PERSONAL SERVICES AGREEMENT 2002-6.3
PHASE III TECHNICAL STUDIES -- SCOPE OF WORK MODIFICATION

The WRIA 1 WATERSHED MANAGEMENT PROJECT JOINT BOARD, hereinafter called Joint Board, and Utah State University, hereinafter called Contractor, in consideration of the mutual covenants herein, agree as follows:

I. EXISTING AGREEMENT MODIFIED: The Joint Board and the Contractor entered into the Agreement, dated February 1, 2002, made a part hereof by this reference, hereafter called Agreement. The parties hereby jointly agree to modify the Agreement as to the Scope of Work (Exhibit "A") and Compensation (Exhibit "B") thereof by the addition of Exhibit A-3 (Scope of Work) and Exhibit B-3 (Compensation), Exhibit C-3 (Table of Deliverables), and D-3 (Calendar), attached hereto and forming part of the original agreement by this reference.

II. MODIFICATION TO EXISTING AGREEMENT:

(A) The Joint Board shall withhold 25% from each invoice pending delivery and acceptance of final work products. The Joint Board will continue to pay each invoice until 75% of each Scope of Work element has been expended.
(B) The portion of the agreement pertaining to Exhibit "A", is amended to read as follows: See Exhibit "A-3",
(C) The portion of the agreement pertaining to Exhibit "B", is amended to read as follows: See Exhibit "B-3",
(D) Exhibit "C-3", Table of Deliverables, and
(E) Exhibit "D-3", Calendar,
(F) The term of the Agreement is extended to December 31, 2005.

III. OTHER TERMS AND CONDITIONS OF EXISTING AGREEMENT REMAIN THE SAME: The parties agree that, except as specifically provided in this modification, the terms and conditions of the Agreement continue in full force and effect.

IN WITNESS WHEREOF, the parties have executed this Agreement this _____ day of March, 2004.

CONTRACTOR:

_____
Contractor Signature Date

STATE OF UTAH)
) ss.
COUNTY OF CACHE)

On this _____ day of March, 2004, before me, personally appeared _____ to me known to be the _____ (title) of Utah State University and who executed the above instrument and who acknowledged to me the act of signing and sealing thereof.

WITNESS my hand and official seal hereto affixed the day and year first above written.

_____
NOTARY PUBLIC in and for the State Of Utah, residing at _____. My commission expires: _____.

JOINT BOARD
Recommended for approval:

_____
Jeff Monsen, Director—Public Works Date

Approved as to form:

_____
Sr. Civil Deputy Prosecuting Attorney Date

Approved:
Accepted for Joint Board:

By: _____
Pete Kremen, Whatcom County Executive

STATE OF WASHINGTON)
) ss.
COUNTY OF WHATCOM)

On this _____ day of March, 2004, before me, personally appeared Pete Kremen to me known to be the Executive of Whatcom County, who executed the above instrument and who acknowledged to me the act of signing and sealing thereof.

WITNESS my hand and official seal hereto affixed the day and year first above written.

_____
NOTARY PUBLIC in and for the State Of Washington, residing at _____
My commission expires: _____.

EXHIBIT A-3
SCOPE OF WORK

3. PHASE III SOW: DECISION SUPPORT SYSTEM AND DATABASE MANAGEMENT SYSTEM

This section summarizes tasks associated with DSS and DBMS development. The task descriptions have been simplified and clarified to more accurately represent what will be done. Detailed descriptions of each task have been added to help clarify exactly what will be delivered in both form and function. The term plug-in used in some sections refers to a software module that extends the MapWindow GIS platform upon which the DSS is being built. Note that source code deliverables associated with this task will not be delivered in paper form. Delivery of software associated with task 3 will be as follows:

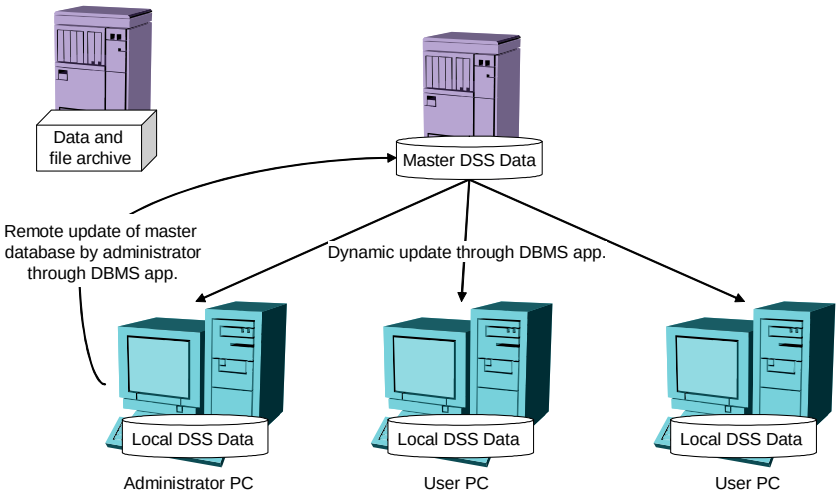
Pre-beta:

1) During software development prior to the beta release date, USU may choose to release pre-beta software to WRIA through the DSS/DBMS web-based auto-update system and/or through CDs to get feedback on design issues or functions. WRIA may supply feedback through the Elementool bug-tracking system or by e-mail to USU.
2) In cases when WRIA response is essential to completing a task, a formal memo will be sent to WRIA indicating the needed information and last date by which it would be required to be received in order to meet the beta deliverable deadline.
3) All data and information provided by WRIA to USU in the requested format and within the requested time frame will be included in the databases that are delivered with the Beta deliverable.

Beta:

1) USU will indicate in writing which if any data and information required by the DBMS/DSS were not received and were therefore not included in the beta deliverable.
2) USU will deliver one complete set of installation CDs (as many as needed to hold all of the software) for beta review.
3) Binary software components will also be available through the web-based update system.

Final:



Overview of WRIA Data Storage

Figure 3.1. Overview of WRIA DSS data storage. The master DSS database is housed in a central server. The DBMS application updates this data to local user PCs. An administrator may remotely edit and update the data in the master DSS database. A "Data and file archive" is distinct from the DSS databases. This raw "Data and file archive" is, by definition, not organized into a relational database structure, nor is it dynamically linked to either the master or local DSS databases.

1) For the final product deliverable, all task 3 related software components will be delivered as part of a single set of installation CDs.
2) Because this deliverable may require as many as 10 or more CDs for a single install, USU will not be required to produce 10 copies of the full set.
3) The auto-updating function on the web-site is being provided in lieu of USU sending multiple copies of the CDs.

3.1 Phase III Detailed Work Plan – DSS/DBMS

3.1.1 Task 3.1: Continued Database Update and Integration

Summary:

This task specifically refers to manipulating and organizing data into databases and folder structures (where applicable) as needed by the DSS and DBMS. This task does not include a software deliverable; rather, it includes delivery of three specific data repositories, as shown in Figure 3.1.

The three data repositories shown in Figure 3.1 include:

1) The local data repository on the installed users' personal computer.
2) The remote "master" data repository on a central WRIA owned and operated server.
3) An archive of raw data sources including text, grid, image and shape files from which data for the DSS was derived.

The master DSS data repository is housed on a central server and contains several relational databases associated with each of the data visualization modules, DSS models, and the watershed characterization report generator and scenario builder modules. It also contains a directory tree of shape file, grid and image data used by the DSS. The local users' PCs contain a mirror image of the master DSS data repository. This local repository can be automatically updated from the master server using the DBMS application (described in Task 3.5). The DBMS application also includes functionality for remotely editing the master server.

Schedule:

- Preliminary Draft Reports/Databases
  - Delivered to WRIA, December 17, 2004
    - 3.1A - Master DSS data repository including databases and data files on a central server
    - 3.1B - DSS data repository including databases and data on installation CDs
    - 3.1C - Data and file archive server
    - 3.1D - Metadata for GIS and non-GIS data sets included in the master DSS data repository
    - 3.1E - Final database structure document
    - 3.1F - Database of citations
  - WRIA comments on Preliminary Draft Reports/Databases to USU, January 28, 2005
    - (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU).
  - Conference call to discuss Preliminary Draft Reports/Databases, February 17, 2005

- Draft Reports/Databases
  - Draft of above delivered to WRIA, March 11, 2005
  - WRIA Comments on Draft Reports/Databases to USU, April 8, 2005
  - Conference call to discuss comments on Draft Reports/Databases, May 5, 2005

- Final Draft 1 Reports/Databases (Full Beta) for Peer Review
  - Final Draft 1 of above delivered to WRIA, May 20, 2005
  - WRIA and Peer Review comments on Final Draft 1 Reports/Databases, August 5, 2005
  - Conference call to discuss comments on Final Draft 1 Reports/Databases, September 1, 2005

- Final Draft 2 (Full Release version of DSS) Reports/Databases
    - Final Draft 2 of above delivered to WRIA, September 23, 2005
    - WRIA approval of products, October 31, 2005

Deliverables:

3.1.A Master DSS data repository including databases and data files on a central server

As shown in Figure 3.1, the master DSS data repository includes databases and files that are used in the DSS. This data repository is dynamically linked to the local users' PCs through the DBMS utility. For the sake of efficiency, we propose that WRIA ship to USU the servers (maximum of two) that will host the master DSS data repository so that it can be set up and configured at USU. Then we will take this server to Bellingham and set it up in an office designated by WRIA. (Note: if circumstances require that the server cannot be delivered to USU for configuring then a budget adjustment will be needed to pay for this activity to be done by USU technicians on site at WRIA). We will make sure that all of the databases and files needed by the DBMS are on the server, and that the server can interact with local installed PCs through an Internet connection using the DBMS utility. We will test the server and ensure that the databases are all working properly, meaning that they can be accessed through the DBMS utility.

Any problems with wiring in the building, firewalls, or other internet connectivity issues must be resolved by WRIA prior to our delivery of the server. A system for backing up the server or otherwise ensuring the protection of the physical computer and electronic data must be provided by WRIA. We will not be including emergency power supplies, tape back up mechanisms, anti-virus software or other third party tools to assure the integrity of the system.

After we have setup and tested the server, we will not provide on-going maintenance of the server or its electronic data. Testing the server will include ensuring that three computers designated by WRIA as "representative user computers" can access the server and obtain data updates and binary code updates. The selected computers will have one of the following operating systems: Windows, 98, 2000 or XP, and we recommend that one be connected to the Internet by modem and that one be connected to the Internet by Ethernet card. Once these three tests are successful, it will be assumed that any issues encountered by WRIA with respect to getting a computer to access the server are unique to specific computer configurations. These issues will have to be resolved by WRIA, not USU.

While the DSS may work on other operating systems and configurations, USU is only responsible for ensuring functionality on the three WRIA-selected representative user computers. WRIA is welcome to test and installation on other operating systems, but USU will not be responsible for ensuring that they work.

3.1.B DSS data repository including databases and data on installation CDs

A full raw installation to a user's local computer of all data and binaries required by the DSS using the DBMS utility over the Internet can take four to forty hours depending on the Internet connection speed. To alleviate this problem, USU will provide WRIA with one set of CDs that can be used to complete a base install on a user's local computer. This will be a set of CDs that include all of the GIS project files, data files and databases used by the DSS. Note that archival data in the "Data and file archive" server in figure 3.1 will not be included on these CDs.

In addition to the data and binaries used by the DSS, the CD installation will also include the DBMS utility, so that users who install the CDs can get updates through the internet using the DBMS utility.

WRIA will be responsible for duplicating and circulating this set of CDs among users. USU will ensure that the CDs install the working DSS properly on three test machines identified by WRIA as representative user computers running Windows 98, 2000, or XP operating systems.. Once these tests have been completed successfully, it will be assumed that installation problems on other computers are due to user-specific configuration issues. Rectification of these issues will be the responsibility of WRIA.

3.1.C Data and file archive server

For the sake of efficiency, it is proposed that WRIA deliver computers to USU to be used for the Data and File Archive server indicated in Figure 3.1 at the same time that the computer for the Master DSS data server is delivered. The archive server will then be loaded with all data and files that have been accumulated by USU during the term of this project and will be delivered to WRIA. The Data and File Archive may be the same physical machine delivered under task 3.1.B. The physical storage space on this machine is subdivided into sections that hold the Master DSS Data Repository used by the DSS and other sections that hold the Data and File Archive.

The Data and File Archive is an archive of raw data sources including text, grid, image and shape files from which data for the DSS was derived. This is raw data which, by definition, is in its original state before being processed for use in the DSS. As such, there are no software links for extracting or converting this data into a usable form for the DSS.

This data and file archive is being delivered for archival purposes. It is the responsibility of WRIA to maintain this archive, to add new files and data to it, to back it up as necessary, and to extract information from it to be used in the DSS if needed. USU will not be responsible for ensuring that WRIA users maintain this data in any usable form (e.g. we are not responsible for ensuring that WRIA individuals do not rename folders or rearrange the data structure).

3.1.D Metadata for GIS and non-GIS data sets included in the master DSS data repository

USU will provide metadata files for all GIS and non-GIS data sets included in the Master DSS Data Repository and directly used by the DSS. These files will include at a minimum a statement of the original source of the data, projection information (for spatial data), and steps taken to produce the data from its original source.

For GIS data, the meta data will be accessible through the DSS GIS interface by right-clicking on the GIS data layer in the legend, and selecting the "View Metadata" menu item. For non-GIS data, the metadata will be included in a folder of metadata on the user's computer.

It is expected that WRIA will supply metadata to USU for all datasets given to USU by WRIA. Where metadata has not been supplied by WRIA, it will be noted in the DSS, and instructions will be given on where metadata files should be placed on the Master DSS Data Repository by WRIA for automatic integration with the DSS. In other words, if we have not been given the needed metadata for a particular dataset, we will add a "placeholder" file to the DSS that has instructions on how the correct metadata can be added to the DSS to replace the placeholder.

3.1.E Final database structure document

USU will provide WRIA with a document that lists each of the datasets used by the DSS including the following information: table structure for tabular data, key structures and joined table elements where they exist, common fields between shape file attribute data and tabular data where they exist, field names and data types for tabular data, indications of which data sets are used by which DSS modules; instructions for adding, replacing, or updating the data these datasets.

While the DBMS utility can be used for basic editing of databases (see Task 3.5), USU will not provide data editors for all datasets used by the DSS. It is expected that WRIA will purchase and maintain active licenses for third party software used for this purpose and that this software will be used by server administrators to update and maintain datasets as needed on the server. We recommend ArcView for editing and updating shape files, Microsoft Access and SQL Server Administrator for editing and updating databases, and Notepad or other text editor for editing and updating ASCII text data files.

3.1.F Database of citations

USU will provide WRIA with a table of citations referenced in model documentation. This table will include all citations readily available at the time it is assembled. It will be the responsibility of WRIA to update the table as new citations are identified.

Budget needed for completion:

$14,049

3.1.2 Task 3.2: Watershed Characterization Module

Summary:

This task includes completing the watershed characterization (WC) plug-in and producing technical documentation and end-user software user's manuals. The functionality requirements for the WC plug-in have been through several iterations of discussion resulting in the current design. A brief history follows.

In March 2002, a scoping meeting was held in Bellingham at which a first prototype watershed characterization module was presented. This prototype was based on the WC reports developed previously by WRIA. At this meeting, several comments and requests were made. These are documented in Attachment DSS-A. Note that while some of the feature requests were very clear and accepted by USU as doable, others were either very vague, required additional discussion, or were noted as difficult, and likely not to be included by USU.

In an attempt to come to a final set of requirements and report sections, a mock-up report was built in December 2002 integrating the well-defined and doable requests from March. This new report design was reviewed by WRIA and comments were returned to USU in January 2003. These comments are included with this SOW as Attachment DSS-B. Based on these comments, a new semi-functional alpha version of the WC module was built and taken to WRIA for a live demonstration in February 2003. Additional comments and discussion has continued since that time.

From February 2003 to the present, we have been working to complete a working WC plug-in with all of the function requests, and report section requests. In the process of doing so, we have had to make significant updates to other DSS components. The DBMS utility (Task 3.5) had to be upgraded and worked on so that the WC report tables can be updated remotely from the master database repository and to allow WRIA to aid in filling in data needed for the report. Significant work had to be done on the DSS databases (Task 3.1) so that there would be data available in the system to populate the WC report. Significant work on data visualization (Task 3.3) had to continue so that the graphs, plots, and maps needed by the report could all be generated. It should be clear that this coinciding work was needed to enable progress on watershed characterization.

On July 31, 2003, USU sent WRIA a listing of data needs and other watershed characterization issues ("WATERSHED CHARACTERIZATION DATA NEEDS AND ISSUES.doc")

This document lays out USU's anticipated requirements from WRIA to complete watershed characterization. As of October 2003, a comprehensive response to this request has not been received; however some useful feedback has been received and used to guide the final report design shown below. This final design is somewhat different than the last proposal and demo version in that sections 4.5 and 4.6 have been moved to 5.3 and 5.4, and the separate sections on water use (previously sections 8, 10 and 12 have been merged into one section on water use, now section 8). This was done as per several requests from WRIA to make a single water balance section. Note that completion of many sections of this report is contingent on USU's timely receipt of the necessary data in the needed format from WRIA. Table 3.1 outlines the final design of the WC report sections.

Table 3.1. Final Watershed Characterization Report Design

Section #	Section Title	Description
	Report Overview and Disclaimer	This section includes a block of text that is editable by WRIA DSS administrator that gives instructions on how to use the report, and a WRIA disclaimer. It also has a non-editable disclaimer provided by USU.
1.0	Drainage Summary	

Section #	Section Title	Description
1.1	Overview and Description	Lists drainages included in the report, with their area and brief description.
1.2	Drainage Locator Map	Shows a map of the full WRIA with the drainages selected for the report highlighted.
2.0	Social and Economic Indicators	This section shows statistics broken down by populated drainages as approximated by totaling census blocks within each drainage in the Washington census and estimating overlap totals.
2.1	Population Statistics	Population count, year of census, and estimated growth by selected drainages.
2.2	Economic Indicators	Average household income, residents per household, total number of households by selected drainages.
2.3	Population Demographics	Breakdown of population by age group and by populated places in the selected drainages by drainages.
2.4	Economic Activity by Sector (Aggregation of All Places)	Employed population ages 16 and older in the selected drainages, broken down by sector of the economy and by selected aggregation of drainages.
2.5	Zoning Distribution	Table and pie chart of total zoning distribution in the selected drainages by title 20 commercial zoning.
2.6	Zoning Map	Map of selected drainages highlighting the title 20 commercial zoning layer.
2.7	Map of Political Boundaries	Map showing county and city boundaries, airports, major roads and major landmarks
3.0	Land Cover	This section aggregates all land cover for the selected drainages.
3.1	Land Cover Distribution	Table and pie chart showing the total area and percentage totaled of each type of land cover in the selected drainages
3.2	Land Cover Map	Map of the selected drainages highlighting the land cover layer.
4.0	Fish Species and Habitat	
4.1	Known and Historical Fish Presence	Table of species in alphabetic order by drainage showing historical, known, and presumed fish presence
4.2	Fish Periodicity	Table of species by drainage showing periodicity.
4.3	Fish Restoration Geographic Priorities	Table of text block descriptions of key fisheries areas and stream reaches by drainage with commentary on habitat actions or potential land use effects (text to be provided by WRIA 1.)
4.4	Fisheries Map	Map showing streams, culverts/known blockage to fish passage, towns, roads for orientation, and salmonid fish distribution.
4.5	Fish Habitat Restoration Projects	A map of habitat restoration projects by drainage. (NRT database 2002)
4.6	Fish Hatchery Map	A map of fish hatchery locations with orienting roads and cities including state, tribal, and locally funded hatcheries. (Map data to be provided by WRIA 1.)
5.0	Surface Water Hydrology	
5.1	Streamflow Summary Charts	Charts showing box plots of streamflow per month for each streamflow station in the selected drainages.
5.2	Map of Lakes and Streams	Map showing selected drainages, lakes, streams and other water bodies in the selected drainages.
5.3	Legally Established Instream Flow Requirements	Table of Instream flow requirements by drainage
5.4	Stream Closure Status	Table of stream closure by drainage
5.5	Flood Plains and Floodways	Map of 100 year flood plain (Map data to be provided by WRIA 1.)
6.0	Ground Water Hydrology	
6.1	Map of Aquifer Boundaries, Recharge Areas and Wellhead Protection Areas	Map showing aquifer boundaries, groundwater head contour, well data.
6.2	Number of Wells by Drainage	Table of number of wells by drainage, includes comment field by drainage.

