

Washington State Interagency Ground Water Committee

A Report on Nitrate Contamination of Ground Water in the mid-Columbia Basin

September 17, 1996

Publication No. 96-17



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Executive Summary

In May 1995, officials from the Washington State Departments of Agriculture, Ecology and Health along with the Washington State Conservation Commission met with representatives from the Region 10 office of the US Environmental Protection Agency to discuss nitrate contamination of ground water in the mid-Columbia Basin. As a result of that meeting, a subcommittee of the Interagency Ground Water Committee was directed to conduct an environmental and public health assessment of the nitrate problem in the area encompassed by Adams, Benton, Franklin, Grant, Lincoln, and Whitman Counties.

The purpose of this review was to: identify the extent and magnitude of the nitrate problem and identify populations at risk; develop a strategy to address public education and risk communication; and provide recommendations for short and long term corrective measures.

As a result of the review, the Subcommittee has concluded that nitrate contamination of ground water at significant levels does exist in localized areas within the mid-Columbia Basin and is resulting in exposure to part of the population through drinking water supplies¹. The nature and extent of adverse health effects associated with these exposures is not known.

Wells demonstrating high nitrate-nitrogen levels are clustered within the eastern Benton County, western Franklin County, Othello, Ephrata, and Moses Lake areas. There is general agreement among Washington State's regulatory agencies and research organizations that irrigation and agricultural practices have accounted for a majority of the nitrogen loading. Shallow wells (those less than 300 feet in depth) appear to be at much greater risk for nitrate contamination than wells deeper than 300 feet. The regional analysis indicates that of the 631 wells in the data set used as either domestic or public water supply wells, ~20% or 127 wells had an average nitrate-nitrogen level above the state drinking water standard of 10 mg/l.

Analysis of drinking water sources, from a "population served" perspective, indicates that public water supply wells located within the mid-Columbia Basin, serving 66 % (~200,500 individuals) of the population, have not exceeded the state Drinking Water Maximum Contaminant Level (MCL²) of 10 mg./l nitrate-nitrogen. People which receive drinking water from a public water supply system that has reported at least one exceedence of the drinking water MCL for nitrate-nitrogen within the past three years is estimated at 13 % (~39,500 individuals). Nitrate-nitrogen MCL exceedences are determined at the source (well) and, because of blending or other treatment, do not necessarily indicate the nitrate concentration delivered to the consumer. A more detailed analysis of public water systems with nitrate MCL exceedences indicates that the number of individuals on public water systems which lacked, at least temporarily, treatment options and therefore delivered drinking water at concentrations greater than the MCL is ~1,700 or 0.6% of the total population in the study area.

Drinking water quality monitoring data does not exist or was not accessible for the approximately 65,000 people (21%) using private (domestic) wells for their source of drinking water. Because most private wells are

¹ The problem of elevated nitrate concentrations in ground water is not confined to the mid-Columbia Basin. Other counties in Washington with localized areas of high nitrate-nitrogen include: Clark, Island, King, Pierce, Lewis, Spokane, Thurston, Walla Walla, and Whatcom.

² Maximum contaminant level (MCL) means the maximum permissible level of a contaminant in water the purveyor (water system) delivers to any public water user, measured at the locations identified under WAC 246-290-300(7)(f).

shallow and vulnerable to contamination, a significant proportion of domestic well users may be exposed to elevated nitrate levels in their drinking water.

The Department of Health conducted a survey among health care providers within the Mid-Columbia Basin for cases of methemoglobinemia (blue baby syndrome) detected within the past five years. A total of seven possible cases of methemoglobinemia were reported by physicians (one in Lincoln County and six in Benton County). None of these reported cases resulted in hospitalization. A direct link between these cases and nitrate ingestion via drinking water from wells could not be established, nor ruled out, during the initial study.

Recommendations resulting from the assessment include enhancing or increasing ongoing efforts and initiating new actions. Ongoing efforts include: continued nitrate concentration database development (statewide), increased voluntary domestic well water quality testing; investigation into health impacts; and increased use of agricultural Best Management Practices. New activities called for include: targeted educational outreach to health care providers, stakeholder groups and the general public; establishment of an epidemiological surveillance program; identification of persons at increased risk from exposure; and support for local efforts to establish and development one or more Ground Water Management Areas within the mid-Columbia Basin.

Summary of Findings

- F-1. There are several areas in the mid-Columbia Basin exhibiting nitrate concentrations in ground waters above natural levels. In some areas the nitrate concentrations exceed the Safe Drinking Water Act MCL for drinking water. Areas with elevated nitrate concentrations include locations in eastern Benton and western Franklin Counties and, and sites near Othello, Quincy, and Moses Lake.*
- F-2. There are relatively few data points of ground water nitrate concentration within the central and eastern portions of the mid-Columbia Basin. As a result, the level of confidence regarding current ground water quality in the central and eastern portions of the Basin is lower than for the western portion.*
- F-3. Nitrate-nitrogen concentrations are greatest in shallow ground waters. A significant decrease in nitrate-nitrogen concentrations is found in ground water samples collected from depths below 300 feet. The highest percentage of samples exceeding state Drinking Water Standards (10 mg/l nitrate-nitrogen) are obtained from shallow wells (less than 300 feet deep). Most private domestic drinking water wells are shallow wells.*
- F-4. Achieving the goal of "All persons have access to safe drinking water supplies" is a high priority for all involved.*
- F-5. There exists a substantial gap in data related to the nitrate exposure of individuals who obtain drinking water from private domestic wells*
- F-6. A significant number of people in the mid-Columbia basin are currently exposed to drinking water which exceeds the nitrate-nitrogen drinking water MCL.*
- F-7. Based on current information, it is not known whether the elevated nitrate levels in ground water within the Basin have had a health impact on residents.*
- F-8. There is an insufficient understanding of the magnitude of the health risks associated with exposure to drinking water supplies above the nitrate-nitrogen drinking water MCL. This lack of understanding is cause for concern regarding health effects on sensitive populations.*

Summary of Recommendations

Grouped by relative priority for implementation

Highest Priority

- R-6. *Immediate and ongoing efforts should be undertaken by public health officials to identify sensitive populations/individuals and ensure they have access to safe drinking water supplies.*
- R-5. *Persons on private domestic drinking water wells should have easy access to well testing to verify their specific well water quality. These persons should also be provided with information on practices they can undertake to minimize current and future risks of contamination of their drinking water source. The Home*a*Syst program, programs through the local health departments and/or Conservation Districts are all possible vehicles to implement this recommendation.*
- R-9. *The Department of Health, in conjunction with and concurrence from local health jurisdictions, should conduct targeted educational outreach to local health care providers and sensitive populations. A key element in the educational outreach to health care providers is information on the range of clinical manifestations associated with methemoglobinemia.*
- R-13. *State and federal agencies should support local efforts to establish and undertake one or more Ground Water Management Areas in the mid-Columbia Basin. This support may be best provided through formal adoption of a Memorandum of Understanding outlining agency commitments.*
- R-12. *Private industry, including agricultural chemical dealers, field representatives, private consultants and food processors, should take a lead role in working with producers to promote practices to reduce excess nitrogen loading.*

