GWMA PLAN

Citizens and local governments working together for safe drinking water...

Officially adopted by the Boards of County Commissioners of Adams, Franklin and Grant Counties in August, 2001, and by the Lincoln County Board of County Commissioners in August, 2005.


GWMA Project Office
449 E. Cedar Blvd.
Othello, WA 99344
509-488-2802
gwma@cbgwma.org
www.gwma.org

06 December 2001
TABLE OF CONTENTS

I. EXECUTIVE SUMMARY ........................................................................................................... 1

II. GLOSSARY OF TERMS ........................................................................................................... 1

I. INTRODUCTION ....................................................................................................................... 1-1

1.1 AUTHORITY AND SCOPE .................................................................................................. 1-1

1.2 HISTORY ............................................................................................................................... 1-2

1.3 GWMA LOCATION AND BOUNDARIES ........................................................................... 1-3

1.4 ACKNOWLEDGMENTS ........................................................................................................ 1-4

1.5 PLAN DEVELOPMENT APPROACH – A GRASSROOTS EFFORT .................................. 1-4

1.6 PLAN WRITING STYLE AND CONTENTS ......................................................................... 1-5

2. GOALS, OBJECTIVES, AND MEASURES OF SUCCESS .................................................... 2-1

2.1 GOALS .................................................................................................................................. 2-1

2.1.1 Groundwater Quality Goal .............................................................................................. 2-1

2.1.2 Public Information and Education Goal ........................................................................... 2-2

2.1.3 Research and Implementation Goal .................................................................................. 2-3

2.1.4 Fiscal Management Goal ................................................................................................. 2-3

2.2 OBJECTIVES ......................................................................................................................... 2-4

2.3 MEASURES OF SUCCESS ..................................................................................................... 2-5

3. ORGANIZATION AND ADMINISTRATION ........................................................................... 3-7

3.1 GWMA ORGANIZATIONS ..................................................................................................... 3-7

3.1.1 Lead Agency ....................................................................................................................... 3-7

3.1.2 Ground Water Advisory Committees .............................................................................. 3-7

3.1.3 GWAC Executive Board .................................................................................................. 3-8

3.1.4 Administrative Board ........................................................................................................ 3-8

3.1.5 Sub-committees ................................................................................................................. 3-9

3.1.5 Community Producer Groups .......................................................................................... 3-9

3.2 BUDGET ALLOCATION COMPONENTS ............................................................................. 3-10

3.2.1 Program Administration ................................................................................................... 3-10

3.2.2 Characterization and Monitoring .................................................................................... 3-11

3.2.3 Research and Implementation ......................................................................................... 3-11

3.2.4 Public Information and Education Program ...................................................................... 3-12

3.3 PROGRAM TIMELINES ........................................................................................................ 3-13

3.4 PLAN IMPLEMENTATION PROCESS ................................................................................ 3-14

3.4.1 Strategy Matrices .............................................................................................................. 3-15

3.4.2 Implementing Agencies ................................................................................................... 3-15

3.4.3 Funding Needs and Process .............................................................................................. 3-15

4. THE EXECUTIVE BOARD ....................................................................................................... 4-1

4.1 PROCESS-RELATED DECISIONS ....................................................................................... 4-1

4.1.1 GWMA-Sponsored Projects ............................................................................................ 4-1

4.1.2 Contracts ............................................................................................................................ 4-2

4.1.3 Major Budget Expenditures ............................................................................................. 4-2

4.1.4 Personnel Changes .......................................................................................................... 4-2

4.2 MAJOR PRESS RELEASES ................................................................................................... 4-2

4.3 OVERSIGHT AND MANAGEMENT OF PROJECTS .......................................................... 4-3

4.4 PLAN DEVELOPMENT, REVIEW, AND REVISION OVERSIGHT .................................. 4-4

4.5 CONSIDERATION OF EMERGENT ISSUES ..................................................................... 4-4

4.6 EXECUTIVE BOARD STRATEGY MATRIX .......................................................................... 4-4

12 September 2001
TABLE OF CONTENTS

5 GROUNDWATER CHARACTERIZATION ................................................................. 5-1
  5.1 GROUNDWATER QUALITY ................................................................................. 5-1
  5.2 GROUNDWATER QUANTITY ............................................................................. 5-3
    5.2.1 Historical Development of Water Resources in the Region ......................... 5-3
    5.2.2 Known Factors Controlling Groundwater Quantity .................................... 5-3
    5.2.3 Administrative Policy .................................................................................. 5-4
6 IRRIGATED AND DRYLAND AGRICULTURE GWAC PLAN ............................. 6-1
  6.1 COMMITTEE COMPOSITION ............................................................................ 6-1
  6.2 COMMITTEE APPROACH ................................................................................. 6-1
  6.3 COMMITTEE GOALS ......................................................................................... 6-3
  6.4 RECOMMENDED MANAGEMENT STRATEGIES ............................................. 6-4
    6.4.1 Strategy AG1 – Help Develop Nutrient Management Guidelines ............... 6-4
    6.4.2 Strategy AG2 – Help Develop Irrigation Water Management Guidelines ...... 6-6
    6.4.3 Strategy AG3 – Facilitate Implementation of Nutrient and Irrigation Water
        Management Guidelines ............................................................................... 6-7
    6.4.4 Strategy AG4 – Sponsor Projects ............................................................... 6-8
      6.4.4.1 Identification of Geographic Areas Vulnerable to Nitrate Leaching ... 6-9
      6.4.4.2 Sources of Elevated Nitrate Levels in Dryland/Rangeland Wells ......... 6-9
      6.4.4.3 Impact of Irrigation System Conversion .............................................. 6-10
      6.4.4.4 Impacted Aquifer or Aquifer Zones .................................................... 6-10
      6.4.4.5 Groundwater Treatment ................................................................. 6-10
      6.4.4.6 Wellhead Protection Plans ............................................................... 6-10
      6.4.4.7 Abandoned Wells .............................................................................. 6-11
      6.4.4.8 Bulk Fertilizer Handling and Storage .............................................. 6-11
      6.4.4.9 Nitrogen Availability of Organic Sources of Nitrogen ...................... 6-11
    6.4.5 Strategy AG5 – Public Information and Education Program ..................... 6-11
6.5 MONITORING ................................................................................................. 6-12
6.6 ADDITIONAL INFORMATION ........................................................................ 6-14
  6.6.1 Sources of Available Nitrate to Crop ........................................................... 6-14
7 SPRAYFIELD AND WASTEWATER MANAGEMENT PLAN ............................... 7-1
  7.1 COMMITTEE COMPOSITION ............................................................................ 7-1
  7.2 COMMITTEE APPROACH ................................................................................. 7-2
  7.3 COMMITTEE GOALS ......................................................................................... 7-3
  7.4 RECOMMENDED MANAGEMENT STRATEGIES ............................................. 7-4
    7.4.1 Strategy SFWWM1 – Form a Regional Information-Sharing Group ........... 7-4
    7.4.2 Strategy SFWWM2 – Recommend Activities and Practices to Meet or Exceed
        Permit Requirements .................................................................................. 7-5
    7.4.3 Strategy SFWWM3 – Sponsor Projects .................................................... 7-6
    7.4.4 Strategy SFWWM4 – Public Information and Education Program ............. 7-6
7.5 MONITORING ................................................................................................. 7-8
7.6 ADDITIONAL INFORMATION, DATA, AND ANALYSIS ............................... 7-9
  7.6.1 Background and Regulatory Requirements – POTWs ............................... 7-9
  7.6.2 Background and Regulatory Requirements – Food Processors ................. 7-10
  7.6.3 Agronomic Application Rate – Definitions and Limitations ....................... 7-11
  7.6.4 Winter Storage Requirements .............................................................. 7-11
8 ENVIRONMENT AND RECREATION GWAC PLAN ........................................ 8-1
  8.1 COMMITTEE COMPOSITION ............................................................................ 8-1
# TABLE OF CONTENTS

8.2 COMMITTEE APPROACH ........................................................................................................... 8-1
8.3 COMMITTEE GOALS .................................................................................................................... 8-3
8.4 RECOMMENDED MANAGEMENT STRATEGIES ................................................................. 8-3
  8.4.1 Strategy ER1- Recommend Voluntary BMPs for Managed Recreation Areas .................. 8-3
  8.4.2 Strategy ER2 - Support Activities/Share Resources with Other GWACs ...................... 8-5
  8.4.3 Strategy ER3 - Public Information and Education Program ............................................. 8-5
    8.4.3.1 Enhancing School Curricula ..................................................................................... 8-5
    8.4.3.2 Educate the Public Regarding Popular Misconceptions ........................................... 8-6
8.5 MONITORING ............................................................................................................................. 8-7
8.6 ADDITIONAL INFORMATION, DATA, AND ANALYSES ...................................................... 8-7
  8.6.1 Surface Water Nitrate Levels ............................................................................................... 8-7
  8.6.2 Effect of Nitrate on Fish ...................................................................................................... 8-9
  8.6.3 Naturally Occurring Nitrate and Atmospheric Deposition .............................................. 8-10
  8.6.4 Effects of Recreational Activities and Surface Water Nitrate on One Another................ 8-11

9 DAIRY, FEEDLOT, AND CATTLEMEN GWAC PLAN ............................................................... 9-1
  9.1 COMMITTEE COMPOSITION ................................................................................................. 9-1
  9.2 COMMITTEE APPROACH ...................................................................................................... 9-1
  9.3 COMMITTEE GOALS .............................................................................................................. 9-3
  9.4 RECOMMENDED MANAGEMENT STRATEGIES .............................................................. 9-3
    9.4.1 Strategy DFC1- Help Develop Nutrient Management Guidelines ................................. 9-4
    9.4.2 Strategy DFC2 - Suggest BMPs for Voluntary Implementation ..................................... 9-4
    9.4.3 Strategy DFC3 – Help Facilitate Implementation of Nitrate Management Strategies ...... 9-6
    9.4.4 Strategy DFC4 – Form a Regional Advocacy Group ...................................................... 9-6
    9.4.5 Strategy DFC5 – Sponsor Projects .................................................................................. 9-7
    9.4.6 Strategy DFC6 - Public Information and Education Program ....................................... 9-9
      9.4.6.1 Local Communication .............................................................................................. 9-9
      9.4.6.2 Public Perception ..................................................................................................... 9-10
  9.5 MONITORING .......................................................................................................................... 9-10
  9.6 ADDITIONAL INFORMATION, DATA, AND ANALYSIS .................................................. 9-11
  9.6.1 Definitions of AFOs and CAFOs ....................................................................................... 9-11

10 URBAN AND RURAL RESIDENTIAL GWAC PLAN .............................................................. 10-1
  10.1 COMMITTEE COMPOSITION .............................................................................................. 10-1
  10.2 COMMITTEE APPROACH ................................................................................................... 10-1
  10.3 COMMITTEE GOALS ............................................................................................................ 10-1
  10.4 RECOMMENDED MANAGEMENT STRATEGIES ............................................................. 10-2
    10.4.1 Strategy URR1- Sponsor Projects ................................................................................ 10-2
      10.4.1.1 Identify Populations at Risk from Consumption of High-Nitrate Groundwater ....... 10-2
      10.4.1.2 Accelerate Wellhead Protection Planning For Group A Public Water Systems .... 10-2
    10.4.1.3 Decommissioning of Abandoned or Unused Wells .................................................. 10-3
    10.4.1.4 Domestic Well Density and Groundwater Degradation ......................................... 10-4
  10.4.2 Strategy URR2 - Public Information and Education Program ....................................... 10-4
    10.4.2.1 Educate the At-Risk Populations ............................................................................... 10-4
    10.4.2.2 Role of the General Public in Protecting Groundwater Quality .............................. 10-5
    10.4.2.3 Wellhead Protection Planning and Water Quality Monitoring for Private Domestic and Group B Wells ................................................................. 10-5

iv  12 September 2001
TABLE OF CONTENTS

10.4.2.4 Proper Well Installation Inspection ................................................. 10-7
10.4.2.5 Decommissioning of Abandoned or Unused Wells .......................... 10-7
10.4.2.6 Potential of Septic Systems to Contribute Nitrate to Groundwater .. 10-8
10.4.2.7 Fertilizer Use on Residential Lawns ............................................. 10-8
10.4.2.8 Nitrate Management on Noncommercial Farms and Ranches .......... 10-9
10.4.2.9 Domestic Well Density and Groundwater Degradation .................. 10-10

10.5 MONITORING ......................................................................................... 10-10

11 REFERENCES ............................................................................................. 11-1

LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GWMA Sub-Committees</td>
</tr>
<tr>
<td>2</td>
<td>Community Producer Group (CPG) Characteristics</td>
</tr>
<tr>
<td>3</td>
<td>Grant Funding Distribution</td>
</tr>
<tr>
<td>4</td>
<td>Top 20 Dominant Crops in GWMA</td>
</tr>
<tr>
<td>5</td>
<td>List of State Discharge Program Permit Holders</td>
</tr>
</tbody>
</table>

LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location of the Columbia Basin Groundwater Management Area</td>
</tr>
<tr>
<td>2</td>
<td>GWMA Organization Chart</td>
</tr>
<tr>
<td>3</td>
<td>Community Producer Group (CPG) Map</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

## LIST OF ATTACHMENTS

<table>
<thead>
<tr>
<th>ATTACHMENT</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Petition for GWMA</td>
</tr>
<tr>
<td>A2</td>
<td>WAC 173-100</td>
</tr>
<tr>
<td>A3</td>
<td>Memorandum of Understanding (MOU)</td>
</tr>
<tr>
<td>A4</td>
<td>List of GWAC Members and Technical Support Members</td>
</tr>
<tr>
<td>B1</td>
<td>GWMA Draft Bylaws</td>
</tr>
<tr>
<td>B2</td>
<td>GWMA Public Information and Education Plan</td>
</tr>
<tr>
<td>B3</td>
<td>Recommended Management Strategy Matrices by GWAC</td>
</tr>
<tr>
<td>B4</td>
<td>List of Concurring Agencies and Letters of Concurrence</td>
</tr>
<tr>
<td>B5</td>
<td>Schedule of the Plan Concurrence and Certification Process</td>
</tr>
<tr>
<td>B6</td>
<td>State Environmental Policy Act (SEPA) Checklist</td>
</tr>
<tr>
<td>C</td>
<td>Broad-based GWMA Projects (Non-GWAC Specific)- Current, Completed and Proposed:</td>
</tr>
<tr>
<td>C1</td>
<td>Biennial Well Sampling Project</td>
</tr>
<tr>
<td>C2</td>
<td>1999 Public Opinion Survey</td>
</tr>
<tr>
<td>C3</td>
<td>Geographic Information System (GIS) Database</td>
</tr>
<tr>
<td>C4</td>
<td>Leaching Vulnerability Index Project</td>
</tr>
<tr>
<td>C5</td>
<td>GWMA Information Documentary</td>
</tr>
<tr>
<td>C6</td>
<td>Proposed Hydrostratigraphy Study</td>
</tr>
<tr>
<td>D1</td>
<td>Hydrogeological Characterization Report (Kennedy/Jenks Consultants) – Available Upon Request</td>
</tr>
<tr>
<td>D4</td>
<td>Nitrogen Loading Activities</td>
</tr>
<tr>
<td>E1</td>
<td>Estimated Fertilizer Guidelines</td>
</tr>
<tr>
<td>E2</td>
<td>Irrigation Water Management Guidelines and Template</td>
</tr>
<tr>
<td>E3</td>
<td>Deep Soil Sampling Program for 2000</td>
</tr>
<tr>
<td>E4</td>
<td>Irrigation Water Management Cost Share Program</td>
</tr>
<tr>
<td>E5</td>
<td>GWMA BMP Implementation Survey for 1999</td>
</tr>
<tr>
<td>E6</td>
<td>Deep Soil Nitrate Monitoring Plan</td>
</tr>
<tr>
<td>F1</td>
<td>SFWM GWAC Innovative Cropping System Demonstration Project</td>
</tr>
<tr>
<td>G1</td>
<td>Golf Course Best Management Practices</td>
</tr>
<tr>
<td>H1</td>
<td>Minimum Elements of Dairy Nutrient Management Plans</td>
</tr>
<tr>
<td>H2</td>
<td>Nutrient Management Specialist</td>
</tr>
<tr>
<td>H3</td>
<td>DFC GWAC Winter Mineralization Study</td>
</tr>
<tr>
<td>I1</td>
<td>Methemoglobinemia Study</td>
</tr>
<tr>
<td>I2</td>
<td>Onsite Sewage System Position Paper</td>
</tr>
</tbody>
</table>
A complete printed copy of the Columbia Basin GMWA Plan document may be obtained by contacting the Columbia Basin GMWA Project Office, 449 E. Cedar Blvd., Othello, WA 99344, 509-488-2802 ext 108 or e-mail gwma@cbgwma.org. The document is also available on the GWMA website at www.gwma.org.
I. EXECUTIVE SUMMARY

The residents of Adams, Franklin, and Grant Counties are stewards of the groundwater resources underlying their counties for current and future generations. Concerns over high groundwater nitrate concentrations led to official designation of the tri-county area as a Ground Water Management Area (GWMA) by Washington State Department of Ecology (Ecology) in February 1998. As the Lead Agency, the Boards of County Commissioners of the three counties joined with more than 100 local volunteers to form and direct the GWMA efforts. They have developed this document as their plan to inform the public and guide their groundwater protection activities focusing on the nitrate problem. The staff of the local Conservation Districts, Health Districts, and county governments will coordinate, facilitate, and implement the GWMA activities.

The local GWMA participants recognize that nitrogen used in irrigated agriculture, meaning all nitrogen-loading activities within the irrigated areas of the three counties (see Attachment D4), has likely been contributing source of nitrate input into the region’s groundwater. They have agreed that the most effective methods that will lead to improving regional groundwater nitrate levels in the GWMA are the following:

- Widespread irrigation water management and use of nutrient management guidelines in fertilizer use and application on agricultural lands.
- Public education about drinking water safety and groundwater protection.

The plan presents: 1) the current understanding of the nature of the groundwater nitrate problem and sources that may contribute nitrate to groundwater, 2) management strategies recommended by the local GWMA volunteers to reduce groundwater nitrate levels, and 3) a process to implement the strategies and monitor their progress. The plan contains specific goals used to guide implementation of nitrate management strategies.

Monitoring implementation of the strategies and progress in achieving the GWMA goals will be conducted on a regular basis. The monitoring results and results of evaluation of progress made in achieving the GWMA goals and objectives will be reported by 31 December 2005.
II. GLOSSARY OF TERMS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFO</td>
<td>Animal Feeding Operation</td>
</tr>
<tr>
<td>AG GWAC</td>
<td>Irrigated &amp; Dryland Agriculture Ground Water Advisory Committee</td>
</tr>
<tr>
<td>AKART</td>
<td>All known, available, and reasonable treatment</td>
</tr>
<tr>
<td>bgs</td>
<td>Below ground surface</td>
</tr>
<tr>
<td>BMP(s)</td>
<td>Best management practice(s)</td>
</tr>
<tr>
<td>BNC</td>
<td>The 1998 Baseline Nitrate-N Concentrations</td>
</tr>
<tr>
<td>Board</td>
<td>Ground Water Advisory Committees Executive Board</td>
</tr>
<tr>
<td>CAFO</td>
<td>Concentrated Animal Feeding Operation</td>
</tr>
<tr>
<td>CBP</td>
<td>Columbia Basin Project</td>
</tr>
<tr>
<td>CD</td>
<td>Conservation Districts</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>CPG</td>
<td>Community Producer Group(s)</td>
</tr>
<tr>
<td>CRBG</td>
<td>Columbia River Basalt Group</td>
</tr>
<tr>
<td>Dairy NMP</td>
<td>Dairy Nutrient Management Plan</td>
</tr>
<tr>
<td>DFC GWAC</td>
<td>Dairy, Feedlot &amp; Cattlemen Ground Water Advisory Committee</td>
</tr>
<tr>
<td>Dryland</td>
<td>Geographical areas without irrigated water systems</td>
</tr>
<tr>
<td>E&amp;R GWAC</td>
<td>Environment &amp; Recreation Ground Water Advisory Committee</td>
</tr>
<tr>
<td>Ecology</td>
<td>Washington State Department of Ecology</td>
</tr>
<tr>
<td>ECPAS</td>
<td>East Columbia Plateau Aquifer System</td>
</tr>
<tr>
<td>EPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
<tr>
<td>Federal</td>
<td>United States of America Federal Government</td>
</tr>
<tr>
<td>FSA</td>
<td>Farm Service Agency</td>
</tr>
<tr>
<td>ft/d</td>
<td>Feet per day</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System Database</td>
</tr>
<tr>
<td>GMA</td>
<td>Growth Management Act</td>
</tr>
<tr>
<td>GWAC(s)</td>
<td>Ground Water Advisory Committee(s)</td>
</tr>
<tr>
<td>GWMA</td>
<td>Columbia Basin Ground Water Management Area or Ground Water Management Area</td>
</tr>
<tr>
<td>GWMA Plan</td>
<td>Columbia Basin Ground Water Management Area Plan</td>
</tr>
</tbody>
</table>
SR
Sampling Regions

SSA
Sole Source Aquifer

State
State of Washington

STATSGO
State soil geographic (database)

SWDP
State Waste Discharge Permit

Tri-County
The Counties of Adams, Franklin and Grant

URR
Urban & Rural Residential Ground Water Advisory Committee

USBR
U. S. Bureau of Reclamation

USEPA
U. S. Environmental Protection Agency

USGS
United States Geographical Survey

WAC
Washington Administrative Code

WCC
Washington Conservation Commission

WDOH
Washington State Department of Health

WHP
Wellhead Protection Plan

WHPA
Wellhead Protection Plan Area

WSDA
Washington State Department of Agriculture

WSU
Washington State University
1 INTRODUCTION
The residents of Adams, Franklin, and Grant Counties are stewards of the groundwater resources underlying their counties for current and future generations. Groundwater provides a majority of potable water for residents. Concerns about concentrations of nitrate in groundwater above a federally-mandated level brought the citizens of the three counties together to develop ways to preserve and enhance groundwater safety and reliability. Their cooperative effort has resulted in preparation of this planning document to inform and guide their groundwater protection efforts. This document has been prepared in accordance with the guidelines presented in Washington Administrative Code (WAC) 173-100.