Section #	Section Title	Description
7.0	Water Quality	
7.1	Map of 303(d) Listed Waterbodies	Map showing all water bodies, indicating 303(d) listed waters in red.
7.2	Table of 303(d) Listed Waterbodies	Table showing listed water bodies with a text field indicating why the water body is listed.
7.3	Coliform Sample Site Map	Map showing sampling locations where coliform data was collected.
7.4	Coliform Sample Summary Table	Table of coliform data by sampling location within the selected drainages, including average value and number of samples.
7.5	Temperature Sample Site Map	Map showing sampling locations where temperature data was collected.
7.6	Temperature Sample Summary Table	Table of temperature data by sampling location within the selected drainages, including average value, maximum an minimum recorded, and median value, and number of samples.
7.7	Nutrient Sampling Site Map	Map showing sampling locations where nutrient data was collected.
7.8	Nutrient Sampling Summary Table	Table of nutrient data by sampling location and parameter within the selected drainages, including average value and number of samples. Nutrient parameters summarized here include: Dissolved Ortho Phosphate, Total Nitrite, Ortho Phosphate, Total Phosphorus, Total Nitrate, Total Kjeldhal Nitrogen, Total Ammonia, Total Nitrite + Nitrate
8.0	Water Budget	
8.1	Precipitation	Map showing distribution of precipitation within the selected drainages.
8.2	Chart of Water Balance	Chart showing total water distribution by month.
8.3	Table of Water Use by Sector	Table showing total water availability by month and total water use by month and by sector.
8.4	Water Supply Systems	Table showing names, contact information population served (number of connections) of water supply systems in the selected drainages
9.0	Shellfish	
9.1	Near Shore and Estuarine Commercial Shellfish Activity	Table of shellfish activity only for those drainages that border the ocean. One text block field per drainage.
9.2	Map of Near Shore and Estuarine Commercial Shellfish Activity	Map of shellfish activity indicated by colored areas on the map.
9.3	Shoreline Mgt. Program	Map of shoreline management designations provided by WRIA 1 staff. (Map data to be provided by WRIA 1.)
10.0	Recreation	
10.1	Location and Available Activities	Table of available recreation activities in the selected drainages, indicating locations, types of activities, and contact vs. non-contact water recreation.
10.2	Map of Marinas, Water Parks and Beaches	Map showing locations of recreational activities. Place labels on map correspond with places in table.

Schedule:

- Alpha Releases
  - A Workable/Reviewable Alpha release delivered to WRIA, April 1, 2004
    - 3.2A – Alpha Watershed Characterization module
  - WRIA comments on Watershed Characterization module, May 7, 2004
  - Conference call to discuss comments on Watershed Characterization module and final date for resolving features, May 26, 2004

- Preliminary Draft Reports/Databases
  - Preliminary draft of the following delivered to WRIA, December 17, 2004
    - 3.2A - Watershed Characterization plug-in for generating summary watershed reports

        - 3.2B - WC plug-in technical specifications document
        - 3.3C - WC plug-in source code with low-level documentation
        - 3.3D - End-user WC plug-in user's manual
    - WRIA comments on Preliminary Draft Reports/Databases to USU, January 28, 2005
        - (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU).
    - Conference call to discuss Preliminary Draft Reports/Databases, February 17, 2005

- Draft Reports/Databases
    - Draft of above delivered to WRIA, March 11, 2005
    - WRIA Comments on Draft Reports/Databases to USU, April 8, 2005
    - Conference call to discuss comments on Draft Reports/Databases, May 5, 2005

- Final Draft 1 Reports/Databases (Full Beta) for Peer Review
    - Final Draft 1 of above delivered to WRIA, May 20, 2005
    - WRIA and Peer Review comments on Final Draft 1 Reports/Databases, August 5, 2005
    - Conference call to discuss comments on Final Draft 1 Reports/Databases, September 1, 2005

- Final Draft 2 (Full Release version of DSS) Reports/Databases
    - Final Draft 2 of above delivered to WRIA, September 23, 2005
    - WRIA approval of products, October 31, 2005

Deliverables:

3.2.A Watershed Characterization plug-in for generating summary watershed reports

This deliverable refers to the actual plug-in code module and source code for the report generator. The WC module is a MapWindow plug-in that adds a new button to the MapWindow interface. When the user clicks on this button they launch the WC form, which allows them to select predefined aggregations of drainages, or new aggregations of drainages. The user also selects an output path and type (Word document or PDF file). The user then starts the report. It can take 10 – 30 minutes to complete depending on the size of the aggregation, and the amount of data to be summarized. When the report is finished it is opened in the default PDF or DOC viewer on the user's computer.

3.2.B WC plug-in technical specifications document

This document describes all of the tables and shape files that are used by the WC plug-in, including tables, fields, shape files, shape file key names, and other information necessary to populate a database to work with the WC plug-in.

3.2.C WC plug-in source code with internal documentation

USU will document the source code directly in the code. This documentation will include function and subroutine descriptions and names and uses of variables used in the code (this level of documentation is referred to throughout the remainder of this scope of work as "low-level documentation"). Where subroutines, functions, and variables are parts of 3rd party libraries (for example, GigaSoft ProEssentials or .NET framework) USU will not be required to document these subroutines, functions and variables. USU will give this source code to WRIA on a CD. USU will not be responsible for errors in any software that arise from a user modifying the source code. USU will not provide programming training or software development training to WRIA. It is expected that if WRIA is interested in exploring, modifying or otherwise using the source code, WRIA has the capabilities to do so unaided by USU. Levels of internal documentation will not be required beyond what is described here.

3.2.D End-user software user's manual

USU will provide WRIA with an end users manual that explains how to run the WC plug-in, provides basic troubleshooting tips and screenshots of the software in use. For watershed characterization it is expected that this will be a document of approximately four pages.

Budget needed for completion:

$10,969

3.1.3 Task 3.3: Data Visualization Modules

Summary:

This task includes completing the data visualization plug-ins for viewing surface water quantity, surface water quality, well-log, digital photo and other databases delivered as part of the prioritized task list. Internal documentation, technical specifications, and end-user manuals will also be produced.

Schedule:

- Alpha Releases
  - April 1, 2004 Workable/Reviewable Alpha Releases delivered to WRIA
    - 3.3A – Alpha Map Window module
    - 3.3C – Alpha Stream Flow Data Analyst plug-in
    - 3.3G – Alpha Water Quality Analyst plug-in
  - WRIA comments for 3.3A, 3.3C, 3.3G modules to USU, May 7, 2004
  - Conference call to resolve comments on 3.3A, 3.3C, 3.3G modules, and final date to resolve features for these components, May 26, 2004

  - June 3, 2004 Workable/Reviewable Alpha Releases to WRIA
    - 3.3S – Alpha Photoviewer plug-in
  - WRIA comments for 3.3S module to USU, July1, 2004
  - Conference call to resolve comments on 3.3S module, and final date to resolve features for this module, July 14, 2004

  - August 6, 2004 Alpha Releases delivered to WRIA
    - 3.3W – Alpha ISF/FH Data Viewer
    - 3.3AA – Alpha Macroinvertebrate Data Viewer
  - WRIA comments for 3.3W and 3.3AA modules, September 3, 2004
  - Conference call to resolve comments on 3.3W and 3.3AA modules and final date to resolve features for these modules, September 15, 2004

- Preliminary Draft Reports/Documentation
  - Preliminary Draft of the following to WRIA, December 17, 2004
    - 3.3A - MapWindow GIS data visualization application
    - 3.3B - MapWindow GIS end user's manual
    - 3.3C - Streamflow data analyst plug-in
    - 3.3D - Streamflow data analyst plug-in source code and low-level documentation
    - 3.3E - Streamflow data analyst plug-in technical specifications
    - 3.3F - Streamflow data analyst plug-in end user manual
    - 3.3G - Water quality data analyst plug-in
    - 3.3H - Water quality data analyst plug-in source code and low-level documentation
    - 3.3I - Water quality data analyst plug-in technical specifications
    - 3.3J - Water quality data analyst plug-in end user manual

        - 3.3K - Well-log data viewer plug-in[1]
        - 3.3L - Well-log data viewer plug-in source code and low-level documentation[1]
        - 3.3M - Well-log data viewer plug-in technical specifications[1]
        - 3.3N - Well-log data viewer plug-in end user manual[1]
        - 3.3O - Groundwater head contour viewer plug-in[1]
        - 3.3P - Groundwater head contour viewer plug-in source code and low-level documentation[1]
        - 3.3Q - Groundwater head contour viewer plug-in technical specifications[1]
        - 3.3R - Groundwater head contour viewer plug-in end user manual[1]
        - 3.3S - Digital photo viewer plug-in
        - 3.3T - Digital photo viewer plug-in source code and low-level documentation
        - 3.3U - Digital photo viewer plug-in technical specifications
        - 3.3V - Digital photo viewer plug-in end user manual
        - 3.3W - Instream flow data viewer plug-in
        - 3.3X - Instream Flow data viewer plug-in source code and low-level documentation
        - 3.3Y - Instream Flow data viewer plug-in technical specifications
        - 3.3Z - Instream Flow data viewer plug-in end user manual
        - 3.3AA - Macroinvertebrate data viewer plug-in
        - 3.3BB - Macroinvertebrate data viewer plug-in source code and low-level documentation
        - 3.3CC - Macroinvertebrate data viewer plug-in technical specifications
        - 3.3DD - Macroinvertebrate data viewer plug-in end user manual
    - WRIA comments on Preliminary Draft Reports/Databases to USU, January 28, 2005
        - (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU).
    - Conference call to discuss Preliminary Draft Reports/Databases, February 17, 2005

- Draft Reports/Databases
    - Draft of above delivered to WRIA, March 11, 2005
    - WRIA Comments on Draft Reports/Databases to USU, April 8, 2005
    - Conference call to discuss comments on Draft Reports/Databases, May 5, 2005

- Final Draft 1 Reports/Databases (Full Beta) for Peer Review
    - Final Draft 1 of above delivered to WRIA, May 20, 2005
    - WRIA and Peer Review comments on Final Draft 1 Reports/Databases, August 5, 2005
    - Conference call to discuss comments on Final Draft 1 Reports/Databases, September 1, 2005

- Final Draft 2 (Full Release version of DSS) Reports/Databases
    - Final Draft 2 of above delivered to WRIA, September 23, 2005
    - WRIA approval of products, October 31, 2005

Deliverables:

3.3.A MapWindow GIS data visualization application

This is a non-reviewable deliverable that is fundamental to the DSS and provides GIS data visualization and interaction. Enhancements to MapWindow that will be required to adapt it to this project include: adding metadata viewing capability, layer grouping in the legend, and feature labeling. WRIA will receive MapWindow and a base set of plug-ins and components, although source code and low-level documentation will not be provided. These non-reviewable plug-ins and components include: Shape File Editor, Grid Wizard, Attribute Table Editor, TIN Builder/Viewer (for 3-D terrain visualization and "fly-through"), Feature Identifier/Labeler, App Builder (for editing configuration files) and MapWinGIS ActiveX control. These tools were developed under previous contracts with other agencies and are subject to source code distribution limitations intended to protect USU and the other agencies which jointly hold the intellectual property rights.

Comment [d1]: Please see the insertion

[1] GWQN and GWQL modules are non-reviewable

3.3.B MapWindow GIS end user's manual

This is a non-reviewable document that instructs end users how to use the MapWindow interface and base set of plug-ins. This manual will be important for end users to have for navigating the primary DSS interface. Although this document is non-reviewable, we will provide it in editable format (html or Word) so that WRIA can customize it or add to it if needed.

3.3.C Streamflow data analyst plug-in

The streamflow data analyst plug-in provides data visualization and analysis of streamflow data. Built in functions include monthly, seasonal and annual box plots, time series plots, correlation plots, count plots, analysis of extreme events (e.g. 7Q10) and multiple time series plots.

3.3.D Streamflow data analyst plug-in source code and low-level documentation

Source code with low-level documentation for this plug-in will be given to WRIA.

3.3.E Streamflow data analyst plug-in technical specifications

Technical specifications including required database structure for this plug-in will be given to WRIA.

3.3.F Streamflow data analyst plug-in end user manual

An end user manual explaining how to use this plug-in will be given to WRIA.

3.3.G Water quality data analyst plug-in

The water quality data analyst plug-in provides data visualization and analysis of water quality data. Built in functions include monthly, seasonal and annual box plots, time series plots, correlation plots, count plots, multiple time series plots, grouping of stations, multiple parameter plots and criterion analysis.

3.3.H Water quality data analyst plug-in source code and low-level documentation

Source code with low-level documentation for this plug-in will be given to WRIA.

3.3.I Water quality data analyst plug-in technical specifications

Technical specifications including required database structure for this plug-in will be given to WRIA.

3.3.J Water quality data analyst plug-in end user manual

An end user manual explaining how to use this plug-in will be given to WRIA.

3.3.K Well-log data viewer plug-in[1]

The well-log data analyst plug-in provides data visualization of well log data. Built in functions include viewing well log data and well log images based on clicks on the map.

3.3.L Well-log data viewer plug-in source code and low-level documentation[1]

Source code with low-level documentation for this plug-in will be given to WRIA.

[1] GWQN and GWQL modules are non-reviewable.

3.3.M Well-log data viewer plug-in technical specifications[1]

Technical specifications including required database structure for this plug-in will be given to WRIA.

3.3.N Well-log data viewer plug-in end user manual[1]

An end user manual explaining how to use this plug-in will be given to WRIA.

3.3.O Groundwater head contour viewer plug-in[1]

The groundwater head contour viewer plug-in provides data visualization of well log data. Built in functions include viewing well log data and well log images based on clicks on the map.

3.3.P Groundwater head contour viewer plug-in source code and low-level documentation[1]

Source code with low-level documentation for this plug-in will be given to WRIA.

3.3.Q Groundwater head contour viewer plug-in technical specifications[1]

Technical specifications including required database structure for this plug-in will be given to WRIA.

3.3.R Groundwater head contour viewer plug-in end user manual[1]

An end user manual explaining how to use this plug-in will be given to WRIA.

3.3.S Digital photo viewer plug-in

The digital photo viewer plug-in provides data visualization of digital photographs. Built in functions include viewing photos and photo comments based on a click on a photo icon on the map.

3.3.T Digital photo viewer plug-in source code and low-level documentation

Source code with low-level documentation for this plug-in will be given to WRIA.

3.3.U Digital photo viewer plug-in technical specifications

Technical specifications including required database structure for this plug-in will be given to WRIA.

3.3.V Digital photo viewer plug-in end user manual

An end user manual explaining how to use this plug-in will be given to WRIA.

3.3.W Instream flow data viewer plug-in

The instream flow data viewer plug-in provides data visualization of instream flow data. Built in functions include 1-D and 2-D habitat visualization based on clicks on the map at specific instream flow locations.

3.3.X Instream Flow data viewer plug-in source code and low-level documentation

Source code with low-level documentation for this plug-in will be given to WRIA.

3.3.Y Instream Flow data viewer plug-in technical specifications

Technical specifications including required database structure for this plug-in will be given to WRIA.

[1] GWQN and GWQL modules are non-reviewable

3.3.Z Instream Flow data viewer plug-in end user manual

An end user manual explaining how to use this plug-in will be given to WRIA.

3.3.AA Macroinvertebrate data viewer plug-in

The macroinvertebrate data viewer plug-in provides data visualization of taxa present and their densities associated with collection at each of the intensive Instream Flow sampling sites.

3.3.AB Macroinvertebrate data viewer plug-in source code and low-level documentation

Source code with low-level documentation for this plug-in will be given to WRIA.

3.3.AC Macroinvertebrate data viewer plug-in technical specifications

Technical specifications including required database structure for this plug-in will be given to WRIA.

3.3.AD Macroinvertebrate data viewer plug-in end user manual

An end user manual explaining how to use this plug-in will be given to WRIA.

Budget needed for completion:

$10,969

3.1.4 Task 3.4: Scenario Builder Module

Summary:

USU has determined that the most suitable way to build the functions of the Scenario Builder Module (Task 3.4) and the Analysis Modeling System (Task 3.6) is to incorporate them in a single MapWindow plug-in. The plug-in that contains the functions of both of these tasks is called the "model manager/scenario builder." To build scenarios in the model manager/scenario builder, one assembles and combines different "scenario elements". The specific scenario elements that will be built under this task allow one to simulate: land cover changes, water rights changes, best management practices, climate input changes, population changes, zoning changes and water storage changes in order to define potential management scenarios to be evaluated within the DSS.

Schedule:

- Alpha Releases
  - September 2, 2004 Workable/Reviewable Alpha Releases delivered to WRIA
    - 3.4A – Alpha Scenario Builder
    - 3.4E – Alpha Land Cover Change module
    - 3.4I –Alpha Best Management Practice module
    - 3.4M – Storage Change module
    - 3.4Q – Climate Change module
    - 3.4U – Population Change module
    - 3.4Y – Diversion/Transfer module
  - WRIA comments for 3.4A, 3.4E, 3.4I, 3.4M, 3.4Q, 3.4U, 3.4Y modules to USU, October 1, 2004
  - Conference call to resolve comments on 3.4A, 3.4E, 3.4I, 3.4M, 3.4Q, 3.4U, 3.4Y modules, and final date to resolve features for these components, October 20, 2004

- Preliminary Draft Reports/Documentation
  - Preliminary Draft of the following to WRIA, December 17, 2004
    - 3.4A - Scenario builder functions in the DSS Model Manager plug-in

        - 3.4B - Scenario builder functions source code and low-level documentation
        - 3.4C - Scenario builder functions technical specifications
        - 3.4D - Scenario builder functions end user manual
        - 3.4E - Land cover change scenario element
        - 3.4F - Land cover change scenario element source code and low-level documentation
        - 3.4G - Land cover change scenario element technical specifications
        - 3.4H - Land cover change scenario element end user manual
        - 3.4I - Best management practices scenario element
        - 3.4J - Best management practices scenario element source code and low-level documentation
        - 3.4K - Best management practices scenario element technical specifications
        - 3.4L - Best management practices scenario element end user manual
        - 3.4M - Storage change scenario element
        - 3.4N - Storage change scenario element source code and low-level documentation
        - 3.4O - Storage change scenario element technical specifications
        - 3.4P - Storage change scenario element end user manual
        - 3.4Q - Climate change scenario element
        - 3.4R - Climate change scenario element source code and low-level documentation
        - 3.4S - Climate change scenario element technical specifications
        - 3.4T - Climate change scenario element end user manual
        - 3.4U - Population change scenario element
        - 3.4V - Population change scenario element source code and low-level documentation
        - 3.4W - Population change scenario element technical specifications
        - 3.4X - Population change scenario element end user manual
        - 3.4Y - Diversion and inter-basin transfer scenario element
        - 3.4Z - Diversion and inter-basin transfer scenario element source code and low-level documentation
        - 3.4AA - Diversion and inter-basin transfer scenario element technical specifications
        - 3.4BB - Diversion and inter-basin transfer scenario element end user manual
    - WRIA comments on Preliminary Draft Reports/Databases to USU, January 28, 2005
        - (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU).
    - Conference call to discuss Preliminary Draft Reports/Databases, February 17, 2005

- Draft Reports/Databases
    - Draft of above delivered to WRIA, March 11, 2005
    - WRIA Comments on Draft Reports/Databases to USU, April 8, 2005
    - Conference call to discuss comments on Draft Reports/Databases, May 5, 2005

- Final Draft 1 Reports/Databases (Full Beta) for Peer Review
    - Final Draft 1 of above delivered to WRIA, May 20, 2005
    - WRIA and Peer Review comments on Final Draft 1 Reports/Databases, August 5, 2005
    - Conference call to discuss comments on Final Draft 1 Reports/Databases, September 1, 2005

- Final Draft 2 (Full Release version of DSS) Reports/Databases
    - Final Draft 2 of above delivered to WRIA, September 23, 2005
- WRIA approval of products, October 31, 2005

Deliverables:

3.4.A Scenario builder functions in the DSS Model Manager plug-in

Scenario builder functions in the DSS model manager plug-in allow a user to link together different scenario elements (e.g. change landuse + add a best management practice) to create a scenario. Each of the scenario elements has the ability to modify data in the DSS to simulate the required scenario. The scenario builder functions link these elements together and allow the user to "run" a set of scenario elements prior to

running a model. Doing this sets up the input data sets needed by the model so that the model can simulate the modified conditions.

The scenario builder functions allow one to add new elements to a scenario, log the scenario in a local database for future use, lock the scenario so that it can't be modified without a password, export the scenario to a file so that it can be passed to another user, and import a scenario from a file.

The scenario builder does not include generic tools for building new elements, however WRIA will be given documentation on the scenario element code interface, and the source code to all scenario elements to use as a reference when new elements are to be built by WRIA.

3.4.B Scenario builder functions source code and low-level documentation

Source code with low-level documentation for these functions will be given to WRIA within the full model manager source code.

3.4.C Scenario builder functions technical specifications

Technical specifications including required database structure for scenario builder functions will be given to WRIA within a full model manager technical specifications document.

