Monitoring and describing baseline groundwater water-quality conditions.
- Monitoring and describing baseline conditions for groundwater/surface water interactions, focused on the interactions between the uppermost portions of the study area aquifer system and the main-stem drainage.

Many of the most pressing environmental or public drinking-water health issues that the state faces occur or begin near-surface (degradation of groundwater quality, impacts of groundwater allocation on stream flow, dilution of or contribution to surface water quality problems by groundwater discharge). Consequently, monitoring and characterization should primarily focus on the surficial aquifer system. While monitoring and sampling of private water supply wells (*Tier 1* wells) can support much of the work, it is strongly recommended that a backbone system of dedicated monitoring wells (*Tier 2* wells) be installed as a component of each study. Assessment studies would precede and augment, but not replace, problem-specific regulatory investigations.

Field activities for the assessment studies would include:

- Single-event sampling and analysis for a set list of common water-quality constituents for all Tier 1 and 2 wells.
- Single-event sampling and analysis for a customized list of water-quality constituents of unique concern to the study basin for all Tier 2 wells.
- Quarterly or bimonthly water-quality monitoring for a one-year period for a short-list of indicator parameters for all Tier 1 and 2 wells.
- Quarterly or bimonthly water-level monitoring of Tier 1 wells for a one-year period.
- Continuous water-level monitoring of Tier 2 wells for a one-year period.
- Hydraulic parameter testing of Tier 2 wells.
- A low-flow season seepage run along the main-stem drainage.
- Installing a network of in-stream piezometers along the study area main-stem drainage for periodic water-quality and water-level monitoring for a one-year period.

All studies would be conducted in close collaboration with local stakeholders; local interest and consent in the work would be a major factor in the prioritization process. Local agencies would be encouraged to inherit and operate ongoing measurement programs of the Tier 2 monitoring-well networks established during each study.

In October 2002, a $100,000 grant was awarded to the EA Program through Section 104(b)(3) of the Clean Water Act to support a groundwater characterization and monitoring pilot study. Tasks required by the grant include the selection of a high priority groundwater basin and the initiation of a field assessment study of groundwater conditions in the selected basin. Field work for this pilot study is scheduled for 2003-2004, although it remains unclear if funding will be available to complete the full study proposal. A short list of priority study areas in the southwest region of the state currently is being developed for final selection of a candidate basin. This

effort is being guided by the input and information needs developed by Ecology's Southwest Regional Office Water Program's Regional Management Team (WRMT).

Long-term

1. *If the groundwater assessment pilot study is successful, identify or pursue a reliable, long-term funding source to establish a permanent, EA-based program for the assessment of high-priority basins*.

Ultimately, it is recommended that Ecology pursue legislative recognition and dedicated funding for a long-term state program for assessing Washington's baseline groundwater conditions. Initially, it is recommended that EA Program management actively search for opportunities for cooperative funding with other interested stakeholders, both inside and outside of the agency. As an example, it is possible that the state departments of Agriculture and Health may have an interest in information regarding ambient groundwater quality conditions for chemicals of concern not included on the baseline list of study analytes. Costs for the collection and analysis of special constituents, such as pesticides or pharmaceuticals, could potentially be subsidized by cooperative funding from interested parties such as these organizations.

2. *Conduct basin studies as described above on a progressive schedule, selecting study areas largely on the basis of priorities identified by the regional water management teams*.

The number of basins studied at any given time is largely a function of the resources the state and Ecology decide to devote to the effort. A goal for this program is the production of an internet-accessible report series, possibly a continuation of the Washington State Water Supply Bulletin series. The collective reports, published on the internet, can be used in tandem with reporting by other organizations as a dynamic atlas of the state's hydrogeologic and groundwater conditions in critical areas of interest.

3. *Using Tier 2 monitoring wells installed during individual basin studies, incrementally build a larger scale (ultimately statewide) monitoring network focused on trend information for nitrate and water levels*.

One or two Tier 2 index or bellwether wells could be identified during each basin study to serve as representative monitoring points for repeat, long-term measurement of larger-scale changes in water quality and water-level conditions in surficial aquifer systems. Index wells from individual study areas could be joined over time to collectively build a state ambient monitoring network for measuring trends in both water level and water-quality conditions in priority basins. Ecology managers should recognize the long-term resource demands that would arise as an assessment program matures (including the additional costs and staff time associated with periodic trend monitoring of index wells), and plan accordingly.