1.1 AUTHORITY AND SCOPE
In mid-1997, the Boards of County Commissioners of Adams, Franklin, and Grant Counties passed resolutions requesting the designation of a Ground Water Management Area (GWMA) process under the Revised Code of Washington (RCW) Chapter 90.44.400 through 90.44.440 and Chapter 173-100 of the WAC. The GWMA approach to water issues was supported by all participating local, State, and federal entities as a local alternative to the federal Sole Source Aquifer designation proposed by the U.S. Environmental Protection Agency (EPA) in 1996 (See Section 1.2). The local governments requested designation of the GWMA based on favorable public comments received during public hearings and meetings held in each of the three counties between 1995 and 1997.

The Boards of County Commissioners submitted the “Petition to Designate a GWMA for Adams, Franklin and Grant Counties” (Petition) to the Washington State Department of Ecology (Ecology) proposing formal designation of a GWMA within their borders. The Petition was signed by the Ecology Director in February 1998. Attachment A1 is a copy of the Petition and Attachment A2 is a copy of WAC 173-100 guidelines.

Ecology’s groundwater management program process provides local governments with a method to achieve groundwater protection goals. The program establishes protocols and guidelines for developing a local groundwater management plan. The guidelines establish a process that allows the planning process to incorporate groundwater issues, concerns and opportunities from all interested groups and agencies. The process is designed so that a groundwater management plan can be developed locally while being supported by State legislation and policies.

After local review and acceptance (a process termed "concurrence"), this Ground Water Management Area Plan (GWMA Plan) will be submitted to Ecology for certification. Once it is
certified, local and State agencies will be obligated to derive guidance from the GWMA Plan when considering plans, programs, and policies that may impact implementation. The GWMA Plan is not intended to contradict the county plans developed under the Growth Management Act. The information and projects developed as part of GWMA activities are intended to help refine and clarify the county plans.

While recognizing that other water issues are also important to the environment and the economy, local initiators of the GWMA designation determined that nitrate loading of aquifers was the first critical, scientifically documented, solvable issue for management by the local citizens. For this reason, the GWMA Plan does not address groundwater constituents other than nitrate.

1.2 HISTORY
In 1992, the Palouse Clearwater Environmental Institute notified EPA that they intended to file a petition for Sole Source Aquifer (SSA) designation for the Eastern Columbia Plateau Aquifer System (ECPAS). By August 1994, EPA had determined that sufficient evidence and public support existed for a SSA designation to propose the designation and begin the public participation process. An EPA-appointed peer-review panel of six scientists formed in 1995 and concluded that EPA’s original proposal contained technical weaknesses. The panel recommended that additional information be reviewed before designation.

In May 1995, based on concerns about nitrate concentrations in groundwater supplies in the mid-Columbia Basin, a sub-committee of the Washington State Interagency Groundwater Committee was directed to conduct an environmental and public health assessment of nitrate levels in groundwater in the area encompassed by Adams, Benton, Franklin, Grant, Lincoln, and Whitman counties. As a result of the assessment, the sub-committee concluded that nitrate existed in groundwater at significant levels in localized areas within the mid-Columbia Basin, resulting in exposure of part of the population to nitrate in drinking water supplies. The nature and extent of adverse health effects associated with these exposures is not known. Based on the assessment, the sub-committee issued a report to agency management recommending establishment of a comprehensive, coordinated, and cooperative program to provide a framework for the design and implementation of locally driven solutions to documented groundwater quality concerns.

In January 1997, EPA issued the “Support Document for Consideration of the Eastern Columbia Plateau Aquifer System as a Sole Source Aquifer” (EPA 1997). In the conclusion of this document, EPA states that ECPAS meets the criteria for SSA designation because 1) the aquifer
is the sole or principal source of drinking water, and 2) contamination of the aquifer would create a significant hazard to public health.

In mid-1997, the Boards of County Commissioners of Adams, Franklin, and Grant Counties passed resolutions requesting the establishment of a GWMA process and submitted the Petition (Attachment A1) to Ecology proposing formal designation of a GWMA within their borders. The Petition was signed by Ecology in February 1998. The GWMA strategy was an attractive alternative to the EPA’s proposed SSA designation because the GWMA program calls for the appointment of local groundwater advisory committees to provide for effective and coordinated local management of the groundwater resource. Subsequently, EPA indefinitely suspended the SSA designation process pending the results of the local GWMA effort. Additional details regarding the history of events leading to GWMA designation are presented in the Petition.

In mid-1998, following designation of the GWMA, a diverse group of more than 100 local citizens joined together to form five Ground Water Advisory Committees (GWACs) representing suspected sources of nitrate in local groundwater. These GWACs were formed to research the nitrate issues and provide input to the development of this GWMA Plan. The GWMA Plan development effort is led by the Adams, Franklin, and Grant County Commissioners, the five GWACs, and a GWAC Executive Board seated by members of the GWACs so appointed (see Figure 2). The staff of the six Conservation Districts (CDs) and the three local Health Districts (HDs) in the GWMA counties lead the planning, administration, research, and implementation tasks of the GWMA.

Six State and federal agencies, including the State of Washington Departments of Agriculture (WSDA), Ecology (Ecology) and Health (WDOH); the Washington State University College of Agriculture and Home Economics (WSU); the Region 10 of the US Environmental Protection Agency (EPA); and the Washington Conservation Commission (WCC), signed a Memorandum of Understanding (MOU) in October 1996 to support the GWMA efforts with funding and technical assistance. Attachment A3 is a copy of the MOU. By accepting the Petition and signing the MOU, Ecology and the other MOU signatory agencies showed their agreement with the program’s locally directed approach.

1.3 GWMA LOCATION AND BOUNDARIES
The GWMA includes the combined areas of Adams, Franklin, and Grant Counties in eastern Washington. The GWMA boundaries incorporate 5,985 square miles or 3,830,400 acres. The area includes all or portions of Water Resource Inventory Areas (WRIAs) numbered 33, 34, 36,
41, 42, and 43 falling within the geographical boundaries of these three counties. Figure 1 shows the location of the GWMA.

Groundwater within the boundary of the GWMA is found within an aquifer system comprising the Columbia River Basalt Group and interbedded and overlying sediment units. For this plan this is called the Columbia River basalt aquifer system (or aquifer system). Generally this aquifer system is subdivided into four aquifers, defined by the geologic unit hosting it. These are the suprabasalt sediment (or overburden) aquifer, the Saddle Mountains aquifer, Wanapum aquifer, and Grande Ronde aquifer. The degree of interconnection between these aquifers, groundwater travel times within the aquifer system, and groundwater flow pathways in the aquifer system and in the aquifers is subject to discussion among technical experts. The suprabasalt and Saddle Mountains aquifer systems are not contiguous throughout the GWMA. The Wanapum is continuous beneath almost the entire GWMA. The Grande Ronde is continuous beneath the entire GWMA.

1.4 ACKNOWLEDGMENTS
The GWMA Plan presented in this document was developed from information gathered from GWMA participants experienced and knowledgeable about their respective technical fields and industries and their communities at large. They have spent many volunteer hours discussing, refining, and contributing the many ideas included in this plan. These volunteers worked diligently through the many unanticipated setbacks and demands of the GWMA Plan development process. This GWMA Plan has also benefited immensely from contributions made by many staff of local agencies and the funding support of Ecology, the WCC and the EPA. These funding sources were instrumental in getting the project started and maintaining the efforts of the GWMA. Attachment A4 provides a list of the many local individuals and technical support staff who contributed to the GWMA effort and completion of this plan.

Finally, the Boards of County Commissioners wish to thank all GWMA participants, interested citizens, industry experts, and agency technical support members whose experience and knowledge were pivotal to development of the GWMA Plan. Their cooperation, commitment, dedication, and perseverance in this effort have been invaluable to its completion.

1.5 PLAN DEVELOPMENT APPROACH – A GRASSROOTS EFFORT
Nitrate loading to groundwater in the Columbia Basin comes from a variety of “diffuse” non-point sources (meaning any source of water pollution not attributable to a specific location or
practice as defined in section 502(14) of the Clean Water Act). In the opinion of local leaders who proposed the GWMA, enforcement of additional State or local regulations to control these non-point sources of nitrate are prohibitively costly and unlikely to achieve success.

Local leaders believe that sustainable groundwater protection will be achieved now and in the future when local residents understand, and accept the need to change attitudes and practices. Local residents’ understanding and acceptance are attained by maximizing their participation in developing and implementing the recommendations presented in this GWMA Plan. Therefore, the development of this plan and its effective implementation will be proactive and necessarily voluntary and locally-driven.

The GWMA is unique in that it includes participants from a wide spectrum of local interests. Local participants represent irrigated and dryland crop growers, municipal and industrial wastewater land application site operators, livestock industry operators, urban and rural residential interests, and environmental and recreation interest groups. It is precisely this wide participation that allows their recommendations to be regional in focus and far-reaching and far-sighted in scope.

1.6 PLAN WRITING STYLE AND CONTENTS

This GWMA Plan has been written in a level of language to allow its use by a wide range of local citizens and other interested groups. It is understood that parts of the GWMA Plan may not be as easily readable by everyone as it was necessary, in places, to provide a clear and unambiguous presentation of concepts and methodologies or to describe a sensitive viewpoint. It is hoped that, if needed, the local citizens will seek further explanation from staff of the local CDs and HDs or their colleagues who participated in the plan development process.

The contents of this document are organized to make their reference and review efficient for the local citizens and other reviewers. Following information about the GWMA organization and its mission, the strategies recommended by each of the five GWACs to reduce nitrate levels in groundwater are presented. Much of the detailed supporting information and data are included in enclosed Attachments A1 through I2.

The following sections are contained in this GWMA Plan:

- Section 1.0 provides introductory information such as the GWMA’s legal authority to complete its work, and its history and approach.
• **Section 2.0** presents the GWMA program goals, objectives, and methodologies to measures its success.

• **Section 3.0** focuses on the multitude of efforts to develop the GWMA organization to the point of completing this plan. It describes the executive and decision-making organizations of the GWMA and administration of its many staffing, financial, and implementation functions. It also presents timelines for the GWMA activities and discusses the plan implementation process.

• **Section 4.0** describes the function of the GWMA Executive Board and its many roles and responsibilities. This section also discusses the Executive Board’s roles after certification of the plan and its role in periodic review and revision of the plan.

• **Section 5.0** presents a brief summary of the understanding regarding groundwater occurrence and distribution of nitrate within it.

• **Sections 6.0 through 10.0** present the components of the GWMA Plan as developed by each of the five GWACs. The composition, approach, and goals and objectives of each GWAC are presented, followed by its recommended management strategies. Finally, proposed methodologies are presented to monitor the progress in implementing the recommended strategies.
2 GOALS, OBJECTIVES, AND MEASURES OF SUCCESS

The GWMA participants have developed a number of goals to guide their efforts through development of this GWMA Plan and into the future. Goals have been established for groundwater quality, public information and education, research and implementation, and fiscal management. These goals, associated objectives, and measures of success in achieving them are described in this section.

The GWMA plans to regularly evaluate the progress made toward meeting its goals. It will modify its strategies as necessary so that progress will continue to be made. A progress report is planned for completion by 31 December 2005.

2.1 GOALS

The GWMA has developed four goals, as described below.

2.1.1 Groundwater Quality Goal

The GWMA participants have collectively developed and adopted the following groundwater quality goal to guide them in focusing the efforts of various projects, data collection, and technical analysis:

"The groundwater quality goal of the GWMA is the reduction of nitrate concentrations in the groundwater of the three participating counties."

The GWMA participants believe that the planned implementation of best management practices (BMPs) will lead toward improving trends in groundwater nitrate levels. They have established the above goal while recognizing that a number of threshold values exist that provide decision making opportunities regarding nitrate levels in groundwater. These threshold values include the federal safe drinking water standard (40 CFR 141.11), the State of Washington water quality standard (WAC 173-200), the WDOH trigger level (WAC 246-290-320), the State of Oregon Ground Water Management Area designation level (ORS 468B.180), natural background levels, and other levels established by various states as well as international organizations and governing bodies.

The adopted water quality goal is “tailored to the specific conditions of the area,” as recommended in WAC 173-100-100 (Attachment A2). The GWACs developed the above goal following extensive discussions that reconciled the various viewpoints of the participants. The following factors were considered by the GWMA participants when developing the goal:
• It is achievable in a reasonable time frame given the available data and current level of understanding of occurrence and movement of nitrate in area groundwater.

• It helps define specific indicators to measure success.

• It conceptualizes the framework for actions that the GWMA will undertake or support.

• It is inclusive of various goals expressed by the GWMA participants and the MOU signatory agencies.

• It is cost effective because it directs GWMA resources where they are most needed.

• It is progressive because it rejects the status quo for nitrate levels in groundwater in the Columbia Basin.

• It does not limit project success to specific numerical thresholds, recognizing that nitrate travel times in some areas with relatively high groundwater nitrate levels cannot be reduced within a specific time frame.

• It does not constrain the project or the local economy because it does not specify a timeframe for achievement. Any specified timeframe must be tied to nitrate travel times in soil and groundwater, which are expected to be highly variable across the GWMA due to varying hydrogeologic conditions, soil types, and land use.

2.1.2 Public Information and Education Goal

The overall goal of the GWMA Public Information and Education Plan is to develop and maintain a communication program, using the results of sponsored projects and other available information or information to be generated, to:

• Increase public awareness of, and support for, the GWMA and its recommendations and strategies.

• Improve public knowledge of the potential health impacts of nitrate in groundwater.

• Facilitate voluntary implementation of recommended strategies to reduce nitrate levels in GWMA groundwater.

The GWMA Public Information and Education Plan is introduced in Section 3.2.4.
2.1.3 **Research and Implementation Goal**

The GWMA has and will continue to sponsor a number of research projects as presented throughout this document. The GWMA goal for these projects is to 1) increase knowledge regarding more efficient and effective uses of irrigation water and nitrogen fertilizers under the unique environmental conditions that exist in the Columbia Basin, and 2) achieve other GWMA goals for groundwater protection. It is the intent that this research will not duplicate work that has already been accomplished by other research entities. When appropriate, such research will be conducted with the assistance and cooperation of institutions such as WSU, CDs, Natural Resources Conservation Service (NRCS), WSDA, and others.

The goal of the implementation activities of GWMA is to introduce the following ideas and practices into the operations of the GWMA stakeholders:

- Promote the use of nutrient and irrigation water management guidelines for crops grown in the Columbia Basin.

- Promote deep soil testing as a grower education tool, and measure effectiveness of management techniques of GWMA stakeholders.

- Assist in the development of Nutrient Management Plans for dairies.

- Educate/inform growers of the importance of recognizing and crediting the different sources of nitrogen that crops may use beneficially.

- Provide education on the current state and results of better nitrate management.

- Assist in providing tools and services that will provide data for irrigation water management, including weather data distribution.

- Encourage conversion to more efficient irrigation systems.

2.1.4 **Fiscal Management Goal**

The fiscal management goal of GWMA is to track and verify expenditures and obtain the funding necessary to establish and operate the GWMA activities. The GWMA staff has developed procedures to perform the following tasks:

- Ensure that expenditures made from each Grant follow the guidelines set forth by that Grant.
• Provide clear and concise tracking of the expenses and income to successfully respond to any financial audits.

• Establish procedures for the timely payment of outstanding bills incurred through normal operations of GWMA.

• Obtain approval for the expenditure of funds from the Board and authorization from the Lead Agency and the grant award agency.

• Work with Franklin County and the Franklin Conservation District, the lead fiscal agencies for GWMA.

• For all contracting agents with GWMA, ensure that proper procedures are followed for obtaining goods and services, including advertisement, competitive bidding, interviewing, and selection, drafting and signing of contracts, and follow-up to ensure that the promised product or service was delivered on a timely basis within the budget allowed.

• Submit applications and scopes of work for new grants as necessary to ensure that GWMA has adequate funding to fulfill its overall goal to reduce nitrate in groundwater.

2.2 OBJECTIVES

As stated in the Petition (Attachment A1), the objectives of the GWMA program are as follows:

1. Develop a coordinated Ground Water Management Area Plan among the counties of Adams, Franklin, and Grant that addresses the current and future drinking water, agricultural, and industrial needs.

2. Develop and implement a series of coordinated agricultural BMPs designed to reduce nitrate off site migration, including the promotion of agricultural waste application and fertilizer practices which help to preserve groundwater quality.

3. Collect and incorporate existing nitrate groundwater data into a shared data management system so as to improve understanding of the extent of nitrate levels in groundwater within the GWMA.

4. Participate in and/or establish a long-term groundwater quality and quantity monitoring program in the mid-Columbia Basin including an area-wide
ambient groundwater monitoring system by which to monitor the progress of new and improved agricultural practices.

5. Establish educational programs for promoting the protection of groundwater quality, and provide continuing forum open to stakeholders in the area to discuss cooperative method toward continued improvement of groundwater quality.

2.3 MEASURES OF SUCCESS

The success of GWMA activities in achieving its goals will be evaluated by quantifying the following three indicator measures:

1. **Trends in the Adoption/Implementation of BMPs.** Adoption and implementation of BMPs on a sufficiently large scale are the first steps toward helping reduce groundwater nitrate levels over time.

2. **Trends In Nitrate Levels in Baseline Well and Extent of Deep Nitrate Migration.** The long-term success of the GWMA will be determined in large part by a scientifically demonstrable decrease in groundwater nitrate levels across the three-county area. Strategies to periodically monitor, analyze, and report groundwater nitrate concentrations and nitrate deep migration will be employed to evaluate project progress.

3. **Trends in the Level of Public Awareness of the Causes and Health Implications of High Nitrate Levels in Ground Water.** The GWMA public information and education projects will facilitate the continued adoption and implementation of BMPs and will strive to foster and maintain a high level of public participation in GWMA projects and the decision-making process.

These measures act as “resource allocation strategies” to help GWMA focus its resources on geographical areas and projects that are most likely to achieve the stated goals.

The GWMA undertakes specific activities to quantify the above measures. Following Ecology’s certification of the GWMA Plan, work plans will be developed for these activities to describe specific objectives, tasks, and methodologies to obtain and interpret data, deliverables, schedules, and the agencies to implement the strategy. Results of the analysis will be presented in periodic progress reports as described elsewhere in this document. The GWMA participants recognize
that successful implementation of these projects requires local citizen participation with support from cooperating State and federal agencies.
3 ORGANIZATION AND ADMINISTRATION
Following designation of the GWMA in 1998, more than 100 local volunteers united to form its various organizations. This group was aided by assistance from staff of the local CDs and HDs and a range of technical advisers to develop this GWMA Plan and carry out its projects and other recommendations. This section contains a description of the GWMA organizations, its budgetary allocation components, timelines, and program implementation process.

3.1 GWMA ORGANIZATIONS
The GWMA organizations are described below. Figure 2 depicts the organization chart of the GWMA in the Petition (Attachment A1). All meetings of the GWAC Executive Board, GWACs and their sub-committees are held in open public forum.

The GWMA has drafted bylaws to outline procedures for the public participation process and formalize roles and responsibilities. The GWMA draft bylaws provide a detailed description of the process of selection of members of the GWMA organizations. The draft bylaws are provided in Attachment B1 of this document.

3.1.1 Lead Agency
The Lead Agency, which consists of the Boards of County Commissioners of Adams, Franklin and Grant Counties, oversees the activities of the GWMA. The Lead Agency has final approval authority over all GWAC Executive Board recommendations on GWMA projects, the hiring of personnel and the allocation of funds. Upon approval of an Executive Board recommendation, a formal county resolution is signed and issued by the Commissioners as affirmation of its approval. The Lead Agency will continue to function in this role following certification of the GWMA Plan.