3.4.D Scenario builder functions end user manual

An end user manual explaining how to use the scenario builder functions will be given to WRIA as a sub section of the full model manager end user manual.

3.4.E Land cover change scenario element

The land cover change scenario element is used to modify land cover as part of a defined scenario. One land cover change scenario element can be used to make multiple changes to land cover or multiple land cover change elements may be used to make multiple changes.

3.4.F Land cover change scenario element source code and low-level documentation

Source code with low-level documentation for this scenario element will be given to WRIA.

3.4.G Land cover change scenario element technical specifications

Technical specifications including required database structure for this scenario element will be given to WRIA.

3.4.H Land cover change scenario element end user manual

An end user manual explaining how to use this scenario element will be given to WRIA.

3.4.I Best management practices scenario element

The best management practices scenario element is used to implement a defined best management practice in a scenario. Best management practice scenario elements result in changes to loading parameters used in water quality models.

3.4.J Best management practices scenario element source code and low-level documentation

Source code with low-level documentation for this scenario element will be given to WRIA.

3.4.K Best management practices scenario element technical specifications

Technical specifications including required database structure for this scenario element will be given to WRIA.

3.4.L Best management practices scenario element end user manual

An end user manual explaining how to use this scenario element will be given to WRIA.

3.4.M Storage change scenario element

The storage change scenario element is used to create a surface water storage scenario for surface water quantity modeling.

3.4.N Storage change scenario element source code and low-level documentation

Source code with low-level documentation for this scenario element will be given to WRIA.

3.4.O Storage change scenario element technical specifications

Technical specifications including required database structure for this scenario element will be given to WRIA.

3.4.P Storage change scenario element end user manual

An end user manual explaining how to use this scenario element will be given to WRIA.

3.4.Q Climate change scenario element

The climate change scenario element is used to reduce or increase precipitation and temperature data by a selected percentage on a monthly time-step (where available) to simulate the effects of climate change on model results.

3.4.R Climate change scenario element source code and low-level documentation

Source code with low-level documentation for this scenario element will be given to WRIA.

3.4.S Climate change scenario element technical specifications

Technical specifications including required database structure for this scenario element will be given to WRIA.

3.4.T Climate change scenario element end user manual

An end user manual explaining how to use this scenario element will be given to WRIA.

3.4.U Population change scenario element

The population change scenario element is used to change the population in different parts of the WRIA to simulate the effects of population change on model results.

3.4.V Population change scenario element source code and low-level documentation

Source code with low-level documentation for this scenario element will be given to WRIA.

3.4.W Population change scenario element technical specifications

Technical specifications including required database structure for this scenario element will be given to WRIA.

3.4.X Population change scenario element end user manual

An end user manual explaining how to use this scenario element will be given to WRIA.

3.4.Y Diversion and inter-basin transfer scenario element

The diversion and inter-basin transfer scenario element is used to add a surface water diversion, recharge or transfer between drainages.

3.4.Z Diversion and inter-basin transfer scenario element source code and low-level documentation

Source code with low-level documentation for this scenario element will be given to WRIA.

3.4.AA Diversion and inter-basin transfer scenario element technical specifications

Technical specifications including required database structure for this scenario element will be given to WRIA.

3.4.BB Diversion and inter-basin transfer scenario element end user manual

An end user manual explaining how to use this scenario element will be given to WRIA.

Budget needed for completion:

$15,004

3.1.5 Task 3.5: Database Management System

Summary:

The database management system (DBMS) includes two software components. The first is the DBMS Utility (also called the "DBMS Application", or "DSS Launchpad"). The second is the data management component within the model manager plug-in. In both cases, the DBMS is software used for manipulating data for the DSS, it is not the data, nor is it a specific table or database.

The DBMS Utility checks for all needed software on the user's computer every time the DSS starts. If a piece of needed software is not present, then it allows the user to automatically download the needed software and install it on their computer. The DBMS Utility is also used to ensure that current data is on the user's computer for use by the models, visualization tools, and scenario builder. If the user clicks the "Scan for Updates" button, then the DBMS Utility will identify any data on the server that is newer than data on the user's computer and will automatically download and update the data at the user's request. The DBMS Utility can be used by administrators to modify and update databases on the master DSS data and file repository. If an administrator uses the DBMS Utility to edit data on the server, then these edits are logged including date and time of the edit, name of the users computer, and which tables and records were edited.

The data management component of the model manager plug-in (part two of the DBMS) interacts with the scenario builder functions in the model manager plug-in to store all requisite information associated with a defined scenario including data sources, scenario elements used and modeling options selected so that the underlying assumptions of the scenario can be evaluated and replicated. The data management component will also facilitate data transfer between models in the analysis modeling system by storing scenario IDs and attaching these to file names in a table of scenario logs. Each model will open and maintain its own connections with databases, and/or shape files and grid files needed by the model. However, it is the responsibility of the DBMS to pass the needed information to the models to allow them to open these connections. Models do

not necessarily "talk to each other". Rather, each model talks to the file system and relational database directly, exchanging information by both reading from and writing to common locations.

Schedule:

- Alpha Releases
  - April 1, 2004 Workable/Reviewable Alpha Releases delivered to WRIA
    - 3.5A – DBMS Utility
  - WRIA comments for 3.5A module to USU, May 7, 2004
  - Conference call to resolve comments on 3.5A module, and final date to resolve features for this component, May 26, 2004

  - September 2, 2004 Workable/Reviewable Alpha Releases delivered to WRIA
    - 3.5E – Model Manager module
  - WRIA comments for 3.5E module to USU, October 1, 2004
  - Conference call to resolve comments on 3.5E module, and final date to resolve features for this components, October 20, 2004

- Preliminary Draft Reports/Documentation
  - Preliminary Draft of the following to WRIA, December 17, 2004
    - 3.5A - DBMS Utility
    - 3.5B - DBMS Utility source code and low-level documentation
    - 3.5C - DBMS Utility technical specifications
    - 3.5D - DBMS Utility end user manual
    - 3.5E - DBMS functions in within the DSS Model Manager plug-in
    - 3.5F - DBMS functions source code and low-level documentation
    - 3.5G - DBMS functions technical specifications
    - 3.5H - DBMS functions end user manual
  - WRIA comments on Preliminary Draft Reports/Databases to USU, January 28, 2005
    - (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU).
  - Conference call to discuss Preliminary Draft Reports/Databases, February 17, 2005

- Draft Reports/Databases
  - Draft of above delivered to WRIA, March 11, 2005
  - WRIA Comments on Draft Reports/Databases to USU, April 8, 2005
  - Conference call to discuss comments on Draft Reports/Databases, May 5, 2005

- Final Draft 1 Reports/Databases (Full Beta) for Peer Review
  - Final Draft 1 of above delivered to WRIA, May 20, 2005
  - WRIA and Peer Review comments on Final Draft 1 Reports/Databases, August 5, 2005
  - Conference call to discuss comments on Final Draft 1 Reports/Databases, September 1, 2005

- Final Draft 2 (Full Release version of DSS) Reports/Databases
  - Final Draft 2 of above delivered to WRIA, September 23, 2005
- WRIA approval of products, October 31, 2005

Deliverables:

3.5.A DBMS Utility

The DBMS utility is a combination of several executables that reside on the master server and the local user's PC, separate from the DSS. The DBMS Utility is used to update local DSS installations from the master server, and to remotely edit data on the master server, and to download newer code modules and required installation packages to make the DSS work. The DBMS can update any part of the DSS including itself, given that there is an active connection to the Internet.

When a dataset has been updated or modified on the server, then users can receive the updates using the DBMS Utility. When an administrator edits the master DSS database using the DBMS utility, the DBMS utility tracks the edits (including the computer name of the individual who made the edit, which data was edited, and when the edits were made.)

3.5.B DBMS Utility source code and low-level documentation

Source code with low-level documentation for all of the DBMS Utility executables will be given to WRIA.

3.5.C DBMS Utility technical specifications

Technical specifications for the DBMS Utility including required database structure for the automatic updating routine and installation requirements for server and PC based DBMS utility executables will be given to WRIA.

3.5.D DBMS Utility end user manual

An end user manual explaining how to use the DBMS utility will be included as part of the full DSS documentation and will be given to WRIA.

3.5.E DBMS functions within the DSS Model Manager plug-in

The DBMS functions that are not part of the DBMS Utility, that are used to manage data requests between scenario elements and models in the DSS are all encoded in functions within the model manager plug-in. These functions will be delivered as part of the model manager plug-in.

3.5.F DBMS functions source code and low-level documentation

Source code with low-level documentation for DBMS functions that are distinct from the DBMS utility will be given to WRIA within the full model manager source code.

3.5.G DBMS functions technical specifications

Technical specifications including required database structure for DBMS functions that are distinct from the DBMS utility will be given to WRIA within a full model manager technical specifications document.

3.5.H DBMS functions end user manual

A section of the full model manager plug-in end user manual will focus on how to use the tables that are part of the DBMS functions for passing inputs and outputs between models and scenario elements.

Budget needed for completion:

$8,203

3.1.6 Task 3.6: Analysis Modeling System

Summary:

The analysis modeling system is incorporated in the Model Manager plug-in and includes “model interfaces” used to integrate and link models, and “data filters” used to convert outputs from one model to inputs for another model. Data filters are also needed to format data for storage in the data visualization databases.

Within the model manager plug-in, a user can define the sequencing of models for a particular scenario analysis. The model manager links the models by defining execution sequence, and by passing parameters, and inputs and outputs to and from the

models as they are sequentially executed. If the user chooses to explore a particular scenario that only requires execution of a subset of the models, then a scenario for that subset of models can be selected from a list of available scenarios, and executed by the user.

Two types of components are described listed in the deliverables, including model manager interfaces for each of the DSS models, and data filters to convert data between formats needed by each model.

Schedule:

- Preliminary Draft Reports/Documentation
  - Preliminary Draft of the following to WRIA, December 17, 2004
    - 3.6A - Model manager interface for surface water quantity model
    - 3.6B - Surface water quantity model interface source code and low-level documentation
    - 3.6C - Surface water quantity model interface technical specifications
    - 3.6D - Surface water quantity model interface end user manual
    - 3.6E - Model manager interface for Lake Whatcom model
    - 3.6F - Lake Whatcom model interface source code and low-level documentation
    - 3.6G - Lake Whatcom model interface technical specifications
    - 3.6H – Lake Whatcom model interface end user manual
    - 3.6I - Model manager interface for coarse surface water quality model
    - 3.6J - Coarse surface water quality model interface source code and low-level documentation
    - 3.6K - Coarse surface water quality model interface technical specifications
    - 3.6L - Coarse surface water quality model interface end user manual
    - 3.6M - Model manager interface for instream flow model
    - 3.6N - Instream flow model interface source code and low-level documentation
    - 3.6O - Instream flow model interface technical specifications
    - 3.6P - Instream flow model interface end user manual
    - 3.6Q - Data filters to convert data to formats needed for each model
    - 3.6R - Data filters source code and low-level documentation
    - 3.6S - Data filters technical specifications
  - WRIA comments on Preliminary Draft Reports/Databases to USU, January 28, 2005
    - (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU).
  - Conference call to discuss Preliminary Draft Reports/Databases, February 17, 2005

- Draft Reports/Databases
  - Draft of above delivered to WRIA, March 11, 2005
  - WRIA Comments on Draft Reports/Databases to USU, April 8, 2005
  - Conference call to discuss comments on Draft Reports/Databases, May 5, 2005

- Final Draft 1 Reports/Databases (Full Beta) for Peer Review
  - Final Draft 1 of above delivered to WRIA, May 20, 2005
  - WRIA and Peer Review comments on Final Draft 1 Reports/Databases, August 5, 2005
  - Conference call to discuss comments on Final Draft 1 Reports/Databases, September 1, 2005

- Final Draft 2 (Full Release version of DSS) Reports/Databases
  - Final Draft 2 of above delivered to WRIA, September 23, 2005
- WRIA approval of products, October 31, 2005

Deliverables:

3.6.A Model manager interface for surface water quantity model

The WRIA-wide surface water quantity model, including a water rights component, will require a model manager interface for it to be used within the DSS model manager. This interface is a dynamic link library

(DLL) that communicates between the model and the model manager, passing required parameters, inputs, and outputs to and from the model.

3.6.B Surface water quantity model interface source code and low-level documentation

Source code with low-level documentation for the surface water quantity model interface will be given to WRIA.

3.6.C Surface water quantity model interface technical specifications

Technical specifications for this model interface including inputs, outputs and parameters used by the model will be given to WRIA.

3.6.D Surface water quantity model interface end user manual

An end user manual explaining how to use this model interface will be given to WRIA.

3.6.E Model manager interface for Lake Whatcom model

The Lake Whatcom water quality model will require a model manager interface for it to be used within the DSS model manager.

3.6.F Lake Whatcom model interface source code and low-level documentation

Source code with low-level documentation for this model interface will be given to WRIA.

3.6.G Lake Whatcom model interface technical specifications

Technical specifications for this model interface including inputs, outputs and parameters used by the model will be given to WRIA.

3.6.H Lake Whatcom model interface end user manual

An end user manual explaining how to use this model interface will be given to WRIA.

3.6.I Model manager interface for coarse surface water quality model

The coarse surface water quality model will require a model manager interface for it to be used within the DSS model manager.

3.6.J Coarse surface water quality model interface source code and low-level documentation

Source code with low-level documentation for this model interface will be given to WRIA.

3.6.K Coarse surface water quality model interface technical specifications

Technical specifications for this model interface including inputs, outputs and parameters used by the model will be given to WRIA.

3.6.L Coarse surface water quality model interface end user manual

An end user manual explaining how to use this model interface will be given to WRIA.

3.6.M Model manager interface for instream flow model

The instream flow model will require a model manager interface for it to be used within the DSS model manager.

3.6.N Instream flow model interface source code and low-level documentation

Source code with low-level documentation for this model interface will be given to WRIA.

3.6.O Instream flow model interface technical specifications

Technical specifications for this model interface including inputs, outputs and parameters used by the model will be given to WRIA.

3.6.P Instream flow model interface end user manual

An end user manual explaining how to use this model interface will be given to WRIA.

3.6.Q Data filters to convert data to formats needed for each model

Several data filters will be required to convert data between different formats used for output and input in each model and by the data visualization and watershed characterization components.

3.6.R Data filters source code and low-level documentation

Source code with low-level documentation for all data filters will be given to WRIA.

3.6.S Data filters technical specifications

Technical specifications for all data filters including input data format and output data format inputs will be given to WRIA.

Note: Deliverables will also include the USU version of PHABSIM and USU's rapid assessment software systems. These software systems will be provided as executables only, and the associated software manuals are non-reviewable.

Budget needed for completion:

$13,617

Notes:

- Completion of certain deliverables will require that data from WRIA be received by a specified date. These dates will need to be indicated in the above table as the schedule is established.
- No review cycle is listed for low-level code documentation. A standard for internal code documentation has been adopted and will be adhered to as described in section 3.2.C above. Sample code showing this level of documentation is provided below:

```
Public Function GetExtreme(ByVal ExtremeType As ExtremeTypes, ByVal D As Object, ByVal V As
Object, ByVal M As Integer, ByVal N As Integer, ByRef Result As Double, ByRef Conf95 As
Double, ByRef Conf5 As Double) As Boolean
        'This function computes the extreme streamflow event (i.e. 7Q10) based on frequency
analysis and supplied parameters. The parameters include:
        '   ExtremeType    An enumeration that takes the values 0=HighFlow or 1=LowFlow
        '   D              An array of dates
        '   V              Array of double precision daily streamflow values.
        '   These two arrays must line up(same length, each date has one flow).
        '   M              Intiger that indicates the averaging period in days. For '7Q10,
       M=7.        Must be less than or equal to 365.
        '   N              Positive integer indicating return period in years. For 7Q10, N=10.
        '   Result         Returns the expected high or low flow.
        '   Conf95         Returns the upper confidence limit on the flow estimate.
        '   Conf5          Returns the lower conficence limit on the flow estimate.
        'The function returns a boolean value. True means that it ran correctly.
        '
        Dim StdDev As Double    'temporarily stores standard deviaiton
        Dim Mean As Double      'temporarily stores mean
        Dim AllYearExtremes() As Double 'array of doubles containing the extreme value for
each year
        Dim bResult As Boolean  'boolean to indicate success of the function
        Dim Prob As Double      'temporarily stores the probability of exceedance
        If ExtremeType = ExtremeTypes.LowFlow Then
            Prob = 1 / N
        Else
            Prob = 1 - 1 / N
        End If
        bResult = True
        Try
            AllYearExtremes = GetAllYearExtremes(ExtremeType, D, V, M)
            TakeLogs(AllYearExtremes)
            Mean = GetMean(AllYearExtremes)
            StdDev = GetStdDev(AllYearExtremes)
            Result = GetInvNorm(Prob, Mean, StdDev)
            GetConf(AllYearExtremes, Prob, Conf5, Conf95)
            Result = Math.Round(Math.Exp(Result), 2)
            Conf5 = Math.Round(Math.Exp(Conf5), 2)
            Conf95 = Math.Round(Math.Exp(Conf95), 2)
            If Result < 0 Then Result = 0
            If Conf5 < 0 Then Conf5 = 0
            If Conf95 < 0 Then Conf95 = 0
        Catch ex As Exception
            bResult = False
        End Try
        Return bResult
End Function
```

Attachment DSS-A: March 2002 Scoping Meeting Minutes for WC module

Date:	March 11, 2002
Time:	1:00 p.m. – 4:00 p.m.
Place:	Bellingham Public Library Meeting Room

Agenda

1.	Watershed Characterization Design

MEETING ATTENDANCE

Bob Sullivan – Parametrix
Dave Callery – Parametrix (Hardin-Davis)
Chris Fairbanks – PUD No.1
John Sproul – Whatcom County
Sue Blake – Whatcom County
Thom Hardy – USU
Skip Richards – Non-muni. Water Systems Caucus
Steve Seymour – WDFW
Peter Gill – PUD No.1
Kasey Ignac – Small Cities Caucus
John N. Thompson – Whatcom County
Jeremy Freimund – Lummi Nation
Renee LaCroix – City of Bellingham
Becky Peterson – PUD No.1
Andy Ross – Lummi Nation
Willy Lynch – Lummi Nation
Terry Holland – Whatcom County
Leigh Gable – Anvil Corporation

Documents Distributed

- *Watershed Characterization Screen Shots*

Meeting contents

1. Watershed Characterization Design

Thom Hardy has begun constructing a program to present summary level information to DSS users. Thom will base the program on Sue Blake and Becky Petersen's work to compile the Watershed Characterization. The audience for the characterization is comprised of non-technical users.

Thom stressed that the design and functionality of the characterization are open to discussion. Thom asked the attendees to view the characterization work to-date as a template for the final product.

The attendees discussed whether the characterization would be capable of comparing the summary information of different scenarios. While the characterization is not intended to produce side by side scenario comparisons, the user will be able to look at the summary characteristics of different scenarios and produce plots.

The attendees reviewed the hand out of characterization screen shots and suggested possible design features to Thom.

Page 1, Initial Screen: Attendees discussed how much freedom the user would have to select specific drainages or aggregations of drainages. Suggestions included:

- Include the option to select drainages by clicking on a map of the WRIA, or by selecting from an alphabetical drop-down list.
- Allow the user to choose from a set of approximately 20 pre-defined aggregations – these would be the default aggregations. The users could also define their own aggregations.
- Build in the capability for the user to draw irregular polygons to select portions or various drainages (difficult).
- Allow the user to aggregate drainages based on the delineation of confined and unconfined aquifers (difficult).

Page 2, Features Map: Attendees felt that the features map was too crowded. The map could be broken into separate maps of:

- Infrastructure such as transportation, city boundaries, power lines, etc
- Lakes and streams with designated DOE 303(d) streams
- Fish habitat and instream flow
- Aquifer boundaries, recharge areas, and wellhead protection areas
- Land use

- Others (e.g. socioeconomic).

All maps should include enough basic features such as main arterial roads to help orient the user.

Page 3, Land Use Map: Attendees suggested other land use maps/tables including:

- Zoning and future zoning
- Drainage districts (not available)
- Fish habitat restoration projects (Nooksack Recovery Team database)
- A table of the number of wells by drainage
- Socio-economic activity by sector (available through EcoNorthwest?).

Page 4, Summary Descriptions: Attendees suggested using 2000 census data, and including projected population growth by drainage.

Page 5, Water Quantity Stream Flow Summary: Suggestions included:

- Include maps that identify gauge locations (Ecology instream flow sites and actual streamflow sites) and precipitation stations.
- Expand flow characterizations to depict how closely estimated values match gauge data.
- Include estimated unimpaired hydrology.
- Ensure that precipitation data consists of measured data and estimates from David Tarboton and Connely Baldwin's work.