Advantages of the Proposed Approach

At the current level of Ecology funding, the proposals recommended above will take a number of years to bear fruit, and may not meet all of the immediate information needs for stakeholders. However, the proposed approach:

- Represents a step towards meeting the state's legal responsibility to better understand and manage its groundwater.
- Enables the state to progressively measure compliance with the legal goals already in place for groundwater protection, beyond a site scale.
- Further develops a state-based infrastructure for groundwater knowledge, allowing the state to move away from being solely dependent upon the expertise and information provided by USGS or consultants contracted by regulated parties.
- Provides groundwater information at a scale that is closer to many of Ecology's business needs.
- Serves an appropriate role for state government and does not compete with, or replicate, work conducted by USGS or private consultants.
- Is an appropriate niche for, and is well suited to the resources of, the EA Program groundwater group.
- Allows basic assessment to take place further from the pressures of the regulatory arena.
- Allows the highest information needs of the state to be addressed first.
- Provides technical assistance to local stakeholders who may not be able to assemble the necessary funding to retain an organization with appropriate expertise.
- Is consistent with the 1996 EPA Clean Water Act guidelines requesting that states report groundwater quality data for select aquifers or hydrogeologic settings (e.g., watersheds) within the state.[8]
- Facilitates data comparison between study areas and can be applied simultaneously at multiple locations as resources allow.
- Is adaptable to the diverse range of hydrogeologic conditions present in the state, addressing a significant problem for the design of a statewide ambient monitoring network.
- Helps to provide a sound technical basis and context for more detailed, problem-specific studies (e.g., TMDLs), potentially reducing the time and costs of such studies.

[8] Anzzolin, A.R. and Siedlecki, M., 1998, Monitoring Ground Water Quality, National Water Quality Monitoring Council 1998 Conference Proceedings. These guidelines recommend that state groundwater quality be assessed incrementally, according to priority. This recommendation was made to allow an improvement in the quality of the information reported to the federal government. The guidelines also encourage states to provide information on groundwater/surface water interactions.

- Is well suited for cost-sharing arrangements with other organizations interested in groundwater information.
- Balances its focus between water-quality and water-quantity issues, serving the needs of a variety of stakeholders.
- Offers technical advantages over the use of randomly selected wells for broad-scale monitoring (the approach used by many other states).

Appendix

Evaluation of Legal Mandates

It is important for any strategic planning effort to closely review the legal mandates that guide the Department of Ecology efforts. The following information, while not an exhaustive presentation, summarizes references in the available statutes and regulations that directly or indirectly address the responsibilities of Ecology to monitor or inventory groundwater/ hydrogeologic conditions.

Water Resources Act of 1971 (Chapter 90.54 RCW)

In addition to the general principals outlining the responsibilities of the state in ensuring an adequate and clean water resource for its citizens (including a full recognition of the interrelationship between surface water and groundwater), Section 90.54.030 RCW specifically directs Ecology to "…become informed with regard to all phases of water and related resources of the state….the department shall: 1) Develop a comprehensive water resource data program that provides the information necessary for effective planning and management on a regional and statewide basis." The data program shall include "…a system for collecting and providing access to water resource data on a regional and statewide basis….". The practical result of these directives has been the development of a data management system for tracking water rights. The agency is also directed to "…3) Develop such additional data and studies pertaining to water and related resources as are necessary to accomplish the objectives of this chapter." No explicit language is included in the statute that directs the agency to monitor groundwater quality or quantity conditions, or systematically inventory or characterize the aquifer systems of the state for efficient water management; these activities are effectively at the discretion of the agency to conduct.

Water Pollution Control (Chapter 90.48 RCW)

Section 90.48.010 RCW indicates that the state will "…exercise its powers, as fully and as effectively as possible, to retain and secure high quality for all waters of the state." Section 90.48.030 RCW gives Ecology jurisdiction over the control and prevention of pollution of the waters of the state including "underground" water. However, there is no explicit directive in the statute that requires the state to conduct ambient monitoring or assessment activities to determine the state's success or failure in meeting these objectives.