3.1.2 Ground Water Advisory Committees
The GWMA program is a grass-roots effort by local citizens. A diverse group of over 100 local area volunteer residents form the following five Ground Water Advisory Committees (GWACs) that represent five nitrate sources of concern:

- Irrigated and Dryland Agriculture GWAC
- Sprayfield and Wastewater Management GWAC
- Dairy, Feedlot, and Cattlemen GWAC
- Urban and Rural Residential GWAC

- Environment and Recreation GWAC

The GWACs were formed to research the nitrate issues that were of concern to their constituency groups, provide input to the GWMA process, and develop the GWMA Plan. They have met regularly since 1998 to consider, discuss, and decide on a variety of ideas related to their issues. Several projects that were conceived or received by the GWACs have been proposed to the GWMA Executive Board for consideration and funding. The GWACs are assisted by State and federal government agencies as technical support members. Figure 2 displays the composition of the GWACs.

The participants of each GWAC nominated individuals to be voting members. Each GWAC voting member was subsequently nominated by the Lead Agency and appointed to their respective GWAC by Ecology. The GWAC participants determined the manner by which the committee would conduct approval of business before the committee. The GWACs required a simple majority “yes” vote by the voting members present to approve the business of the committee. The GWACs then made their recommendation for approvals of projects, programs, activities, policy, and/or funding to the Executive Board. This process formalized the GWAC decision-making process.

The mission of each GWAC was established by the Lead Agency and the Executive Board. Following certification of the GWMA Plan, each GWAC will meet and set a scope of future activities at its discretion.

### 3.1.3 GWAC Executive Board

After being seated, each of the five GWACs elected three representatives (one member from each of the three representative counties) for a total of 15 voting members to serve on the GWAC Executive Board (Board). The Board is the governing body of the GWACs and serves as the official body of the GWMA. Its purpose is to maintain the direction of the GWACs in meeting the goals of the GWMA Plan and provide suggestions for spending priorities. It is expected that the Board will retain its form and function following certification of the plan through completion of its many projects.

The Board’s decision-making process is explained in detail in the draft bylaws (Attachment B1). Section 4.0 describes the Board’s roles and responsibilities.
3.1.4 **Administrative Board**

In May, 2001, the GWAC Executive Board saw the benefit of creating an Administrative Board. While the Executive Board will remain as the governing body of the GWMA for the purpose of overseeing the GWMA Plan, the Administrative Board will oversee the day to day operation and administrative function of implementing the GWMA Plan and projects. The Administrative Board will report its activities to the GWAC Executive Board. The Administrative Board is made up of six members, one county commissioner representative from each of the three Boards of County Commissioners of Adams, Franklin and Grant Counties and one citizen member from each of the three counties. The citizen members are nominated and appointed by the Lead Agency. These members are considered from the members that make up the GWACs and the GWAC Executive Board, and provide a broad representation of the participant groups that make up the GWMA.

3.1.5 **Sub-committees**

A number of sub-committees have been formed to address special issues of concern to the GWMA. The participants of these sub-committees have been selected from the GWACs. Each sub-committee elected voting members to decide on its recommendations. Technical advisers from the MOU signatory agencies (See Section 3.4 below), contractors, and others have attended these meetings and contributed to the discussions. Table 1 summarizes the sub-committees formed to date, their missions, timelines, and current status.

3.1.6 **Community Producer Groups**

The areas within the three-county GWMA have been divided into 17 Community Producer Groups (CPGs). The CPGs are grouped geographically by soil type, predominant irrigation system, natural boundaries (water bodies, mountains, etc.), and communities. The purpose of establishing CPGs was primarily to gather representation for involvement in the GWMA process. Grant County has nine CPGs, Franklin County five, and Adams County three. Figure 3 shows the boundaries of the CPGs. Table 2 presents a summary of the characteristics of the CPGs as defined by the CDs.

The CDs currently meet with the CPGs regularly to provide updates and information on GWMA. GWMA will continue to work with this partnership as a mechanism to encourage implementation of BMPs, disseminate information relating to technology and the results of research projects and availability of programs, and to continue to gain input from the local grower community regarding methods to reduce nitrate in groundwater.
3.2 BUDGET ALLOCATION COMPONENTS

All GWMA activities have received funding through a variety of local, State and federal sources. These funds have been expended to support four “budgetary allocation components”: project administration, characterization and monitoring, research and implementation, and public information and education. Each component is described below. Future funding to support implementation of plan recommendations is discussed in Section 3.4.3.

3.2.1 Program Administration

Currently, program administration is divided into two areas of responsibility. The first deals primarily with the development of this plan and includes timely communication with volunteers and participating agencies as well as tracking volunteer participation, meeting organization and execution, preparation of various progress reports, and web site updates. The second area of responsibility involves fiscal management and reporting. This task includes preparation and submittal of invoice vouchers, processing of payment requests, preparation of reimbursement checks, tracking and recording of payments and receipts, preparation of quarterly and annual progress reports, and preparation of grant applications. Additionally, the GWMA utilizes contract services to assist with plan implementation and information/education efforts.

3.2.2 Characterization and Monitoring

The goal of this task, as defined by the Characterization and Monitoring (C&M) sub-committee (Section 3.1.4), is to help produce scientific data and information for the GWMA to use in its effort to minimize nitrate in groundwater. The objectives to achieve this goal include:

1. Define the three-dimensional distribution of groundwater nitrate concentrations within Adams, Franklin, and Grant counties.

2. Correlate the major causes and controls to nitrate concentrations in groundwater.

3. Develop a long-term monitoring plan to track nitrate concentration trends with the emphasis on:
   - Assessing BMP effectiveness on a sub-watershed basis.
   - Identifying regional concentration trends and their impacts on the availability of clean drinking water.
The C&M sub-committee provides oversight for development of projects. The sub-committee consists of members from the five GWACs, technical advisers from the local CDs, HDs, and irrigation districts, and representatives from USGS, Ecology, EPA, WSDA, and WSU. Activities to date include the following:

- Sampling of approximately 600 wells in the fall of 1998 and 2000 to provide data for future trend analysis.

- Creation of a GIS database that includes well sampling locations, field boundaries, and irrigation and crop types.

- Preparation of a hydrogeologic characterization report that satisfies the statutory obligations of WAC 173-100-100 (See Attachment D1).


- Development and issuance of a request for proposal titled “*Determination Of Hydro-Stratigraphy For Baseline Sampling Wells And Area-Wide Hydro-Stratigraphy Mapping*”.

- Preparation of a long-term monitoring program to measure BMP effectiveness (Attachment E6).

Future activities will include a biennial well sampling program, nitrate concentration trend analysis, BMP effectiveness monitoring, drinking water monitoring, and further refinement of describing the distribution of nitrate in the GWMA. Other projects may be proposed in the future to address issues as they arise.

3.2.3 **Research and Implementation**

The Board is responsible for determining the direction of GWMA activities to achieve its goal of reducing groundwater nitrate levels. Following the strategies recommended in this plan, changes in current practices will be voluntarily implemented to improve irrigation water management and
nutrient management. Research will be voluntarily conducted that will lead to expanding knowledge, or improving practices leading to more efficient or effective use of water and nutrients. The Board is expected to meet on a periodic basis and review progress relating to these activities. In addition, the GWACs have the option to meet on a periodic basis to determine the effectiveness of both research and implementation activities, and can recommend changes in direction or introduce new ideas and practices to the Board. If the Board approves such changes but they involve significant changes in policy or expenditures, they are forwarded to the Lead Agency for authorization.

3.2.4 Public Information and Education Program
The GWMA has embarked on an aggressive campaign to improve agricultural and other human activities that have contributed to the presence of nitrate in Columbia Basin groundwater. Early in the development of the GWMA program, local leaders understood that a continuous public information and education effort would be needed in order for the recommended strategies and programs to be accepted and implemented by the GWAC constituency groups and the general public.

A Public Information and Education Plan was developed in 1998 and approved in January 1999 by the Board (approved plan) to provide direction for GWMA information/education activities during the early part of the GWMA project. This plan is enclosed as Attachment B2. Attachment B2 also includes a supplement to the approved Public Information and Education Plan that expands on the framework of the approved plan by providing additional detail and information developed and implemented since the approved plan’s inception. Results of a public opinion survey conducted by Evans/McDonough Company, Inc. in September 1999 to evaluate public recognition and opinion regarding GWMA and its activities are summarized in Attachment C2.

In 1998, the estimated budget for the information and education program was approximately $450,000 and was planned for allocation over the 3-year period from 1998 to 2000. The approved plan identifies a range of tools and options for communication without specifically identifying the distribution of those funds. It is anticipated that the Board will determine expenditures for the GWMA’s communication effort as specific projects are brought forward and evaluated.
3.3 PROGRAM TIMELINES

Timelines established for the various GWMA activities include submittal of the GWMA Plan to Ecology and its certification, project-specific timelines, and the 5-year program progress reporting schedule. These timelines are briefly described below.

**GWMA Plan Submittal and Certification** – After internal review and acceptance of the draft GWMA Plan, the GWAC Executive Board will submit the plan to the Lead Agency to begin a process termed concurrence. In accordance with the process set forth in WAC 173-200-120 (Attachment A2), Ecology and the Lead Agency will concurrently hold a series of public workshops and public hearing in each of the participating counties of the GWMA for the purpose of taking public testimony on the GWMA Plan. Following these hearings, the Lead Agency will evaluate the plan for technical soundness, economic feasibility and consistency with WAC 173-100-100, consolidate public hearing testimony, and prepare findings to identify any revisions that may be necessary to the plan. These findings will be presented to the GWACs and the GWAC Executive Board for resolution prior to submission of the plan to Ecology for certification.

During the concurrence process, the Lead Agency will make the GWMA Plan available to constituency groups and local agencies for review and comment. These groups and entities will be asked by the Lead Agency to endorse the plan by indicating in writing their concurrence and their willingness to promote and adopt the recommendations and BMPs outlined in the plan. A list of the concurring agencies and constituents, and copies of their letters of concurrence, can be found in Attachment B4.

The certification process may take up to 6 months. During this process, the plan will be reviewed by Ecology and the other MOU signatory agencies (See Section 3.4 below). The GWMA will consider agency comments, revise the plan accordingly, and resubmit it for adoption. Attachment B5 outlines the schedule of the GWMA Plan concurrence and certification process. Following final certification of the plan by Ecology, local and State agencies will be obligated to derive guidance from the adopted GWMA Plan when considering plans, programs, and policies that may impact implementation.

The GWMA will consider any new information gathered at the workshops, and all other comments received on the plan during the concurrence process. If substantive revisions are deemed necessary, the GWMA will revise the plan and resubmit it to the Lead Agency. If deemed necessary the revised Plan may be resubmitted for local review and adoption and MOU signatory concurrence.
SEPA Review Process - The Lead Agency will review the GWMA Plan in accordance with the State Environmental Policy Act (SEPA), chapter 43.21C of the Revised Code of Washington. Attachment B6 is a copy of the SEPA checklist. The SEPA checklist will be filed with the planning departments of each of the three GWMA counties to begin the SEPA review process. The Adams County Planning Department will act as the lead contact during the SEPA review process and will coordinate all required activities of the process with the planning departments of Franklin and Grant counties. Public hearings required by the SEPA review process will be held in conjunction with the Lead Agency and the Ecology public hearings on the GWMA Plan as scheduled in each community.

Project-Specific Timelines – Many projects have been recommended by the GWACs as part of their management strategies. Several projects have already been initiated. The duration and completion schedules for these projects vary. However, a minimum annual reporting and evaluation is envisioned for each project. Projects lasting less than 1 year may be evaluated on an expedited schedule. It should be noted that the timelines and priority for the GWMA projects are necessarily dependent on which agencies supply the funds and their timelines for allocation and release of funds.

Five-Year Review and Reporting Process – By 31 December 2005, the GWMA will provide a comprehensive evaluation report to EPA and Ecology describing its activities and their results in achieving its goals and objectives. The 5-year report will also provide a plan for future activities and propose modifications to the GWMA Plan, if needed. Internally, the GWMA will perform an annual evaluation of its activities during the previous year and plan for the following year’s activities. Adjustments in goals and objectives or changes in implementation, data collection, or analysis methodologies will be presented and discussed by the Board.

3.4 PLAN IMPLEMENTATION PROCESS

The bulk of the implementation task will begin after certification of the GWMA Plan. However, early implementation of many initiatives and projects has already begun. These projects will continue and may be augmented with additional projects and expanded scope. A commensurate level of funding must be obtained to complete the GWMA efforts. The range of strategies recommended by the GWACs, agencies that will be involved in their implementation, and an approximate level of funding for the recommended strategies are presented below.
3.4.1 Strategy Matrices
The strategies recommended by the Board in Section 4.0 and the GWACs in Sections 6.0 through 10.0 include a number of specific projects. These projects are listed in “strategy matrices” enclosed as Attachment B3. These matrices are tables that identify the implementing agencies, expected completion timeline, expected cost of completion, and priority rankings. Each project has been prioritized as either funded, partially funded, or seeking funding to implement.

3.4.2 Implementing Agencies
The six Conservation Districts in the GWMA counties have led the planning, administrative, and research and implementation tasks delegated to them by the Lead Agency. The three HDs of Adams, Franklin, and Grant counties have helped implement a number of GWMA-sponsored projects. These local agencies will continue in their roles as staff and budgetary resources allow.

Six State and federal agencies including Ecology, WSDA, WDOH, WSU, EPA, and WCC, signed a MOU (Attachment A3) to support the GWMA efforts with funding and technical assistance and serve the GWMA program as technical support members to the GWACs. These agencies will help implement the GWAC recommendations, as staff and budgetary resources allow. Private contractors may be hired to perform specific projects or tasks.

3.4.3 Funding Needs and Process
The strategy matrices (Attachment B3) indicate the projects for which grants and other funds will be sought. A source of long-term funding must be developed to implement the GWMA Plan. This source may be augmented by grants and other local funds as they become available. Based on preliminary estimates, the anticipated cost of implementing the recommended projects is approximately $28,840,000. Currently, a total of approximately $4.2 million has been allocated for GWMA activities through 2004 and divided among its many projects. Table 3 presents a breakdown of the GWMA funding to date. The GWMA is currently exploring funding alternatives to obtain additional funding to enable it to complete its mission.
4 THE EXECUTIVE BOARD

The GWAC Executive Board (Board) is the primary vehicle responsible for review and authorization of the GWMA activities, subject to final approval by the Lead Agency. The Board’s decision-making process is described in detail in Attachment B1. It is anticipated that this process will not change following certification of the GWMA Plan and through implementation of its recommended strategies.

The Board has the following key responsibilities:

- Review and approve decisions regarding the process of conducting GWMA business.
- Review and approve major press releases.
- Oversee and manage conduct of the GWMA-sponsored projects.
- Oversee development and approval of this GWMA Plan and provide future review and revision.
- Consider emergent issues.

The above responsibilities are further described in the sections below. A strategy matrix is presented in Attachment B3-1 summarizing the projects sponsored by the Board. This matrix complements similar matrices developed by each of the GWACs as presented in Sections 6 through 10.

4.1 PROCESS-RELATED DECISIONS

The Board reviews and approves decisions regarding the process of conducting GWMA business. These decisions generally relate to the categories described below.

4.1.1 GWMA-Sponsored Projects

The GWACs have recommended a number of projects in Sections 6 through 10. Other significant projects (described below in Section 4.3) have been sponsored by GWMA that are relevant to goals of multiple GWACs. The GWACs, local agencies, or the GWMA sub-committees propose projects to the Board for review and approval. Upon approval by the Board, a recommendation from the Board is then made to the Lead Agency for final approval and funding of the project.

Typically, a proposal is submitted to the Board describing the goals, objectives, technical and project management approaches, staffing needs, anticipated budget requirements, and completion
schedules. Approved projects that are to be conducted by the agencies will also have to provide scope, schedule, budget and final report to the Executive Board (Section 4.3). If projects conceived by the GWMA are to be contracted out, the Board may assign a sub-committee to develop a scope of work for public advertisement. For example, in the past the GWMA Characterization and Monitoring Sub-committee (Section 3.1.4) has developed several projects for contractor bid.

4.1.2 **Contracts**

The Board receives and recommends to the Lead Agency approval of contracts with independent consultants and contractors who may be needed to help complete specific GWMA projects. The GWMA projects to be conducted by the MOU signatory agencies are also subject to review and approval by the Board and the Lead Agency. The Board provides oversight of the conduct of the project, development of project scope, and any disputes that may arise.

Neither the GWMA nor the Board has legal authority to contract for services and disburse GWMA funds. The Franklin Conservation District and Franklin County are currently “contracting agencies” providing contracting services on behalf of the GWMA.

4.1.3 **Major Budget Expenditures**

The Board authorizes funding for all approved GWMA projects in the form of a recommendation to the Lead Agency. Projects requiring funds in excess of $2,500 will also need to be approved by the Board and the contracting agencies (Franklin County and Franklin Conservation District). Contracting agency approval is a procedural requirement rather than exercising authority over GWMA activities.

4.1.4 **Personnel Changes**

The Board has the responsibility to review and approve changes in GWMA personnel. The GWMA and the Board do not have the legal authority to directly employ staff. Through an interlocal agreement, the staff is officially employed by the CDs. Additionally, the Lead Agency has specific interest in reviewing matters relating to personnel changes.

4.2 **MAJOR PRESS RELEASES**

GWMA activities are routinely subject to discussion by its participants and other members of the public. These discussions are periodically reflected in local newspaper articles. It is important to the success of its mission that the GWMA issue accurate, timely, and orchestrated public
messages regarding ongoing GWMA activities or issues of importance that arise from time to time. The Board reviews and approves all public announcements it deems as “major,” with the concurrence of the Lead Agency. The protocol to consider and approve press releases is described in the draft Bylaws (Attachment B1).

4.3 OVERSIGHT AND MANAGEMENT OF PROJECTS

The Board provides oversight and management of projects that have been approved for implementation. It receives project progress reports, considers proposed changes to methodology and approach (if any), and sets conditions and procedures for termination of these projects.

The Board considers a variety of projects including those recommended by GWACs (Sections 6 through 10) as well as those that have broad-based objectives or implications, cover the entire GWMA industry/general public base, and/or benefit the goals of multiple GWACs. Staff of the CDs, HDs, other GWMA participants, and private consultants have helped conduct these projects. The following non-GWAC-specific broad-based projects have been approved and implemented or are currently being proposed for consideration:

- Biennial well sampling studies including the fall 1998 baseline sampling and the fall 2000 sampling events.
- The Geographic Information System (GIS) Database mapping project.
- The Leaching Vulnerability Index project.
- The development of the GWMA information compact disk.
- The proposed hydrostratigraphy mapping study.

Additional details on these projects are presented in Attachments C1 through C6, respectively.

The GWMA plans to conduct sampling of baseline wells on a biennial basis. The data and other information obtained during the fall of 2000 and subsequent sampling events will be analyzed and compared with the 1998 baseline results to monitor for changes in the occurrence and distribution of groundwater nitrate across the GWMA. The long-term groundwater nitrate monitoring activities are described further in Attachment C1.
4.4 PLAN DEVELOPMENT, REVIEW, AND REVISION OVERSIGHT
The GWAC participants have spent many volunteer hours developing the concepts presented in this GWMA Plan. The Board has provided the primary oversight mechanism for consistent and accurate presentation of these concepts in the GWMA Plan. The Board will be the primary local group that will remain actively engaged with the participating State and federal agencies during Ecology’s certification of the GWMA Plan. The Board will also be the primary vehicle to conduct periodic future review, as required by WAC 173-100, and authorize revisions to the GWMA Plan, subject to Lead Agency approval.

4.5 CONSIDERATION OF EMERGENT ISSUES
The GWMA participants realize that the cooperative dialogue fostered by interaction of the diverse range of local stakeholders makes the GWMA organization invaluable in considering future issues relating to nitrate in Columbia Basin groundwater or to the Basin water resources in general. The Board will act as the primary forum for consideration and discussion of these issues as they emerge. If warranted, the Board will request that GWACs consider providing assistance to the Board on pertinent issues.

4.6 EXECUTIVE BOARD STRATEGY MATRIX
Attachment B3-1 contains the list of projects sponsored by the Board. This attachment provides information on implementing agencies, timelines, and required/expended completion budgets.
5 GROUNDWATER CHARACTERIZATION

The GWMA contracted in 1998 to complete a characterization of the hydrogeology and groundwater nitrate distributions within the three-county area. This task was authorized under the Characterization and Monitoring component of the GWMA program (Section 3.2.2). The members of the GWMA Characterization and Monitoring sub-committee (Section 3.1.4) discussed and drafted scopes of work for two projects. These projects culminated in three reports titled *Hydrogeological Characterization Report* (Kennedy/Jenks Consultants 2000), and U. S. Geological Survey *Summary of Nitrate Concentrations in Ground Water of Adams, Franklin, and Grant Counties, Washington, Fall 1998 – A baseline for Future Trend Analysis* (Ryker and Frans 2000) and *Estimating the Probability of Elevated Nitrate (N02+NO3) Concentrations in Ground Water in the Columbia Basin Ground Water Management Area, Washington* (Frans 2000). These reports are enclosed as Attachments D1, D2, and D3, respectively.