Page 6, Water Use

More work is needed for this page. It used estimates for domestic and agricultural use based on a different method than the one done by PUD No.1 staff (this is the current official estimate). More discussion is needed to see if the PUD No.1 methodology can distinguish between agricultural use and other (domestic, commercial, etc) consumptive uses. Some attendees felt it was important to be able to separate the two. Group C needs to be removed from the data on public water systems. The WRIA 1 project could estimate the percentage of agricultural, residential, and industrial use by examining parcel data for areas served by public water systems, but it would take considerable effort and resources. Additional work is needed to update or revise the annual withdrawals table.

Page 7, Fisheries: Attendees suggested:

- Include species and associated periodicity.
- Add maps/tables of fish blockage and culvert inventory data, NRT projects in the basin, and priority fisheries areas.
- Include problems such as fish blockages

Page 8, Recreation, Shellfish, Industry: Attendees suggested putting shellfish on a separate page. Shellfish would be expanded to include nearshore and estuaries. For shellfish and estuarine data, one attendee suggested contacting the Whatcom Marine Resources Committee. Recreation information includes locations of marinas, water parks, and beaches.

Page 9, Water Quantity and Supply: The domestic/municipal water supply graph needs to be modified pending resolution of the topics discussed for page 6 (the graph was based on an older method). The public water system table should be updated.

Page 10, Preliminary Water Budget: Additional information could be added to the graph. The graph also needs to be revised to reflect resolution of issues on page 6 (as on Page 9, the graph was based on an older method). (See general comments.)

Page 11, Temperature Monitoring Summary: This whole section needs to be revisited. It doesn't make sense to have the temperature information included in the current format.

Page 12, Beneficial Uses Impairment Status Table: Work is needed to modify the table. An attendee suggested automating the impairment table to generate a report for any aggregation of drainages the user happens to select. This may not be feasible.

Page 13 and 14, Potential Reasons/Causes for Impairment of Beneficial Uses, and Potential Reasons/Causes for Impairment of Beneficial Uses – Water Quantity: No comment from attendees. Likely will be dropped from the report.

Page 15, Potential Reasons/Causes for Impairment of Beneficial Uses – Water Quality: This page was originally designed to link to a spreadsheet object. Thom Hardy recommended eliminating this page. There was general agreement for this recommendation.

Page 16, Solutions/Recommendations/Opportunities: This page may not be needed. It is recommended to be dropped.

General Comments:

- Include a "hot link" on terms that require an explanation.
- Place page titles in the upper right-hand corner.
- Include an option to display the water year on graphs. Include the option for the user to display graphs in millions of gallons, gallons per minute, and cubic feet per second.
- Add a page to display economic data. If there is no data, the program should designate the page as inactive.

Attachment DSS-B: Watershed Characterization Alpha Deliverable Comments

USU and WRIA have had several iterations of comments and responses based on this memo, resulting in the final report design outlined in the Table 3.1 in section 3.2 in this Scope of Work.

Watershed Characterization Report Comments

Source	ID #	Location	Comment
PjG	1	General	Overall this appears to be a great improvement on format and content as well.
PjG	2	General	I saw very little in the way of documentation/reference material for the summarized information. People will have a hard time taking this seriously without proper data documentation. Please include metadata with each Chart/Table/Map, i.e. Author, date,
PjG	3	General	This is the first time it was stated that the watershed Characterization module would not be able to summarize scenarios as USU states on the 8th bullet of the cover page. The Phase III Checkpoint document dated 8/30/2002 clearly states that the WC module will also summarize "proposed management options that have been evaluated within the DSS." (line 39) Useful information from the scenario runs could be stream flow, habit availability, land cover, water quality, water use, etc. The WC module may be the best place to summarize the results of a proposed scenario for the public. If the WC module is not going to be able to evaluate scenarios I don't know why it needs to be connected to the DSS at all. A summary of current data could have been done locally two years ago. If the scenario comparison module includes the same information it may suffice as USU states, however, I am skeptical considering there is no completed work on this module to date and it is likely more complicated than the WC module.
PjG	3.1	General	There was no description of water scale this would happen at Basin – subbasin – Watershed – Subwatershed – Drainage? Previously we were told that summaries could be created of any aggregation of Drainages that we choose. Is this still the case?
PjG	4	General	A brief description of how we will receive the Alpha deliverable and the needed hardware/OS and training would be helpful for all DSS deliverables.
PjG	5	Overview and Disclaimer	A paragraph or two of background on the project is needed. For many this will be there first introduction the project and will be lost without background info. See Sue & Becky earlier work or Phase III SOW introduction. I can provide sources for this info if requested.
PjG	6	Overview and Disclaimer	A "How to read this Report" section may be helpful. Background info on watershed terminology, reference/metadata locations, what to use the report for.
PjG	7	Overview and Disclaimer	A paragraph on how to get involved, who is already involved, and who to contact is also needed. This could be included in the project background section described above.
PjG	8	Section 1.2	I have a river mile estimate worksheet already completed for WC that I could send if you would like.?
PjG	9	Section 1.2	In the 'Brief Description" section include information on water quantity as it pertains to low flows during irrigation season and floods during winter months. Include a sentence or two on the water right closure status of the watershed. A description of the main aquifers in the watershed is also missing.
PjG	10	Section 1.2	Include source information for data layers on map. Maps may layout better in landscape.
PjG	11	Section 3.0	Note data source and include all classes agreed upon for updated NLCD dataset. Make sure pie chart matches map in colors and classes if possible.
PjG	12	Section 4.0	The historical field is misleading when this field is empty and the Existing field is filled. It implies that there currently are fish where they didn't go historically. I don't think the data source supports this. Include row for Chinook.
PjG	13	Section 4.4	Include field of closure dates for those drainages that have a partial closure status.

Source	ID #	Location	Comment
PjG	14	Section 4.5	Each ISF requirement table should include locational information and possibly a map. A single watershed may include multiple ISF sites.
PjG	15	Section 5.1	There will need to be a Stream Flow Summary Chart for each stream in the watershed.
PjG	16	Section 6.0	Needs some aquifer information i.e. aquifer makeup, depth, transmissivity
PjG	17	Section 6.2	What kind of Wells? Table needs some context, e.g. "exempt wells per unit area."
PjG	18	Section 8	This section should be called Water Use, with a summary chart of water use by sector and possibly a good place for the water right information. A synopsis of the dominant water use in the watershed and its source, i.e. rural from exempt wells, ag from surface water, etc.. Section 8.1 could be details on agricultural use, section 8.2 Industry, section 8.3 domestic, and on through the list.
PjG	19	Missing section	Flood plain information and FEMA map
PjG	20	Missing section	There needs to be a water right section. Including quantities by water right type, water use, new applications, etc… It would work well in a Water Use section.
PjG	21	Missing section	Section 5.4 could be dams and hydro projects
PjG	22	Missing section	Ongoing and future monitoring work
PjG	23	Missing section	Data gaps that could be improved with monitoring
AA	24	General	All data sources, including dates, must be listed on tables and figures so that we know where the info comes from
AA	25	8,10,12	combine all water use sections 8,10,12 into one water use section with sub headings ag, industrial and domestic/muni.
AA	26	4.4, 4.5	4.4 and 4.5 should moved to section 5.0
AA	27	5.3, 5.1	5.3 should precede 5.1
AA	28		The report reflects possible USU confusion over land use and land cover. Fake data listed is land cover only. Land use data would be better in the socio economic section. Do NOT show land use AND land cover on one map, it would be too much info and hard to represent clearly
AA	29	General	Report shows possible USU confusion over surface water delineation terms. Upper Main Stem Nooksack example is not a DRAINAGE, it is an aggregation of several drainages. Page 16 shifts to term "sub-watershed." Ideally, report could be generated at smallest delineation, the DRAINAGE, as well as aggregated groups of drainages originally selected by Sue and Becky for summary purposes (ie Lynden North, etc.)
AA	30	Cover memo	Note #8 on cover memo: I understand the distinction being made between the scenario comparison report and the watershed characterization report. However, I think there are cases where because we have no actual data, we need the characterization report to include the "baseline or existing conditions" model simulation to help characterize the drainage. For example, if we want to describe current conditions in a drainage where there is not currently a stream flow gage, the sw qn model will be able to produce a stream flow estimate for current conditions at a node for each drainage. This model estimate could be represented in the watershed characterization for ungaged drainages.
AA	31	General	It is important for consistency that the Watershed Characterization draw from the same databases that the models draw from.
AA	32	General	Will the alpha version to be delivered in Jan draw from this "master database?"
AA	33	Section 2.5	I do not understand the term "future zoning." To my knowledge there is current zoning as described in Co Comp plan and subarea updates and there could be "proposed zoning

Source	ID #	Location	Comment
			changes" when these areas come up for periodic review, but I would not include "proposed zoning changes" in section 2.5. Do not use zoning abbreviations in table like "C-forest" since most people do not know this means commercial forestry.
AA	34	General	What is a "priority fisheries area?" Include definition in report.
AA	35	Table 4.1	needs a location name column if there is more than one named stream or trib in the drainage. Title should be "Known and historical fish species PRESENCE"
AA	36	General	The inclusion of "unit run off (inches)" in many tables is not useful unless it can be readily compared or viewed in the context of a water budget and resulting stream flow. What we need is a chart or table that shows in stream flow settings in WAC compared to actual or estimated average in stream flows on at least monthly basis (combine Table 4.5 with Table 5.2 and model estimates where there are no "observed" flows)
AA	37	Text box 4.6	What level of detail did you intend for text box 4.6? Miles of riparian rehab? Number of LWD structures? Number of NRT projects?
AA	38	Section 4.7	Why include hatchery withdrawal since the water mostly all returns to stream? Fish production, return or survival related numbers would be more valuable. WDFW tracks # fish released and #spawners returning to each hatchery
AA	39	Map 6.1	I think we only have current maps of SURFICAL aquifer boundaries. If you intend to include the other aquifers below the surficial, you will need a 3D display. Many aquifer boundaries will not show at a drainage or watershed scale, since aquifer boundaries do not necessarily conform to surface water drainage boundaries.
AA	40	Section 6.2	The raw number of "wells" is not very useful. If the intent was to show all ground water use, then gw use numbers would be better. If the intent is to show typical aquifer yields in the area under the drainage, then this is a different number also.
AA	41	Section 7	All water quality data in section 7 should include accepted standard or MCL for reference
AA	42	Table 12.3	Title for Table 12.3 should be Public Water Systems (as defined by DOH not ownership category)
EK	43	General	Include units of measure in tables
TH	44	General	The watershed characterization workshop (WS) summary from March 11, 2002 on page one-two had suggestions for input of report request options such as Drainage drop down lists, etc. This document only models outputs and does not describe input options.
TH	45	General	In the WS workshop summary page one Thom expresses that summary characteristics of scenarios will be available for plots. This is not listed or characterized here.
TH	46	Section 5.3	Include 303(d) stream designations3
TH	47	General	Provide "hot-link" for term definitions – from WS comments
TH	48	General	Include option to display water year on graphs – from WS general comments
QLTT	49	General	It is assumed that the purpose of the review is to comment on format of the report vs. data. If this is not the case, additional comments would need to be provided.
QLTT	50	General	A number of these comments are similar to those made during the workshop in March 2002. It would be helpful to know why USU did not address all of the March comments in this version (maybe it is not practical or possible).
QLTT	51	Format/Layout	The source of the information should be accessible in some manner. Likewise, it should be possible to refer to a definition of the terms used (example, what is the definition of "non-forested" in Table 3.1
QLTT	52	Format/Layout	• The Characterization Module should enable the user to generate maps that display information requested by the user. A base map should be provided with the user able to add layers of information as desired. The base map should include enough basic features such as main arterial roads to help orient the user. Layer should include those identified in the report as well as:

Source	ID #	Location	Comment
			o Federal, tribal, and international boundaries, urban growth boundaries o Public water system water supply sources; o Public water system service area boundaries (recognizing that not all systems have service areas designated but it should be possible to add them as they become available); o Infrastructure such as major power lines (County Planning has a number of layers that could fit this need); o Wellhead protection areas; o Aquifers, recharge areas; o Drainage districts; o Number of wells o Fish habitat projects
QLTT	53	Format/Layout	Maps should have a north arrow, scale and legend;
QLTT	54	Format/Layout	Information related to the various beneficial uses should be organized so that out-of-stream uses are together (follow each other), and in-stream uses are together.
QLTT	55	General	A concern was raised about what happens when for example, the current number of zoning categories changes from 5 to 10 – does this mess up the electronic display or printed display?
QLTT	56	Format/Layout	Table 4.5 should identify the waterbody
QLTT	57	General	A water budget (or something similar) is desired
QLTT	58	General	A placeholder should be added that enables information on related programs to be added to the module as it is obtained.
QLTT	59	General	Add land cover and as noted previously include definition of terms and where the information comes from.
QLTT	60	Tables	Unclear what Table 4.1 is supposed to communicate
QLTT	61	Display	Table 5.1/5.2 – what will be displayed here? Modeled streamflow? Actual streamflow? Would be good to display both.
QLTT	62	Display	Page 11 – It would be useful to reference the parameter for which a waterbody is listed in the map generated in Table 7.1. An idea would be to color code the applicable section so that for example, fecal coliform would be brown and temperature could be red.
QLTT	63	General	Information displayed on pages 12, 13, and 14 is no longer needed because that information can be viewed in the data visualization module. Instead, it would be useful to display information that would enable the user to quickly understand if there are any problems related to water quality and if so, what are they (the 303(d) page provides some information but not all). For example, is it possible to generate a table for temperature that shows the number of exceedances for a given time period (conversely, if there are not exceedances that would be good to know).
QLTT	64	General	Although it may not be possible to access the information now, a placeholder should be provided that enables the user to view compliance information for public water systems (required in Consumer Confidence Reports).
QLTT	65	General	It is assumed that the consumptive use estimates (12.2) come from the PUD work – terminology should be consistent.
QLTT	66	Table	It is not clear what Table 13 is intended to communicate. A description is needed to avoid confusion (the concern is that the term “impairment” for example, has a different meaning to various people so it would be good to offer an explanation
QLTT	67	General	Consistent use of significant figures.
QLTT	67	General	Include the option to select drainages by clicking on a map of the WRIA, or by selecting from an alphabetical drop-down list
QLTT	67	General	Allow the user to choose from a set of approximately 20 pre-defined aggregations –

Source	ID #	Location	Comment
			these would be the default aggregations. The user could also define their own aggregations

4. PHASE III SOW: SURFACE WATER QUANTITY

The Phase III surface water quantity activities comprise development and implementation of continuous stream flow models and their validation for use in analyzing the relative performance of management options. Semi quantitative uncertainty analysis as detailed below will be used to quantify the uncertainty associated with modeled streamflow.

The capabilities of the surface water quantity model include the ability to evaluate and compare scenarios across management options including: (a) Water use changes, e.g., ability to add new uses and to interchange Surface Water and Ground Water uses; (b) Land use changes, e.g., account for development, ability to adjust irrigation efficiency; (c) Allow different water use rates; (d) Augmentation of surface water flows in any user-defined period (of particular interest for low-flow conditions); (e) Representation of trans-drainage diversions and surface strage facilities; (f) Water rights enforcement. Due to deferring the coupling of the surface water and groundwater models, the impact of groundwater withdrawals and uses on groundwater levels will not be a model output. Where groundwater withdrawals are part of a management option they will be implemented as direct withdrawals from the lumped saturated zone store of the surface water quantity model. As such an approximation of the impact on baseflow will be modeled, but will be less accurate than what would have been possible with groundwater coupling. See September 16, 2003 memo from USU on impact of deferring groundwater model development for details.

The general model characteristics that were recommended in the Surface Water Quantity Phase II Task 4 report will be followed. Provision of training to WRIA 1 personnel is not budgeted as part of Task 4. Training is budgeted separately in Section 11.

4.1 Phase III Detailed Work Plan – Surface Water Quantity

Phase III work is centered on building a surface water quantity model that will be an integral part of the Decision Support System (DSS). There are five key model components:

1. Rainfall-runoff transformation
2. Evapotranspiration calculation
3. Water use calculation
4. Ecological flow and water rights accounting
5. Diversion and surface storage accounting

The first component converts incoming rainfall to runoff considering, for example, the effect of land use/land cover, land management, and soil properties. The second component calculates the water leaving the system due to evapotranspiration from natural and irrigated crops, and other land uses (forested, urban, etc). The third component allows the amount of water required for various uses—urban, agricultural, etc.— to be calculated based on measured data and per capita use assumptions, evapotranspiration estimates, and irrigation efficiency. Fourth, to provide information on how the various scenarios impact ecological flow and water rights, the amount of water available to fulfill each right is assessed within the framework of the demands calculated in the water use component. Fifth, a mechanism to account for proposed diversions and storage scenarios is required. The relationship between these model components is shown in Figure 4.1.1.

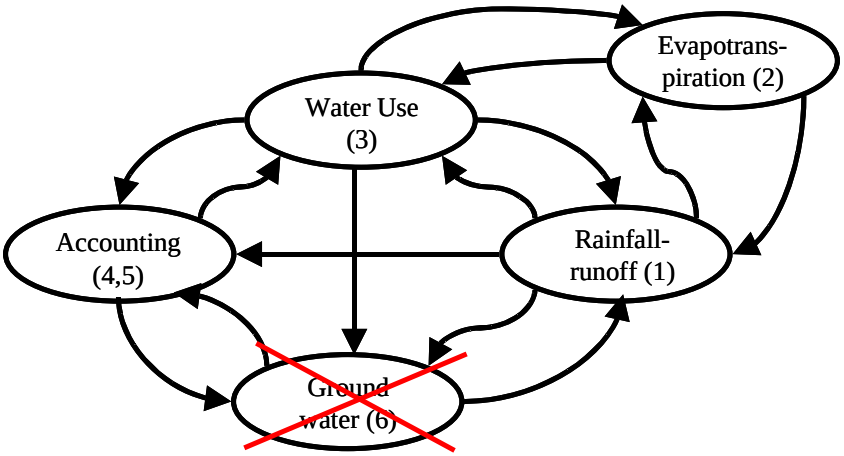


Figure 4.1.1. Relationship between model components with component number listed in parentheses after name. Note that in this revision the linkages to Groundwater (ellipse 6) that have been deferred are not included.

In addition to these model components there are related DSS components (being developed by the DSS team) that support the surface water quantity model to provide graphical user interface control over management alternatives that involve different land use/land cover (the Land-use/land cover modifier) and diversions, inter basin transfers and surface storage (the Diversion/inter-basin transfer locator, and Surface storage locator). These will be designed in close collaboration with all other groups.

Comment [DGT2]: There was mention of a storage locator – but at present I am unaware of any management options that will require storage. Given the financial limitations modeling of storage and storage locator is being deferred.

The two tasks under surface Water Quantity are:

Task 4.1: Develop and Implement Surface Water Quantity Model Components and Integrate into the DSS
Task 4.2: Validation of Model through Analyses of Scenarios

4.1.1 Task 4.1: Develop and Implement Surface Water Quantity Model Components and Integrate into the DSS

Background:

This task represents a refinement and extension of the original surface water quantity Task 5 from the Phase II SOW, and is a continuation of work initiated under EDN14. The surface water quantity model is comprised of hydrologic and water management model components along with the necessary DSS components to specify management options directly related to surface water quantity, such as land use, diversions, transfers and surface storage. As noted in Phase II Task 4 report, the integration of the hydrologic and water management model components will be developed to function as one unit.

Purpose/Objectives:

The purpose of this task is to provide a computer simulation capability that can be used to explore "what if" types of questions (scenarios) relative to the impacts of land and water management options on surface water flows in WRIA 1.

Geographic Area:

The area of application of surface water quantity modeling is all of WRIA 1, though, due to limitations of data availability, it will not be possible to provide uniformity in the quality of modeling results for the entire WRIA. Direct inputs or statistically estimated inputs from upstream areas may be used in certain areas where this is preferable to modeling areas not impacted by management alternatives. Areas with inadequate DEM and land cover data will not be modeled (Drainages in Fraser subbasin highlands, which is also omitted from the surface water quality modeling area).

Specific USU Subtasks:

The model will be developed in a modular fashion to facilitate future modifications to the individual components, listed above. We first describe the overall approach and function for each model component. We then describe the pre-modeling steps necessary to develop the database of climatic data to be used as inputs to the model. We also describe select DSS components that will be designed as part of this task. Finally, we list several milestones that will serve as significant points at which agreement on the approach will be obtained. Technical memos presenting the design of selected components will be prepared and transmitted to WRIA 1: Evapotranspiration[2] (item 2 below); Water use, management, and rights (items 3-5 below), combined into one memo. In addition, a memo describing the calibration parameters[3] and associated procedures will be prepared and transmitted to WRIA 1.