Water Quality Standards for Ground Waters of the State of Washington (Chapter 173-200 WAC)

Section 173-200-030 WAC details the state's "Antidegradation" policy for groundwater. The Antidegradation policy states that "…existing and future beneficial uses shall be maintained and protected and degradation of ground water quality that would interfere with or become injurious to beneficial uses shall not be allowed." While there are requirements for permitted site-specific activities to monitor their impacts on groundwater quality, and numeric and narrative water

quality standards are promulgated for groundwater, there is no explicit ambient monitoring requirement defined for the state to determine the success or failure of meeting the goals of the policy.

Regulation of Public Ground Waters (Chapter 90.44 RCW)

Section 90.44.130 RCW describes Ecology's authority to establish limits on water use within designated ground water areas, sub-areas, or depth zones to protect from overdraft. These areas may be designated "…as adequate factual data become available…". The statute does not, however, explicitly direct the agency to monitor state water-level conditions for this purpose.

Ground Water Management Areas (GWMA)(Chapter 90.44.400 RCW) and Ground Water Management Areas and Programs (Chapter 173-100 WAC)

These directives allow for the establishment of GWMAs in designated areas of the state. Long-term monitoring (including, presumably, effectiveness monitoring in those cases where a GWMA is initiated to address specific existing problems) is a requirement of all GWMA programs, but is the responsibility of the local GWMA organization, not the state.

Clean Water Act (CWA)

The CWA Title 33, Chapter 26, Subchapter 1, Section 1254 (a)(5) [FWPCA §104] states that the federal government will, in cooperation with the states, "…establish, equip, and maintain a water quality surveillance system for the purpose of monitoring the quality of the navigable waters and *ground waters*…and to the extent practicable, conduct such surveillance by utilizing the resources of …the United States Geological Survey." Title 33, Chapter 26, Subchapter 1, Section 1256 (e)(1) [FWPCA §106] directs that the federal government will withhold CWA grant monies from states that do not establish and operate programs "…necessary to monitor…the quality of navigable waters *and to the extent practicable, groundwaters*…; and provision for annually updating such data and including it in the report required under Section 1315 [FWPCA §305(b)]". To date, the state has not considered it practicable to establish a permanent ambient water quality surveillance system for groundwater. At this time, the bulk of the data used to meet the 305(b) biennial report requirement for reporting on ambient groundwater quality conditions is drawn from the Washington State Department of Health drinking water database.

Growth Management Act (Chapter 36.70A RCW)

Section 36.70A.170 (1)(d) RCW requires local agencies to designate, and adopt ordinances to protect, "critical areas" under their jurisdiction. The definition of critical areas includes aquifer recharge areas. The Ecology guidance document regarding the development of Critical Aquifer Recharge Area (CARA) ordinances recommends aquifer characterization procedures a local jurisdiction can use to classify its CARAs. These procedures focus on the evaluation of aquifer vulnerability. The characterization and monitoring of local hydrogeologic conditions for the purposes of designating a CARA is a local, not state, responsibility. Site-specific

characterization and compliance monitoring can be required by the local jurisdiction for new facilities or activities within a CARA, but this is the responsibility of the project proponent.

Geological Survey (Chapter 43.92 RCW)

The statute describing the objectives of the Washington State geological survey (Section 43.93.020 RCW) states "…The survey shall have for its objects: …investigation and report upon the water supplies...of the state". The survey will also pursue "…an examination of the physical features of the state with reference to their practical bearing upon the occupations of the people; the preparation of special geological and economic maps to illustrate the resources of the state; the preparation of special reports with necessary illustrations and maps, which shall embrace both the general and detailed description of the geology and natural resources of the state, and the consideration of such other kindred scientific and economic questions as in the judgment of the director shall be deemed of value to the people of the state." To date, the Geology and Earth Resources Division of the Washington State Department of Natural Resources has not adopted the assessment of the state's *hydrogeologic* resources or water supplies as part of its working program.