5.1 GROUNDWATER QUALITY

The Kennedy/Jenks Consultants (2000) report focuses on a preliminary description of the main geological units, nature and relationship of the key water-producing zones, and the three-dimensional distribution of nitrate in groundwater under land use activities within the GWMA. The description of GWMA hydrogeology is primarily based on readily available existing information from previous studies performed by USGS, WSU, Ecology, local CDs, and private consultants. The description of nitrate distribution in GWMA groundwater is based on available historical data and information and was significantly augmented by the results of the 1998 baseline sampling effort (Section 3.2.2). The results of the baseline sampling effort were also statistically analyzed by the USGS and published in the spring of 2000.

The main findings of the Kennedy/Jenks Consultants (2000) report are as follows:

- Groundwater in the GWMA occurs in a multi-aquifer system comprising the Grande Ronde, Wanapum, Saddle Mountains basalt aquifers and the overlying suprabasalt (overburden) sediments. The Grande Ronde and Wanapum aquifers underlie all of the GWMA, but the extent of the Saddle Mountain aquifer is limited. The suprabasalt aquifers are found within the main structural basins such as the Quincy and Pasco basins and are the primary recipient of the surface recharge water from both precipitation and man-made (i.e., irrigation) sources.

- Groundwater movement in the basalt aquifers appears to occur predominantly laterally between adjacent lava flows. Although currently not well understood, vertical movement
of groundwater appears to occur between the basalt layers through a combination of natural and man-made pathways. The regional groundwater flow directions appear to be predominantly south and southwesterly. The local directions and rates of groundwater flow are variable.

- In many locations groundwater found in the suprabasalt aquifers appears to be the direct result of recharge by the imported irrigation water. The extensive canal system and non-uniformity in sediment characteristics exerts a large influence on groundwater movement, occurrence of perched groundwater, downward movement of soil moisture and groundwater recharge, and travel time of nitrate to groundwater.

- The soils across the GWMA are generally relatively coarse-grained, ranging from silt loams to gravelly sand with areas of relatively fine-grained soils occurring in some areas. The permeability of the major soil classes observed in GWMA ranges between 0.2 to 20 inches per hour.

- During the 1998 baseline sampling event, the nitrate-N concentrations detected in 573 sampled wells were quite variable ranging from less than the detection limit of 0.01 milligrams per liter (mg/L or ppm) to 84.0 mg/L. Nitrate-N concentrations were greater than 10.0 mg/L in 23 percent (133) of the sampled wells. Forty-seven percent (269) of the sampled wells contained nitrate-N at levels greater than 5.0 mg/L. Nitrate-N was not detected in 7 percent (43) of the wells. The median nitrate-N values for the GWMA was 4.3 mg/L and the values for Adams, Franklin, and Grant Counties were 4.0, 5.9, and 3.7 mg/L, respectively. Locations where relatively higher nitrate levels were measured during the fall 1998 sampling event generally correspond to locations where higher nitrate levels were also measured historically.

- Shallow wells (generally less than 200 feet) sampled in all three counties appear to represent groundwater with higher nitrate levels than deeper wells (generally deeper than 200 feet), suggesting that the source of nitrate loading is predominantly application at the surface. Shallow wells had a median nitrate-N value of 5.7 mg/L compared to the Deep wells at 3.3 mg/L.

During completion of the characterization and monitoring projects and follow-up discussions among GWMA participants and with the MOU signatory agencies, several gaps in scientific knowledge were identified regarding nitrate distribution, migration, and characterization in the
GWMA. The management strategies recommended by the GWACs in Sections 6 through 10 include a number of projects that attempt to fill these data gaps. The full list of projects for each strategy is presented in Attachment B3.

5.2 GROUNDWATER QUANTITY
Ecology's designation of Adams, Franklin, and Grant Counties as a groundwater management area was based on the Petition written to address a regional water quality concern relative to nitrate. This brief section is provided to meet the statutory obligation to address groundwater quantity under the authority of WAC 173-100.

5.2.1 Historical Development of Water Resources in the Region
Except along the river banks, this area of Washington was poorly known and sparsely settled until the turn of the last century. Native Americans had been living among the cliffs and coulees since the end of the last ice age, approximately 10,000 years ago, but the region’s arid conditions meant that villages were constructed close to the waterways. In the early 1900s the land in the region remote from the rivers, if used by man at all, was used for grazing and dryland wheat farming.

Some crop irrigation was provided by wells, but most crops relied on rainfall for moisture. In the late 1800s and through the early 1900s attempts were made to develop irrigation from the area's lakes, creeks and the Columbia River. Irrigation projects were often unprofitable and were abandoned after only a few years of operation. In the 1920s, many homesteads and croplands were abandoned due to a lack of water. Population in the area declined through 1930s. Additional information on early land uses within the GWMA is provided in the U.S. Department of the Interior (1978).

In 1933, the Federal Government began construction of Grand Coulee Dam and on 30 August 1935 the project was authorized as an irrigation project by the Harbors and Rivers Act. The first test water flowed into the Main Canal from Banks Lake and headed for the farmland in the Columbia Basin on 10 August 1951. The number of irrigated acres grew rapidly in the first decade of operation, but has slowed in recent years as laws and policies have stymied allocation of additional water resources for irrigation.

5.2.2 Known Factors Controlling Groundwater Quantity
Regional rainfall averages 7 to 15 inches per year. Most streams in the region are seasonal and flow during annual winter runoff events. Recharge of the aquifers may occur from losing reaches
of the Columbia River or its tributaries though regionally these features a generally regarded as discharge features. Aquifer recharge may also occur on highlands around the fringe of the Columbia Basin.

The unconfined uppermost aquifer in Adams, Franklin, and Grant counties may not have stored or yielded significant quantities of water before the development of the Columbia Basin Irrigation Project (CBIP). Irrigation return flow and seepage, whether from the CBIP or deeper irrigation wells, is primarily responsible for the unconfined upper aquifer recharge. The lower Columbia River Basalt confined aquifers or aquifer systems have been studied, but interpretations of the available studies vary. The mechanisms of recharge are poorly understood and the best available science to use to clarify the situation is subject to debate.

In a recent study, the USGS developed a water budget for a portion of Franklin County (Drost et al. 1997). The report states that groundwater flow in the unconfined aquifer system has increased seven-fold over predevelopment conditions, and the unconfined water table has risen up to several hundred feet in some areas. In 1986, flow through the groundwater system had apparently reached equilibrium at roughly 400,000 acre-feet per year and there appeared to be 5,000,000 acre-feet of water in storage in the upper, unconfined aquifer. No assessment of water quantity in the confined basalt aquifer systems is available, although water levels in the shallower parts of these confined systems have been declining in many areas.

5.2.3 Administrative Policy

Much of the area in Adams, Franklin, and Grant counties is currently subject to groundwater withdrawal management through sections of WAC chapters 173 and 508. Three sub-areas have been designated within the GWMA for special management protocols. These sub-areas and their boundaries are described in the WAC and briefly discussed below. All cited Ecology regulations contain a provision that “the Department of Ecology shall initiate a review of the rules established in this chapter whenever new information, changing conditions, or statutory modifications make it necessary to consider revisions.”

*The Odessa Groundwater Management Sub-Area (WAC 173-128A)* - The Odessa Sub-Area management policy is defined in WAC 173-130A. The purpose of the chapter is “to provide a procedure for managing groundwater within the Odessa groundwater sub-area to insure the maintenance of a safe sustaining yield from the groundwater body within a reasonable and feasible pumping lift.”
The Quincy Groundwater Management Sub-area and Zones (WAC 173-124) - The Quincy Sub-Area management policy is defined in WAC 173-134A.

The Columbia Basin Project - WAC 508-14 sets forth the boundaries of the Columbia Basin Project and provisions for withdrawal of groundwater.
6 IRRIGATED AND DRYLAND AGRICULTURE GWAC PLAN

The Irrigated and Dryland Agriculture GWAC (committee) serves to identify and develop management strategies addressing nitrate contribution to groundwater associated with production agriculture. The following information is presented in this section:

- The committee’s composition.
- The committee’s approach to evaluating the role of irrigated and dryland farming activities in contributing nitrate to groundwater.
- The committee’s goals and objectives.
- The committee’s recommended management strategies.
- The methodology to monitor for progress in achieving the goals and objectives.

Finally, additional information regarding specific concepts that the committee advocates are provided in this section.

6.1 COMMITTEE COMPOSITION

The core group of the committee consists of grower representatives from the GWMA Community Producer Groups (see Section 3.1.5, Figure 4). Other committee participants include representatives from the local irrigation districts, local CDs, WSU, NRCS, the Farm Bureau, and local representatives from trade organizations such as the Washington Potato Commission and the Washington Association of Wheat Growers, and the fertilizer industry. These representatives have regularly attended the meetings and helped form and develop the technical ideas presented in this section. The meetings were coordinated and facilitated by GWMA staff and staff of the CDs.

6.2 COMMITTEE APPROACH

The agricultural community recognizes that farming practices result in economic and environmental benefits and may also cause environmental concerns. The committee recognizes the concept that surface application of nitrogen in the irrigated portion of the three-county region can be a contributing source of nitrate in groundwater. The agricultural community is willing to voluntarily change its practices to reduce potential adverse impacts on groundwater nitrate levels.
From the perspective of agriculture, efforts in the following three areas are needed to minimize nitrate migration to groundwater in the Columbia Basin:

- Nitrate source control – Sources of nitrate include fertilizers, organic sources such as process water and manure, and irrigation water. Managing the amount of nitrate applied to fields may substantially affect nitrate levels in groundwater.

- Nitrate transport control - Nitrate may move from the surface through the soil profile to the groundwater table only if carried or transported by water.

- Understanding site conditions - Site conditions relevant to deep nitrate migration include environmental factors such as precipitation, soil texture and structure, aquifer characteristics, etc., and the presence of irrigation systems and crop type.

The committee agreed early on that the two most effective systems of BMPs that the agricultural community can use in its efforts to control nitrate sources and nitrate deep migration are nutrient (fertilizer) management and irrigation water management.

The specific BMPs recommended by the committee are designed to protect groundwater while supporting realistic crop yields for the economic viability of farming operations. The definition of BMP used by the committee is “practices or systems of practices found to be the most effective, practicable (including economic and institutional considerations) means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals” (NRCS 1992a).

The committee anticipates that the following factors complicate the implementation of BMPs in the Columbia Basin:

- No single practice or system of practices will fit all cropping scenarios. The recommended BMPs must be seen as components of site-specific management systems for individual farm operations. Up to 100 different types of crops are produced in the area. These crops are grown over approximately 815,000 acres of irrigated and 1,237,400 acres of dry-farmed areas (Washington Agricultural Statistics Service 1998). Additionally, irrigation methods vary from rill irrigation to pressurized sprinklers to drip systems.

- It is likely that the nitrate present in parts of the GWMA is the result of activities over past decades. Groundwater nitrate levels in some areas might have been elevated before
large-scale irrigated farming began in the 1950s. It may be many years before changes in groundwater nitrate concentrations are observed in some of these areas.

- It is unknown why groundwater nitrate levels are elevated in the cultivated dryland and rangeland areas. Precipitation in these areas is typically no more than 15 inches per year, and nitrogen fertilizer application rates are relatively low in cultivated dryland and zero in rangeland areas.

- Protecting the soil resource may inevitably pose some risk to the water resource. The manual of irrigation practices produced by WSU and Ecology for Washington’s non-point source management program states, “Some deep percolation is required, desirable, and inevitable” (Canessa and Hermanson 1995, pp. 3-20). For example, in some areas of the GWMA, excess salts must be leached from the root zone on a regular basis.

The committee will address the potential agricultural sources of nitrate in groundwater in an approach that prioritizes allocation of GWMA resources on geographical areas and issues where its actions can be expected to have the greatest impact. The agricultural community believes that its success in this effort depends on patience, cooperation, and participation by regulatory agencies and other interested parties.

6.3 COMMITTEE GOALS
Intensive irrigation began in the Columbia Basin in the 1950s with the start of the CBIP. Although farming methods used at the time were state of the art, these practices held a greater potential for groundwater impact than the technology and management systems that many growers currently practice. Continuing and accelerating implementation of BMPs is an important goal of the GWMA. To accomplish this, the committee has developed strategies that can be adopted voluntarily by growers to minimize the potential migration of nitrate to groundwater by agricultural activities. As directed by the GWMA Lead Agency and the Board, the committee has set the following specific objectives to fulfill its goal:


3. Facilitate farm-scale implementation of the nutrient and irrigation water management guidelines.
4. Sponsor projects and discuss topics of interest to the agricultural community.

5. Help inform the Columbia Basin public about the actions taken by agricultural producers to protect groundwater quality.

6. Support activities of and share resources with other GWACs to achieve their goals and objectives.

**6.4 RECOMMENDED MANAGEMENT STRATEGIES**

This section recommends strategies to achieve the above objectives along with elements of a public education and information program to address objective number 5. Activities to monitor progress of the recommended strategies are presented in Section 6.5. Table B3-2 (Attachment B3) contains information on agencies, timelines, and required funding to implement these strategies.

**6.4.1 Strategy AG1 – Help Develop Nutrient Management Guidelines**

Management of nutrient application is often achieved by application at “agronomic rate.” The NRCS defines agronomic rate as “The rate of nutrient addition required to reach a realistic crop yield goal for soil, climatic and management conditions” (NRCS 1992a). Environmental problems begin when the nitrogen application rate, timing, and placement are not appropriate. Excess nitrogen, when transformed to nitrate, may migrate below the root zone toward groundwater under the following conditions:

- Nitrogen may be applied at rates greater than crops can use when uncertainty exists about the actual amount of nitrogen available to the crop. The uncertainty is created when the various sources of available nitrogen that may supply part of the crop’s nitrogen need are not accounted for. These sources include residual nitrogen in the soil, nitrate in irrigation water, and organic sources of nitrate such as manure and crop residue (see Section 6.6.1 for additional information).

- The irrigation water application schedule may not be balanced with crop needs. If excess water is applied or the timing of water application does not coincide with plant needs, irrigation water may carry water-soluble nitrate out of the crop root zone. The grower may then choose to apply more nitrogen to meet plant needs.

- Applied nitrogen may not be fully utilized if other factors are limiting crop growth. These factors may include lack of adequate rainfall (in dryland areas), insect damage,
disease and other crop injuries, inadequate field preparation, deficiencies in availability of other plant nutrients, and others.

- Unrealistically high crop yield goals may lead some growers to over-apply nitrogen. The most economic yield is not always the maximum yield.

The WSU fertilizer recommendations are a primary source of nutrient guidelines currently in use by growers in the Columbia Basin. These guidelines have been modified for some crops by experienced growers and private industry crop consultants. The GWMA requested and received “Estimated Fertilizer Guidelines” for “dominant” crops from crop associations and commissions. Table 4 lists the top 20 dominant crops selected from the 1998 Agriculture Statistics based primarily on acreage and economic value. The Estimated Fertilizer Guidelines are enclosed in Attachment E1.

The committee recommended that the following elements be considered in developing the Estimated Fertilizer Guidelines:

- Recommendations regarding fertilizer placement, timing of application, and realistic crop yield goals.

- Procedures for crediting the various sources of nitrate including inorganic fertilizers, organic sources, residual soil nitrogen, and irrigation water. See Section 6.6.1 for a discussion of these sources.

- Recommendations on soil and tissue sampling to reduce uncertainty about crop nutrient needs.

- Recommendations regarding efficient use of irrigation systems and uniform application of irrigation water for all crops.

- Recommendations to manage for all crops in the rotation and not focus on one crop.

The committee recommends that the GWMA have the guidelines reviewed further by the crop consultant associations, WSU, and NRCS, and finalize the guidelines for use by the growers in the Columbia Basin. The committee understands that certain guidelines may require further research to evaluate their feasibility for incorporation into farming practices and effectiveness in preventing nitrate migration to groundwater.
6.4.2 **Strategy AG2 – Help Develop Irrigation Water Management Guidelines**

In the irrigated portion of the GWMA, minimal progress can be made toward groundwater protection without effective irrigation water management. Nitrate may move from the surface through the soil profile to the groundwater table only if carried or transported by water. Even minimal applications of nitrogen may travel to groundwater if enough water is applied, whether from precipitation or irrigation, to move it past a plant’s roots faster than the plant can use it. The nutrient guidelines (estimated fertilizer guidelines), developed under Strategy AG1, will be largely ineffective if the transport of nitrate to the water table by irrigation water is not minimized.

The following conditions that may lead to over-application of water also lead to loss of nitrogen:

- Uncertainty about the actual amount of water available to the crop.
- Uncertainty about the timing and amount of irrigation water needed by crops.
- Factors limiting crop growth such as insect damage, disease, crop injury, inadequate field preparation, inadequate precipitation, or inadequate irrigation water management, which may cause applied water to not be fully utilized.
- Inaccurate application of irrigation water by improperly designed, maintained or operated systems.
- Uncertainty about timing and requirements for salt leaching required to maintain soil productivity.

The GWMA developed a set of irrigation water management guidelines based on NRCS guidelines (NRCS 1992a) as part of its Irrigation Water Management Cost Share Program. It also developed an Irrigation Water Management Plan template for use by the cost share recipients. The guidelines and template are enclosed in Attachments E2. They were assembled from information provided by the personnel from WSU, CDs, NRCS, and consultant associations, during several meetings and exchanges in the fall of 1999. These guidelines include the following main elements:

- Irrigation water management requires soil moisture monitoring and irrigation water scheduling according to crop need and weather conditions. Moisture monitoring reduces uncertainty regarding the actual amount of water available to the crop. Monitoring can
be done using soil probes with simple tools such as tensiometers and electric resistance blocks, or high-priced systems with computer-linked soil probes.

- Management practices that focus on minimizing the movement of nitrogen below the “effective” root zone are emphasized. The committee recognizes that the effective root zone varies by crop and is often shallower under irrigation than dryland production.

- Salt leaching events should be scheduled to minimize deep migration of nitrate and should be scheduled based on laboratory testing or field observations of salt buildup.

It should also be noted that backflow prevention devices are required by the WSDA when fertilizers are delivered to crops through irrigation systems.

The committee recommends further review of these guidelines by the consultant associations, WSU, and NRCS before being finalized for use by the growers in the Columbia Basin. The committee understands that certain guidelines may require additional research to evaluate their feasibility for incorporation into farming practices and their effectiveness in preventing nitrate migration to groundwater.

### 6.4.3 Strategy AG3 – Facilitate Implementation of Nutrient and Irrigation Water Management Guidelines

The GWMA has sponsored and provided resources to facilitate developing nutrient and irrigation water management guidelines as discussed above. It has provided direction, focus, and resources to assist in organizing technical grower meetings. The guidelines have been discussed and evaluated in these meetings with input from growers and their consultants. The GWMA has made the guidelines and ancillary information available to growers. The committee recommends that the GWMA continue focusing its resources on facilitating farm-scale implementation of the guidelines. The following specific activities are recommended:

- Promote soil testing for nitrate through implementation of deep soil sampling educational programs and purchase of deep soil sampling equipment for use by growers and others. Deep soil testing is an educational tool that allows growers to evaluate where nitrate is present in the soil profile. However, the cost of the sampling equipment may be prohibitive to many growers. A first phase of this educational program was conducted in the spring of 2000. Seventy-three growers provided 373 fields that were sampled in this program. Attachment E3 presents additional details regarding this program and its results.
Promote irrigation water management plans and implementation by all effective means such as the current cost share program. A first phase of this cost-share program was conducted in the spring of 2000. Eighty-four growers provided approximately 47,500 acres for irrigation scheduling in this program. Attachment E4 presents additional details regarding this program and its results.

Identify sources of and help distribute readily available services and data necessary for site-specific irrigation water management plans. Public sources of services and data include the Bureau of Reclamation Agri-Met and the WSU PAWS systems weather stations. Weather data distribution systems include data available from these sources through the CDs, National Weather Services National Oceanographic Atmospheric Administration (NOAA) weather broadcast, local newspapers, and the internet. Some individual growers and agri-businesses have set up their own weather stations for private use.

Encourage growers to convert to more efficient irrigation systems. Conversion from rill irrigation to sprinkler methods of irrigation has been credited with an increase in irrigation efficiency. However, the committee lacks information to assess whether further gravity-to-sprinkler conversion will significantly improve groundwater quality (see Section 6.4.4.3 below).

Continue to refine systems of scheduling for wheel-line and hand-line irrigation on those fields where the typical set lengths of 12 or 24 hours apply irrigation water in excess of the water holding capacity of the soil.

Promote improved systems of rill/furrow irrigation such as surge-flow rather than continuous flow throughout the entire set length.

Schedule maintenance leaching to minimize groundwater impact.

Promote cropping systems to manage nitrate movement. These systems may include the use of second crops, cover crops, and deep-rooted crops to recover and/or store nitrogen that would otherwise pass the crop root zone.