The surface water quantity model will be integrated with other models in the DSS. The integration takes the form of fixed format input/output tables for sequential model execution. All of these activities are integral to the DSS required to evaluate water management scenarios for the watershed management plan. Integration with the DSS is simplified by the predefined input/output tables for the surface water quantity model, as the database of outputs will be readily accessible by the DSS for viewing. The model will be executed when necessary as a subroutine stored as a dynamic link library (dll) that contains all necessary model components, which have the following functionality.

1. Rainfall-runoff transformation. The TOPNET framework recommended in SWQN Phase II Task 4 report will be adopted. The TOPMODEL representation for hillslopes, and a more appropriate conceptual representation for the lowland drainages will be drawn from current hydrologic modeling principles or existing code. The internal time step will be hourly, while daily averages will be used in calibration and most DSS applications.
2. Evapotranspiration calculation. Currently, we plan to acquire a well-tested existing implementation of the Penman-Monteith method. This is a combined energy- and water-balance method that takes into account wind effects. Several of the other inputs required must be derived from other types of climatic data, but is still the recommended method by experts in the field.
3. Water use calculation. This will be determined by per unit area rates for each land use/water use type (e.g., agricultural/PUD-served, residential/private well). The rates will be modifiable to explore the impacts of various changes to land use such as, conservation, irrigation efficiency, and permeability. The approach will be consistent with that used in Phase II (the WRIA 1 Water Accounting Model), but will be adapted to run within the framework of a continuous model. Specifically, the effective precipitation and associated Crop Irrigation Requirement (CIR) for agricultural land will be calculated at least daily in place of any specific year or long-term averages. It is anticipated that this will serve as the primary method for determining water use. However, to facilitate examination of water rights allocations (current or future), the use rates for land use/water use pairs may be suspended and replaced by water rights amounts as specified in the "ecological flow and water rights accounting" component.
4. Ecological flow and water rights accounting. This component represents what was called the "water management" model in Phase II. The nomenclature has changed to distinguish it from the more traditional water management models that treat problems such as deriving optimal rule curves for reservoirs to meet a specified demand subject to constraints on reservoir operation. Here the ecological and water rights accounting component will provide information on the amount of water available to fulfill each water right under each management scenario. This component will account for: (1) user-specified demands that can vary by the day of the year and (2) water-rights limited operation (by establishing a fixed priority date for withdrawals).
5. [4]Diversion, transfers and surface storage accounting. This component will track the water in diversions, transfers and surface storage, and apply the user-specified rules or respond to water rights limitations.

There will be uncertainty associated with these model components attributable to many sources such as input error and uncertainty, model error due to oversimplification, and calibration error. These uncertainties will be evaluated using semi

[2] As of writing this September 2003 revision to the statement of work a draft of the Evaporation memo was submitted on December 12, 2002. Comments were received and a revised draft with responses submitted on January 22, 2003.

[3] As of writing this September 2003 revision to the statement of work a draft a Calibration memo was submitted on November 25, 2002. Comments were received and a second version with responses to comments submitted on January 22,2003. Further comments were received and a third version with additional responses submitted on March 14, 2003.

[4] Tarboton modified the description here because with deferring of groundwater no work will be done relative to aquifer storage and recovery. There was also overlap between functions under point 4 and point 5 because both involve reduction of surface water, referred to as withdrawals under 4 and diversions under 5. I am not sure what the appropriate distinction between withdrawals and diversions is, but here it is one of scale. We will use withdrawals to represent depletions that occur within a drainage, while diversions and transfers are depletions that remove water from a drainage.

quantitative sensitivity analysis. The sensitivity and uncertainty analysis refers to the uncertainty in model predictions due to uncertainty in model parameters. The model parameters involved in the surface water quantity model are listed in table 4.1 below which was also in the calibration memo (Baldwin and Tarboton, March 14, 2003, table 6 line 156).

Table 4.1 Model parameters

Notation and Units	Description	Estimation
f_i	Impervious fraction	From land cover. GZA, MAN
f (m^{-1})	Saturated store sensitivity	From STATSGO. GZA, MC
T_o (m^2/hr)	Soil profile lateral conductivity	From STATSGO. GZA, MC
K (m/hr)	Vadose zone vertical saturated hydraulic conductivity	From STATSGO and land cover. GZA, MC, MAN
$\Delta\theta_1$	Drainable moisture content	From STATSGO. GZA
$\Delta\theta_2$	Plant available moisture content	From STATSGO. GZA
d (m)	Soil Store depth	From STATSGO. GZA
c	Soil zone drainage sensitivity	Value: 1
ψ_f (m)	Wetting front suction	From STATSGO. GZA
V (m/hr)	Overland flow velocity	Initial Value: 360 MC
CC (m)	Canopy capacity	From vegetation. GZA, MAN
Cr	Intercepted evaporation enhancement	From vegetation. GZA, MC, MAN
Albedo	Incident radiation reflectivity	From vegetation. GZA, MAN
Lapse Rate (^oC/m)	Temperature change with elevation	Value: 0.0053
K_c (for evapotranspiration component)	Crop coefficient	From existing data. MAN
Channel parameter		
n	Manning's n	Initial Value: 0.024 MC

Notes: GZA = GIS Zone Average, MC = Multiplier Calibrated, MAN = Responsive to Management alternatives.

This table indicates which parameters are calibrated and which parameters are estimated independently. Regardless of how each parameter is estimated we will estimate subjectively (i.e., using professional judgment, prior experience, and known literature values) for each parameter, lower and upper bounds on the parameters value. These bounds will be used in model runs to establish the sensitivity of model outputs one parameter at a time. In this procedure each parameter will be adjusted between its lower and upper bound values while holding all other parameters constant at their calibrated or reference values. This approach provides a simple measure of the sensitivity of model output to parameter uncertainty, but neglects any interaction between model parameters.

One key attribute for evaluating different management scenarios under uncertainty is to use the *relative performance* between the scenarios as a guide, instead of relying strictly on the numerical output. In other words, even if uncertainties render a specific numerical result suspect, there may be situations where a difference between two management options is meaningful.

Before any of these components can be used to determine the impact of any "what-if" scenarios, a spatio-temporal database of climate data inputs must be derived from existing temporal (point) and spatial (PRISM) climate data. It is anticipated that a continuous set of climate data will be derived for each drainage. The parameters will consist of precipitation, temperature (max, min, dew-point), wind, and solar radiation. For precipitation, a method such as Delauney triangulation will be used in conjunction with the PRISM precipitation surface to yield historical spatio-temporal precipitation. A similar approach will likely be used for temperature. The time scale will be hourly for precipitation, temperature and solar radiation, while other parameters may be daily and spread evenly over the hours in the day (e.g., daily average wind speed of 5 mph would be applied at every hour of the day). The methodology for developing this climate database will be described in the documentation for the program.

Climatic and hydrologic data limitations were noted in Phase II Task 1 report. Other data needs noted more recently include land cover data. The model will be capable of using any land cover / land use data in the correct format. While it is possible to acquire more refined land cover data, the sensitivity of the model to land cover data inputs is not yet known and cannot be assessed until the surface water quantity and other models are completed. USU will document the formats required for land use data for use by Whatcom County or others developing new land cover data for model input. For planning and decision purposes the focus should be more on planned changes in land use under different management alternatives, rather than refining estimates of existing land use.

The select DSS components needed to specify certain water quantity management options are listed below. The functionality of each is described and will be implemented as a graphical user interface within the DSS.

- Land-use/land cover modifier. One of the management options specified is the ability to change land use in WRIA 1. A method for changing land use will be provided, which will subsequently be used in the surface water quantity model to determine impacts on ground and surface water. A wide range of land covers (see Table 4.2 below) will be incorporated, from highly impervious surfaces to dense expanses of the full range of types of native vegetation.
- Diversion inter-basin transfer locator. Many of the DSS worksheets refer to various diversion options. This tool will allow users to identify such diversions or inter-basin transfers. The associated parameters, such as volumes and schedule for diversions or water rights priority date, will also be provided in a dialog box.
- Surface storage locator (off-stream and reservoir). Similar to the diversion locator, this component will be provided in a dialog box and will allow the user to identify characteristics of storage components, such as volume-area curves and operating policies or water rights priority date.

http://www.epa.gov/mrlc/definitions.html **NLCD 1992 Classification System** **With 1 added class 89 Dairy**			
Code	**Sub-code**	**Class**	**Description**
10		**WATER**	**All areas of open water or permanent ice/snow cover.**
	11	Open Water	All areas of open water, generally with less than 25% cover of vegetation/land cover
	12	Perennial Ice/Snow	All areas characterized by year-long surface cover of ice and/or snow.
20		**DEVELOPED**	**Areas characterized by a high percentage (30 percent or greater) of constructed materials (e.g. asphalt, concrete, buildings, etc).**
	21	Low Intensity Residential	Includes areas with a mixture of constructed materials and vegetation. Constructed materials account for 30-80 percent of the cover.
	22	High Intensity Residential	Includes highly developed areas where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20 percent of the cover. Constructed materials account for 80 to100 percent of the cover.
	23	Commercial/Industrial/ Transportation	Includes infrastructure (e.g. roads, railroads, etc.) and all highly developed areas not classified as High Intensity Residential.
30		**BARREN**	**Areas characterized by bare rock, gravel, sand, silt, clay, or other earthen material, with little or no "green" vegetation present regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the "green" vegetated categories; lichen cover may be extensive.**
	31	Bare Rock/Sand/Clay	Perennially barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, beaches, and other accumulations of earthen material.
	32	Quarries/Strip Mines/ Gravel Pits	Areas of extractive mining activities with significant surface expression.
	33	Transitional	Areas of sparse vegetative cover (less than 25 percent of cover) that are dynamically changing from one land cover to another, often because of land use activities. Examples include forest clearcuts, a transition phase between forest and agricultural land, the temporary clearing of vegetation, and changes due to natural causes (e.g. fire, flood, etc.)
40		**FORESTED UPLAND**	**Areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25-100 percent of the cover.**
	41	Deciduous Forest	Areas dominated by trees where 75 percent or more of the tree species shed foliage simultaneously in response to seasonal change.
	42	Evergreen Forest	Areas dominated by trees where 75 percent or more of the tree species` maintain their leaves all year. Canopy is never without green foliage.
	43	Mixed Forest	Areas dominated by trees where neither deciduous nor evergreen species represent more than 75 percent of the cover present.
50		**SHRUBLAND**	**Areas characterized by natural or semi-natural woody vegetation with aerial stems, generally less than 6 meters tall, with individuals or clumps not touching to interlocking. Both evergreen and deciduous species of true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions are included.**
	51	Shrubland	Areas dominated by shrubs; shrub canopy accounts for 25-100 percent of the cover. Shrub cover is generally greater than 25 percent when tree cover is less than 25 percent. Shrub cover may be less than 25 percent in cases when the cover of other life forms (e.g. herbaceous or tree) is less than 25 percent and shrubs cover exceeds the cover of the other life forms.

Table 4.2 Land cover types

60		**NON-NATURAL WOODY**	**Non-Natural Woody - Areas dominated by non-natural woody vegetation; non-natural woody vegetative canopy accounts for 25-100 percent of the cover. The non-natural woody classification is subject to the availability of sufficient ancillary data to differentiate non-natural woody vegetation from natural woody vegetation.**
	61	Orchards/Vineyards/ Other	Orchards, vineyards, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals.
70		**GRASSLANDS/ HERBACEOUS**	**Upland areas characterized by natural or semi-natural herbaceous vegetation; herbaceous vegetation accounts for 75-100 percent of the cover.**
	71	Grasslands/ Herbaceous	Areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25 percent, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.
80		**PLANTED/CULTIVATED**	**Planted/Cultivated - Areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation accounts for 75-100 percent of the cover.**
	81	Pasture/Hay	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.
	82	Row Crops	Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.
	83	Small Grains	Areas used for the production of graminoid crops such as wheat, barley, oats, and rice.
	84	Fallow	Areas used for the production of crops that do not exhibit visable vegetation as a result of being tilled in a management practice that incorporates prescribed alternation between cropping and tillage.
	85	Urban/Recreational Grasses	Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.
	89	Dairy	Dairy farms as determined by Whatcom Conservation District Farmplan polygons, and verified by Washington Department of Ecology Dairy Points (2003)
90		**WETLANDS**	**Areas where the soil or substrate is periodically saturated with or covered with water.**
	91	Woody Wetlands	Areas where forest or shrubland vegetation accounts for 25-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.
	92	Emergent Herbaceous Wetlands	Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water

Parenthetically, it is important to note that management options will be essentially "static" in the sense that they cannot be changed directly within a model run. For example, it will not be possible to place a storage device that comes on line in a particular year, or is removed in a particular year. The approach proposed here is to compare the full model runs where the storage device is present in one run and removed in the other.

To facilitate communication with the water quantity Technical Team, several milestones are identified that represent points at which agreement on the approach will be obtained through conference calls or technical memos. The plans will also be coordinated with the Flood Division (Whatcom County) through the Quantity Technical Team. Model components will be documented by reference to the source literature for existing components or a detailed description of the functionality of model components to for new or modified components. In some cases (such as the evapotranspiration and water use components), the degree to which the automated implementation is similar to the original approach developed in Phase II will be described. The user interface milestones will be represented visually as "screen-shots" of the various interfaces and recommendations for changes to the information content and organization will be considered. Important milestones to be developed in this task are listed below:

1. Management option check point. The management options relating to water quantity were examined by USU and the water quantity tech team in March 2002. The higher priority/more implementable management options were identified are listed in the second paragraph of this section (4.0).
2. Generic rainfall-runoff transformation model design. The document "SWQN Model Description" was distributed to WRIA 1 at the September 2002 checkpoint meeting and provides information on the design of this component and items 3 and 4.

3. Determining which processes are needed in which drainages (snow melt, glacier dynamics, drainage modifications, etc.)[5]
4. Design of the required processes[6]
5. Evapotranspiration component design. Technical memo delivered to WRIA 1 and ready for approval by WRIA 1.
6. Water use component design. Technical memo to be provided to WRIA 1 (combined with items 7 and 8 below).
7. Ecological flow and water rights accounting
8. Diversion/storage accounting
9. Land-use and land cover modifier (user-interface component)
10. Diversion/inter-basin transfer locator (user-interface component)
11. Surface storage locator, including on-stream reservoir, and off-stream surface reservoir (user-interface component)

At each milestone where the task involves management scenarios (9, 10, 11), input will be allowed to facilitate estimating the economic impact/cost at a pre-feasibility level of detail. For example, capital and annual operation & maintenance (O&M) costs for storage facilities, diversion structures, etc. Interest rates, useful life, and salvage value may also be input by the user.

Technical documentation for Peer review

1. The technical material related to defining calibration data sets and model parameters;
2. Summary descriptions of each model and in particular any modifications made to the underlying model structures;
3. Detailed summary comparisons between predicted and observed model performance that specifically targets model uncertainty in terms of input data and model output results as assessed through the semi-quantitative sensitivity analysis (This is not the formal uncertainty and sensitivity analysis that would follow the beta model reviews;
4. Explicit documentation on model-to-model communication in terms of data and time-step resolution; and
5. A draft 'user manual' for the surface water quantity model that (1) describes the inputs accessible to the DSS for the development of scenarios, and (2) provides explanation of outputs necessary for review of modeling results. This manual is not required to give details on how to recalibrate the model.

Schedule:

- Calibration memo approval by WRIA. WRIA currently has the third revision with comments for consideration. March 12, 2004
- Evapotranspiration memo approval by WRIA. WRIA currently has the second revision with comments for consideration. March 12, 2004
- Water use, management and rights memo
  - Draft memo submitted to WRIA on March 26, 2004
  - WRIA comments to USU April 15, 2004
  - Conference call to resolve comments April 22, 2004
  - Final memo submitted to WRIA on May 14, 2004
  - WRIA approval on June 4, 2004.
- Report on model development and calibration results
  - Preliminary Draft December 17, 2004
  - Comments from WRIA on Preliminary Draft Report January 28, 2004
  - Conference call to resolve comments on Preliminary Draft Report February 15, 2005
  - Draft Report March 11, 2005
  - Comments from WRIA on Draft Report April 8, 2005
  - Conference call to resolve comments on Draft Report May 3, 2005
  - Final Draft 1 Report (Peer Review step) May 20, 2005
  - Comments from WRIA (and peer reviewers) on Final Draft 1 Report August 5, 2005
  - Conference call to resolve comments on Final Draft 1 Report August 30, 2005
  - Final Draft 2 Report on model development and calibration results September 23, 2005
- WRIA approval October 31, 2005

[5] As of writing this October 2003 revision the Calibration memo, the third draft of which was submitted in March 2003 identifies the proposed representation of snow melt and glacier dynamics through the use of upstream boundary conditions.

[6] As of writing this October 2003 revision the required processes that will be modeled are described in the August 30, 2002 Draft Surface Water Quantity model descriptions that were submitted for the September 2002 checkpoint.

Deliverables:

The deliverable will be a technical report and associated computer model within the DSS. This report will only cover model development and calibration results.

- A computer program (the surface water quantity model) consisting of a set of processes for each drainage and associated scenario generation components.
- User's manual that describes how to prepare model input and use the model within the DSS.
- Technical report giving descriptions of the processes incorporated in the model and calibration results.

Budget:

$84,189[7].

4.1.2 Task 4.2: Validation of Model through Analyses of Scenarios

Background:

The water quantity models will be assembled to provide the capability of exploring "what if" questions regarding the ecological and economic implications of alternative land use and water management throughout the entire WRIA 1 area. Analysis of selected management scenarios will be performed by USU personnel to validate the model developed in Task 4.1.

Purpose/Objectives:

The purpose of this task is primarily to validate the model developed in Task 4.1, but will also serve to demonstrate and illustrate the formulation, simulation, and analysis of the water quantity implications of management scenarios.

Geographic Area:

As indicated in Task 4.1, the entire area of WRIA 1 will be the domain of the surface water quantity simulation model.

Specific USU Subtasks:

For the purposes of validation, demonstration, and illustration we will implement and present results from three model run scenarios:

1. Historical. An estimate of pre-development land cover and stream morphology conditions for depletion analysis
2. Existing. An estimate of current land cover and stream morphology conditions
3. Full buildout. A future condition with land cover / land use changed to represent build out at current zoning and population projections for 2015 as described in the most recent Whatcom County Comprehensive Plan. .

The specification of these scenarios will be provided to WRIA 1 as a technical memo. The memo does not require the actual data to be available, but seeks approval from WRIA 1 that the proposed approach is acceptable.

Because it is not possible to conduct an accurate analysis of undepleted flow conditions for periods where required climatological and other data are unavailable (scenario 1 above), the calibrated surface water quantity model will be capable of making estimates of flow regimes that would be obtained under a wide range of circumstances, including:

1. Current hydrologic conditions with current surface water abstractions removed;
2. A wide range of other hydrologic conditions represented by a variety of combinations of data sets, including actual (where full climatological and other required data is available), theoretical (where full climatological and other required data are provided by scientifically defensible theory) and hypothetical (where the data are assumed for the sake of

[7] This budget is the amount required to complete outstanding work as of September 2003. This reflects savings due to limitations of scope due to deferral of groundwater coupling, but also includes additional personnel cost due to USU having lost Connely Baldwin with the WRIA 1 project work stoppage and this task being taken on by PhD level Research Assistant Professor Dan Ames.

argument) in the absence of current surface water abstractions, that enable the development and analysis of ecological flow regimes.

We note here that although the model will have this capability, the scope of this validation task does not involve USU performing any analysis of scenarios beyond the three scenarios listed above. Before the depletion analysis scenario can begin, the Water Quantity Technical Team must approve the:

- historical land cover data to be used.
- historical stream network to be used.
- the specific method to be used for the evaluation of changes in artificial drainage

As noted in the Phase II surface water quantity Task 4 report, the primary function of the surface water quantity model (and the DSS) is to determine the relative performance of different management scenarios to help inform management decisions. The key phrase is *relative performance*, since the uncertainty in accurately specifying actual values may be large in some cases. We anticipate that for some important model predictions the uncertainty will be quite large. This is a fact of life, when data is limited, and will have to be considered by decision makers in the negotiation of instream flows. However, even when absolute uncertainty is large, the uncertainty in relative quantities between alternative management scenarios may be less. In these cases, we are suggesting that decisions be based upon relative performance measures. Following is a hypothetical numerical example to illustrate this. Suppose that the absolute uncertainty of a quantity under management alternative 1 is between 20 and 80. Under management alternative 2, the absolute uncertainty may be between 30 and 120. These ranges may be rather limiting, especially if a desired target is 50 or more. However, the relative performance of individual simulations between management alternatives 1 and 2 may be that management alternative 2 always results in between 40% and 60% more flow than management alternative 1. This is information on relative performance that the model will provide for use as a guide for decision-making.