Medium Priority

- R-1. *The Departments of Ecology and Health should continue to collect and incorporate existing nitrate concentration data into a shared database so as to improve understanding of the extent of nitrate contamination of ground water within the mid-Columbia Basin. Specific attention should be paid to improving data density in the central and eastern portions of the mid-Columbia Basin. The results of this activity should be reviewed on an annual basis and findings presented annually to the Secretary of Health and the Directors of the Departments of Agriculture, Ecology, and the Washington Conservation Commission*
- R-2. *The Department of Health should conduct follow-up investigations to determine, to the extent possible, the causal agent(s) of reported cases of methemoglobinemia. Additionally, the Department of Health should establish an epidemiological surveillance program in which detection of events, such as a case of methemoglobinemia, would trigger follow-up protocols for further investigation and intervention.*
- R-3. *Public health officials should continue to assess potential health impacts from nitrate exposure.*
- R-4. *The Washington State Department of Agriculture, in conjunction with Washington State University-Cooperative Extension, and the Conservation Districts within the mid-Columbia Basin should begin an assessment of application rates of nitrogen fertilizers to various crop types in order to determine areas of past, current, and potentially future nitrogen overloading.*

- R-7. *There should be continued development, testing, and implementation of agricultural Best Management Practices or other measures which reduce nitrogen application to crop specific agronomic rates. Specific elements should include:*
- *Increase the activities of Conservation Districts, the Natural Resources Conservation Service and Washington State University-Cooperative Extension to promote implementation of irrigated agriculture Best Management Practices;*
 - *Develop and implement uniform crop nitrogen recommendations based on specific crops, soils, and climate; and,*
 - *Design and implement pilot studies focusing on innovative farm techniques which reduce nitrogen loading to crops and monitor results for future expansion of findings.*
- R-8. *Educational avenues for reducing health risks associated with drinking water supplies currently contaminated by nitrate should be pursued as a short term response. Education must not be relied on without a concurrent effort to implement nitrate loading reduction measures as part of a long term solution.*
- R-10. *The Washington State Department of Agriculture in concert with local Conservation Districts and WSU-Cooperative Extension Service should implement educational activities specifically directed to regulated activities associated with fertilizer application management techniques which reduce nitrogen overloading.*
- R-11. *The Department of Ecology should continue to implement the recently issued "Implementation Guidance for the Ground Water Quality Standards" for those activities for which it has authority and which may affect ground water quality. Within the mid-Columbia Basin, priority activities should include those which may cause or contribute to elevated nitrate concentrations in ground water.*

A Report on Nitrate Contamination of Ground Water in the mid-Columbia Basin

I. Background

Mid-Columbia Basin Nitrate Assessment

In May 1995, officials from the Washington State Departments of Agriculture, Ecology and Health along with the Washington State Conservation Commission met with representatives from the Region 10 office of the US Environmental Protection Agency (EPA) to discuss nitrate contamination of ground water in the mid-Columbia Basin. As a result of that meeting the Interagency Ground Water Committee (IGWC)¹ was asked by the represented agencies to form a small working group to conduct both an environmental and public health assessment of the nitrate problem in the area encompassed by Adams, Benton, Franklin, Grant, Lincoln, and Whitman counties. That working group is referred to in this report as the "Subcommittee". Specifically, the Subcommittee was requested to:

- 1) Identify the extent and magnitude of nitrate contamination in ground water,
- 2) Identify the populations who are likely to be at risk from drinking ground water which exceeds the nitrate Maximum Contaminant Level (MCL)²;
- 3) Provide a framework in which both short and long term corrective measures can be designed and implemented including interagency integration and cooperation, and definition of roles for state, local and federal agencies.
- 4) Provide recommendations for short-term and long-term actions which when implemented will address both the environmental and public health concerns associated with nitrate contaminated ground water.

The following report is the result of a cooperative effort between members of the IGWC; the Departments of Agriculture, Ecology, Health, the Washington State Conservation Commission and other stakeholder agencies and organizations (see Appendix 2 for a list of participants).

Project Area Overview

The area which is the subject of this assessment encompasses 7,691,072 acres within the counties of Adams, Benton, Franklin, Grant, Lincoln, and Whitman.

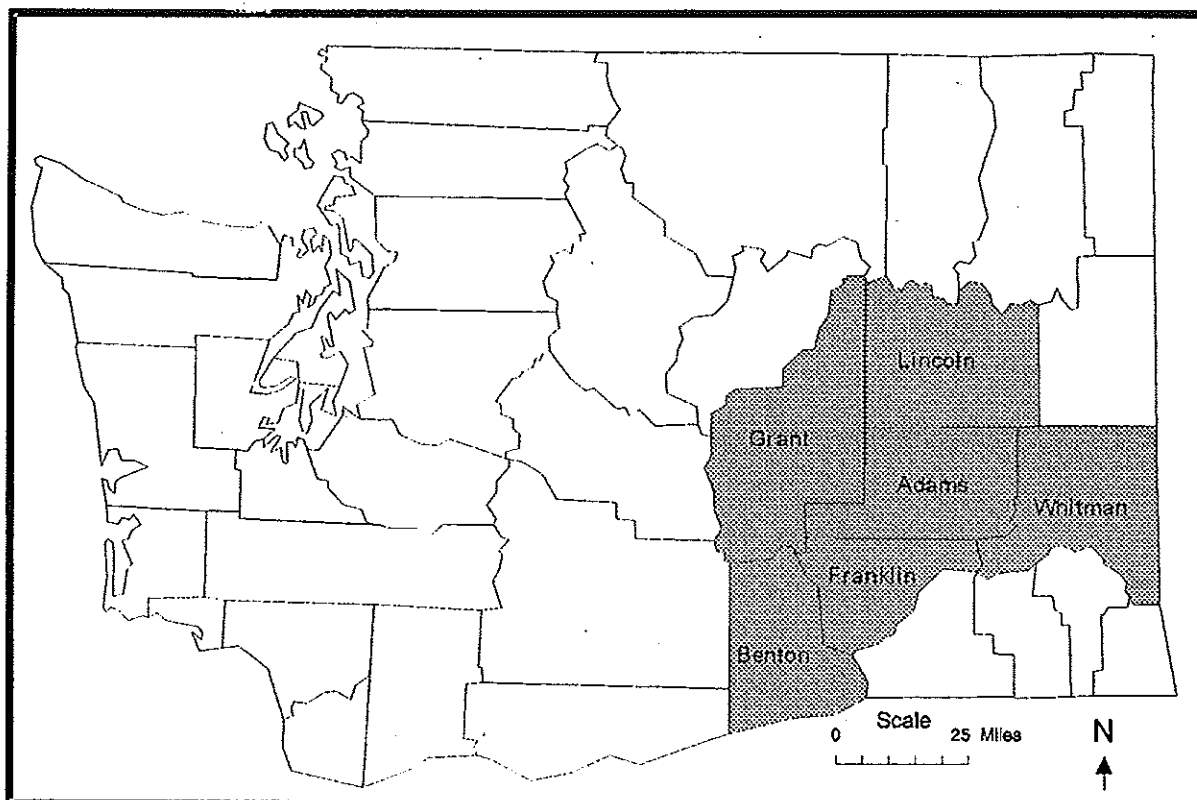
The area is highly dependent upon agriculture as an economic base. Approximately 60-65% of the assessment area is used for agricultural purposes. Agriculture within the western portions of the assessment area began to expand with the construction of the Columbia Basin Irrigation Project (CBIP) in the mid to late 1940's. The CBIP allowed water from the Columbia River to be used on large tracts of what had previously been arid land,