6.4.4 **Strategy AG4 – Sponsor Projects**
The GWMA has sponsored several projects to develop tools to help evaluate the effectiveness of the recommended nutrient and irrigation water management BMPs in minimizing nitrate transport.
below the effective root zone. The committee has also recognized that it needs to consider several topics for future discussion such as nitrate sources and transport mechanisms in areas where well water samples contained high nitrate levels. The projects and topics of interest to the committee are presented below along with recommended courses of action.

6.4.4.1 Identification of Geographic Areas Vulnerable to Nitrate Leaching.
Well water monitoring is an important tool in measuring GWMA’s success in achieving its goals. However, the committee believes that understanding the movement of nitrate in the effective root zone allows a more rapid and timely evaluation of the effects of BMP implementation in minimizing nitrate transport to groundwater. As presented in Section 6.2, site-specific soil properties have a great influence on deep migration of nitrate from agricultural fields. The committee supported a GWMA Leaching Vulnerability Index project to develop a preliminary model to rank geographic areas for their vulnerability to nitrate leaching. These areas were ranked based on soil properties, dominant crops grown, and other characteristics. Attachment C4 contains additional information on the Leaching Vulnerability Index project.

The committee recommends that the GWMA use the results of the Leaching Vulnerability Index model as one tool to help prioritize allocation of its resources to help growers located within the more vulnerable areas better manage nitrate deep migration.

6.4.4.2 Sources of Elevated Nitrate Levels in Dryland/Rangeland Wells.
Wells exhibiting unusually high nitrate levels were identified in the mostly cultivated dryland and rangeland areas outside the Columbia Basin Project areas. The fertilizer inputs and groundwater recharge rates are relatively low in these areas compared with the irrigated areas, and there is no apparent link between nitrate levels and soil characteristics. It should be noted that no nitrogen fertilizer is applied to rangeland. Surface runoff may be a more likely nitrate transport mechanism to areas of groundwater recharge than direct deep migration through the soil profile. Soil conservation programs and BMPs, including contour farming, filter strips on waterways, and others are in place to minimize erosion and surface water runoff to protect the water resource. In addition to surface water runoff to recharge areas, other suspected sources include proximity to localized areas of groundwater-irrigated farming, substandard well construction, deteriorated or abandoned wells, livestock wastes, and crop residue.
The committee supports research through its ongoing technical work to identify the sources of elevated nitrate levels and mechanisms of nitrate transport to groundwater in the dryland and rangeland areas.

6.4.4.3  **Impact of Irrigation System Conversion**
Conversion from rill irrigation to sprinkler methods of irrigation has been credited with an increase in irrigation efficiency. However, farm acreage remaining in rill irrigation may be unsuitable for sprinkler systems for some topographic conditions, field shapes, and crops grown.

The committee recommends that conversion of additional acreage that is currently in rill irrigation to sprinkler, or other systems be assessed as to whether the additional conversions may significantly improve groundwater quality.

6.4.4.4  **Impacted Aquifer or Aquifer Zones**
The 1998 baseline well sampling results indicated the distribution of groundwater nitrate in wells with well depth. However, no specific conclusion regarding the contributing aquifer(s) could be made.

The committee recommends that the GWMA, through its ongoing technical work such as the proposed hydrostratigraphy mapping project, identify specific aquifers or aquifer zones where elevated groundwater nitrate concentrations have been detected.

6.4.4.5  **Groundwater Treatment**
The committee currently has no knowledge of aquifers or aquifer zones exhibiting high nitrate concentrations where remediation or treatment could be an effective tool. In the event that such areas are delineated, the committee supports projects to explore treatment solutions involving agricultural practices as effective, conservative, and economic options. The committee recognizes that the application of groundwater which contains high levels of nitrate onto crops may be utilized as a method of nitrate uptake, and in certain situations, considers that the use of crops for nitrate reduction in aquifer zones can provide a benefit to public health and the environment.

6.4.4.6  **Wellhead Protection Plans**
Wellhead Protection Plans establish the zone(s) from which water is drawn and inventory sources of nitrate as well as other contaminants within these zones which also should be managed. WHPs are required for most public water systems to protect both the community’s health and its
economic investment in a water system. The committee recognizes that while the GWMA Plan addresses nitrate contamination issues only, small public systems and individual wells may also benefit from wellhead protection planning. The committee supports the recommendations of the Urban & Rural Residential GWAC in addressing the agricultural sources of nitrate in wellhead protection plans (see Sections 10.4.1.2 and 10.4.2.3).

6.4.4.7 Abandoned Wells
The committee recognizes that wells that have not been properly decommissioned may act as conduits for transport of nitrate to groundwater. State regulations require decommissioning of abandoned wells (WAC 173-160). The committee supports the recommendations of the Urban & Rural Residential GWAC in estimating the extent of the abandoned well hazard and the cost of proper decommissioning (see Sections 10.4.1.3 and 10.4.2.5).

6.4.4.8 Bulk Fertilizer Handling and Storage
Bulk fertilizer handling and storage are regulated activities. The WSDA oversees compliance with rules for the safe storage and handling of bulk fertilizers in liquid or dry form. WSDA publishes a guidance document (WSDA 1995) and fact sheets that help explain these sometimes complicated rules. Appendix B of the WSDA guidance document addresses practices pertinent to the GWMA goals. The committee does not believe any additional recommendations beyond this guidance are needed.

6.4.4.9 Nitrogen Availability of Organic Sources of Nitrogen
The committee supports the recommendations of other GWACs for analysis of the nutrient contents of livestock industry wastes and municipal biosolids (See Section 9.4.1). Estimates of nitrogen mineralization curves should be developed for these and other byproducts that are land applied under various climatic and soil conditions encountered in the Columbia Basin.

6.4.5 Strategy AG5 – Public Information and Education Program
The State of Washington has conducted previous programs to establish BMPs for agricultural non-point source pollution [for example, the Management Practices for Irrigated Agriculture and the irrigation management practices presented in Canessa and Hermanson (1995)]. While previous programs have produced good information, most have lacked an aggressive information outreach program and incentives necessary to help growers implement practices on the ground. The committee accepts the GWMA public information/education program as a cornerstone
strategy to provide critical information and incentives to the Columbia Basin agricultural community to expedite implementation of BMPs.

The committee recommends that the GWMA public information/education program include the following specific activities to help inform the Columbia Basin about the actions taken by the agricultural producers to protect groundwater quality:

- Identify innovative and effective educational media and programs for reaching agricultural producers.
- Track the dissemination of information to producers to document effectiveness of the information.
- Evaluate the effectiveness of various educational approaches such as use of the Community Producer Groups to facilitate outreach.
- Inform the general public about the actions taken by the agricultural producers to protect groundwater quality.

The committee strongly supports the GWMA’s public information and education program to carry its recommendations to all segments of the GWMA community and those outside the Columbia Basin who take an interest in agricultural practices and water quality.

6.5 MONITORING

Procedures to monitor the progress of each recommended management strategy are presented below. Work plans will be developed as warranted to describe the monitoring process and data collection and analysis for the strategies. The data and information collected will be evaluated on an annual basis and the results will be included as part of the GWMA 5-year progress report due by 31 December 2005.

Strategies AG1 & AG2 - Develop Nutrient and Irrigation Water Management Guidelines

The progress in further review and finalization of the guidelines prepared by GWMA will be monitored as a matter of high priority. Progress evaluations will be made annually and the results included as part of the 5-year report.

Strategy AG3 - Facilitate Implementation of Nutrient and Irrigation Water Management Guidelines
The progress in implementation of guidelines will be monitored through quantifying the two measures of success listed in Section 2.3; namely, trends in adoption and implementation of BMPs and trends in nitrate deep migration based on results of the deep soil sampling program.

The trends in adoption and implementation of BMPs will be quantified by measuring the following parameters:

- Acreage, or number of facilities, on which agricultural BMPs have been implemented.
- Number of growers or operators implementing BMPs.
- Amount of cost-share dollars used by growers/operators to implement BMPs.

Information on these items will be obtained from the GWMA Irrigation Water Management (IWM) Cost Share Program, local IWM consultants, other agencies assisting growers with IWM such as NRCS, FSA, CDs, and the Grant County Public Utility District. The GWMA has instituted the voluntary IWM Cost Share Program for growers desiring to learn more about the use of BMPs for irrigating their properties to reduce nitrate leaching. Eligibility for the program extends to agricultural operations, dairies, feedlots, golf courses, and sprayfield operations in the three participating counties. The GWMA will use its GIS database to track where cost-share resources are applied. The GWMA GIS database will contain, when completed, information on farm acreage, crops, soil types, and irrigation systems. Additional details regarding the IWM Cost Share Program and the GIS database are provided in Attachments E4 and C3, respectively.

In addition to the IWM programs, grower surveys will be conducted to provide indications of the extent to which local growers have implemented BMPs. The Conservation Districts Partnership conducted a grower survey of agricultural BMP implementation in Grant, Adams, and Franklin counties in August 1999. The survey focused on irrigation water and nutrient management practices. The results of the survey may be used to establish time trends in acceptance and implementation of agricultural BMPs. Another survey is planned for the summer of 2001. A description of the August 1999 survey is included as Attachment E5.

The trend in nitrate deep migration in soil will be quantified by measuring changes in soil nitrate concentrations with depth. Changes in soil nitrate levels underlying agricultural lands, associated with implementation of BMPs, will be monitored annually. Briefly, this monitoring involves advancing cores at many fields down to a maximum depth of 10 feet or to a shallower depth as indicated by auger refusal. In each field, soil samples will be collected at 1-foot increments,
composited for each depth, and sent to a commercial laboratory for nitrate-N analysis. The details of soil sampling is provided in the Deep Soil Nitrate Monitoring Plan, enclosed as Attachment E6. Additionally, continued monitoring of deep soil sampling may provide useful information as to number of cooperators implementing BMPs, if not initially showing a decrease in the soil profile.

**Strategy AG4 – Sponsor Projects**

These projects will be presented to the Board for funding and technical support. Progress reports will be made to the Board as part of the requirements for receiving support.

**Strategy AG5 – Public Information and Education Program**

Progress on dissemination of information will be reported as part of overall GWMA progress reporting process (see Section 3.3 for more detail).

### 6.6 ADDITIONAL INFORMATION

This section presents additional information regarding sources of available nitrate to crops as cited in Section 6.4.1.

#### 6.6.1 **Sources of Available Nitrate to Crop**

In addition to commercial fertilizer and nitrogen that may be in irrigation water, the following sources of nitrogen should also be accounted for when applied to farmland:

*Soil Organic Matter, Crop Residue, and Nitrogen-Fixing Plants* – Soil organic matter is a source of nitrogen to crops and should be accounted for in field nitrogen balance calculations. Crop residue consists of plant leaves, stalks, roots and fruits that remain after harvest. Field residue increases on fields under conservation practices meant to build soil and prevent erosion. It may be difficult to balance inputs and nitrogen tied up with crop residue under this condition. In fields where the previous crop consisted of nitrogen-fixing plants such as legumes, management requires allowing credits for this nitrogen source.

*Animal Wastes* - Animal wastes supply essential plant nutrients, including nitrogen, and have beneficial soil-building effects when applied to fields. Animal waste can be analyzed for nutrient content and estimated nitrogen mineralization curves can be developed for various climatic and soil conditions in the Columbia Basin.
Municipal Biosolids - Municipal biosolids may be applied to agricultural fields. The nitrogen availability of municipal biosolids needs to be accounted for when applied to farmland.

Food Processing Byproducts – The byproducts include solid residual and process water from food processing operations. The water and nutrients in process water are valuable resources that can be recycled through land application. Land application is an effective and conservative treatment that helps maintain the competitiveness of the regional food processing industry.
SPRAYFIELD AND WASTEWATER MANAGEMENT PLAN

The Sprayfield and Wastewater Management GWAC (committee) identifies and develops management strategies addressing nitrate contribution to groundwater associated with land application of wastewater and biosolids. The following information is presented in this section:

- The committee’s composition.
- The committee’s approach to evaluating the role of its constituency groups in contributing nitrate to groundwater.
- The committee’s goals and objectives.
- The committee’s recommended management strategies.
- The methodology to monitor for progress in achieving the goals and objectives.

Finally, additional information regarding selected constituency groups and specific concepts they advocate are provided in this section.

The committee gratefully acknowledges the guidance it received from review of the Lower Umatilla Basin Groundwater Management Area Action Plan (Oregon State Division of Environmental Quality 1997) in developing this document.

7.1 COMMITTEE COMPOSITION

The committee includes participants primarily from the food processing industry and publicly owned wastewater treatment facilities (POTWs). Other industries with a potential to discharge some type of wastewater to groundwater include stormwater dischargers, hatcheries, packinghouses, gravel operations, and other industrial and agricultural enterprises. The contribution from the latter industries, although not quantified, is not believed to be appreciable. Likewise, only five POTWs, including resorts and residential developments, are permitted by Ecology to discharge wastewater to land. The committee believes that the existing regulatory approach to discharges by these industries is sufficiently protective of groundwater quality relative to nitrate. Therefore, the information presented and strategies recommended in this section are directed toward the food processors and POTWs. The other regulated industries mentioned above are encouraged to keep informed regarding the issues discussed herein. Permitted facilities located within the GWMA are listed in Table 5. Figure 2 displays the composition of the GWMA.
GWACs. Additional relevant information on the food processing industry and the POTWs is presented in Sections 7.6.1 and 7.6.2, respectively.

### 7.2 COMMITTEE APPROACH

The term “wastewater” does not accurately describe municipal discharge, referred to as “reclaimed water,” or the discharge from food processors, referred to by the industry as “process water.” In the remainder of this section, “process water” is used to refer to both these discharges to land.

The food processors and POTWs often apply the process water to land in sprayfields. Additionally, POTWs apply biosolids to land (see Section 7.6.1). Land application of process water and biosolids can be an effective process in the reuse and recovery of nutrients and water. Frequently, these land applications are conducted to grow a crop. As such, food processors and POTWs convert the byproducts of human activity into recycled products: nutrient and water for growing plants or water to recharge to the water resource. Land application management practices are intended to protect the existing and future beneficial uses of groundwater.

Industries and municipalities within the GWMA strive to achieve the goal whereby water and nutrients are recycled with land treatment. Reuse of a resource is an element of sustainable development enabling people to meet their current needs and have the resources available to meet the needs of future generations. The performance of the management system is routinely documented. The food processors and POTWs emphasize scientific solutions for groundwater quality issues.

All discharges from the food processors and POTWs are conducted under permits issued by Ecology to protect the existing and future beneficial uses of groundwater. Processors and cities must obtain National Pollutant Discharge Elimination System (NPDES) or State Waste Discharge permits to discharge to the waters of the State, infiltration ponds, lagoons and other storage structures, or to apply process water to the land (WAC 173-216 and 173-220). Currently, 37 dischargers are permitted to apply process water to land within the GWMA boundaries (Table 5) (Ecology, written communication to GWMA, 2000).

The management of these permitted discharges has changed in recent years from a practice of disposal to minimize nuisance factors, to a strategy of careful management and innovative utilization of a valuable resource. When the emphasis was on prevention of surface runoff, past permitting practices had the potential to contribute to nitrate in groundwater. Additionally, in the past, permits limited the area upon which process water was applied, thereby concentrating
process water applications. In recent years, sprayfield management and monitoring have led to considerable progress in nutrient recycling and groundwater protection.

Currently, when municipalities and processors apply water to land, applications are scheduled in an attempt to meet anticipated crop needs. Nitrate taken up by crops is not available for transport to groundwater. Currently, industrial and municipal land applicators strive to minimize application of excess nitrogen. Applications are planned based on the “agronomic rate” of nitrate application (see Section 7.6.3), although as noted by Ecology and Washington State University “…deep percolation either from irrigation or rainfall cannot be completely eliminated” (Canessa and Hermanson 1995, p. 17).

Because the nitrogen-containing discharges from the food processors and POTWs are regulated, the goals and recommended strategies discussed below are closely tied to Ecology permitting requirements.

### 7.3 COMMITTEE GOALS

The committee believes that the existing regulatory approach in overseeing process water management is sufficiently protective of groundwater quality. Process water from the GWAC constituency groups’ facilities is discharged under permits issued by Ecology and requirements imposed by state regulation to protect the existing and future beneficial uses of groundwater. Therefore, the committee’s goal is to define strategies that can be adopted voluntarily to improve land and water use activities that may potentially contribute to elevated nitrate levels in groundwater. As directed by the GWMA Lead Agency and the Board, the committee has set the following objectives to fulfill its goal:

1. Help develop means by which the committee constituency groups can have access to the information they need to meet or exceed permit requirements.

2. Sponsor projects to evaluate and demonstrate innovative water and nitrate reuse and recovery options of interest to the constituency groups.

3. Help inform the Columbia Basin public about the committee constituency groups efforts to maintain the delicate balance between environmental protection and resource utilization for the economic health of the region.

4. Support activities of and share resources with other GWACs to achieve their goals and objectives.
7.4 RECOMMENDED MANAGEMENT STRATEGIES

This section recommends strategies to achieve the above objectives along with elements of the public information and education plan. Activities to monitor progress of the recommended strategies are presented in Section 7.5. Table B3-3 (Attachment B3) contains information on agencies, timelines, and required funding to implement these strategies.

7.4.1 Strategy SFWWM1 – Form a Regional Information-Sharing Group

Voluntary involvement in an information-sharing regional group could help the GWAC constituency groups understand regulations and facilitate discussions with Ecology on uniform and practicable implementation of regulatory action. The committee recommends establishing an ongoing working group, or encouraging an existing regional entity to fill this role. The following tasks may be undertaken by this group:

- Contact facilities producing process water and offer sources of information and assistance on process water management, reuse, and recovery.
- Assist POTWs, food processors, and other permitted facilities to meet or exceed the requirements of State permits for land application of process water.
- Assist the GWMA in tracking the progress toward achieving the committee goals.
- Advocate continued advance in adoption of water recovery and reuse practices by the constituency groups.
- Promote use of innovative water and nitrate reuse and recovery systems by all effective means including educational outreach to constituency groups and research and demonstration projects.
- Seek dialogue with Ecology regarding consistent and practicable implementation of regulations related to winter storage requirements for facilities using land application. Strongly consider innovative winter storage options. See Section 7.6.4 for description and justification of this item.
- Provide information to the constituency groups on how to best monitor consumptive use, plant removal, and residual soil levels of nitrogen before and after crop growing seasons.
- Work with Ecology to define and adopt a scientific and flexible definition of “agronomic rate” when used for sprayfields. See Section 7.6.3 for description and justification.
• Discuss with Ecology the environmental and economic ramifications of the state’s anti-degradation policy. This policy may lead to water treatment goals that exceed safety requirements regardless of economic impacts. Careful consideration must be given to what constitutes “all known, available, and reasonable methods of prevention, control, and treatment” (AKART) as applicable to nitrate degradation of groundwater. Excessive and unreasonable treatment costs do not serve the public interest.

7.4.2 **Strategy SFWWM2 – Recommend Activities and Practices to Meet or Exceed Permit Requirements**

The committee recommends that the constituency groups voluntarily adopt the activities and practices listed below to allow them to meet or exceed the requirements of their permit. The committee recommends no specific monitoring and reporting on the status of adoption of the recommended practices since these are required components of wastewater discharge permits issued by Ecology for these facilities.

• Market process water as a valuable commodity. Process water is a valuable commodity, since it contains nutrients such as nitrate, and therefore should be considered a useful resource. The committee encourages use of treatment and water reuse strategies by the constituency groups that utilize these nutrient resources.

• Properly design and manage the sprayfields. When properly designed and managed, these natural treatment systems can efficiently remove nitrate in the Columbia Basin.

• Exercise diligence in monitoring and reporting process water land application requirements as stipulated in the facilities’ permits.

• Monitor and report consumptive use, plant removal, and residual soil levels of nitrogen before and after crop growing seasons. Use water and nutrient availability information that may be obtained during the land application season to adjust management practices.

• Adhere to cross-connection control measures as required by the WDOH and/or install and maintain backflow prevention devices within the irrigation system when the system is used to apply process water to land. However, the members realize that in some instances their control may be limited over the operation of the irrigation systems that apply process water to sprayfields.
7.4.3 **Strategy SFWWM3 – Sponsor Projects**

The committee agrees that insufficient information and data are currently available in the public domain regarding innovative techniques for water and nitrate reuse and recovery under the environmental conditions and facility and sprayfield operating procedures followed in the Columbia Basin. Therefore, the committee recommends that GWMA consider and authorize selected projects to allow further assessment of management options to prevent deep migration of nitrate as a result of process water application. Projects may address the following key items:

- Support projects demonstrating innovative water reuse by POTWs. Ephrata, Royal City, Warden, and Connell are currently introducing new municipal treatment facilities where demonstration projects utilize infiltration basins to recharge groundwater or use land application. Land application requires treatment of process water to meet WDOH effluent reuse standards to meet groundwater quality goals.