In evaluating the management scenarios, climatic conditions need to be considered. These climatic conditions represent the "seasonal and other variations" for which water availability is to be estimated, as noted in the March 2000 WRIA 1 Watershed Management Project Final Scope of Work. Two distinct climate periods were demonstrated in the Phase II analysis of long-term precipitation and stream flow data (see the surface water quantity Phase II Task 3 report, appendix A). The periods were shown to be coincident with variation in a sea surface temperature pattern termed the Pacific Inter-decadal Oscillation (PDO). In evaluating management scenarios we will provide four options for input climate data:

1. Use the 1961-90 period which represents approximately 15 years in each PDO phase and may be termed "average" climatic conditions,
2. Use only the drier climate conditions (1976-1996) to provide a more conservative assumption,
3. Use the wetter period of record (1947-1976),
4. Construct an extremely dry worst case scenario by grouping together the driest 10% of the years for which climate data is available.[8]

The input data files defining these options will be provided and in the DSS a user will be able to select any of these options or provide their own climate data input file. We recommend that initial comparisons of management scenarios will use the first climate period option (1961-1990). A second tier of analysis can then be performed on a small subset of options receiving deeper consideration. For these the performance under other climate input options should be assessed. In comparing the management scenarios listed above being used for validation we will use climate data input option 1 for all management scenarios. We will also run and analyze all four climate data input options with one management scenario. Unless directed otherwise we will do this for the existing conditions scenario, because that provides the most opportunity for validation against existing data. Analysis of additional management scenarios with other climate data input options is beyond the budgeted scope of this validation task.

Schedule:

- Uncertainty/sensitivity methods memo
  - Draft to WRIA April 16, 2004
  - WRIA comments to USU May 14, 2004
  - Conf call to resolve comments June 17, 2004
  - Final uncertainty/sensitivity memo to WRIA July 2, 2004

[8] It has been suggested that the 1928-30 dry period be explored as a worst case scenario. Due to lack of data, this is not likely to be feasible. However, it may be possible to accomplish a similar effect by selecting only the driest 10% of years across all available years.

    - WRIA approval July 16, 2004
- Scenario definition memo defining spatial data inputs for Historical, Existing, and Full Buildout conditions
    - Draft to WRIA. April 9, 2004
    - WRIA comments to USU April 23, 2004
    - Conference calls to resolve comments,
        - Existing – April 29, 2004
        - Historical – May 6, 2004
        - Full Buildout – May 13, 2004
    - Final scenario definitions memo to WRIA May 28, 2004
    - WRIA approval for scenario definitions memo to USU June 11, 2004
- Report on analysis of scenarios (The material for the report for this sub-task [4.2] will be included in a section of the full report in the same schedule as outlined under section 4.1 above)
    - Preliminary Draft Report, December 17, 2004
    - WRIA Comments on Preliminary Draft Report to USU, January 28, 2004
    - Conference call to resolve comments February 15, 2005
    - Draft Report March 11, 2005
    - WRIA Comments on Draft Report April 8, 2005
    - Conference call to resolve comments May 3, 2005
    - Final Draft 1 Report to WRIA, May 20, 2005 (Peer Review step)
    - WRIA & Peer Review Comments on Final Draft 1 Report to USU August 5, 2005
    - Conference call to resolve comments, August 30, 2005
    - Final Draft 2 Report September 23, 2005
    - WRIA approval, October 31, 2005
- Uncertainty/Sensitivity Technical Memo
    - Draft Uncertainty/Sensitivity Technical Memo to WRIA, October 21, 2005
    - WRIA comments to USU, November 4, 2005
    - Conference call to resolve comments, November 18, 2005
    - Final Uncertainty/Sensitivity Technical Memo to WRIA, December 2, 2005
    - WRIA approval of Uncertainty/Sensitivity Technical Memo, December 16, 2005

Deliverables:

The deliverable for this task will be:
1) A technical report that details the results of the analyses of the management scenarios run. This will include model validation that compares results to existing data for the existing conditions scenario. The report will include detailed descriptions of all the assumptions and data inputs used to obtain the scenario results.

2) A technical memo with a description of our assessment of the range of uncertainty of data inputs and model parameters from the semi-quantitative sensitivity analysis.

Budget:

$39,163[9]

[9] This budget is a revised estimate as of September 2003. This reflects some savings due to limitations of scope due to deferral of groundwater coupling, but also includes additional personnel cost due to USU having lost Connely Baldwin with the WRIA 1 project work stoppage and this task being taken on by PhD level Research Assistant Professor Dan Ames, resulting in a small net increase for this task.

5. PHASE III SOW: GROUND WATER QUANTITY

USU is assuming that all work related activities for the ground water quantity component of the project to develop a multi- (or single) layer model has been deferred. USU will only provide technical documentation on the existing status of the technical modeling, existing data files and MODFLOW software developed to date (Task 5.1 and 5.2), and completion of the single well application module (Task 5.3).

Deliverables:

A technical memo will be prepared that provides explicit documentation on the existing status of the ground water quantity model development, provides a description of the existing data file structure(s) necessary to implement the five layer model, documents the agreed to set of assumptions and input parameters for the multi-layer model, documents any existing linkages between completed ground water quantity work (model and/or databases) and the Data Visualization module of the DSS, and a brief description of what must be undertaken to complete this component of the SOW as provided in the June 16, 2003 reduced effort version. The existing, actual data files and MODFLOW software developed to date will also be delivered. This work assumes that the documentation described in this deliverable will not undergo peer review but will be reviewed by the technical team for completeness.

Budget: $ 3,000

5.1.3 Task 5.3: DSS Module for a Single Well Water Right Application

Background:

Because of the variability and complexity of proposed water uses, there is a great deal of commensurate variability and uncertainty in the DOE procedures used in granting or rejecting applications for new water rights. Considerable improvement can be made for providing the applicants and regulators with a simple methodology for preliminary evaluation of the effects of proposed ground water recovery activities. This will be accomplished by developing and providing to potential users PC-based on-line calculation software. The assumptions, input data, and output results have been discussed via phone and email with the WRIA 1 Water Quantity Technical Team. We note that this task has been practically completed before the current scope of work was prepared.

Purpose/Objectives:

In this task, a modeling tool for evaluating ground water right applications will be developed. This effort will address the following management options of March 2000 SOW:

Voluntary Water Transfer/Diversion
Additional Allocations
Modify the location and/or timing of withdrawals
Water banking

The principal objective of this task is to develop a simple tool to assess the effects of new allocations or modification of old ones on the groundwater regime and surface water depletion. This tool will be based on the well-known and documented analytical solution that estimates stream flow depletion for a single well, pumping at a constant rate. This solution will be extended, via superposition and convolution methods, to estimate stream flow depletion caused by multiple wells with variable pumping rates.

Software Description:
PC-based software will be developed for analyzing the effect of multiple ground water wells pumping at time-varying pumping rates on transient stream flow depletion rates. The approach will use the following assumptions:

The wells are located in a single aquifer whose interactions with other hydrogeologic units are negligible.
The aquifer is homogeneous and isotropic, and may be confined or unconfined.
The aquifer is in direct or indirect (clogging layer) contact with the stream.
Single or multiple wells are allowed.
The pumping schedules are user defined.

Input data

Well locations with respect to the stream course
Aquifer properties (transmissivity and storativity)
Required time period for predictions
Pumping schedule for each well

Output

Visual depiction of the input data
Graph and table of stream flow depletion as a function of time.

Schedule and Deliverables:

Alpha software version and draft report delivered to WRIA technical liaison, May 15, 2003.
The single well application preliminary draft report and beta software have been delivered to WRIA. The error detected in the Beta software previously delivered will be corrected and a final version of the software provided. WRIA has indicated that they will utilize the draft report to develop their own user manual (Llyn Doremus email, 10/7/03), and no further work from USU will be undertaken on this element except to provide the deliverables listed below. This deliverable is non-reviewable. Deliverable elements:

- Corrected final version of the software provided (refer to second sentence in above paragraph).
- Existing data files related to the project tasks with technical memo for documentation.
- CD of model source code
- One set of CDs with executable software developed to date (most current version)

Note: These deliverables are non-reviewable.
To be delivered May 28, 2004

Budget:

$0

6. PHASE III SOW: SURFACE WATER QUALITY

Work related to surface water quality in Phase III will principally involve developing and calibrating water quality models that will assist in informed decision-making for key portions of WRIA 1. Conceptual models of water quality in WRIA 1 have been constructed and were used as guides in determining specific water quality models to be applied to different portions of the WRIA 1 area. The efforts described in the EDN13 and EDN 8 revised SOW (attached) provided the framework upon which Phase III efforts will be built. The models and focus areas identified during EDN13 will be populated with data collected and evaluated under Phase II and Phase III of the project. The modeling suite will then be integrated with the WRIA 1 Decision Support System. The USU team will work closely with the Water Quality Tech Team in carrying out the tasks described below for surface water quality. Collaboration is essential to ensure project deliverables are complete and on time.

6.1 Phase III Detailed Work Plan – Surface Water Quality

6.1.1 Task 6.1: Surface Water Quality Monitoring for Model Calibration and Validation

Background:

As a result of Tech Team and Staff Team discussions and prioritizations, the original EDN 13 monitoring efforts have been modified and the Phase III SOW now reflects this change in focus and direction. The intentions of the original EDN 13 scope were to capture the drought, low flow conditions present in later summer of 2001. This short window passed without sampling occurring. Therefore, in an effort to facilitate model selection and data to be collected in Phase III, the EDN scope was rewritten. The outcome of the discussions is reflected in what is now identified in EDN 13 and the following Phase III task. Additionally, this task is intended to cover other data needs that may be identified in EDN 8 as well as gaps noted in the Phase II assessments.

Purpose/Objectives:

Monitoring under Phase III will be was focused on implementing monitoring needs and analysis tasks identified through EDN 8 and EDN 13, as identified in the subtasks below. This work will be conducted in conjunction with the Water Quality Tech Team.

Field and laboratory measurements of samples obtained at selected locations important for Phase III modeling efforts, as identified in EDN 13, will be were made for one or more of the following constituents depending on the specific needs: organic matter (e.g., total organic carbon, biochemical oxygen demand, ultraviolet absorbance at 254 nm), algal biomass (e.g., chlorophyll A), nitrogen (total Kjeldahl, ammonia/ammonium, nitrite and nitrate), phosphorus (organic, dissolved reactive phosphate, total reactive phosphate, dissolved total phosphorus, and total phosphorus), and other specific target contaminants such as dissolved oxygen, temperature, and pH.

The majority of the water quality monitoring under Phase III was carried out by local entities and interested parties in the WRIA 1 Watershed Management Project with assistance where needed by USU personnel, using Phase III funding. In conjunction with the Phase III water quality monitoring activities, a detailed quality assurance/quality control (QA/QC) plan will be developed to ensure data integrity and quality.

Geographic Area:

Specific geographic areas will be identified in EDN8 (Lake Whatcom) and as identified by EDN13 (WRIA-wide except Frasier and Lake Whatcom).

Specific USU Subtasks:

Data collection under Tasks 6.1.1.1 and 6.1.1.2 was completed July 2003.

6.1.1.1 Task 6.1.1. Conduct Monitoring as Identified by EDN 8

Provide input to Ecology on their Quality Assurance Program Plan to ensure that all tasks required by USU are addressed

- Design and facilitate data collection efforts.
- Analyze data collected.
- Incorporate data collected into the WRIA 1 database.

6.1.1.2. Task 6.1.2. Conduct Monitoring as Identified by EDN 13

- Facilitate data collection efforts.
- Collect water quality data and other physical parameters in support of surface water quality modeling.
- Analyze data collected.
- Incorporate data collected into the WRIA 1 database.

Data collection under Tasks 6.1.1.1 and 6.1.1.2 was completed July 2003.

6.1.1.3 Task 6.1.3. Incorporation of Additional Data into Surface Water Quality Database

- Data submitted prior to November 1, 2003 by the Department of Ecology, City of Bellingham, Nooksack Tribe, and Lummi Nation provided in a USU specified electronic format will be incorporated into the surface water quality database. Incorporation of any other datasets can be negotiated, but will not be part of this SOW.
- Provide instructions for WRIA1 personnel to add additional data to the surface water quality database.

Schedule:

Completion of all data collection was accomplished in July 2003. Completion of all data collection and data entry after November 2003 will be the responsibility of the participants of the WRIA 1 Watershed Management Project. The USU responsibility for incorporation of data into the database will end in November 2003.

The bulleted schedule below applies to the Data Analysis technical memo for EDN 8 and 13, the QA/QC technical memo for EDN 8 and 13, and incorporation of the data from both EDN 8 and 13 into the water quality database.

- Conference call to define and reach agreement on memo contents and structure for the Data Analysis technical memo, March 4, 2004.
- Final Data Analysis technical memo, which will contain all of the items agreed to in the first bullet, provided to WRIA on April 2, 2004.
- Conference call to define and reach agreement on memo contents and structure for the QA/QC technical memo, April 1, 2004.
- Final QA/QC technical memo, which will contain all of the items agreed to in the first bullet, delivered to WRIA on May 7, 2004.
- Surface water quality database updated with data collected as part of EDN 8 and EDN 13 incorporated into the DSS Data Visualization component on May 28, 2004.
- Incorporation of surface water quality data from various agencies listed above completed on May 28, 2004.
- A description of how to add additional data to the surface water quality database provided to WRIA on May 28, 2004.

Deliverables:

Two of the following deliverables have been changed to technical memos because they do not require the full WRIA review process. It is assumed that the following technical memos will be reviewed once by the Surface Water Quality Technical Team and USU will address any comments in a final version of these memos. The content of the memos will be defined and agreed upon as described previously.

- As previously outlined, the content of the data analysis technical memo will be defined and agreed to with the SWQLTT. Information will be provided in the form of time series plots, frequency plots, and other graphical representations, tables of summary and other statistical analyses, and narrative analysis of the information collected. This will primarily be accomplished using the Data Visualization component of the DSS. The technical memo will be inclusive of data collected as part of EDN 8 and EDN 13 through July 2003.
- QA/QC technical memo, as defined in the subtask above, that documents data quality for both the field and laboratory analysis.
- Surface water quality database including newly collected data as part of EDN 8 and EDN 13 incorporated into the data visualization component of the DSS
- Updated version of the surface water quality database including final data provided by agencies listed above (deadline November 14, 2003) incorporated into the data visualization component of the DSS. The database deliverable will be provided on 10 CDs only.

Note: USU's involvement in the development of the long term monitoring plan as part of Phase III will be minimal. See details in Task 11 of this SOW.

Budget:

Data collection for Lake Whatcom was from sources other than those of the WRIA 1 Project and is complete.

$9,479 for subtask 6.1.1 – Costs include both the facilitation of monitoring activities and data collection.

6.1.2 Task 6.2: Surface Water Quality Model Development

Background:

In the course of the data gathering, analysis, and distillation process during Phase II, it became apparent that many of the data gaps could not be filled with short-term water quality monitoring. A comprehensive long-term monitoring network and program will be required. However, since estimates of water quality are required to facilitate current watershed management tasks, mathematical modeling will be used to fill the gaps.

Purpose/Objectives:

Phase III objectives under this task will include: the continuation of organizing and distilling data to meet specific input requirements for selected models; populating surface water quality models; calibrating and validating models; and, where necessary, verifying computer code built for the key geographical areas chosen in EDN 13 and EDN 8 (Lake Whatcom) in conjunction with WDOE TMDL work. Additionally, code for carrying out sensitivity and uncertainty analysis of model inputs and results will be constructed for the Lake Whatcom model. These capabilities will be incorporated into the Surface Water Quality module of the DSS.

The purposes of Task 6.2 are to: provide WRIA 1 technical personnel with the capability to quantitatively assess the impact of watershed management on surface water quality; to be able to search, in a scientifically sound, consistent, and efficient way, for preferred management options and parameters relative to prescribed criteria; and to identify, quantitatively for Lake Whatcom and qualitatively for the coarse and medium resolution models for the WRIA 1 drainages, the uncertainty associated with different options in terms that are commonly accepted and are communicable to stakeholders and technical watershed managers. The sensitivity and uncertainty analysis for the Lake Whatcom and the coarse and medium resolution models are described later in this section.

Both model calibration and the development of management plans (e.g., best management practices) are viewed as decision problems characterized by uncertainty. Within the surface water quality uncertainty analysis module integrated into the DSS for Lake Whatcom, the user will be able to describe model inputs or outputs in terms of probability distributions and explore relationships between the model inputs and output. Both traditional Monte Carlo and first order error analysis approaches will be provided.

Throughout model development, integration of the models into the DSS will be a priority. This aspect of the work is covered under Task 6.3 and includes data and model result filters constructed to connect the models with the database and linkages with other disciplinary models. The surface water quality models will be designed to interact with all disciplinary areas of the WRIA 1 project; namely, when data needs for assessment of management scenarios cannot be met from the surface water quality and other technical databases, model results will be used to provide the necessary information. Although most of this interaction will take place under the umbrella of the DSS, the data needs must be communicated among models.

The specifics of the surface water quality modeling efforts are detailed in EDN 13 and EDN 8. These EDNs include detailed descriptions of the geographic areas chosen for modeling, the specific modeling approaches chosen for each area, the temporal and spatial resolution of each of the models chosen, and other important modeling details. In the current scope of work, USU is proposing to fully develop, calibrate, and integrate the models for Lake Whatcom (see EDN 8), the WRIA 1-wide coarse resolution models, and the medium resolution model for the Dakota Creek drainage (EDN 13). Completion of the fine resolution models for the South Fork Nooksack (temperature only) and Fishtrap (full water quality) drainages described in EDN 13 have been deferred.

Technical team coordination and communication

To facilitate communication with the water quality Technical Team, several milestones are identified that represent significant points at which agreement on the approach will be obtained through regular conference calls. It is anticipated that documentation

of the model components will include a detailed description of the functionality of model components to be implemented. Important milestones that have been developed or still need to be developed for this task are listed below:

1. Determine specific sites in the WRIA for focused modeling efforts.
2. Finalize space and time scales for models at each site
3. Selection of specific models or model approaches for each site
4. Determine which processes are needed in which drainages (Temperature, nutrient balance, fecal coliform, etc.)
5. Design of the algorithms required to model the processes
6. Loading estimates for key species at model system boundaries
7. Water quality management decision components (user-interface component – common with SWQN technical group, Section 4.11) and SWQLTT management options and DSS scenario needs
8. Communication of SWQL results with other technical portions of the DSS

Coordination with WDOE for Lake Whatcom modeling efforts

The needs of WDOE for the Lake Whatcom TMDL development and the needs of the WRIA 1 Watershed Management Project result in a preference for two complementary paths, as described in EDN 8. Elements of the Lake Whatcom modeling efforts described under EDN 8 are designed to parallel and complement TMDL modeling efforts of WDOE. WDOE will develop a 2-dimensional dynamic model of the lake and calibrate it initially using empirical data. Empirical data will also be used to develop loading models using multiple regression techniques. A paired watershed study will be conducted as part of the data collection to provide information required to develop a method to estimate both natural and developed pollutant concentrations and hydrodynamic conditions. These data will be used to calibrate and validate the model. The WRIA 1 approach will have a more rapid start-up and result in a simpler model with the advantage of more rapid execution and more spatial resolution in the watershed loading model but the disadvantage of less spatial resolution in the lake response model.

An important part of the articulation process is to ensure that the models provide consistent results. This process involves four steps to ensure consistency. First, both models must use consistent inputs – that is, lake geometry, flows, loadings, kinetic and mass transfer coefficients, boundary and initial conditions, and other inputs must be consistently specified. To this end, we proposed to use the same CEQUAL-W2 input files in the WRIA 1 model as will be used by WDOE and will provide watershed loading estimates in the same format as the empirical watershed loading model from DOE. Second, in-lake processes must be specified consistently with differences only in the degree of spatial resolution. Third, output must be consistently presented. The WRIA 1 model will provide outputs in a format consistent with that of the WDOE model so that output display and summarizing routines may be the same for both models. Finally, the ability to compare the output of the two models must be provided so that users will be able to demonstrate this consistency.

The purpose of EDN 8 was to develop a watershed loading and lake modeling and monitoring proposal for Lake Whatcom. Due to the parallel efforts by Ecology toward this end, the work is being carried forward in parallel and articulation with Ecology's distributed modeling work for Lake Whatcom and their empirical approach to watershed loading prediction. The work under EDN 8 is primarily toward the development of this plan – to do so will require some effort in building the model elements described in the draft EDN 8 proposal so the monitoring needs can be established that will support both the WRIA1 and Ecology efforts in model development. These elements will be developed to an extent sufficient for coordination with the monitoring work to be carried out in 2002-2003 by WDOE. Coordination with WDOE will be carried out via regular communication with the WDOE team via phone and email and articulation meetings 3-4 times throughout the process in Olympia and Bellingham.

Geographic Area:

Specific geographic areas have been identified in EDN 8 and EDN 13. The areas identified in EDN 13 for fine resolution modeling (South Fork Nooksack and Fishtrap) have been deferred and are not part of the current scope of work. However, the existing data files, software developed to date, and other documentation for fine resolution models will be provided as a deliverable.