¹ The Interagency Ground Water Committee was formed in 1991. The IGWC is a multiagency group created to promote coordination and cooperation between federal, state, local, and tribal governments and private stakeholder groups regarding ground water protection issues.

² Maximum contaminant level (MCL) means the maximum permissible level of a contaminant in water the purveyor (water system) delivers to any public water user, measured at the locations identified under WAC 246-290-300(7)(f).

making it suitable for growing high value crops such as potatoes, fruit, corn, and small grains. In areas not covered by the CBIP, increases of ground water use for irrigation purposes have increased to over 700,000 acre-ft/year and in the process caused declines in lower aquifers and significant increases in shallow, water table aquifers. Along with these changes in water levels, increases in the concentration of nitrogen compounds in ground water have been detected across much of the assessment area.

Figure One: Mid-Columbia Basin Ground Water Study Area



Historical records indicate that over the past forty years, since the beginning of the CBIP and the increase in irrigated agricultural practices, significant areas of the mid-Columbia Basin have experienced rising ground water levels and increases in ground water concentrations of nitrogen compounds. Generally, there is agreement among Washington State's regulatory agencies and research organizations that irrigation and agricultural practices have accounted for a majority of these increases.

Previous Water Quality Related Activities Conducted Within the Mid-Columbia Basin

A substantial effort within the mid-Columbia Basin has been directed towards the identification and correction of both surface and ground water quality problems by federal, state, and local governments. Significant regulatory requirements for the application of both pesticides and fertilizers through irrigation systems have been put into place by the Department of Agriculture. Several of the area's larger Conservation Districts developed and are implementing general Best Management Practices (BMPs) to reduce pesticide and nitrogen loading to agricultural areas where ground and surface water quality are at risk. Washington State University-Cooperative Extension has been engaged in the development of new and innovative farm techniques which reduce nitrogen loading, distributes educational materials regarding ground water quality protection, and oversees the state's Home*a*Syst program.

In addition to these activities, the federal and state governments have, over the past five years, channeled nearly a million dollars to areas within the mid-Columbia Basin determined to be at risk from both ground and surface water quality degradation (Table One below).

Table One: Federal and State Grant Funded Ground Water Quality Protection Activities in the Mid-Columbia Basin Washington 1990 - 1996

County/City	Activity	Dollars
Columbia Basin	Development of Best Management Practices Manual for Irrigated Agriculture to prevent/reduce pesticide and nitrate contamination; educational outreach to agricultural professional on findings.	\$ 268,000.00
Columbia Basin	Promote and coordinate educational outreach programs regarding agricultural nonpoint source surface and ground water pollution in the irrigated and dryland areas of Eastern Washington	\$ 40,000.00
Columbia Basin	Assist in development of Wellhead Protection Areas in rural areas.	\$ 17,657.00
Columbia Basin	Development and implementation of Home*a*Syst program directed towards ground water protection on rural drinking water wells.	\$ 98,724.00
Ephrata	Assess impacts to ground water of sewage lagoons	\$ 52,500.00
Franklin	Examine agriculture's influence on water quality in the county.	\$ 102,880.00
Franklin	Assessment to determine agricultural related sources of shallow ground water contamination with emphasis on nitrate contamination.	\$ 96,233.00
Franklin	Select and inventory two rural public water supply systems located in Wellhead Protection areas; provide technical assistance to develop 15 farm water quality plans; conduct training and education to agricultural groups and public	\$ 41,412.00
Franklin - Benton	Conduct ground water investigations of the Pasco aquifer in conjunction with local government	\$ 110,000.00
Grant	Assess the potential of nitrate leaching into ground water within the Mid-Columbia Basin	\$ 64,050.00
Lincoln	Characterize the hydrogeology of the eastern portions of Lincoln County and assess the potential to leach pesticides and nitrate into ground water.	\$ 23,287.00
City of Pullman	Update computer model of aquifer common to cities of Pullman, WA and Moscow, ID	\$ 29,100.00
City of Ritzville	Assess impact of sewage lagoons on shallow ground water.	\$ 26,185.00
Total		\$970,028.00

These activities are wide ranging in nature. These activities cover ground water data collection to assess the scope and magnitude of ground water quality concerns, the establishment of agronomic rates of nitrogen

application, and assisting small communities develop solutions to the problem of waste water disposal via land application³.

II. Identification of the extent and magnitude of nitrate contamination in ground water

Criteria for Data Acceptance

The assessment of both the extent and magnitude of nitrate contamination in ground water within the area was conducted using data previously collected by a variety of governmental entities for varying purposes. The fact that this data was compiled from numerous unrelated ground water studies and assessments raises the issue of data compatibility or "are apples being compared to oranges?" In order to address this issue the Subcommittee established a data use criteria. The foundation of this criteria is that data which was to be included in the assessment is assumed to have been collected and analyzed under Quality Assurance/Quality Control (QA/QC) protocols established by the EPA⁴.

In order to increase the likelihood that approved protocols were followed, the Subcommittee elected to limit the data sources to the following:

- a) Data collected by the US Geological Survey as part of a study conducted in the basin;
- b) Data collected either by the Department of Ecology or required by the Department of Ecology to be collected by a third party for Solid Waste Facilities, Land Application Facilities, MTCA (Model Toxics Control Act) Clean-up Facilities, RCRA (Resource Conservation and Recovery Act) Facilities (upgradient wells only)⁵;
- c) Data collected by Public Water Systems as required by the Department of Health;
- d) Data collected by individual Conservation Districts under either a federal or state grant where a QA/QC plan was required and approved by the Departments of Ecology or Health.

Furthermore, ground water data from these sources was limited to wells from which there had been at least three samplings since 1985 having at least one of those samplings conducted since 1990. An exception to this criteria was permitted for wells having fewer than the three samplings, but the available samples were obtained subsequent to 1990 and collected under scenarios a-c.

While the Subcommittee realizes that application of these data acceptance criteria does not eliminate the possibility of inaccurate data from being included in the analysis, erroneous data have been kept to a minimum.