- Support projects demonstrating innovative land treatment practices using new irrigation and cropping system combinations. It is possible that the seasonal consumptive use of water and nutrients may be extended with the inclusion of cropping systems designed to recover nitrate, especially rotations including deep-rooted and cool season crops. The committee has sponsored a research project to promote innovative cropping systems to increase nitrogen removal from soil. A more detailed description of this project, including goals and a progress report, is provided in Attachment F1.

7.4.4 **Strategy SFWWM4 – Public Information and Education Program**

The committee considers the GWMA public information and education program as a cornerstone strategy to inform the public of the activities the constituency groups undertake to protect the quality of the area groundwater resource. The committee recommends that the GWMA endorse educational materials, addressing the topics listed below, in its public information/education program to help inform and educate the public on the efforts of committee constituency groups to balance environmental protection with regional economic health. The committee agrees that these topics are important to the long-term success of their operations in the Columbia Basin.

*Public Perception.* Like many conveniences of modern living, safe municipal process water management by POTWs may be taken for granted, yet the public has an economic investment in process water management and an important role in this complex, frequently forgotten arena. Technical solutions are often available, yet failure to involve an educated public may limit implementation. Periodic reports to the public by POTWs on progress toward nitrate management
through meeting permit goals can counter this “out-of-sight, out-of-mind” perspective. The committee points out that feedback from the public participation process will help decision-makers understand how the public perception regarding process water management has changed and can guide efforts at further communication.

The food processors understand that the general public may currently be unaware of, or misunderstand, the following:

- The food industry must conduct process water management under close scrutiny by Ecology and comply with specific regulatory guidelines.

- Food processors’ land application systems, including sprayfields, are efficient water treatment methods for removing constituents such as nitrate from water.

- Agronomic systems of process water treatment by means of land application are a viable management tool.

**Public Concerns About Water Reuse.** Public concerns about the safety of water reuse may be founded in misinformation. Incomplete knowledge could lead to negative public attitudes causing the loss of an effective, economically realistic, and conservative treatment method in reclaiming process water. The committee suggests that the GWMA focus on increasing public understanding of technical issues and policy alternatives regarding proven innovative process water reuse projects in the Columbia Basin and the benefits of these projects.

**Lack of Public Understanding Regarding Increasing Treatment Costs.** Incomplete understanding of water recycling economics and processes can lead to prohibitively expensive treatment requirements. Complex or high-priced solutions may be no more effective than simpler, less expensive options for water treatment, especially to remove nitrogen and other plant nutrients. Expensive, engineered solutions, though effective, may not be reasonable where less expensive solutions, such as land application, are as effective.

To gain the support of a well-informed public, the incremental costs of groundwater protection and improvement must be assessed. The public will benefit from a continuing forum for dialogue to determine whether regulatory requirements exceeding safe drinking water standards can be met without economic hardship.

The State anti-degradation policy states that the existing groundwater quality is to be maintained, except where AKART are already employed, or when “an overriding consideration of the public
interest will be served” (WAC 173-200). This policy may lead to water treatment goals that exceed those required for safety regardless of economic impacts. Careful consideration must be given to what constitutes AKART in this circumstance. Excessive and unreasonable treatment costs do not serve the public interest.

7.5 MONITORING

Procedures to monitor the progress of each recommended management strategy are presented below. Work plans will be developed as warranted to describe the monitoring process and data collection and analysis for the strategies. The data and information collected will be evaluated on an annual basis and the results will be included as part of the GWMA 5-year progress report due by 31 December 2005.

Strategy SFWM1 – Form A Regional Information-Sharing Group

The committee will report to the Board by June 2001 on the progress made to 1) form the regional group and 2) begin discussions on the topics of importance. The results of group discussions will be periodically reported to the Board on a schedule to be determined later.

Strategy SFWM2 – Recommend Activities and Practices to Meet or Exceed Permit Requirements

The recommended practices are intended to be voluntary. Ecology permits require routine monitoring and reporting on the status of sprayfield operations.

Strategy SFWM3 – Sponsor Projects

These projects will be presented to the Board for funding and technical support. Progress reports will be made to the Board as part of the requirements for receiving support. The committee encourages its constituency groups to provide information on relevant projects that they may conduct independently of the GWMA. This information will become part of the GWMA report to the public on the progress of its efforts.

Strategy SFWM4 – Public Information and Education Program

Progress on disseminating information will be reported as part of the overall GWMA progress reporting process (see Section 3.3 for more details).
7.6 ADDITIONAL INFORMATION, DATA, AND ANALYSIS

This section presents additional information, data, and analysis regarding the concepts discussed in the preceding sections and are cited where used.

7.6.1 Background and Regulatory Requirements – POTWs

Funded primarily by public monies and local resident utility users, the POTWs are essential to residential and industrial development. The committee believes that the existing regulatory oversight of POTWs is sufficiently protective of groundwater quality.

POTWs vary in sophistication throughout the GWMA. Currently, municipalities such as Ephrata, Royal City, Mattawa, Moses Lake, Quincy, Connell, and Warden are planning or constructing a new generation of wastewater treatment facilities or upgrading existing facilities. Ephrata and Royal City facilities will utilize infiltration basins to recharge groundwater with process water. This application requires treatment of wastewater to meet WDOH effluent reuse standards for groundwater quality goals. Warden and Connell facilities will utilize land application of process water.

As local municipalities work with permitting authorities, the committee cautions all to consider carefully the specific needs and economic circumstances within each community as the regulation-based AKART principle is applied.

Storage structures are employed at various stages in the management of municipal wastes. For some public facilities, ponds or lagoons are the final stage of process water treatment. Of concern to the committee is the consistent and practicable implementation of regulations related to winter storage requirements for those facilities using land application.

Permitting provisions limit volumes of process water that are allowed to be applied to land and detail the sampling point, frequency, methods of analysis, and recordkeeping requirements for water monitoring (see Ecology 1996, Table 2.1, Checklist of Requirements to Comply with the Groundwater Quality Standards). Groundwater monitoring is frequently used up gradient and down gradient of the sprayfield to evaluate its effect on groundwater. Where crops are grown, permits often require yearly crop management plans to be filed with Ecology several months in advance of the growing season. Those permitted to apply process water to land must comply with State Environmental Policy Act (SEPA) rules.

Ecology defines biosolids as “municipal sewage sludge that is a primarily organic, semisolid product resulting from the wastewater treatment process, which can be beneficially recycled.”
Biosolids management is regulated by State law and intended to conform to all federal rules under the federal Clean Water Act. A number of biosolids applicators hold permits, which outline monitoring, analysis, recordkeeping and other requirements.

### 7.6.2 Background and Regulatory Requirements – Food Processors

The food processing industry feeds the public and provides a strong economic base to the Columbia Basin by providing jobs for employees, farmers, and a multitude of service industries. The committee believes that the existing regulatory approach in overseeing process water management is sufficiently protective of groundwater.

It is likely that the public is generally unaware that process water is generated from the processing of raw agricultural commodities. The food processors typically apply the process water to sprayfields. Application of the process water to sprayfields is considered a water treatment method.

Food processors’ permits limit the volumes of process water that are allowed to be applied to land and specify the sampling point, frequency, methods of analysis, and recordkeeping requirements for water monitoring. Groundwater monitoring is frequently used up gradient and down gradient of the application site. Where crops are grown, permits often require yearly crop management plans filed with Ecology several months in advance of the growing season.

Process water storage structures are employed at various stages in the management of food processing wastes. Of concern to the committee is the consistent and practicable implementation of regulations related to winter storage methods for those facilities using land application. Consideration should be given to innovative storage mechanisms (see Section 7.6.4 for additional discussion).

Food processors do not stipulate nitrate-loading reduction practices in contracts with growers. Food processors strive to obtain and pay incentives to growers who provide the highest quality raw products, such as a crop of potatoes that will mature at the proper time, have high solids content, low sugars, low internal defects, and low disease for longer storage life. Lower quality products are an economic disincentive and may result in a possible loss of contract. Growers must apply the right amounts of fertilizer, crop protectants, and water at the proper times to produce high quality products. Economics on both the part of the grower and the food processor have led to a self-regulation mechanism. The Irrigated and Dryland Agriculture GWAC Plan, presented in Sections 6.2, 6.4.1, and 6.4.2 describes nutrient and irrigation management guidelines that will be
the basis for changes in grower practices. The industry therefore views stipulations by food processors in their contracts with growers as unnecessary.

7.6.3 **Agronomic Application Rate – Definitions and Limitations**

The NRCS (Section IV, Amendment 14, 1992a, page 9) defines the agronomic rate as:

“...the rate of nutrient addition required to reach a realistic crop yield goal for soil, climatic and management conditions.”

Ecology (1996, p. 129) defines the agronomic rate as:

“Rate at which a viable crop can be maintained and there is a minimal leaching of chemicals downwards below the root zone. Crops should be managed for maximum nutrient uptake when used for wastewater treatment.”

For State discharge permit holders managing sprayfield crops, Ecology’s definition does not provide clear guidelines for crediting nitrate uptake by cover crops, second crops, and soil storage of nutrients that will be used by the next season’s crop. Rather, for these application sites, a mass balance approach is applied. This accounting process mandates balancing nutrients that go on the field with what “comes off” within a single growing season—primarily balancing inputs with the nutrient content of harvested crops, with some credits for volatilization and other minor losses. This nutrient budgeting process does not allow for maintaining the reserve of nutrients in the soil profile or cover crops necessary for crop management.

7.6.4 **Winter Storage Requirements**

Storage structures are employed at various stages in the management of process water. Of concern to the committee is the consistent and practicable implementation of regulations related to winter storage methods for those facilities using land application. The capacity of a land application site for nutrient and hydraulic loading is an important consideration for good management and design of a system that is protective of groundwater. Proper design and good management encompass the requirements of AKART farming for land application. The agronomic rate of application for nutrients and irrigation water is a key driving force in designing a land application system that implements AKART. Agronomic rates can therefore be used as a design basis in establishing the capacity of a land application site for both irrigation and nutrients (See Section 7.6.3 for limitations of the current definitions of the agronomic rate). Given the need and desire to operate an agronomically sound land application system, the agronomic salts leaching requirement is the
most critical design limiting factor. Seasonal storage is required to manage the land application within the leaching requirement as needed to control salt buildup. Storage should provide flexibility to manage irrigation in a manner that is reasonable for agronomic crop production, leaching requirement, and groundwater protection.
8 ENVIRONMENT AND RECREATION GWAC PLAN
The Environment and Recreation GWAC (committee) evaluated the general relationship between
recreational activities and nitrate levels in surface water bodies and in groundwater and the need
for nitrate management strategies for those activities. The following information is contained in
this section:

- The committee’s composition.
- The committee’s approach to evaluating nitrate contribution to groundwater associated
  with recreational and wildlife activities as well as the impact of current groundwater
  nitrate levels on wildlife.
- The committee’s goals and objectives.
- The committee’s recommended management strategies.
- The methodology to monitor progress in achieving the goals and objectives.

8.1 COMMITTEE COMPOSITION
The committee participants have included individuals from the environmental and recreational
interest groups and the general public. These groups include the operators and/or owners of local
golf courses, the Federation of Western Outdoor Clubs, the Audubon Society, and others. Figure
3 displays the composition of the committee.

8.2 COMMITTEE APPROACH
The committee evaluated a range of environmental conditions and recreational activities with
respect to their potential to contribute nitrate to groundwater or be impacted by nitrate in
groundwater. The committee determined whether and how each of these activities could add a
significant amount of nitrate to the environment in order to identify whether BMPs may be
needed. The committee further evaluated whether several commonly held public perceptions in
this context were accurate. The committee used peer-reviewed documents and publications and
professional assessments as the basis of its conclusions. The conditions, activities, and public
perceptions evaluated included the following:
- Operations that utilize fertilizer nitrate including golf courses and public recreation areas such as parks and school fields.

- Nitrate contribution from irrigation water.

- Nitrate contribution from wildlife.

- Current nitrate concentrations in surface water bodies located within the GWMA.

- Effect of nitrate on the local fish population.

- Naturally occurring sources of nitrate.

- Effect of recreational activities such as boating and camping on groundwater nitrate levels, and vice versa.

In identifying and evaluating these conditions and activities, the committee solicited data and information from a number of technical advisers such as staff of the local irrigation districts and WSU, independently gathered data and information, and considered input from those who would be directly impacted by its recommendations. The results of the committee evaluation provided the following conclusions regarding some, but not all, of the items considered above:

- The nitrate concentrations in surface water bodies are not a critical concern for the GWMA. Current concentrations rarely exceed water quality standards or criteria for humans and wildlife (see Section 8.6.1 for supporting information and analysis).

- The committee identified no nitrate concentrations exceeding the level posing a direct threat to fish and waterfowl as identified by the EPA. Management strategies recommended by this committee for protection of groundwater have the potential to reduce the amount of nitrate entering the surface water, thus reducing the amount of aquatic plant growth (see Section 8.6.2 for supporting information and analysis).

- It is unlikely that naturally occurring nitrate is present at sufficiently high concentrations to significantly contribute to current surface water and groundwater nitrate levels in the GWMA (see Section 8.6.3 for supporting information and analysis).

- The committee identified no significant contributions from recreational activities to groundwater nitrate levels. The committee further found that nitrate in groundwater does
not interfere with recreational activities (see Section 8.6.4 for supporting information and analysis).

Should the above issues arise during the GWMA Plan concurrence process, the committee will reconvene to address them.

Results with respect to other issues listed above are presented below as part of recommended management strategies.

8.3 COMMITTEE GOALS

The committee’s goal is to define strategies that can be adopted voluntarily by the committee’s constituency groups to protect groundwater quality while sustaining the economic viability of the Columbia Basin communities. As directed by the GWMA Lead Agency and the Board, the committee has set the following objectives to fulfill its goal:

1. Recommend voluntary adoption of BMPs to minimize the effects of recreational activities on groundwater nitrate levels.

2. Lead a public information/education program to develop environmental education options (i.e., educational material, tours by schools) and provide science-based information about the potential contribution of recreational land uses to groundwater nitrate and the effects of nitrate on the environment and recreational activities in the GWMA.

3. Support the activities of and share resources with other GWACs to achieve their goals and objectives.

8.4 RECOMMENDED MANAGEMENT STRATEGIES

This section recommends a strategy to achieve objectives 1 and 3 along with elements of the public education and information program addressing objective number 2. Activities to monitor progress of the recommended strategies are presented in Section 8.5. Table B3-4 (Attachment B3) contains information on agencies, timelines, and required funding to implement these strategies.

8.4.1 Strategy ER1- Recommend Voluntary BMPs for Managed Recreation Areas

Public parks and recreation areas and State rest stops appear to occupy less than 0.5 percent of the total land area in the GWMA (based on planning department and auditor estimates). The committee believes that this acreage does not contribute a significant amount of nitrate to
groundwater. Of this area, schoolyards and school playing fields, some parks, and public green space require landscape management that includes irrigation and fertilization of turf grass or other plantings.

The committee understands the public misperception that because golf courses include expanses of lush green grass in mostly arid surroundings, they must receive an excessive amount of nitrate fertilizer, and therefore are likely significant sources of groundwater nitrate. Several factors discovered by the committee are evidence that this belief is in error. The committee concluded that golf courses are unlikely to contribute significant nitrate to groundwater in the GWMA after considering the following factors:

- Based on polling the majority of golf course operators in the basin, it appears that the total turf acreage used by golf courses is on the order of 2,000 acres. This is two-tenths of one percent (0.2 percent) of the GWMA’s 815,000 acres of irrigated land.

- Golf course managers and owners described their operations to the committee. This informal survey of local golf courses revealed that fertilizer inputs are often based on soil sampling and are professionally managed for economic reasons. The materials provided by golf course representatives included examples of fertilizer application records and research reporting that turf grass uptake of nitrogen allows a minimal amount of leaching below the root zone (U.S. Golf Association 1997).

The committee requested that golf course managers and/or owners, and other recreation area managers, provide their recommended BMPs. The golf course BMPs are based on Environmental Principles for Golf Courses in the United States developed by the Center for Resource Management (1996). The BMPs are reproduced in Attachment G1 for reference.

The committee recommends golf courses and other recreational areas that manage turf grass to follow BMPs that are accepted by their industries for groundwater protection.

Golf courses and recreation areas are eligible for assistance programs and services sponsored by the GWMA and the local CDs. The committee recommends that golf courses and recreational areas take part in the GWMA cost share programs such as deep soil sampling and irrigation water management cost share programs.
8.4.2 **Strategy ER2 - Support Activities/Share Resources with Other GWACs**
The committee reviewed the GWMA Plan components of the other four GWACs to evaluate the potential impacts of their recommended management strategies on the environment and recreational activities in the GWMA. The reviews addressed the following questions:

- Do the recommendations address community concerns related to environmental protection and continuing recreation in the GWMA?
- Are there likely to be unintended impacts of management strategies on the environment or recreational activities? If so, are mitigating strategies suggested?

The committee sought professional opinion where necessary to answer these questions. The general conclusion was that the management strategies recommended by the other committees should reduce the concentration of nitrate in the waters and therefore would have no adverse effects on the environment or recreational activities.

8.4.3 **Strategy ER3 - Public Information and Education Program**
The committee’s strategy consists of two main efforts. The first effort includes encouraging schools to include educational material in school curricula. The second effort includes educating the public on popular misconceptions regarding the mutual effects of recreational activities on groundwater nitrate levels. The committee’s recommendations regarding these two efforts are summarized below.

8.4.3.1 **Enhancing School Curricula**
Although adults form the GWMA’s main audience and will be the implementers of the GWMA Plan, the committee recognizes that its public information and education efforts should not exclude students. The committee’s work with the local CDs, WSU, and staff of GWMA partner agencies, as well as input from community supporters, has revealed that many valuable environmental education programs currently exist that are designed for youth and express messages consistent with GWMA’s issues.

The committee recommends GWMA support of existing programs for children as part of a science curriculum, provided such programs meet one or more of the GWMA’s public education goals. The committee will support GWMA’s efforts in recommending essential elements of environmental education relevant to the GWMA mission, and identifying and helping fill gaps in educational media and programs. The committee believes that the appropriate educational media
should include groundwater education in existing programs. Finally, the committee supports GWMA’s efforts to enhance existing groundwater education programs by providing materials, field trip sites, speakers, or funding or by supporting applications for funding.

8.4.3.2 **Educate the Public Regarding Popular Misconceptions**

The committee understands that the general public may currently be unaware of, or misunderstand, a number of important concepts regarding nitrate contribution to groundwater. These concepts are listed below. The committee recommends that the GWMA endorse educational materials to address these concepts and distribute them by all effective means.

**Contribution of Wildlife to Surface Water Nitrate**

- The committee evaluated whether large populations of wildlife attracted to surface water created by the Columbia Basin Project could contribute significant amount of nitrate to surface waters and ultimately to groundwater. The committee concluded that there is no evidence to support this opinion based on the following information:

  - Surface water nitrate concentration data provided by the Bureau of Reclamation (unpublished data, communicated to GWMA by the Bureau) do not suggest wildlife contribute significant nitrate inputs in stream reaches or lakes where wildlife congregates.

  - Data reported in Embrey and Block (1995, p. 85-86) and communication with a University of California at Davis researcher indicated that there is no evidence to suggest that the nitrate contributions of wildlife, especially waterfowl, are a significant water quality problem. Based on the surface nitrate data that the committee reviewed, the presence of wildlife does not appear to increase the nitrate concentration in surface waters above the health standards for humans.

  - The staff of the Columbia National Wildlife Refuge and U.S. Fish and Wildlife Service presented no water quality concerns to the committee that were linked to wildlife nutrient inputs.

**Relative Magnitude of Nitrate Contribution from Managed Recreation Areas**

- Inform the public about the major sources of elevated nitrate in the GWMA groundwater and the relatively minimal contribution from golf courses and other recreation areas.

**Lack of Significant Amount of Nitrate in Irrigation Water**

- Irrigation water delivered to the farm contains low concentrations of nitrate (Williamson et. al. 1998, p. 16, also unpublished data
communicated to GWMA by the Bureau of Reclamation). Low nitrate levels in irrigation water as delivered reflect the values found in the Columbia River source water. Test results for nitrate show low concentrations in water within the Project’s storage and regulating structures. Additionally, evidence exists that in some areas irrigation canal water dilutes nitrate concentrations in nearby wells (Williamson et al. 1998, p. 16; personal communication, Franklin Conservation District 1999).

8.5 MONITORING
Procedures to monitor the progress of each recommended management strategy are presented below. Work plans will be developed as warranted to describe the monitoring process and data collection and analysis for the strategies. The data and information collected will be evaluated on an annual basis and the results will be included as part of the GWMA 5-year progress report due by 31 December 2005.

Strategy ER1 – Recommend Voluntary BMPs for Managed Recreation Areas

The recommended practices are intended to be voluntary. The committee recommends that GWMA regularly solicit information regarding implementation of the recommended BMPs from the managed recreation areas (golf courses, parks, school fields, etc.).

Strategy ER2 - Support Activities/Share Resources with Other GWACs

No reporting is needed.