Specific USU Subtasks:

- Construct and populate models for key areas as identified in EDN 13 efforts (with exceptions noted above) within WRIA 1 and verify computer code.
- Construct and populate Lake Whatcom watershed loading model as identified in EDN 8 and integrate loading model with the simple lake response model. Coordination with Ecology in the CEQUAL-W2 model development (as described in EDN 8) will ensure compatibility between Ecology and USU efforts. Output from the USU loading model

may be directly used by the CEQUAL-W2 model and will serve as an alternative to Ecology's loading model providing for scenario development.

- Calibrate and validate coarse and medium resolution models for EDN 13 and calibrate and validate models for EDN 8. The effort for the coarse model calibration will be limited (i.e., calibration assumed to hold for areas with similar characteristics).
- Construct quantitative uncertainty and sensitivity analysis modules for Lake Whatcom, and complete uncertainty analysis using the Lake Whatcom model

The Lake Whatcom model is a fine resolution dynamic (time variable) watershed loading and lake response modeling suite. USU will complete a full uncertainty analysis for this model using the first order error analysis (FOEA) approach,[10] For the course and medium resolution models, model inputs will be carefully examined statistically where measurements are available, and a thorough literature search for input values in similar lakes in the Pacific Northwest region will be used for the remainder. Significant efforts will be made to determine the internal correlation structure of those inputs and those correlations will then be considered in the error analysis where they are reasonably able to be determined. The uncertainty analysis package for the Lake Whatcom model will be included in the DSS model manager so that users can conduct their own assessments. The technical memo report will also include full documentation of the analysis process, a description of the parameter input data, and would be included in the DSS help system.

- Complete qualitative uncertainty and sensitivity analysis for coarse and medium resolution models.

The coarse resolution WRIA-wide and the medium resolution Dakota drainage models were designed to execute rapidly (a few seconds per scenario). This suggests that a Monte Carlo approach may be possible for key inputs, although, if the Monte Carlo method proves infeasible, a first order error analysis is of sufficient accuracy and executes much more rapidly. The tools of analysis are the same for both the limited and full uncertainty analysis, with the exception that expert judgment may substitute for first order or Monte Carlo methods in some cases. In a full uncertainty analysis, the primary effort is to identify the key inputs and determine using the literature, measurements made during the WRIA-1 project, and expert judgment the characteristics of those inputs, including their internal correlations. Some effort has already been expended to identify key inputs in general and obtain characteristic values and uncertainty in those values. In the proposed limited uncertainty analysis, expert judgment will be heavily relied upon to save the effort of statistical analysis of literature values and reconciling those values with measurements made in the field, as would be the case for the full analysis. The inputs' internal correlations would be ignored, except in those cases for which the correlation coefficients are readily available. Lastly, a brief summary evaluation of the uncertainty analysis results would be provided in a single technical team-reviewed technical memo (graphical results and brief written interpretation of those results). This will only be undertaken once the peer review process is completed for the report on conceptual model, mathematical model description, and model calibration and authorization to proceed is given by WRIA 1.

- Complete report explaining model construction, population, calibration, and validation.
- Complete technical memo explaining uncertainty analysis efforts and scenario evaluations.

Schedule:

- Existing/Historical/Full-Buildout (E/H/FBO) parameters technical memo representing USU's recommendations across technical elements
  - Draft memo provided to WRIA TTLs, April 9, 2004
  - WRIA comments on memo to USU, April 23, 2004
  - Conference calls to resolve comments:
    - Existing Conditions, April 29, 2004
    - Historical, May 6, 2004
    - Full Buildout, May 13, 2004
  - Final E/H/FBO Technical memo to WRIA TTLs, May 28, 2004
  - Final approval of E/H/FBO memo, June 11, 2004
- Uncertainty/Sensitivity methods memo
  - Draft to WRIA, April 16, 2004
  - WRIA comments on Uncertainty/Sensitivity methods memo to USU, May 14, 2004
  - Conference call to resolve comments to Uncertainty/Sensitivity methods memo, June 17, 2004

[10] The FOEA approach is the only practical one – execution times for the watershed loading model are long – several hours and the lake response model is also quite time consuming. Monte Carlo simulation using even a moderate number of trials would be prohibitive.

- Final Uncertainty/Sensitivity methods memo representing agreements reached during the above conference call to WRIA, July 2, 2004
- WRIA approval of Uncertainty/Sensitivity methods memo, July 16, 2004

- Development and verification of model structures, input files and data structures, and model population through October 2004
- Surface water quality beta model documentation package (Report I)
  - Preliminary Draft to WRIA, [December 17, 2004. This documentation package specifically includes:

1) The technical material related to defining calibration data sets and model parameters, summarized from the technical memo, Data Needs for Surface Water Quality Model Calibration and Definition of Scenarios, approved in March 2003.
2) Summary descriptions of each model and in particular any modifications made to the underlying model structures.
3) Detailed summary comparisons between predicted and observed model performance that specifically targets model uncertainty in terms of input data and model output results. This is not the formal uncertainty and sensitivity analysis that would follow the beta model reviews;
4) Explicit documentation on the water quality model-to-model communication in terms of data and time-step resolution.
5) A description of our assessment of the range of uncertainty of data inputs and model parameters.
6) The surface water quality team will assist with developing the draft 'user manual' for the DSS (as detailed in the DSS section of the SOW) that focuses on the development of scenarios and review of modeling results for the surface water quality component. This manual would not be targeting the detailed model specific use in terms of recalibration.

  - WRIA comments on Report I Preliminary Draft to USU on January 28, 2004
  - Conference call with SWQLTT to discuss/resolve/agree on changes to preliminary draft, February 14, 2005
  - Report I Draft to WRIA on March 11, 2005
  - WRIA comments on Report I Draft to USU on April 8, 2005
  - Conference call to resolve comments on Report I Draft May 2, 2004
  - Final beta model documentation package including Report I Final Draft 1, which includes documented changes from conference call described previously, to WRIA for peer review on, May 20, 2005
  - Delivery of beta version models to peer review, May 20, 2005
  - Peer review comments on Report I final draft 1 to USU on, August 5, 2005
  - USU/WRIA conference call to discuss/resolve peer review comments and document changes or modifications to incorporate in the final draft 1 report, August 29, 2005
  - Report I Final Draft 2 to WRIA on, September 23, 2005 (Final Product).
  - WRIA approval of Report I, October 31, 2005
- Sensitivity and Uncertainty technical memo including the details of a quantitative sensitivity and uncertainty analysis on Lake Whatcom, and a qualitative sensitivity and uncertainty analysis on the coarse and medium resolution models
  - to WRIA on October 21, 2005
  - WRIA comments on sensitivity and uncertainty technical memo November 4, 2005
  - Conference call to resolve comments on sensitivity and uncertainty technical memo November 18, 2005
  - Final Sensitivity and Uncertainty technical memo December 2, 2005
  - WRIA approval of Final Sensitivity and Uncertainty technical memo December 16, 2005
- Data files, software developed to date, and further documentation for South Fork and Fish Trap fine resolution models. (Further work has been deferred), August 27, 2004.

Deliverables:

- Report I: Model Descriptions and Calibration – This report will explain model construction, population, calibration, validation, and documentation of USU developed model components.
- Uncertainty and Sensitivity Analysis technical memo - This memo will explain the uncertainty analysis efforts in Lake Whatcom and the coarse and medium resolution drainages. .
- A beta version of the models will be delivered including a documentation package for peer review. Databases to support model execution will be delivered with models.
- A final version of the models will be delivered within the completed DSS. Databases to support model execution will be delivered with models.
- Data files, software developed to date, and other documentation for South Fork and Fish Trap fine resolution models.
- Existing, historic, and full build-out memo

Budget:

$ 28,828

6.1.3 Task 6.3: Integration of Surface Water Quality Information with Other Portions of the Study

Background:

The surface water quality component (i.e., module/models) of this project requires input from most other modeling components: surface water quantity, ground water quality and quantity, database and decision support systems, and instream flows. It will also supply information back to other components, e.g., fish habitat, ground water quality, and the data visualization components of the DSS. This requires a focused technical collaboration between primarily USU technical team members and to some degree technical exchanges with WRIA 1 Technical Teams.

Purpose/Objectives:

For successful integration among technical elements within the DSS, attention must be paid throughout Phase III to ensure that the information flow among components is facilitated. To this end, focused efforts throughout Phase III will entail the consistent interaction among technical team members of the USU team, and interaction of the USU team with the WRIA 1 technical teams and the Planning Unit to ensure that the integration process succeeds. This will be accomplished using software scoping sessions within the USU group to define data structures (including QA/QC), and regular meetings on-site, via teleconference, and via one-on-one phone and electronic mail with the WRIA 1 technical teams and the Planning Unit to ensure compatibility and completeness. All components of the project, including surface water quality, will be tightly integrated within the DSS.

Geographic Area:

WRIA 1 wide

Specific USU Subtasks:

- Integrate models coarse and medium resolution models into the DSS.
- Detail information needs of DSS for accomplishing goals laid out in DSS worksheets and EDN 8 and EDN 13.
- Construct data filters to incorporate model output into database.
- Construct data filters to directly communicate information between technical elements. This is primarily providing technical assistance in the Database Management component of the DSS as well as the linkages to the Data Visualization, Scenario Builder, and Alternatives Comparison modules.

Schedule:

- Integration of model(s) into DSS completed. December 17, 2004

Deliverables:

- Water Quality module fully integrated in Beta and final DSS deliverables (Section 3 of the SOW) on May 20, 2005 (Beta), September 23, 2005 (Final)

Budget:

$ 7,759

7. PHASE III SOW: GROUND WATER QUALITY

As of May, 2003 when the work stopped, we have nearly completed the single-layer nitrogen model that includes three sub-models: the on-ground nitrogen loading model, soil nitrogen dynamics model, and the fate and transport model. The completed work includes the conceptual models for all three sub-models, data synthesis, model calibration, model verification, and the evaluation of a limited number of test scenarios. Along with these tasks, we have a working module for the DSS that can be used with the nitrogen model.

In addition to the nitrogen model, we have a working version of the report related to heavy metals. The work on this report is about 75% completed for proper submission to WRIA 1. This report will be provided "as is." Therefore, this will be a non-reviewable deliverable.

Deliverables

Nitrate Fate and Transport Model

With the existing budget limitations in mind, we propose the following deliverables to WRIA 1 so that the remaining work of the Phase SOW (May 2002) can be completed at a later stage.

1. Microsoft access data file consisting of ground water quality data and simple document providing the basic details. April 16, 2004
2. Stand-alone single-layer nitrogen model with existing preliminary visual displays for data input and output with both executable and original source codes. April 30, 2004
3. A complete report of the nitrogen model(s) providing details related to on-ground nitrogen loadings, soil nitrogen dynamics, fate and transport, model calibration and verification data and results. May 14, 2004
4. A user-document providing the minimum necessary details of the stand-alone single-layer nitrogen model and its structure, data entry, and output gathering. May 28, 2004

The actual work related to the deliverables described earlier is almost completed except the results and knowledge base are not properly organized. Through the proposed deliverables, we believe that these results and knowledge can be minimally assembled in an efficient and a productive manner such that work on ground water quality can be commenced at a future date.

It should be noted that the budget requested for these deliverables does not include any form of peer review or revisions that may be requested by WRIA 1; if such requests are made, then separate budget allocations should be made to make necessary changes and revisions.

Integration of the Ground Water Quality model into the DSS is deferred.

These deliverables will be reviewed for completeness by WRIA.

Heavy Metals Report

The heavy metals report previously described will be provided "as is" at 75 percent completion. This report is non-reviewable. May 14, 2004

Budget: $25,918

8. PHASE III SOW: INSTREAM FLOW AND FISH HABITAT

The objective of the instream flow component of the WRIA 1 Watershed Management project is to estimate the relationship between stream flow and fish habitat quantity and quality for different fish life stages at selected locations throughout WRIA 1. Specifically, this effort will estimate ecological flow regimes necessary to sustain target fish species and life stages and other related flow dependent resources in WRIA 1. The effort will use the best available science, which will include the evaluation of the methods utilized, and development of a systematic framework to evaluate and estimate the instream flow requirements for the targeted fish species and life stages. Estimated flow regimes will consider sustainability issues.

8.1 Phase III Detailed Work Plan – Instream Flow and Fish Habitat

Note: There will be an amendment to the USU Phase III Scope of Work that relates to additional fieldwork being completed by USU during the summer of 2003 using a Department of Ecology grant to WRIA Joint Board. The work will be performed as outlined in that work plan, compensation schedule, and timeline as set out in the ISF contract amendment to the Phase III USU Scope of Work. The work to be performed by USU is an expansion of subtasks contained in the existing Phase III Tasks 8.1 and 8.6 and involves the field collection and hydraulic/habitat analyses at additional sites in WRIA 1. The contract amendment details do not replace the tasks or deliverables identified in this section of the Phase III Scope of Work. The contract amendment for this effort and the subsequent expansion of fieldwork is the result of additional funds being granted to the WRIA 1 Joint Board by the Washington State Department of Ecology.

8.1.1 Task 8.1: Data Reduction, Hydraulic and Habitat Model Calibration and Validation

Background:

The Phase II SOW and Hardy (2000) identified the specific technical requirements for this task.

Purpose/Objectives:

Task 8.1 will focus on data reduction and development of calibrated hydraulic and habitat models at all sampled field sites. This work will involve analyses using 1-dimensional hydraulic and habitat modeling at the five Rapid Assessment Sites and 2-dimensional hydraulic and habitat modeling at the 22 intensive sites (see Table 8-1). This work will include comparative analyses of modeling results (i.e., habitat versus discharge relationships) using both the rapid assessment and intensive site modeling results where these data (i.e., sampling/analyses) exist at overlapping field sites. This will include a comparison of the Toe-Width Method employed by Washington Department of Ecology at these overlap sites. The task will also involve an iterative approach to habitat modeling for all 27 sites based on a comparison between observed fish species and life stage habitat use, habitat suitability criteria validation work (where appropriate data exist), and conceptual habitat modeling results. These procedures will follow the guidelines outlined in Hardy (2000) as adopted by the WRIA 1 Watershed Management Project. A listing of all sites in which analyses will be completed are as follows:

Table 8-1. Intensive and rapid assessment sites where comparative analyses will be conducted (see Task 8.1).
Table 1. Instream Flow Study Sites in WRIA 1 (2000 – 2001)

Study Site	*Site Characteristics*		
	Site Type[1]	Overlap Site[2]	Measured Flow Range[3]
Whatcom Creek	Intensive	No	15.21 cfs - 133.62 cfs
Bertrand Creek	Intensive	Yes	4.21 cfs to 19.59 cfs
Fishtrap Creek	Intensive	Yes	7.17 cfs to 44.79 cfs
Tenmile Creek	Intensive	Yes	7.89 cfs to 41.54 cfs
Anderson Creek	Intensive	Yes	1.3 cfs to 11.74 cfs
Dakota Creek	Intensive	Yes	0.25 cfs to 0.46 cfs
South Fork Nooksack	Intensive	Yes	375 cfs to 899 cfs
Middle Fork Nooksack	Intensive	Yes	~315 cfs to 814 cfs
North Fork Nooksack	Intensive	Yes	~326 cfs to 2,051 cfs
Mainstem near Confluence	Intensive	Yes	1,320 cfs to 6,050 cfs
Mainstem near Everson	Intensive	No	~2,600 cfs to ~4,100 cfs

Study Site	*Site Characteristics*		
	Site Type[1]	Overlap Site[2]	Measured Flow Range[3]
Mainstem near Lynden	Intensive	No	~2,500 cfs to ~4,000 cfs
Mainstem near Ferndale	Intensive	Yes	2,340 cfs to 3,040 cfs
Mainstem at Estuary	Intensive	No	~1,900 cfs to ~3,300 cfs
Lower South Fork Nooksack	Intensive	No	339 cfs to ~2,300 cfs
Kendall Creek	Intensive	Yes	Upper Site: 0.35 cfs to 34.13 cfs Lower Site: 0.24 cfs to 39.36 cfs
Hutchinson Creek	Intensive	Yes	12.5 cfs to 82.1 cfs
Maple Creek	Intensive	Yes	8.8 cfs to 45.49 cfs
Austin/Beaver Creeks	Intensive	No	Done (8/23/01) 2.14 cfs
Squalicum Creek	Intensive	No	Done (8/06/01) 0.394-0.561 cfs
Johnson Creek	Intensive	Yes	Pending
Black Slough	Intensive	No	Done (9/24/01) Lower Site: 0.865 cfs
Racehorse Creek	Rapid Assessment	Yes	
California Creek	Rapid Assessment	Yes	
Kamm Creek	Rapid Assessment	No	
Haynie Creek	Rapid Assessment	No	
Breckenridge Creek	Rapid Assessment	No	

[1] Methodology applied at "Intensive" sites described in Hardy (2000); methodology applied at "Rapid Assessment" sites described in Kennard (2001)

[2] "Overlap" means at or near a location where the Department of Ecology established minimum instream flow levels as part of the Instream Resources Protection Program (IRPP) in 1986 (Ecology 1986).

[3] The flow ranges used in the computer modeling effort are above and below the measured flows. For the rapid assessment methodology, only one flow is used/measured.

The Task will also include the re-analysis of all intensive field sites previously reviewed by the ISF/FH Technical Team to reflect changes and corrections by WRIA to the substrate/cover coding and revision to the Habitat Suitability Criteria (HSC). The technical specifics have been documented in the ISF/FH Technical Team memorandum and meeting minutes. This reanalysis will require updating of existing substrate and cover coded polygon coverage at each site, re-computing the appropriate distance to cover categories for identified species and life stages, reanalysis of the habitat versus discharge relationships for each site, generating the fish observation overlays on model results at each site, and updating all appropriate documentation. These revisions will also be carried forward to complete analyses at all existing intensive sites.

Geographic Area:

Study site specific for Instream Flows and Fish Habitat

Specific USU Subtasks:

- Field data reduction and QA/QC
- Hydraulic model calibration and validation
- Conceptual development of habitat models for target species and life stages
- Validation of habitat suitability curves
- Development and validation of habitat models for target species and life stages

Schedule:

- Field data reduction and QA/QC. March 31, 2004
- Hydraulic model calibration and validation. March 31, 2004

- Conceptual development of habitat models for target species and life stages. April 30, 2004
- Validation of habitat suitability curves. April 30, 2004
- Development and validation of habitat models for target species and life stages. December 17, 2004
- Preliminary habitat modeling results provided to WRIA, May 28, 2004

Deliverables:

- 8.1.A Reduced field data in electronic format. Includes re-analysis of intensive field sites to reflect changes and corrections to substrate/cover coding and revision to Habitat Suitability Curves. December 17, 2004
- 8.1.B Calibrated hydraulic and habitat models. Includes model software, model documentation that includes input and output files for each site and final habitat suitability curves, and documentation/summary of field methods used for intensive and rapid assessment sites (may be provided as an appendix to the report - largely completed after the 2000 field season. 2 hard copies, 10 cds. December 17, 2004
- 8.1.C Photocopies of field notes (Only field notes for FY 2003 field sites under the DOE Grant will be provided since other field notes have already been provided to WRIA under completed and WRIA approved EDN work). March 31, 2004

Budget:

$ $59,688

8.1.2 Task 8.2: Habitat Utilization Validation Data

Background:

Hardy (2000) and the Phase II SOW identified the need to collect field based habitat use by target species and life stages for use in the habitat suitability criteria, habitat model development, and habitat modeling validation efforts.

Purpose/Objectives:

The habitat utilization validation task will focus on the coordination of collection efforts at intensive study sites. The goal of this effort is to obtain presence and absence data in a spatially accurate manner in order to provide validation data for habitat suitability criteria and habitat modeling. This will continue during the year through the collaborative efforts by salmon co-managers and other resource management agencies. These combined efforts are expected to provide fish utilization data that will be provided to USU to assist in model validation.

Geographic Area:

Instream Flow field data site specific

Specific USU Subtasks:

- Digitize field maps containing fish locations at each site sampled.
- Update databases for fish collection observation data.
- Conduct habitat suitability criteria validation analyses and update criteria where appropriate.

Schedule:

- Field data of fish observations at intensive study sites provided to USU for digitizing and database updates for all transmitted data. February 27, 2004
- Habitat suitability criteria validation. April 30, 2004.