³ Complete details of the listed projects can be obtained from the Department of Ecology-Water Quality Program or directly from the project manager

⁴ Nitrate-nitrogen data collected using protocols presented in EPA/600/2-85/104, Practical Guide for Ground-Water Sampling. Analytical methodologies follow procedures or procedures comparable to those outlined in EPA SW-846.

⁵ Upgradient facilities were chosen because of issues related to map scale and because upgradient data reflects ambient water quality not that impacted by facility specific activities.

Analysis of Well Data Used in the Assessment

Well Use and Sample Population

The database used in the assessment contains 1521 independent samplings collected from 783⁶ well sites throughout the mid-Columbia Basin from the period January 1985 through December 1995. The wells included in the assessment are not evenly distributed throughout the project area (see Appendix One). A majority of the wells are located in the western Franklin and central-southwestern Grant County areas. The reason for this "clustering" is the fact that these areas represent the highest population density in the mid-Columbia Basin and have also been the most intensively studied by the data collecting agencies. The following is a county specific breakdown of the wells and their identified uses which are included in the assessment.

Table Two: Identified Uses for Wells Included in the Assessment

County	Domestic Wells	Public Water Supply Wells	Other ⁷	Total
Adams	28	18	27	73
Benton	63	8	31	102
Franklin	261	35	31	327
Grant	101	52	23	176
Lincoln	7	12	10	29
Whitman	46	0	30	76
Total	506	125	152	783

Nitrate-Nitrogen Distribution in Wells

Existing data collected from the wells listed in Table Two, was used by the Subcommittee to assess the existence and/or extent of nitrate contamination of ground water within the mid-Columbia Basin. For each of the 783 well sites, data collected during the period January 1985 through December 1995 was converted to an arithmetic mean which was then plotted, using the Department of Ecology's Geographic Information System (GIS), on a series of maps illustrating the distribution of average nitrate concentration throughout the mid-Columbia Basin area. The map which is presented in Appendix One of this report, shows the areas of significant nitrate contamination. These areas are western Franklin County, eastern Benton County, and around the cities of Moses Lake, Othello, and Quincy, Washington.

⁶ The 783 wells used in the assessment represent only a small fraction of the wells which currently exist in the area. The Department of Ecology has estimated that as many as 35,000 wells currently exist in the mid-Columbia Basin area (estimate is based on numbers of recorded well logs on file with regional offices of the Department of Ecology).

⁷ The classification of "other" contains those wells not determined to be either domestic or public water supply wells. This classification contains wells used for facility monitoring, irrigation, stock watering, industrial purposes, or unidentified uses other than domestic or public water supply.

In order to further characterize the results of the GIS exercise, further analysis of ground water data collected from each of the 783 well sites was conducted on both a regional and county specific basis. The intent of this analysis was to determine the general percentage of wells in the data base used as primary drinking water sources which have exceeded the drinking water Maximum Contaminant Level (MCL) of 10 mg/l of nitrate-nitrogen.

The results of the regional analysis indicate that of the 631 wells used as either domestic or public water supply wells ~20% or 127 wells had an average nitrate-nitrogen concentration above the nitrate MCL. This same population of wells revealed that ~56% or 354 wells had an average nitrate-nitrogen concentration at or below 5 mg/l⁸.

Table Three: County Specific Distribution of Average Nitrate-Nitrogen Levels for Domestic and Public Water Supply Wells

County	NO ₃ -N < 5 mg/l		NO ₃ -N > 5 < 10 mg/l		NO ₃ -N ≥ 10 mg/l	
	Number	~%	Number	~%	Number	~%
Adams	35	76	9	20	2	4
Benton	53	75	10	14	8	11
Franklin	125	42	79	27	94	31
Grant	97	64	35	23	19	13
Lincoln	15	79	3	16	1	5
Whitman	29	63	14	30	3	7
Totals	354	56	150	24	127	20

The county specific analysis above further clarifies the results of the GIS mapping exercise in that the areas of highest nitrate-nitrogen concentrations in ground water appear to be located in Benton, Franklin, and Grant Counties. The county specific analysis also indicates that ~24% of the drinking water wells analyzed had average nitrate-nitrogen concentrations above 5 mg/l but below 10 mg/l.

Nitrate-Nitrogen Occurrence in Ground Water Related to Well Depth

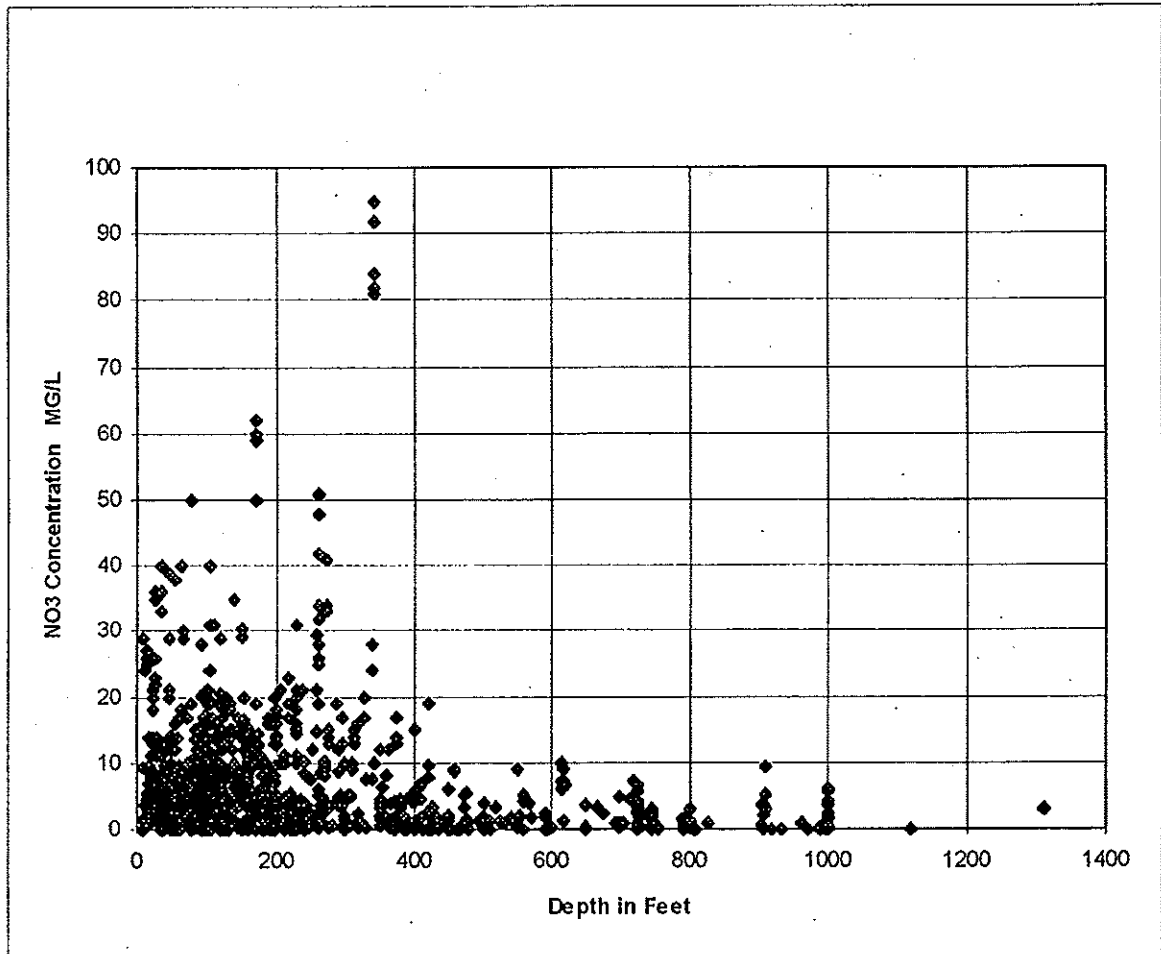
The occurrence of nitrate-nitrogen has previously been linked to well depth in the mid-Columbia Basin. This is particularly true where shallow ground water exists largely due to irrigation return flows from agricultural lands. In a recently released US Geological Survey document⁹, the agency states that "nitrate concentrations are generally lower at greater depths". The report indicates that of the wells analyzed within the Central Columbia Plateau (of which the mid-Columbia Basin is a subarea) 26% of wells less than 300 feet deep had