Safe Drinking Water Act (SDWA) and
Public Water Systems Drinking Water Program (Section 70.119A RCW) and
Group A and B Public Water Supplies (Chapters 246-290 and 246-291 WAC)

The SDWA (Title 42, Chapter 6A, Subchapter XII) outlines federal requirements for the monitoring of water supplied by public water-supply systems serving greater than 25 individuals. Washington has primacy for implementing SDWA requirements, which are administered by the Washington State Department of Health Drinking Water Program. The monitoring requirements of the SDWA are focused on determining water quality compliance with standards at various points in the distribution system of a public water delivery infrastructure. For select test parameters, this includes testing the "source" water, i.e., analysis of the water quality prior to entry into the distribution system or prior to treatment. While testing of the source water quality of a public water supply well does provide some indication of aquifer conditions, no explicit mandate was identified in the SDWA requiring states to monitor ambient aquifer water quality per se.

One passage of Section 70.119A.020 RCW (Notes - Finding -- 1994 c 252) states: "The legislature finds that: … (2) There is a need to comprehensively assess and characterize the ground waters of the state to evaluate public health risks from organic and inorganic chemicals regulated under federal law;…The legislature therefore directs the department of health to conduct a voluntary program to selectively test the ground waters of the state for organic and inorganic chemicals regulated under federal law for the purpose of granting area-wide waivers." (see also Section 70.119A.115 RCW Area-wide waiver program). To date, the practical response to this statement was the initiation of a study in 1994 by the WDOH Drinking Water Program. The WDOH contracted the USGS to conduct a sampling effort to determine the frequency of pesticide detections in public water supply wells across Washington. A large subset of statistically-selected public water supply wells located throughout the state was tested for an extensive list of pesticides during this study. The study findings were used to grant a

waiver from SDWA pesticide monitoring requirements for approximately 75% of the state's public water supply wells[9].

Requirements for two important groundwater protection programs are further outlined in the SDWA. The first, the USEPA-administered Sole Source Aquifer Protection Program (Section 1424(e), SDWA of 1974), allows the federal government to designate certain aquifers in the nation as the sole or principal drinking water source for an area. Eleven aquifers have received federal designation as *sole source* in Washington. All petitions of the federal government to designate an aquifer as sole source must be accompanied by hydrogeologic and drinking water usage data compiled in a technical support document. The SDWA does not explicitly mandate that field-based groundwater monitoring or characterization activities be carried out for this step of the designation process; most often the technical support documents compile and summarize existing groundwater information.

Secondly, under the 1996 amendments to the SDWA, all states also are now required to implement a Source Water Assessment Program for larger (Group A) public water-supply systems, including groundwater-dependent systems. Required elements of the program, administered by WDOH, include the delineation of the source water protection area (for groundwater dependent systems, equivalent to a wellhead protection area) for each system, and an assessment of the susceptibility of each source to contamination. While some larger, highly susceptible sources may necessitate characterization or mapping to accurately delineate a source water protection area, field-based measurement and monitoring of groundwater conditions is not a required or commonly adopted component of the Source Water Assessment Program. More typically, existing information describing hydrogeologic conditions is compiled in order to determine the appropriate protection area and contaminant susceptibility.

Watershed Planning (RCW 90.82/ESHB 2514)

2514 watershed planning units are responsible for performing several stages of technical assessment of the water resources present in their watersheds. This requirement is described as "Phase 2" in the planning process, and involves three levels: Level 1) compiling existing data for the water resources of the watershed, Level 2) collecting new data within the timeframe of the planning process, and Level 3) long-term monitoring of select parameters following completion of a watershed management plan[10]. Information describing hydrogeologic conditions and groundwater availability are required components of 2514 watershed technical assessments; evaluation of water-quality conditions, including water quality of groundwater, is an optional feature of watershed planning. However, the specific requirements for hydrogeologic characterization studies and groundwater monitoring are dependent on the needs and objectives of the planning unit. While the state is identified as a source of technical assistance for watershed assessment studies, there is no explicit legal mandate that it perform specific monitoring or characterization work in support of the planning process.

[9] Ryker, S.J., and Williamson, A.K., 1996, Pesticides in public supply wells of Washington State: U.S. Geological Survey Fact Sheet 122-96, on line at <URL: http://wa.water.usgs.gov/ccpt/pubs/fs-122-96.html>, last updated March 16, 1998

[10] Final Draft, Guide to Watershed Planning and Management, 1999, Economic and Engineering Services, Inc.