Strategy ER3 – Public Information and Education Program

Progress on disseminating information will be reported as part of the overall GWMA progress reporting process (See Section 3.3 for more detail).

8.6 ADDITIONAL INFORMATION, DATA, AND ANALYSES
This section presents additional information, data, and analyses regarding the concepts discussed in the preceding sections.

8.6.1 Surface Water Nitrate Levels
The committee examined surface water nitrate concentrations within the Columbia Basin Project (Project) and the dryland/rangeland areas of the GWMA. The committee embarked on a fact-finding process that included education sessions, examination of readily available data, and
contacts with various professionals. The results of the committee findings are summarized below for each area.

**The Columbia Basin Project Area** - The approximately 622,000 acres of the CBIP cover about 17 percent of the entire GWMA’s 3,740,000 acres (see Attachment D1). The Project comprises one of the largest agricultural irrigation projects in the western United States. The Project diverts about 3 percent of the Columbia River flow at Grand Coulee Dam on an average annual basis (Montgomery Water Group 1997, pp. 7-8). Project return flows discharge back to the Columbia River.

Within the areas served by the Project, the surface water exists predominantly in irrigation canals, storage structures, and drainage canals (or wasteways). In addition, once water was imported into the area by the Project, many seep lakes developed near storage reservoirs such as the Potholes Reservoir. Finally, Crab Creek, Rocky Ford Creek, Moses Lake, and Soap Lake, other smaller lakes, and many intermittent streams existed in the GWMA region prior to the development of the Project and continue to provide some natural inflows (Montgomery Water Group 1997, p. 8).

The committee examined readily available Project surface water nitrate concentration data collected from 18 surface water sampling sites by the Bureau of Reclamation from 1994 to 1998. These sites were chosen for their proximity to sites sampled for a 1991-1992 U.S. Geological Survey reconnaissance investigation of water quality and other factors associated with irrigation (Embrey and Block 1995). The committee additionally reviewed Ecology’s list of impaired streams pursuant to the Clean Water Act, Section 303(d). The results of committee’s review are as follows:

- No Project water in the GWMA has been placed on Ecology’s priority list of waters of the State requiring additional pollution control for nitrate because water quality did not exceed standards or criteria (Ecology 1998a). Criteria do not exist for streams. Additionally, Embrey and Block (1995) reported median and maximum nitrite plus nitrate nitrogen concentrations of 1.7 and 12.0 mg/L for all sites, respectively. They further stated, “Concentrations of dissolved constituents, including nutrients and trace elements, were typically small and with few exceptions, did not exceed various standards and criteria protecting humans and freshwater life.”

- No increasing trend in nitrate concentrations between 1994 and 1998 was noted in the Bureau of Reclamation data.
- The Bureau of Reclamation data indicate that nitrate concentrations peak in winter after the growing season, when groundwater apparently dominates surface water recharge. This conclusion is consistent with the findings reported by Williamson et al. (1998, p. 16) and Embrey and Block (1995), who reported, “Concentrations of dissolved constituents, including nutrients and trace elements, . . . tended to be large during non-irrigation season when groundwater. . . sustains stream base flows.”

_The Dryland Area_ - About 62 percent of the GWMA, or 2,305,000 acres, is used for dryland (non-irrigated) agriculture and livestock range (see Attachment D1). Surface waters in the dryland portion of the GWMA include portions of the Snake and Palouse Rivers forming the southeast boundary of the GWMA and Cow Creek, the major stream drainage in eastern Adams County, flowing from Sprague Lake at the extreme northeast extent of the GWMA to the Palouse River.

In the GWMA outside the Columbia Basin Project, it is likely that groundwater discharge does not contribute significant nitrate to surface water. According to Williamson et. al. (1998, p. 16), within the dryland Palouse sub-unit of their Columbia Plateau study area, lower summer concentrations of nitrate in surface water are in part the result of lower concentrations in groundwater, and surface water nitrate is highest during winter when runoff transports nitrogen to fields.

8.6.2 **Effect of Nitrate on Fish**

Concern has been expressed in committee discussions that fish populations in the Columbia Basin have decreased in recent years. The committee has discovered no information to link the declining fish productivity of Columbia Basin waters with nitrate. The U.S. Geological Survey reconnaissance investigation of 1991-1992 reported declines in crappie, bluegill, and bass in Moses Lake, stating that the reason for the decline had not been determined, although numerous theories had been proposed (Embrey and Block 1995, p. 9).

Wildlife managers continue to link fishery declines to multiple factors, among them excessive algal growth, but additional factors cited include the introduction of predator species, chemical use, the natural aging process in the seep lakes, and the failure of introduced non-native cold water fish to establish reproducing populations.
The committee identified no nitrate concentrations exceeding the level established by EPA as posing a direct threat to fish. The EPA concluded, “the levels of nitrate nitrogen at or below 90 mg/L would have no adverse effects on warm water fish” (EPA 1986).

The growth of algae in surface waters was the concern most often cited as the committee addressed the issue. Excessive growth of algae is an aesthetic concern limiting recreational use of water, clogging irrigation equipment filters, depleting oxygen or reducing the infiltration of sunlight, which threatens aquatic organisms. However, nitrogen is not always the limiting factor in the growth of algae in freshwater systems. In general, phosphorus is the limiting nutrient that controls the excessive growth of algae in freshwater systems.

8.6.3 Naturally Occurring Nitrate and Atmospheric Deposition

It is unlikely that naturally occurring nitrate is present at sufficiently high concentrations to significantly contribute to current groundwater nitrate levels in the GWMA based on the analysis presented below.

In addition to human-related sources, nitrate is introduced to the environment from decaying organic material (plants and animals), atmospheric deposition of lightning-produced nitrate, and mineral sources including rocks and mineral precipitates. Lightning-produced atmospheric deposition of nitrate in the GWMA is negligible compared to industrial sources such as the combustion of fossil fuels. The National Atmospheric Deposition Program (NADP) reports significant nitrate inputs in areas impacted by industrial sources, with recent Eastern Seaboard studies indicating as much as 25 percent of nitrate inputs may come from the atmosphere (U.S. Geological Survey 1999, p. 19). The highest deposition rates are about 6 pounds per acre in the upper Midwest through the Northeast (U.S. Geological Survey 1999, p. 26). There is no station to measure atmospheric deposition in the GWMA. However, at stations in Whitman County, Washington, and Union and Umatilla Counties in Oregon (NADP; see Attachment D1, Section 5.5), where land use and climate are similar to those found in the GWMA, atmospheric deposition from all sources measured just 0.5 to 0.9 pounds per acre per year.

Mineral deposits or rocks containing significant leachable nitrate have not been found in the GWMA (see Section 5.5 of Attachment D1), though some evidence of minor naturally occurring residual soil nitrate in Benton County has been reported by the U.S. Geological Survey (Ebbert et. al. 1995, p. 66 and 69).
8.6.4 **Effects of Recreational Activities and Surface Water Nitrate on One Another**

In locations where human waste disposal is inadequate, recreational activities such as boating, camping, swimming, hiking, hunting, and eco-tourism can contribute nitrate to surface water and groundwater. Although the committee lacks data, it does not believe that these activities are of concern in the GWMA. Algae and excessive plant growth may interfere with the recreational and aesthetic use of water as discussed above in Section 8.6.2.
DAIRY, FEEDLOT, AND CATTLEMEN GWAC PLAN

The Dairy, Feedlot, and Cattlemen GWAC (committee) evaluated the potential contributions of livestock industries to groundwater nitrate levels in GWMA. This section presents areas of agreement within the livestock industry, which in general provide the best management of livestock wastes. The following information is contained in this section:

- The committee’s composition.
- The committee’s approach to evaluation of nitrate contribution to groundwater associated with dairies, feedlots, and beef cattle ranching activities.
- The committee’s goals and objectives.
- The committee’s recommended management strategies.
- The methodology to monitor for progress in achieving the goals and objectives.

The committee gratefully acknowledges the guidance it received from review of the Lower Umatilla Basin Groundwater Management Area Action Plan (Oregon State Division of Environmental Quality 1997) in developing this document.

9.1 COMMITTEE COMPOSITION

The committee participants are representatives of the livestock industry including dairies, feedlots, and beef cattle industries in the Columbia Basin and their industry trade associations. Figure 3 displays the composition of the Groundwater Advisory Committees.

9.2 COMMITTEE APPROACH

Ranchers were among the earliest settlers in the Columbia Basin, beginning in the 1870s (Ron Anglin’s Forgotten Trails). Livestock operations pioneered the development of the Columbia Basin. These industries continue to make significant economic and other impacts in the region. The 1998 gross value of all cattle and calves in the three-county area was estimated at $161,420,000, compared with the 1997 gross value of harvested alfalfa hay in the same region, at approximately $117,450,000 (Washington Agricultural Statistics 1997-1998). Livestock industries employ GWMA residents directly and support trucking and other service industries. Additional indirect benefits include a saving in landfill space resulting from recycling food processing residual solids as livestock feed. The use of land for cattle range preserves some 1,363,000 acres of open space, as estimated by NRCS.
Manure and other animal wastes can supply nutrients to crops because they contain nitrogen and other elements essential to plant growth. The recycling of animal nutrients to increase soil fertility and crop yield is a practice that predates written history. Manure and other animal wastes are used increasingly to supply nutrients to certified organic food production facilities. Additionally, conventional crop production has benefited from supplementing or replacing inorganic fertilizer with animal waste nutrients such as nitrate.

Discharges of wastewater, solid manure, and water that comes into contact with manure and feed to surface waters are regulated under law as described below:

- Dairies (Class A license) are required by RCW 90.64 to develop dairy Nutrient Management Plans (NMPs) by July 1, 2002 and implement the NMPs by 31 December 2003 and will be inspected for compliance. These plans include descriptions of the waste collection and treatment systems, mechanisms for waste storage and transfer, nutrient utilization plans including crops, acreage, etc., estimates of the nutrient value of the waste, and maintenance structures. The minimum elements of a dairy NMP are summarized in Attachment H1.

- A dairy that meets the definition of a Concentrated Animal Feeding Operation (CAFO) (see Section 9.6 for definition of a CAFO) or that has been designated a “significant contributor of pollution” under RCW 90.64.020 is required to obtain a permit under the General Permit for Dairy Operations.

- Feedlots under the Animal Feeding Operation (AFO) (see Section 9.6 for definition of an AFO) or Concentrated Animal Feeding Operation (CAFO) definitions may be subject to the federal Clean Water Act regulating their waste discharges to surface waters through NPDES permits (40 CFR 122). The permit is required based on site-specific characteristics defined by EPA.

- The beef cattle industry is not subject to specific regulations. The committee believes that, where surface runoff is adequately managed and pastures are not overstocked, pastured livestock do not appreciably contribute nitrate to groundwater when compared to other sources in the Columbia Basin.

The committee understands that public perceptions regarding the potential contribution of the livestock industry to groundwater nitrate in the Columbia Basin are associated with application of livestock waste to farmland to grow crops, unplanned leakage or discharges from waste storage
structures, and infiltration of nutrient-containing water through feedyard surfaces. The guidelines provided by the existing regulations and policies (such as the Dairy NMPs) are believed to provide systems of BMPs for the livestock industry to limit waste discharge to surface waters and groundwater. The guidelines are partly based on NRCS (1992a) and NRCS(1992b).

The committee believes that the livestock operators are acting in good faith toward compliance with the relevant State and federal requirements for groundwater protection. Limited assistance with nutrient management planning, engineering assistance, and cost share and loan funds are available through the local CDs and NRCS. However, the committee believes that the assistance is not sufficient to meet existing needs due to inadequate staff and fund availability. Implementation of the management strategies recommended in this section will enhance the ability of livestock operations to comply with existing regulations, including the dairy NMPs.

The committee recommends voluntary development and implementation of NMPs by operations not already required to hold permits or a Dairy NMP as the most reasonable and effective means of environmental protection. The committee’s goals and objectives presented below offer a philosophy of management and continuing dialogue rather than specific dictates. Likewise, the recommended management strategies are not intended to limit the use of any other practice proven to be effective. The committee believes that the most advantageous way to address the issue is by design of site-specific systems of BMPs that are tailored to fit the needs of each operation.

Because the nitrogen-containing discharges from the livestock industry are regulated, the goals and recommended strategies discussed below are closely tied to regulatory requirements.

9.3 COMMITTEE GOALS
The committee’s goal is to define strategies that can be adopted to protect groundwater quality while sustaining the economic viability of livestock industries. As directed by the GWMA Lead Agency and the Board, the committee has set the following objectives to fulfill its goal:

1. Help GWMA develop nutrient management guidelines.

2. Help facilitate voluntary use of the guidelines and implementation of BMPs.

3. Sponsor projects to evaluate the nutrient value of livestock wastes, refine methods of application under certain farming practices, and research other topics of importance to the committee.
4. Help inform the livestock industry and the Columbia Basin public about implementation of BMPs and activities by the livestock industry to protect groundwater quality.

5. Support activities of and share resources with other GWACs to achieve their goals and objectives.

9.4 RECOMMENDED MANAGEMENT STRATEGIES
This section recommends strategies to achieve the above objectives along with elements of a public education and information program to address objective number 4. Activities to monitor the progress of the recommended strategies are presented in Section 9.5. Table B3-5 (Attachment B3) contains information on agencies, timelines, and required funding to implement these strategies.

9.4.1 Strategy DFC1- Help Develop Nutrient Management Guidelines
Compared to most inorganic fertilizers, livestock wastes contain low amounts of nitrogen at rates that are typically applied to land per volume, are subject to some nitrogen loss by volatilization, and release nitrogen slowly under natural conditions. The committee understands that, despite this, if animal waste is applied to land at rates that exceed the agronomic rate, soluble nitrate can be transported to the groundwater under certain conditions.

The committee supports the recommendations of other GWACs to define and adopt a scientific and flexible definition of “agronomic rate” (see Sections 6.4.1 and 7.6.3). The committee further supports the recommendation by the Irrigated and Dryland Agriculture GWAC (Section 6.4.1) to develop nutrient management guidelines that include nitrate contribution from livestock waste. The committee has recommended, under Strategy DFC5 below, that the nutrient value and rate of release of nitrate from livestock waste under various Columbia Basin conditions be quantified to become part of these nutrient management guidelines.

9.4.2 Strategy DFC2 - Suggest BMPs for Voluntary Implementation
The existing regulations and management guidelines presented in Section 9.2 provide a set of BMPs that help minimize nitrate contribution to the Columbia Basin groundwater. These BMPs are not intended to limit the use of any other practice shown to be effective. The committee suggests that the livestock industry voluntarily adopt and implement these BMPs as part of its routine activities as tailored to fit the needs of each operation. These BMPs are described in detail in NRCS (1992b) and NRCS (1992a) and are listed below for reference:
Surface Water Management - Animal feeding operations in the three-county GWMA are unlikely to generate much surface runoff because rainfall is low. The BMPs used to limit the potential transport of nitrate in surface runoff to groundwater, in the event that a precipitation event causes runoff, include the following:

- Minimize contact of surface runoff with manure and feed
- Divert clean surface water and storm water away from manure and feed
- Divert or otherwise manage the water to prevent a discharge where surface water is in contact with manure or stored feed.

Wastewater Management – The wastewater that may be generated from the dairies is captured and utilized using conveyance systems and storage lagoons. These structures protect surface and groundwater by retaining waters that contact manure and silage or other high-moisture feed. The following BMPs have been used to limit the potential discharge of nitrate-containing wastewater from these structures to groundwater:

- Modify older lagoons and conveyance systems, where financially feasible, to meet established standards.
- Apply wastewater and lagoon sediments to land at “agronomic rates” (see Section 9.4.1 for discussion of agronomic rates).
- Prevent damage to seals or structures when cleaning sediments out of lagoons to prevent leakage.
- Construct new lagoons in compliance with established standards.

Solid Manure Management - Manure storage in the semi-arid climate of the Columbia Basin can be managed more simply than in areas with higher precipitation. However, proper manure storage should be practiced to prevent contact with runoff water (see Surface Water Management BMPs above). To be used effectively as fertilizer, manure should be periodically analyzed for its fertilizer value for land application at “agronomic rates.”

Feedyard Surfaces - Where animals are concentrated, soil compaction creates a low-permeability “seal” that inhibits downward movement of wastewater. Anaerobic (oxygen-poor) conditions within and above this layer allow denitrification to occur and reduce the potential for deep
migration of nitrate. The BMPs for feedyards include the following:

- Divert surface water away from feedyards and into holding structures.
- Maintain the seal while removing manure and shaping pens.

9.4.3 **Strategy DFC3 – Help Facilitate Implementation of Nitrate Management Strategies**

The livestock industry has adopted and implemented environmental protection measures, such as the dairies following the dairy NMP guidelines. However, the committee realizes that its success depends strongly on receiving adequate technical and financial assistance. The GWMA has allocated funds to provide a nutrient management specialist to help dairies complete their Dairy NMPs, as described in Attachment H2. The committee recommends that the GWMA provide the following additional assistance:

- Increase the availability of technical assistance to develop nutrient management plans for all livestock industries.
- Allocate cost share funding or other funding assistance to operators implementing environmental protection measures.
- Encourage the local, State and federal agencies to allocate funding to the CDs, NRCS, or the private sector to meet the need for technical assistance not met by the GWMA.

9.4.4 **Strategy DFC4 – Form a Regional Advocacy Group**

Voluntary involvement in a regional information-sharing and advocacy group could help the livestock industry better understand regulations and facilitate discussions with Ecology and other regulatory agencies on uniform and practicable implementation of regulatory action. As operators developed guidelines for this section with the assistance and input of agency representatives, it became clear that inspecting and permitting authorities, State and local technical advisers, and operators do not interpret regulations consistently, and confusion remains over the meaning and intent of regulations. In addition, new lagoons and holding structures are intended to be constructed in compliance with established standards. However, it has become clear that Ecology inspectors and permitting authorities do not interpret regulations consistently, and some confusion exists over the meaning and intent of regulations (see also Section 9.4.5.3). Frequent changes in regulations or their administration further increases uncertainty for operators wishing to comply with regulations.
The committee recommends establishing an ongoing industry working group, or encouraging an existing regional entity to fill this role. The industry group may undertake the following tasks:

- Advocate for fair regulatory practices, facilitate communication between local operators and regulatory and permitting authorities, mediate opposing views, and assist in appeals processes.

- Continue a dialogue with Ecology, EPA, and technical advisers from CDs, WSU, NRCS, and consultants to encourage consistent implementation of waste storage regulations that are site-specific and practicable while effectively protecting groundwater.

- Assure continued participation and representation by the livestock industries in future organizations of the GWMA.

- Encourage more livestock operators to take an organized and visible role in existing community forums and events, such as CD boards and meetings, Farm Service Agency county committees, and State and local hearings on proposed regulatory changes.

- Develop strategies for marketing the economic, fertilizer value, and soil enhancing properties of the application of manure and other livestock wastes.

9.4.5 **Strategy DFC5 – Sponsor Projects**

The committee agrees that sufficient information and data are not currently available in the public domain regarding effective use of livestock waste as fertilizer or the extent of the industry’s contribution to groundwater nitrate compared with other sources. The GWMA has sponsored one project to begin to address some of these issues. The committee recommends that GWMA consider and authorize other projects to further assess livestock waste management options to prevent deep migration of nitrate. Projects may address the following key items.

9.4.5.1 **Relative Contribution of Livestock Wastes to Groundwater Nitrate**

The committee has no knowledge of any data collected by the GWMA documenting the livestock industry’s contribution to groundwater nitrate. Livestock operations are frequently the target of criticism when no obvious source of pollution is apparent. For example, it has been suggested that livestock operations are the source of high nitrate in wells located in areas of dryland agricultural production.
The committee recommends that the GWMA sponsor a project to identify and evaluate the potential extent of discharges of nitrate from livestock operations to groundwater in the Columbia Basin.

### 9.4.5.2 Manure Application on Rill-Irrigated Fields

Currently, Ecology inspectors have suggested that manure application on rill-irrigated fields may produce an illegal discharge (in violation of the federal Clean Water Act) unless return flows are held onsite. Because manure application on rill ground has been a common practice, this interpretation has been controversial. Some conservationists have reported that rill return flows can meet water quality standards if managed correctly.

The GWMA notes that a separately-funded project has begun to evaluate the safe application of manure and other livestock wastes on rill-irrigated fields. The committee supports followup research projects if the results of this study indicate further work is needed.

### 9.4.5.3 Winter Storage

Liquid wastes and manure must be stored at times when land application is not possible. The committee believes that inconsistencies and uncertainty exist about regulatory requirements for design (required volume) of livestock waste storage facilities. Additionally, storage regulations vary widely among the livestock industry, food processors, and POTWs, further complicating comparisons.

The committee recommends that GWMA sponsor research into storage requirements for livestock wastewater under regional climate and soil conditions.

### 9.4.5.4 Nutrient Content of Manure and Other Livestock Wastes

Fresh animal waste contains little nitrogen in a form that is available to plants. However, nitrogen becomes available over time. Consequently, using livestock nutrients to raise crops requires estimating when nutrients become available, a process that is determined by multiple factors such as temperature and available moisture. Rapid, inexpensive, onsite analysis of animal wastes for nutrient content can reduce the operator’s uncertainty about agronomic rates of application.