⁸ Five milligrams per liter of nitrate-nitrogen (1/2 the MCL) is the trigger value above which public water supply systems are required to conduct quarterly samplings for nitrate so as to better characterize the range of nitrate concentrations in their drinking water supply.

⁹ U.S.G.S., Open File Report 95-445 and accompanying fact sheet

nitrate concentrations exceeding the nitrate MCL. Only 8% of wells deeper than 300 feet exceeded the nitrate MCL.

**Figure Two: Nitrate Concentration Related to Sample Depth
Based On Analytical Results Obtained from 783 Wells**



Analysis of the data from the 783 well locations within the IGWC database reveals that out of 1143 ground water samples, 809 were collected from wells which were constructed and obtain ground water from depths of 300 feet or less. Thirty percent of these samples exceeded the drinking water MCL for nitrate. Ten percent of 360 samples collected from wells which were constructed and obtain ground water from depths greater than 300 feet exceed the drinking water MCL for nitrate¹⁰. Within the data assembled by the IGWC, no nitrate-nitrogen drinking water MCL violations were detected below 425 feet.¹¹

¹⁰ Well depth provides an indication as to the depth ground water samples are obtained. This is particularly true in the case of domestic wells where, because of financial concerns, wells generally are not drilled deeper than where the first adequate supply of water is encountered. In the case of deeper public supply wells or large irrigation wells, state regulation provides prohibitions against the interconnection of aquifers, thereby providing assurance that ground water samples obtained from deep wells are from deep aquifers

¹¹ The vulnerability for the lower aquifers within the lower Wanapum and Grande Ronde Basalts appears to be significantly less than for shallower aquifers within the overburden and shallow basalt flows within the interior portions of the mid-Columbia Basin. Preliminary analysis, by the State of Washington, of the vulnerability of the

This relationship has important implications for drinking water wells. Most of the larger public water supply wells are drilled deep to maximize the volume of water available. Most private/domestic drinking water wells are shallow and rarely exceed the first major water bearing zone encountered during drilling. This practice places the shallow domestic wells at higher risk for water quality problems.

Trends in Nitrate-Nitrogen Concentrations

Long term trends in ground water nitrate-nitrogen concentrations are difficult to determine based on the lack of valid historical data. It is generally accepted that prior to agricultural practices the nitrate concentrations in ground water were less than 3 mg/l and therefore over the past fifty years there has been an increase in nitrate levels¹². This assumption is difficult to document with specific data points as throughout the mid-Columbia Basin there exists, over time, substantial variability in the collected nitrate-nitrogen concentration both at individual wells and between wells. The variability in concentrations in the data assembled by the IGWC within the assessment area reveals no clear uniform trend (increasing, decreasing, or stable) in the general nitrate concentrations in ground water during the period 1985-1995.

Subcommittee Conclusions Based on Data Analysis

Based on the data analyzed, the subcommittee makes the following findings:

- F-1. There are several areas in the mid-Columbia Basin exhibiting nitrate concentrations in ground waters above natural levels. In some areas the nitrate concentrations exceed the Safe Drinking Water Act MCL. Areas with elevated nitrate concentrations include locations in eastern Benton and western Franklin Counties and, and sites near Othello, Quincy, and Moses Lake.*
- F-2. There are relatively few data points of ground water nitrate concentration within the central and eastern portions of the mid-Columbia Basin. As a result, the level of confidence regarding current ground water quality in the central and eastern portions of the Basin is lower than for the western portion.*
- F-3. Nitrate-nitrogen concentrations are greatest in shallow ground waters. A significant decrease in nitrate-nitrogen concentrations is found in ground water samples collected from depths below 300 feet. The highest percentage of samples exceeding the nitrate drinking water MCL are obtained from shallow wells (less than 300 feet deep). Most private domestic drinking water wells are shallow wells.*

III. Identification of Populations Potentially Exposed to Nitrate-Nitrogen Concentrations in Drinking Water Supplies Above Safe Drinking Water Act Standards

Estimates of Nitrate-Nitrogen Exposure

As of 1995 approximately 305,000 persons currently reside within the study area. The Washington State Department of Health estimates that ~240,000 receive drinking water from public water supply systems within the study area, with the remaining 65,000 persons receiving drinking water from private domestic wells.

The number of people within the study area served by water systems that have no reported exceedences of the state drinking water MCL for nitrate-nitrogen is calculated at 66 % of the total assessment area population

lower aquifers as part of a review of the Eastern Columbia Plateau Sole Source Aquifer Petition indicates significant isolation of these aquifers from land surface.

¹² U.S.G.S., Open File Report 95-445 and accompanying fact sheet

(~200,500 people). The number of people which receive drinking water from a public water supply system that have reported at least one exceedence of the nitrate-nitrogen drinking water MCL within the past three years is calculated at 13 % of the assessment area population or ~39,500 people. Nitrate-nitrogen MCL exceedences are determined at the source (well) and, because of blending or other treatment, do not necessarily indicate the nitrate concentration delivered to the consumer. A more detailed analysis of public water systems with nitrate MCL exceedences indicates that the number of individuals on public water systems which lacked, at least temporarily, treatment options and therefore delivered, on one or more occasions, drinking water at concentrations greater than the MCL is ~1,700 or 0.6% of the total population in the study area.

Drinking water quality monitoring data does not exist or was not accessible for the approximately 65,000 people (21%) using private (domestic) wells for their source of drinking water. Because most private wells are shallow and vulnerable to contamination, it is believed a significant proportion of domestic well users may be exposed to elevated nitrate levels in their drinking water. Private domestic wells do not have any health department requirements mandating on-going water quality monitoring, although there are monitoring requirements at the time of drilling. Water quality monitoring may also occur when properties are sold.

One trend of concern is the increasing use of multiple exempt¹³ wells as sources of supply for new developments. Such wells are commonly the shallow, highly susceptible wells of greatest concern from a drinking water quality perspective.

Populations Considered at Risk

The term population can refer to subsets of all persons in an area based on physiological factors (e.g., age, health status) or based on geographic criteria. The principal populations considered at risk from elevated nitrate levels in drinking water supplies are infants under six months of age, pregnant women and individuals lacking a fully developed enzyme capability to reduce methemoglobin to hemoglobin. All of these sub-populations are at risk if their drinking water supply exceeds the nitrate drinking water standard of 10 mg/l nitrate-nitrogen, although there is an insufficient understanding of the magnitude of the risks to each of these populations.

Occurrence of Methemoglobinemia in the Mid-Columbia Basin

Documenting the occurrence of methemoglobinemia, or assessing the true magnitude of adverse health impacts associated with nitrate-nitrogen concentrations greater than the nitrate-nitrogen drinking water MCL in drinking water supplies is made difficult from at least three separate perspectives. First, methemoglobinemia is not a reportable disease so diagnosed cases are not necessarily brought to the attention of the Department of Health. Second, many health care providers have received little professional training in environmental illnesses and their diagnosis. For this reason some clinicians may not routinely include methemoglobinemia in their differential diagnosis. Third, when cases of methemoglobinemia are detected, it is often uncertain as to what caused the condition. While the source of the methemoglobinemia might have been elevated nitrate levels in drinking water, it may also have been a result of very high levels of nitrate/nitrite in the diet, or exposure to high concentrations of either nitrate and/or nitrite due to an unrelated exposure route such as some medical treatments.

To begin developing an initial understanding of the incidence of methemoglobinemia the Department of Health conducted a targeted mail survey of specific physicians, midwives, and public health nurses located within the mid-Columbia Basin. The survey sought information on cases of methemoglobinemia that may

¹³ The term "exempt well" refers to the fact that Washington State regulations exempt small wells providing less than 5,000 gallons/day for limited uses from the formal requirements of applying for water rights. Increasingly, persons wishing to avoid the delays and uncertainties of formally applying for water right permits are instead drilling numerous small wells for their water supply. As an example, a subdivision of 100 homes may end up with 25 exempt wells being drilled, rather than a single large well/water system.

have occurred within the counties of interest. Preliminary results of the basin specific portion of the survey suggests that there may have been at least 7 possible cases of methemoglobinemia in the mid-Columbia Basin in the past five (5) years (since these results are based on "recall" there is some uncertainty associated with the accuracy of the estimate).

**Table Four: Suspected or Confirmed Cases of Methemoglobinemia
 As Reported by Health Care Providers
 in the Mid-Columbia Basin**

County	Past Year	Past Five Years
Adams	0	0
Benton	1	6
Franklin	0	0
Grant	0	0
Lincoln	0	1
Whitman ¹⁴	UNK	UNK
Totals	1	7

A statewide survey for cases of methemoglobinemia that resulted in hospitalizations was also conducted. No such cases were reported from the mid-Columbia Basin. *Note: A complete discussion of the Washington Department of Health Survey can be found in the companion report "An Examination of Methemoglobinemia in Washington State - May 1996".*

Subcommittee Conclusions Regarding Public Health Concerns

The Subcommittee makes the following findings:

- F-4. *Achieving the goal of "All persons have access to safe drinking water supplies" is a high priority for all involved.*
- F-5. *There exists a substantial gap in data related to the nitrate exposure of individuals who obtain drinking water from private domestic wells*
- F-6. *A significant number of people in the mid-Columbia basin are currently exposed to drinking water which exceeds the nitrate-nitrogen drinking water MCL.*
- F-7. *Based on current information, it is not known whether the elevated nitrate levels in ground water within the Basin have had a health impact on residents.*
- F-8. *There is an insufficient understanding of the magnitude of the health risks associated with exposure to drinking water supplies above the nitrate-nitrogen drinking water MCL. This lack of understanding is cause for concern regarding health effects on sensitive populations.*

¹⁴ The original survey did not include Whitman County. Douglas County was included but is not considered part of the study area. The results of the Douglas County survey did not identify any cases of methemoglobinemia during the past five years.

IV. Recommended Solutions for the Reduction of Nitrate Exposure to Human Populations in the Mid-Columbia Basin

Ground water quality degradation due to nitrogen loading in several areas of the mid-Columbia Basin is not a recent phenomenon. Because of the nature of ground water and the hydrogeologic characteristics of the mid-Columbia Basin, the benefits of immediate implementation of activities designed to reduce nitrogen and hydraulic loading to the land surface and subsequently to the underlying ground water will not be realized for some time.

Recommendations for the improvement of ground water quality and increased public health protection within the mid-Columbia Basin are multifaceted and include elements which:

- A. Improve the current base of knowledge (from a public health and environmental perspective) regarding ground water quality;
- B. Provide access to safe drinking water in areas where ground water nitrate-nitrogen levels exceed the state drinking water MCL for nitrate-nitrogen;
- C. Provide long term, viable alternatives to current agricultural, and urban activities which contribute to nitrogen overloading in vulnerable areas of the mid-Columbia Basin; and,
- D. Provide educational and outreach materials and training to the general public and stakeholder groups regarding known and scientifically accepted nitrate related health risks, opportunities for private well water testing, likely sources of nitrate in ground water, and methods to limit nitrogen loading.

Recommendations for the Improvement of Current Knowledge

The results of the water quality analysis conducted by the Subcommittee indicates that there currently exists areas of the mid-Columbia Basin where nitrate-nitrogen concentrations exceed state drinking water MCL for nitrate-nitrogen. This data, while able to provide us with a sense of where the problems exist, is considered far from adequate to establish an overall picture of current ground water quality throughout the entire study area. In light of this fact, the Subcommittee makes the following recommendations:

- R-1. The Departments of Ecology and Health should continue to collect and incorporate existing nitrate concentration data into a shared database so as to improve understanding of the extent of nitrate contamination of ground water within the mid-Columbia Basin. Specific attention should be paid to improving data density in the central and eastern portions of the mid-Columbia Basin. The results of this activity should be reviewed on an annual basis and findings presented annually to the Secretary of Health and the Directors of the Departments of Agriculture, Ecology, and the Washington Conservation Commission*
- R-2. The Department of Health should conduct follow-up investigations to determine, to the extent possible, the causal agent(s) of reported cases of methemoglobinemia. Additionally, the Department of Health should establish an epidemiological surveillance program in which detection of events, such as a case of methemoglobinemia, would trigger follow-up protocols for further investigation and intervention.*
- R-3. Public health officials should continue to assess potential health impacts from nitrate exposure.*
- R-4. The Department of Agriculture, in conjunction with Washington State University-Cooperative Extension, and the Conservation Districts within the mid-Columbia Basin should begin an assessment of application rates of nitrogen fertilizers to various crop types in order to determine areas of past, current, and potentially future nitrogen overloading.*

Recommendations to Address "Sensitive" Populations (Short Term)

As noted previously, there exist localized areas of elevated nitrate-nitrogen in ground water in the mid-Columbia Basin. The primary areas are western Franklin County, eastern Benton County, and local areas around Quincy and Moses Lake in Grant County, and Othello in Adams County.