The committee recommends that GWMA sponsor projects to 1) identify rapid, inexpensive, onsite methods of analysis for nutrients in manure and other animal wastes as an operator tool, and 2) develop accurate nitrogen mineralization curves under various climatic and soil conditions.
experienced in the Columbia Basin. See Attachment H3 for a scope of the Winter Mineralization Study.

9.4.6 **Strategy DFC6 - Public Information and Education Program**

The committee considers the GWMA public information/education program as a cornerstone strategy to inform the public of the activities the livestock industry undertakes to protect the quality of the area groundwater resource and to provide information and incentives to the Columbia Basin livestock operators to expedite implementation of BMPs. The committee recommends that the GWMA endorse and distribute educational materials to address the topics listed below. The committee participants agree that these topics are important to the success of their operations in the Columbia Basin.

9.4.6.1 **Local Communication**

The GWMA forums have facilitated communication among livestock producers and across local GWMA participating groups. The community will benefit from a continuing effort to inform the livestock operators and facilitate a dialogue with representatives of the regulatory agencies, other agricultural producers, and the general public. The committee recommends that the GWMA education and information program include the following components:

- Maintain a regional mailing list of livestock operators and keep them informed of the efforts and progress of the GWMA programs.

- Further develop a local forum for disseminating information and facilitating technical exchange regarding BMPs for livestock management and groundwater protection.

- Actively maintain or subscribe to a directory of resources on livestock operation BMPs, including literature information, innovative projects, and analytical resources. Focus on sources of assistance in the public and private sector.

- Assist the livestock industry trade organizations to enhance their local efforts to bring information to their members.

- Cooperate with the WCC in its efforts to document regulatory compliance for dairies within the GWMA that are completing and implementing Nutrient Management Plans.

- Encourage livestock operations to work with neighbors on using animal waste on their fields.
• Help increase livestock operator awareness of the need for procedures for proper management of animal wastes and wastewater.

9.4.6.2  Public Perception

Manure and other livestock wastes are nutrient sources for growing crops. It is likely that there is insufficient public recognition that livestock wastes are a valuable resource that improves soil fertility while enhancing soil structure. It is also likely that the general public overestimates the contribution that livestock operations can make to nitrate levels in groundwater. The committee recommends that the GWMA education and information program include the following components:

• Endorse and distribute materials by all effective means that will educate the public about the facts of livestock waste management and the science of groundwater protection.

• Endorse and distribute materials that will educate the public about the benefits of animal nutrient utilization.

9.5  MONITORING

Procedures to monitor the progress of each recommended management strategy are presented below. Work plans will be developed as warranted to describe the monitoring process and data collection and analysis for the strategies. The data and information collected will be evaluated on an annual basis and the results will be included as part of the GWMA 5-year progress report due by 31 December 2005.

Strategy DFC1 - Help Develop Nutrient Management Guidelines

The progress of developing these guidelines will be tracked as part of the Irrigated and Dryland Agriculture guideline development strategy presented in Section 6.5.

Strategy DFC2 - Suggest BMPs for Voluntary Implementation

The suggested practices are intended to be voluntary. The Dairy NMPs require incorporation of most of these BMPs into the dairy operations. The progress in completing the Dairy NMPs will be tracked, and the number of completed or certified Dairy NMPs will be reported in the 5-year report. This data will be obtained primarily from the CDs.
Strategy DFC3 – Facilitate Implementation of Nitrate Management Strategies
Progress in receiving funding and the level of technical and financial assistance provided to help develop and implement BMPs and the results will be tracked and reported.

Strategy DFC4 – Form a Regional Advocacy Group
The committee will report to the Board by June 2001 on the progress made to 1) form the regional group and 2) begin discussions on the topics of importance. The results of group discussions will be reported periodically to the Board.

Strategy DFC5 – Sponsor Projects
These projects will be presented to the Board for funding and technical support. Progress reports will be made to the Board as part of the requirements for receiving support.

Strategy DFC6 – Public Information and Education Program
Progress on dissemination of information will be reported as part of the overall GWMA progress reporting process (see Section 3.3 for more detail).

9.6 ADDITIONAL INFORMATION, DATA, AND ANALYSIS
This section presents the definitions of AFO and CAFO as cited in the sections above.

9.6.1 Definitions of AFOs and CAFOs
Under the federal Clean Water Act, Concentrated Animal Feeding Operations (CAFO’s) are point sources requiring a National Pollutant Discharge Elimination System (NPDES) permit. CAFO’s include slaughter/feeder cattle, dairy cattle and other livestock. Facilities that stable or confine numbers of animals that exceed threshold limits, and discharge to waters of the United States, require an NPDES permit.

Under the State Water Pollution Control Act, any animal feeding operation that results in the disposal of wastes into waters of the state require a discharge permit; discharges to surface waters require an NPDES permit and those to ground water require a state waste discharge permit. Waters of the state include both surface and ground waters. Normally, the Clean Water Act (Title 33 United States Code, Section 1251 et seq. 40 CFR 122.23) and the State Water Pollution Control Act requirements are administered jointly (Chapter 90.48 RCW; Chapter 173-220 WAC; Chapter 173-216 WAC).
10 URBAN AND RURAL RESIDENTIAL GWAC PLAN

The Urban and Rural Residential GWAC (committee) serves to identify and develop management strategies addressing nitrate contribution to groundwater associated with urban and rural fertilizer use, septic systems, wellhead protection, abandoned wells, well construction, and land development. The following information is presented in this section:

- The committee’s composition.
- The committee’s approach to evaluating the impacts of the urban and rural residences on groundwater nitrate levels.
- The committee’s goals and objectives.
- The committee’s recommended management strategies.
- The methodology to monitor for progress in achieving the goals and objectives.

10.1 COMMITTEE COMPOSITION

Members of the committee are city council members, small water system operators, local HD representatives, members of the general public, homebuilders, and planners. Figure 2 displays the composition of the committee. The committee will recommend strategies to limit the impact of residential sources of nitrate to groundwater quality.

10.2 COMMITTEE APPROACH

The committee serves to identify and develop strategies addressing nitrate levels in groundwater through management of urban and rural residential fertilizer use, septic systems, wellhead protection, abandoned wells, well construction, and land development. Throughout the planning process, the committee will educate the public about, and evaluate the health risks of, nitrate in drinking water and the benefits of implementing BMPs. The committee will promote mechanisms of continuing education when the planning phase of the GWMA program is complete.

10.3 COMMITTEE GOALS

The committee’s goal is to define strategies to protect public health relative to groundwater nitrate through public education. The committee participants advocate disseminating information to the public about drinking water safety and investigating and protecting the groundwater
resource. As directed by the GWMA Lead Agency and the Board, the committee has set the following objectives to fulfill its goal:

1. Sponsor projects to obtain new and/or evaluate existing data on effects of groundwater nitrate levels on public health and the significance of residential sources of nitrate to groundwater.

2. Help inform and educate the public regarding the effects of groundwater nitrate levels on public health and methods to minimize nitrate loading to groundwater by residential activities.

3. Support activities of and share resources with other GWACs to achieve their goals and objectives.

**10.4 RECOMMENDED MANAGEMENT STRATEGIES**

This section recommends a strategy to achieve objective number 1 along with the elements of a public education and information program to address objective number 2. Activities to monitor progress of the recommended strategies are presented in Section 10.5. Table B3-6 (Attachment B3) contains information on agencies, timelines, and required funding to implement these strategies.

**10.4.1 Strategy URR1- Sponsor Projects**

The committee recommends that GWMA sponsor the projects presented below to obtain information necessary to help the GWMA participants protect public health. Other projects may be considered for sponsorship by the committee following certification of the GWMA Plan.

**10.4.1.1 Identify Populations at Risk from Consumption of High-Nitrate Groundwater**

The committee has sponsored a project to identify populations that are exposed to high nitrate levels in groundwater (at-risk populations). Characteristics of the at-risk populations such as age and health status will be recorded. Identification of these water users would involve an analysis of the level of risk to which the users may be exposed. A survey of households in the GWMA will be conducted to collect data and information. The results will be compared between areas of low nitrate concentrations and areas where groundwater nitrate levels have been observed to be greater than health standards. Attachment I1 contains additional information regarding this project.
10.4.1.2 **Accelerate Wellhead Protection Planning For Group A Public Water Systems**

The Group A public water systems serve 15 or more connections or 25 or more people and are subject to State and federal water quality regulations. The regulations require these systems to test water quality and submit test results to WDOH on a regular basis, notify water users of water quality problems, and distribute annual consumer confidence reports. These systems are also required to develop comprehensive Wellhead Protection Plans (WHPs). The WHPs establish the water-bearing zone(s) from which groundwater is drawn and inventory potential sources of degradation within these zones. The WHPs are intended to provide information necessary to protect both the community’s health and its economic investment in a water system. Treatment of contaminated water and development of an alternative supply are very expensive options. Prevention through wellhead protection planning is the more cost-effective way to achieve safe drinking water.

Some Group A public systems in GWMA have completed WHPs, while others are in progress. While, the committee recognizes that the purpose of the GWMA Plan is to deal with nitrate issues only, the committee recommends that GWMA sponsor a project to accelerate wellhead protection planning for smaller Group A water systems. This project would have the following components:

- Assess the status of wellhead protection planning for water systems in the GWMA.
- Identify systems needing WHP assistance. Provide information, refer to services, and support applications for funding.
- Prioritize systems where nitrate levels appear to be increasing.
- Cooperate with organizations such as Evergreen Rural Water of Washington to create a WHP component that addresses agricultural sources of nitrate in groundwater. (Note: Evergreen Rural Water of Washington is a private nonprofit organization that assists small water systems with wellhead protection and other water system management tasks.)

10.4.1.3 **Decommissioning of Abandoned or Unused Wells**

There are many home sites in the Columbia Basin, each of which was likely to have been served by a well. Some of these wells may be assumed to be unused or “abandoned.” These wells are potential conduits for nitrate to travel directly into water sources (EPA 1977, Platt 1997). The committee lacks information to estimate the magnitude of the contribution of these wells to the presence of nitrate in GWMA groundwater.
The committee recommends that the GWMA sponsor a project to evaluate the extent of the hazard to groundwater nitrate caused by abandoned or unused wells, identify and prioritize areas where these wells are a significant source of nitrate in groundwater, and estimate the cost of well decommissioning.

10.4.1.4 Domestic Well Density and Groundwater Degradation

Each well is a potential direct conduit for migration of nitrate to groundwater. Wells that extend through and draw water from more than one aquifer can potentially allow nitrate to migrate from one aquifer to another. Failure to comply with well installation standards and to follow adequate well maintenance practices may compound the problem. For these reasons, it has been suggested that higher numbers of wells may result in higher risk to groundwater quality.

The committee recommends the GWMA sponsor a project to determine whether areas of higher domestic well density in the GWMA are at higher risk of groundwater degradation than those with low well density. The results of the proposed GWMA hydrostratigraphy mapping project will provide a partial answer on the number of wells tapping multiple aquifers. These results will help to assess whether a correlation exists between well density and nitrate concentration in groundwater.

10.4.2 Strategy URR2 - Public Information and Education Program

The committee recommends its public information/education strategy, presented below, as an integral component of the GWMA program. As the committee goal reflects, the specific items considered for the information/education strategy often mirror the projects sponsored under Strategy URR1 in Section 10.4.1.

10.4.2.1 Educate the At-Risk Populations

The committee recommends that the GWMA help develop and distribute educational material on the health implications of high nitrate levels in drinking water to the at-risk populations identified in Section 10.4.1.1. The committee further recommends that the GWMA assist these populations in finding temporary and long-term solutions for improving their drinking water quality. The GWMA activities should be coordinated with any similar or related activities conducted by WSU, and/or the WDOH or the local HDs.
10.4.2.2 **Role of the General Public in Protecting Groundwater Quality**

The general public will benefit from an increased awareness of the vulnerability of their groundwater as a drinking water source and the role they can play in protecting it. The committee recommends that the GWMA program undertake the following tasks:

- Prioritize the messages it sends to the public regarding drinking water safety such as facts about potential health risk from consumption of nitrate-containing groundwater, the concept that nitrate is an indicator of source water vulnerability, practices that contribute to groundwater degradation, and the responsibility of all residents in protecting our drinking water supply.

- Create and maintain (or subscribe to) a directory of resources on drinking water safety and make this readily available to the public through GWMA’s public information distribution efforts.

- Encourage the allocation of local, State and federal funding to the local HDs, CDs, planning efforts, or the private sector to meet continuing public education needs on nitrate-related drinking water safety issues.

- Support local efforts to encourage home owners to purchase, install, maintain, and test backflow prevention devices as required by their public water supply and/or in accordance with the Uniform Plumbing Code.

Water utilized for irrigation by homeowners is often supplied by a public system or domestic well water. An actual or potential physical connection may exist between a drinking water system and a residential irrigation delivery system. Adequate measures should be used to protect backflow into the water system.

10.4.2.3 **Wellhead Protection Planning and Water Quality Monitoring for Private Domestic and Group B Wells**

The GWMA residents drawing water from individual domestic wells may be at a disadvantage regarding knowledge of actual nitrate levels in their groundwater. There is no regulatory requirement for routine well water testing of private domestic wells. Additionally, the cost of regular testing may force some homeowners in the Columbia Basin to not test their water quality, although do-it-yourself guides such as the Farm*A*Syst/Home*A*Syst guide (which is comprehensive and used nationwide) is part of the locally available WSU water quality program.
The Group B public water systems are required to monitor water quality for nitrate annually. The laboratory automatically sends the water testing results to the WDOH and the local HDs. These systems serve two to 14 connections with fewer than 25 customers. While not subject to the federal Safe Drinking Water Act, these systems are governed by State regulations (WAC 246-291). Group B systems are regulated, but the regulations are not enforced consistently.

Domestic wells and Group B systems are often found in proximity to agricultural land use, a contributing source of nitrate in groundwater. The committee recommends that the individual well owner and Group B systems be the focus of the following public education/information activities:

- Encourage homeowner compliance with county ordinances and State law requiring 100 feet between wells and sources of contamination.
- Encourage homeowner implementation of practices to protect their source drinking water, and recommend self-assessment tools for private wellhead protection.
- Promote the availability of accessible, inexpensive water testing to homeowners.
- Encourage the wider dissemination of water testing guidelines, reference materials, and assessment tools, such as Farm*A*Syst/Home*A*Syst, by local agencies and homeowner associations.
- Distribute guides, wellhead protection strategies, and reference materials to landscape contractors, realtors, and land use planners.
- Implement a program of onsite assistance to water users with elevated nitrate levels. The program may include assisting with sanitary surveys and providing information about corrective alternatives. Corrective alternatives may include well repair, connection to a public supply, water treatment options, and use of bottled water.
- Conduct a professional sanitary survey where the well is affected by high nitrate levels indicating a possible health risk. Sanitary surveys may identify possible sources of nitrate, verify the presence of sanitary seals and absence of cross-connections, and assess other safety factors. Options should be provided to well owners when drinking water fails to meet water quality standards.
• Encourage the installation of backflow prevention devices in accordance with the Uniform Plumbing Code, if a domestic well supplies a residential irrigation system.

10.4.2.4  Proper Well Installation Inspection

The committee conducted extensive investigation into the issues of well installation and inspection and driller licensing. A Statewide regulatory program of testing and licensing exists for well drillers, but onsite inspection is not conducted. The State previously had a well inspection delegation program whereby the local HDs would inspect well installation. It is the committee’s conclusion that most homeowners cannot assess whether their wells have been installed to minimum standards.

The committee recommends that the GWMA conduct the following activities:

• Develop informational material on the importance of well installation inspection and inspection options available to homeowners and explore methods to effectively distribute them to homeowners.

• Encourage local HDs, planning departments, developers and real estate agents to inform the public about safe well installation.

• Encourage voluntary industry self-assessment through the Well Drillers Association and other trade associations.

• Consider methods to identify to the public well drillers who have demonstrated adherence to minimum construction standards. Inform the public that Ecology holds records of complaints or enforcement.

• Encourage Ecology to continue the well inspection delegation program. Encourage the legislature to reauthorize funds for this program.

10.4.2.5  Decommissioning of Abandoned or Unused Wells

Safe decommissioning of unused or abandoned wells eliminates both the physical surface hazard and the potential for aquifer contamination posed by open wells. Ecology has established specific procedures for proper well decommissioning (WAC 173-160). The committee understands that cost is a factor in the failure of some owners to properly decommission these wells. A project to estimate the cost of well decommissioning was recommended by the committee in Section 10.4.1.3. The committee additionally recommends that GWMA help develop and
endorse information on proper well decommissioning procedures and the associated cost and explore methods to effectively distribute them to public and contractors.

10.4.2.6  Potential of Septic Systems to Contribute Nitrate to Groundwater

According to the local HDs, onsite sewage disposal is the waste disposal mechanism for approximately one-half of the households in the Columbia Basin. A maximum average of about 26 pounds of total nitrogen per year is typically discharged to septic systems per household (WDOH 1995). These systems consistently remove approximately half of this amount through denitrification (WDOH 1995). In terms of relative environmental inputs in the GWMA, the committee considers this potential source of nitrate as negligible and believes that public perceptions of the risk of onsite sewage disposal systems as a major contributor of groundwater nitrate are inaccurate. This issue has been discussed in more detail in Attachment I2.

Onsite sewage system permitting (including design and citing requirements) is regulated under WAC 246-272 by local HDs up to 3,500 gallons per day (septic systems), by WDOH from 3,500 to 14,500 gallons per day, and by Ecology on systems over 14,500 gallons per day. The committee believes that the current density requirements will serve to significantly reduce the extent of nitrate migration to groundwater from onsite sewage disposal systems (Attachment I2).

The committee recommends that the GWMA help develop and distribute educational material to the general public on the relatively insignificant nitrate contribution from septic systems to groundwater in GWMA.

10.4.2.7  Fertilizer Use on Residential Lawns

The committee learned from the WSU Master Gardener program that the residential use of fertilizer may be poorly managed due to four main factors:

- Instructions are not available for a product acquired in bulk.
- Instructions may not be read, understood, or followed by the purchaser/user.
- Fertilizer may be used in an attempt to correct lawn problems that are unrelated to soil fertility.
- Over application of irrigation water on residential lawns
Educational materials are available that explain fertilizer management for the lawn. The committee sees public apathy or a lack of public awareness as the barrier to BMP implementation. The committee recommends that the GWMA support the following public education activities:

- Encourage use of resources such as the WSU Master Gardener program and its recommended fertilization and irrigation water application methods by Columbia Basin residents.

- Help develop educational materials and encourage point-of-purchase distribution of these materials to homeowners.

10.4.2.8 Nitrate Management on Noncommercial Farms and Ranches

The owners of noncommercial farms and ranches, such as hobby farmers, may lack a background in crop or pasture management and are often unaware of recommendations for fertilizer use and livestock waste management. These small operations may present a growing potential for groundwater impact as their density grows near urban areas. Compared to commercial growers, these property owners may not face economic constraints that serve as a limiting factor on fertilizer use.

Educational materials are available from sources such as the WSU Cooperative Extension service and the CDs. Clubs and service organizations, including 4-H programs, also serve as existing avenues to distribute information. The committee recommends that the GWMA help develop and endorse education material to accomplish the following objectives:

- Increase awareness of owners of hobby and noncommercial farms of their responsibility to protect groundwater quality through proper management of lawn fertilization.

- Encourage organizations such as the WSU Cooperative Extension and the CDs to more proactively serve the noncommercial farms within their service areas.

- Encourage property owners to perform soil nitrate testing and irrigation water management as important aspects of fertilizer management on noncommercial farms and for landscape and lawn maintenance.
10.4.2.9 *Domestic Well Density and Groundwater Degradation*

The committee has recommended (Section 10.4.1.4) that the GWMA sponsor a project to assess whether areas of higher domestic well density in the GWMA are at higher risk of groundwater degradation. Following completion of such a project, the committee recommends development of the results into public education material and distribution of this information to the public. In the meantime, the committee further recommends that the GWMA seek methods to encourage the installation of public water systems in lieu of individual wells.

10.5 **MONITORING**

Procedures to monitor the progress of each recommended management strategy are presented below. Work plans will be developed as warranted to describe the monitoring process and data collection and analysis for the strategies. The data and information collected will be evaluated on an annual basis and the results will be included as part of the GWMA 5-year progress report due by 31 December 2005.

**Strategy URR1 – Sponsor Projects**

These projects will be presented to the Board for funding and technical support. Progress reports will be made to the Board as part of the requirements for receiving support.

**Strategy URR2 – Public Information and Education Program**

Progress on dissemination of information will be reported as part of overall GWMA progress reporting process (See Section 3.3 for more detail).
11 REFERENCES


Platt, T. Lincoln County Conservation District Hawk Creek Final Project Report. Cooperative Extension, Lincoln County.