The immediate health and welfare of individuals within "sensitive" populations currently living in these areas is a concern of both health and environmental protection officials. The Subcommittee makes the following recommendations:

- R-5. *Persons on private (domestic) drinking water wells should have easy access to well testing to verify their specific well water quality. These persons should also be provided with information on practices they can undertake to minimize current and future risks of contamination of their drinking water source. The Home*a*Syst program, programs through the local health departments and/or Conservation Districts are all possible vehicles to implement this recommendation.*
- R-6. *Immediate and ongoing efforts should be undertaken by public health officials to identify sensitive populations/individuals and ensure they have access to safe drinking water supplies.*

Recommendations to Implement Long Term Reduction of Nitrogen Overloading

Long term solutions to the current ground water quality problems which have resulted from nitrogen overloading will require cooperation of numerous federal, state, local, and private agencies and organizations. The recommendations provided below are state suggested only. Implementation of the process described later in this report may result in different or modified recommendations based on local and stakeholder input.

It can be expected that improved water quality resulting from the implementation of actions leading to decreased nitrogen loading will not be realized in the near future. However, through a coordinated effort designed to address nitrogen loading from a wide range of sources, future ground water quality can be improved without serious consequences to the economy of the mid-Columbia Basin. The Subcommittee recommends:

- R-7. *There should be continued development, testing, and implementation of agricultural Best Management Practices or other measures which reduce nitrogen application to crop specific agronomic rates. Specific elements should include:*
- Increase the activities of Conservation Districts, the Natural Resources Conservation Service and Washington State University-Cooperative Extension to promote implementation of irrigated agriculture Best Management Practices;*
 - Develop and implement uniform crop nitrogen recommendations based on specific crops, soils, and climate; and,*
 - Design and implement pilot studies focusing on innovative farm techniques which reduce nitrogen loading to crops and monitor results for future expansion of findings.*

Recommendations for Improving Education and Outreach

The recommendations for improving education and outreach must target agriculture, industry, and the general public. To best accomplish this requires the involvement of several agencies and organizations having previously demonstrated expertise in the area and established relationships with stakeholder groups. The Department of Health, in conjunction with the local health jurisdictions, will likely focus attention upon the general public and specific "sensitive" populations. The Department of Agriculture and local Conservation Districts in conjunction with Washington State University-Cooperative Extension will likely focus on agricultural interests. The Department of Ecology will focus on providing technical information to facilities.

permitted under the state Waste Discharge Permit program. The EPA will likely be a partner in providing financial, technical, and programmatic assistance to many of the stakeholder groups.

Specific recommendations are:

- R-8. Educational avenues for reducing health risks associated with drinking water supplies currently contaminated by nitrate should be pursued as a short term response. Education must not be relied on without a concurrent effort to implement nitrate loading reduction measures as part of a long term solution.*
- R-9. The Department of Health, in conjunction with and concurrence from local health jurisdictions, should conduct targeted educational outreach to local health care providers and sensitive populations. A key element in the educational outreach to health care providers is information on the range of clinical manifestations associated with methemoglobinemia.*
- R-10. The Washington State Department of Agriculture in concert with local Conservation Districts and WSU-Cooperative Extension Service should implement educational activities specifically directed to regulated activities associated with fertilizer application management techniques which reduce nitrogen overloading.*
- R-11. The Department of Ecology should continue to implement the recently issued "Implementation Guidance for the Ground Water Quality Standards" for those activities for which it has authority and which may affect ground water quality. Within the mid-Columbia Basin, priority activities should include those which may cause or contribute to elevated nitrate concentrations in ground water.*
- R-12. Private industry, including agricultural chemical dealers, field representatives, private consultants and food processors, should take a lead role in working with producers to promote practices to reduce excess nitrogen loading.*

V. Framework for Coordinated Agency and Stakeholder Participation

The Subcommittee views correction of the elevated nitrate concentrations in ground water issue as one that will require the coordinated efforts of a variety of federal, state, and local agencies, local jurisdictions, and a variety of stakeholder groups. State agencies possess the majority of the legal authority for ground water protection, but the Subcommittee believes that a state-down regulatory approach will not be effective due to lack of resources and the recognition that on-the-ground changes in nitrate loading activities are more likely to occur if the entities involved in the actions help develop alternatives to their current practices.

Use of the Ground Water Management Area Process

The Subcommittee has investigated several options for establishing stakeholder and local community involvement in a coordinated ground water quality in the mid-Columbia Basin. After reviewing several options the Subcommittee recommends beginning the process to establish a Ground Water Management Area (GWMA) as specified under Chapter 90.44 RCW. The Subcommittee feels that pursuing this process has several distinct advantages over other, more regulatory focused alternatives.

First, if implementation of any plan to improve ground water quality is to be successful it must have significant involvement from local government and stakeholder groups. The process by which a Ground Water Management Area is established and activities implemented requires local government participation and stakeholder involvement. Second, by conducting ground water quality improvement activities within a pre-existing framework the avenues for funding beyond the awarding of grants is greatly increased. Third,

from an administrative perspective, by conducting ground water quality improvement activities process within an established framework that has been codified, the validity of the product will be less likely to be challenged.

In order to decrease development time, the Subcommittee recommends adjusting the process as needed to ensure the following:

- 1) The process is kept focused on addressing priority issues and the development of mechanisms which will allow federal, state, and local authorities to begin implementation of corrective measures in a timely manner;
- 2) Public health issues are addressed;
- 3) Key entities are represented and their contribution to the overall improvement of ground water quality identified;
- 4) Actions developed during the GWMA process to improve ground water quality and which have consensus can be implemented prior to certification of the GWMA; and
- 5) State agencies have an identified role in the process to foster ground water quality improvement in a timely manner.

Development Of A Ground Water Management Area

A Ground Water Management Area can be proposed by any county, city, town, or any other entity having its own incorporated government for local affairs including public utility districts, health departments or districts, water districts, irrigation districts, sewer districts, conservation districts, or ground water user groups. Additionally, the Department of Ecology or other state agency may upon its own initiative propose a Ground Water Management Area. Proposals are to be submitted to the Department of Ecology along with probable boundaries of the GWMA. Included in the proposal is a recommendation as to the lead agency through which subsequent activities will take place. If agreement as to the lead agency cannot be achieved, the Department of Ecology shall attempt to mediate an agreement.

After a proposal is received and agreements as to the lead agency secured, a public meeting is to be held the purpose of which is to both inform the public as to the specifics of the GWMA proposal and solicit public comment.

If the Department of Ecology finds, based on the technical adequacy of the proposal for designation and the comments received as a result of public hearing(s), that the proposal is in the best interest of the public, it shall identify the area as a probable GWMA. The Department of Ecology will then appoint a lead agency and, in cooperation with that agency, establish a schedule for implementing the GWMA process. Included in the schedule will be an assessment of the relative priority areas within the probable GWMA boundaries, the availability of state resources to support local efforts, an assessment as to the severity of the problem(s) which led to a GWMA proposal.

The lead agency in cooperation with the Department of Ecology will appoint members of a Ground Water Advisory Committee (GWAC) which will be responsible for overseeing the development of the ground water management program. Membership of this committee is to be drawn from the following stakeholders:

- Local government legislative authorities
- Local planning agencies
- Local health agencies
- Ground water user groups

- Department of Ecology
- Department of Health
- Department of Agriculture
- Other local, state, and federal agencies as determined by the lead agency and the Department of Ecology
- Effected tribal governments
- Public and special interest groups such as agriculture, well drilling, environmental, business/or industrial groups within the area as determined by the lead agency and the Department of Ecology

Upon establishment of the Ground Water Advisory Committee (GWAC), public meetings are to begin to:

- Identify goals for overall action plan and individual sectors
- Identify how the identified goals are to be achieved
- Brainstorm alternative approaches for addressing the nitrate issue
- Identify the probable activities contributing to the identified problem(s)
- Identify how could activities be done differently to prevent ground water contamination
- Develop an action plan
- Define tasks, duties, roles and responsibilities of all parties responsible for implementing the action plan
- Identify how the action plan will be implemented
- Develop a schedule for implementing the action plan
- Define how to determine whether the action plan was a success

Upon completion of the action plan, the lead agency will hold public hearing on the plans findings and recommendations. The lead agency will consolidate the findings and submit them to the GWAC for resolution (if necessary). Upon resolution of any outstanding issues the Department of Ecology will certify the GWMA. Following certification, state agencies and affected local governments shall adopt or amend regulations, ordinances, and/or programs for implementing provisions of the ground water management plan.

The Departments of Agriculture, Ecology, Health, and the Washington Conservation Commission shall be guided by the plan when reviewing and considering approval of all studies, plans, and facilities in the area. Technical assistance could be provided by the state agencies in the areas of data collection and analysis, meeting support, financial support of action plan development and implementation, and initial implementation of short term activities designed to eliminate immediate concerns related to protection of public health.

R-13. State and federal agencies should support local efforts to establish and undertake one or more Ground Water Management Areas in the mid-Columbia Basin. This support may be best provided through formal adoption of a Memorandum of Understanding outlining agency commitments.

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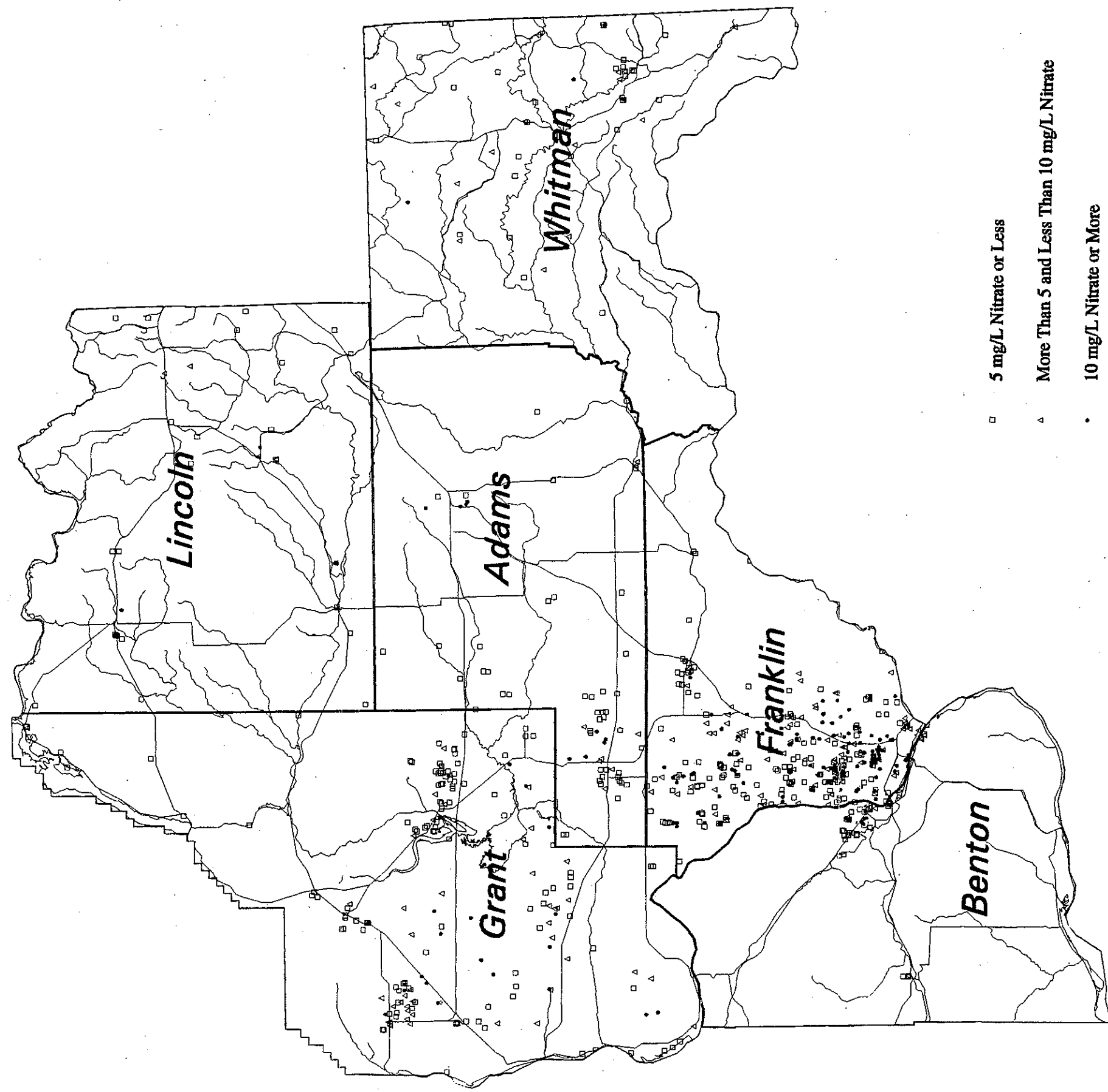
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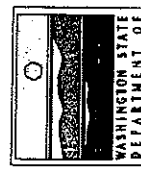
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**Appendix One: Nitrate Distribution Map
of Mid-Columbia Basin Assessment Area**

Nitrate Concentrations in Wells Within the Mid-Columbia Basin



- 5 mg/L Nitrate or Less
- △ More Than 5 and Less Than 10 mg/L Nitrate
- 10 mg/L Nitrate or More



Scale 1:1,000,000
Miles