Deliverables:

- 8.2.A - digitized fish location data. (USU was provided copies of WRIA field notes and photographs and these will not be given back as a deliverable. Only the electronic copies of the digitized fish locations developed at USU will be provided on cd. December 17, 2004
- 8.2.B - Updated (or validated) habitat utilization curves where sufficient data is available to conduct the required analyses for specific species and life stages. Deliverable includes a technical memo describing the extent that fish

utilization data was used or could be used to validate habitat suitability criteria. 10 cds (digitized fish observation data and technical memo) and 2 hard copies (technical memo only) December 17, 2004

Budget:

$ 0

8.1.3 Task 8.3: Updated Basin Stratification for Instream Flow Assessments

Background:

The Phase II SOW and related Phase II technical analyses identified that the existing basin stratification should be revised based on additional information collected as part of ongoing WRIA 1 technical studies. The original stratification was primarily conducted to help guide selection of field sites for field data collection efforts.

Purpose/Objectives:

This task will rely on updated information within the WRIA 1 database to evaluate the existing stratification of the WRIA in terms of instream flow assessment needs. This effort will focus on development of a stratification of drainages into homogeneous areas where stream systems have similar hydrologic, geomorphic, and biological characteristics as outlined in Hardy (2000). The initial purpose of this stratification was to assist in the selection of study sites during the Phase II 2001 field season to obtain representative assessment data throughout WRIA 1. Ultimately the updated stratification will be used in conjunction with the instream flow extrapolation methodology being developed under Task 8.6 to achieve the goals of evaluating, revising, and/or setting instream flows WRIA 1 wide under Task 8.5 (i.e. March 27, 2000 SOW). Review of potential stratifications will be coordinated through both the Instream Flow and Fish Habitat Technical Teams and in conjunction with Task 8.6. It should be understood that depending on the extrapolation methodology employed, different stratifications will likely be required. The technical report on the stratification procedures will documents these different approaches where necessary.

Geographic Areas:

WRIA 1 wide

Specific USU Subtasks:

- Conduct statistical analyses of revised drainage (or reach) level information to revise the basin stratification results.
- Coordinate review of the stratification results with WRIA 1 personnel.
- Finalize the basin stratification(s) and summary report.
- Develop field data collection protocol.

Schedule:

- Basin Stratification Report – Note: This report has already gone through preliminary draft and draft review process.
  - Complete revised statistical analyses of data sets, including new DOE grant site data. October 22, 2004
  -
  - Comments on revised stratification report to USU November 5, 2004
  - Conference call to resolve comments on revised stratification report November 19, 2004
  - Revised report submitted with material for full beta documentation. December 17, 2004
  - WRIA approval, January 28, 2005

- Field Collection Methodology Report
  - Preliminary Draft Field Collection Methodology Report. December 17, 2004.
  - WRIA comments on Preliminary Draft Field Collection Methodology Report January 28, 2004
  - Conference call to resolve comments on Preliminary Draft Field Collection Methodology Report February 16, 2005
  - Draft Field Collection Methodology Report March 11, 2005
  - Comments on Draft Field Collection Methodology Report April 8, 2005
  - Conference call to resolve comments on Draft Field Collection Methodology Report May 4, 2005
  - Final Draft 1 Field Collection Methodology Report May 20, 2005 (Peer Review step)
  - WRIA comments on Final Draft 1 Field Collection Methodology Report August 5, 2005
  - Conference call to resolve comments on Final Draft 1 Field Collection Methodology Report August 31, 2005

- Final Draft 2 Field Collection Methodology Report September 23, 2005
- WRIA approval of Final Draft 2 Field Collection Methodology Report October 31, 2005

Deliverables:

- 8.3.A - Updated basin stratification scheme report.
- 8.3.B - Data collection protocol report to guide field data collection and analyses in future work and serve as the basis for development of the extrapolation methodology discussed under Task 8.5.

Budget:

$ 15,968

8.1.4 Task 8.4: Comparative Analysis of WDOE Instream Flow Requirements

This task has been eliminated.

8.1.5 Task 8.5: Development of Estimated Ecological Flow Regimes

Background:

Hardy (2000) identified the components of an ecologically based flow regime necessary to protect the aquatic resources of rivers. The work was identified as a key component in the Phase II SOW to be completed during Phase III.

Purpose/Objectives:

This task will focus on the development of an analysis and interpretation framework necessary to estimate optimal instream flows for fish species and life stages, and other flow dependent resources in the WRIA throughout the year. The analysis will focus on the integration and interpretation of physical habitat (i.e., micro-habitat), meso-habitat characteristics (i.e., water quality and temperature), hydrology, habitat and riparian maintenance flows, habitat time series (i.e., the time series of available habitat), and potentially estimated growth rates. The integration of these factors is necessary to determine an ecologically based instream flow regime. This task will also explicitly examine validation and verification of modeling results in light of known fish observations where suitable data are available.

Geographic Area:

WRIA 1 wide

Specific USU Subtasks:

- Utilize the calibrated habitat modeling results, estimated or measured hydrology, and species and life stage periodicities to conduct habitat time series at each study site.
- Coordinate with WRIA 1 personnel to develop a framework for interpretation of the modeling results to assist in the development of instream flow recommendations.
- As part of this effort, USU will evaluate existing, historical, and full build out scenarios in terms of habitat conditions within WRIA. The assessment of the changes in channel length between historical and existing conditions will be addressed as part of the technical memo on existing, historical, and full build out scenarios. This memo will identify the specific recommended technical approach to address this scaling issue for channel lengths.

Schedule:

- Complete habitat modeling and related habitat time series modeling. December 17, 2004
- Assist WRIA in the development of an analysis framework for establishing instream flows. August 27, 2004
- ISF framework technical memo, October 1, 2004
- Existing, Historical, Full Buildout technical memo
  - Draft memo to WRIA, April 9, 2004
  - WRIA comments on E/H/FBO memo to USU April 23, 2004
  - Conference call to resolve comments
    - Existing conditions, April 29, 2004
    - Historical conditions, May 6, 2004

        - Full Buildout conditions, May 13, 2004
    - Final E/H/FBO technical memo to WRIA, May 28, 2004
    - WRIA approval of E/H/FBO technical memo, June 11, 2004

Deliverables:

- USU will provide, in coordination with Ecology and WDFW experts, a memo describing a framework for use of instream flow technical information in making management decisions. This memo will be used to assist WRIA in the development of a consistent framework for the interpretation and application of site-specific and extrapolated methodologies to assess instream flow recommendations. This will include, but not be limited to, identification/quantification of aquatic base flows, channel, habitat, and riparian maintenance flows, and general ecological flows that integrate physical, chemical, and biological processes.
- Calibrated hydraulic and habitat modeling components contained within the DSS. Successful completion of this Task is dependent on the successful completion of Tasks 8.6 and 8.7. (Documentation for this element will be in the report for Task 8.1).

Budget:

$ 19,826

8.1.6 Task 8.6: Development and Validation of Instream Flow Extrapolation Methodology

Background:

Hardy (2000) identified the need to develop an extrapolation methodology for establishment of instream flows given that site-specific data could only be collected at a limited number of locations within the WRIA 1 as part of the existing watershed planning project.

Purpose/Objectives:

Pursuant to discussions with the Instream Flow and Fish Habitat Technical teams, a two-day workshop was held in early 2002. The purpose of the workshop was to finalize an action plan for extrapolating the results from the intensive study sites to locations throughout WRIA 1 where the requisite instream flow data have not been collected due to resource constraints. This workshop was open to participation of all Staff Team/Technical Teams, Planning Unit, caucuses, and other interested parties.

Geographic Area:

WRIA 1 wide

Specific USU Subtasks:

Facilitate the coordination and provide technical assistance for the proposed workshop, including:

- Provide draft stratification and extrapolation procedure(s) and other supporting preparatory information to participants prior to the workshop
- Participate in the workshop
- Develop a summary report based on the outcome of the workshop
- Develop the extrapolation methodology and conduct validation work
- Semi-quantitative uncertainty and sensitivity analyses for hydraulic and habitat models. This will entail the simulation of expected variances in depth and velocity solutions in the hydraulic model on habitat versus discharge relationships and include sensitivity of the habitat relationships to differences in habitat suitability curves. Ranges of expected variance in depth and velocity will be derived from previous work and literature values.

Schedule:

- Workshop occurred in April 2002.
- Workshop summary report completed. May/June 2002 (Deliverable 8.6A - completed)
- Uncertainty and Sensitivity methods memo
    - Draft memo to WRIA April 16, 2004

- WRIA comments on Uncertainty and Sensitivity methods memo to USU May 14, 2004
- Conference call to resolve comments on Uncertainty and Sensitivity methods memo June 17, 2004
- Final Uncertainty and Sensitivity methods memo July 2, 2004
- WRIA approval of Uncertainty and Sensitivity memo, July 16, 2004

- Implement extrapolation methodology and validation work, December 17, 2004
- Extrapolation Methodology Report (Deliverable 8.6B).
  - Preliminary Draft of Extrapolation Methodology Report, December 17, 2004
  - Comments on Preliminary Draft Extrapolation Methodology Report January 28, 2005
  - Conference call to resolve comments on Preliminary Draft Extrapolation Methodology Report February 16, 2005
  - Draft Extrapolation Methodology Report March 11, 2005
  - Comments on Draft Extrapolation Methodology Report April 8, 2005
  - Conference call to resolve comments on Draft Extrapolation Methodology Report May 4, 2005
  - Final Draft 1 Extrapolation Methodology Report (Peer Review step) May 20, 2005
  - WRIA and Peer Review comments on Final Draft 1 Extrapolation Methodology August 5, 2005
  - Conference call to resolve comments on Final Draft 1 Extrapolation Methodology Report August 31, 2005

Final Draft 2 Extrapolation Methodology Report September 23, 2005

  - Final WRIA approval of Extrapolation Methodology Report October 31, 2005,
- Uncertainty/Sensitivity technical memo
  - Draft to WRIA October 21, 2005,
  - WRIA comments to USU November 4, 2005
  - Conference call to resolve comments November 18, 2005
  - Final Uncertainty/Sensitivity technical memo December 2, 2005
  - WRIA approval Uncertainty/Sensitivity December 16, 2005.

Deliverables:

- 8.6.A - A report that details the process for development of the extrapolation methodology and validation work from the workshop. Completed.
- 8.6.B - A report that documents the final extrapolation methodology, validation results, identification of uncertainty in the extrapolation method linked to specific strata, and recommendations for future efforts to reduce uncertainty where feasible.
- 8.6.C – A technical memo that documents the semi-quantitative uncertainty and sensitivity analyses results. October 21, 2005

Budget:

$ 29,596

8.1.7 Task 8.7: Instream Flow Selection Methodology Workshop

This Task has been completed and all deliverables provided to WRIA.

8.1.8 Task 8.8: Invertebrate Sample Processing

Background:

The instream flow workshop (Hardy 2000) identified bioenergetics modeling as a quantitative assessment tool for modeling fish habitat for determining instream flow needs within WRIA 1. This approach has certain analytical advantages not inherent in the physical habitat based modeling also being undertaken. Collection of necessary data for implementing this approach was identified during the Phase I scoping process and data collection was part of the Phase II work. One component of the required data is quantification of food availability (i.e., macroinvertebrate density and size distribution) at each intensive study site. Macroinvertebrate data was collected during both the 2000 and 2001 field seasons at all intensive instream flow study sites.

The macroinvertebrate samples collected as part of the field work were being processed for free as part of collaborative efforts of the salmon co-managers. They have completed 80 of the 100 samples collected during the FY 2000 field season and work is underway to process the remaining FY 2000 samples and the 140 samples collected during the FY 2001 field season. The samples that have been processed will also be analyzed to count the number of bugs into sizes for use in the bioenergetics modeling.

Purpose/Objectives:

This task requests allocation of funds to complete the remaining invertebrate sample processing in order to undertake the bioenergetics modeling. Failure to process these data would preclude the application of this modeling approach which has been identified as a technical assessment method to be implemented. Decisions regarding the selection of laboratory protocols, level of taxonomic resolution, the use and selection of regionally respected professional taxonomists, and the form of final data analysis will be made in conjunction with the Instream Flow/Fish Habitat Tech Team. Note: The current budget is estimated for sample processing to remove macroinvertebrates from the samples and categorize into size classes only. If more extensive processing (e.g., taxonomic resolution, additional statistical analyses) are desired, then budget modifications to reflect this level of effort will be required.

Geographic Area:

FY 2000 and FY 2001 instream flow study sites

Specific USU Subtasks:

- Process bug samples
- Update databases with data

Schedule:

- Complete processing of samples by March 28, 2003 (assuming current level of processing)
- Update databases by May 28, 2004
- Develop data visualization module within DSS to display where invertebrate sampling occurred and data available. May 28, 2004

Deliverables:

- Update databases with macroinvertebrate information that will be in a form agreed upon with the Instream Flow/Fish Habitat Tech Team and integrated into data visualization module of DSS. (Provided as part of DSS data visualization module - Task 3.3 - Macroinvertebrate data viewer plug-in). December 17, 2004

Budget:

$ 0

Note: This budget assumes that the delineations of the invertebrate samples are at the resolution indicated in the SOW. However, as noted in the Phase III SOW version 3 comments, the Instream Flow and Fish Habitat Technical Teams may elect to expand the analysis. If this occurs, then a revised budget will be prepared and submitted for a contract modification.

8.1.9 Task 8.9 Integration of Instream Flow Model Results and Fish Habitat Data into the DSS

Remaining work in this task incorporated into Task 3

Background:

As in all other aspects of the project that require technical linkages between different models and between models and the WRIA 1 database, the instream flow and fish habitat analysis capabilities will have to be integrated into the DSS.

Purpose/Objectives:

The purpose of this task is to identify and document all informational linkages between instream flow and fish habitat models, other models, and the WRIA 1 database. This task will develop the necessary graphical interfaces and modules of instream flow and fish habitat to interact efficiently with the main module of the DSS. This task will focus on software development to integrate the analytical instream flow and fish habitat tools with the main module of the GIS-based DSS.

Geographic Area:

WRIA 1 wide

Specific USU Subtasks:

- Develop linkages to surface water quantity and quality model results to provide:
  - Habitat time series
  - Chronic and acute exposure metrics
  - Habitat versus flow relationships for target species and life stages
- Species and life stage distributions and seasonal periodicity
- Linkages to drainage and reach specific physical, chemical, and biological data within the DBMS
- Integration of instream flow extrapolation procedure into the DSS

Schedule:

- This task is inherently incorporated in the delivery schedule of Task 3 with Preliminary Draft Report delivery on December 17, 2004, then follows the established review cycle for the DSS.

Deliverables:

- The completed DSS relevant software and a report that documents its proper use.
- Updated database for all relevant physical, chemical, and biological data.
- Integration of instream flow extrapolation methodology into DSS.

Budget:

$ 0

9. PHASE III SOW: WATERSHED PLAN, EIS, AND SOCIO-ECONOMIC COORDINATION

9.1 Phase III Detailed Work Plan – Watershed Plan, EIS, and Socio-economic Coordination

Successful creation and implementation of a watershed management plan for WRIA 1 will require close coordination of USU and the contractor selected by the Joint Board to write the watershed plan, conduct the state and federal EIS, and incorporate the socio-economic components into the watershed plan. Much of the work needed for the formulation of the plan must come from the various water planning and management institutions that are resident in WRIA 1 itself. However, the following coordination tasks will be required:

9.1.1 Task 9.1: Technical Assistance and Information Exchange

The only activities to be completed under this work element will be the review of the technical sections of the Watershed Plan being developed by WRIA. These technical sections relate to the summary material developed by USU under Phase I, II, EDN, and Phase III work. This effort is assumed to require no more than a person week for each of the Principal Investigators, no travel requirements, and comments provided will not require an iterative review process by WRIA. This review will focus on the evaluation of how the work completed by USU has been characterized, summarized, and applied to ensure it is technically correct.

Background:

The technical studies conducted by USU in Phases I, II, EDN, and Phase III have focused primarily on assessing the available data in WRIA 1 and model development in anticipation of the information needs of the watershed management plan. However, it is customary in water resources planning activities for these sorts of technical support studies to be conducted after organized and systematic work on scoping, identification of potential management options, etc., has been done. This is currently underway in the WRIA, and as a result, much coordination remains to be done to integrate the final work on technical activities with the preparation of watershed management planning documents.

Purpose/Objectives:

The purpose of this task is to provide an effective interface between the work done by USU in the technical support studies and development of the DSS with the contractor responsible for development of the watershed management plan and related documentation and with WRIA 1 personnel and teams.

Specific USU Subtasks:

This effort will entail each PI reviewing the technical sections of the Watershed Plan that relate to summary information contained in the Phase I, II, EDN, and Phase III deliverables to ensure that the technical material is represented accurately and has been properly characterized and applied.

Schedule:

February 20, 2004.

Deliverables:

Each technical section of the Watershed Plan that deals with summary information derived from the USU Phase I, II, EDN, and Phase III deliverables will be reviewed and editorial comments provided back to WRIA in the form of either red line/strike-out of the electronic copies or in memo form using page and line number format.

Budget:

$ 15,000

9.2.2 Task 9.2: Specialized Technical Support for Watershed Plan and EIS Development - Eliminated

10. PHASE III SOW: PROJECT MANAGEMENT

The main objective for this component is focused on overall technical coordination among all study elements and facilitating information exchange within the WRIA 1.

10.1 Phase III Detailed Work Plan – Project Management

The following tasks provide a work plan for addressing the project management objectives.

10.1.1 Task 10.1: Project Coordination for Study Components

The focus of this task will involve two separate levels of effort. At the project level, Dr. Hardy and Dr. McKee will have overall management responsibilities for all components of the project at USU. USU will coordinate project activities with their counterpart as designated by the Joint Board. At the technical level, USU has assigned one or more Technical Team Leaders associated with each study component to parallel the Technical Team Leaders on the WRIA 1 Staff. The Technical Team Leaders at USU will have overall responsibility to manage the technical implementation of each study component in close collaboration and coordination with their respective Technical Team Leaders for WRIA 1. Each Technical Team Leader will be responsible for coordinating efforts within their respective technical teams. Conference calls will be scheduled on a regular basis to facilitate communication among all technical components with participation consisting of both the WRIA Technical Team Leaders and USU Technical Team Leaders. The purpose of the calls will be to discuss status of deliverables, schedule, budget, identify problems encountered, and decisions or direction that is needed. The calls are envisioned to be no longer than 1 hour in duration and not more frequent than every other week. Exceptions to the duration and frequency of the calls may be necessary in order to resolve unanticipated problems or to expedite decision-making.

Schedule:

- Task 10.1 will be completed December 16, 2005

Budget:

$9,500

10.1.2 Task 10.2: Public Involvement and Education Coordination - Eliminated

10.1.3 Task 10.3: Coordination of Independent Review Panel - Eliminated

10.1.4 Task 10.4: Project Tracking

This Task will involve the following:

- USU will continue using the detailed subtask budget breakdown that clearly shows the estimated time allocations by staff level (e.g., PI, research engineer, research technician, etc.) developed for previous SOWs. These estimates for each subtask will be setup in a master tracking spreadsheet for all funded work elements.
- USU will clearly identify what the specific deliverables are for each Task (subtask where appropriate) and their delivery date. This will also include, where appropriate, intermediate work products (not deliverables) necessary to complete the task and requiring WRIA interaction and their required completion dates.
- On a weekly basis, USU will hold both a PI and staff team meeting where the time allocations (and estimated costs) for each labor category for each identified subtask will be summarized and tracked against the original budgets in the tracking spreadsheet. USU will also confirm with the PI and technical team members assigned to each work element that the estimated completion date for each deliverable has not changed. This is not an estimate of the percent completion on a weekly basis but whether the target date for completion remains on track as specified in the calendar for project deliverables.
- USU will report during weekly (or as scheduled) Contract Administrator calls with WRIA the status of each subtask in terms of current cumulate expenditures and status of meeting target dates for each deliverable.
- In the event that either the estimated budget or timeframe of deliverables appear to be a problem, the nature of the problem will be concisely identified in either an email or brief memo to WRIA and a remedial plan of action mutually formulated that can be agreed to by WRIA. This will/may also require concurrence with the Joint Board or its administrative staff.

- When a 'request' is received at USU via the WRIA Tech Teams or Contract Administrator that can not be identified as an element within the SOW or its stated assumptions, USU will send the request to the Contract Administrator with a request for direction on how USU is to proceed.

The intent of this effort is not only to communicate project status and progress but also to provide information that will facilitate the quarterly project reporting requirements by the WRIA 1 staff team. To facilitate this activity, USU is allocating a half-time position during Phase III.

Along with the Beta phase of the DSS and model elements being presented in December 2004 or other agreed upon date, USU will be present at the next scheduled Joint Board Meeting to answer questions. The Joint Board will approve continued work and changes that are needed. This approval may result in the change of timing, redefinition of content or elimination of elements of the SOW. This approval will also serve as content quality control checkpoint.

Schedule:

- Task 10.4 will be completed December 16, 2005.

Budget:

$45,519

10.1.5 Task 10.5: Project Deliverables Technical Writing Support – Eliminated

11. PHASE III SOW: TECHNOLOGY TRANSFER

11.1 Phase III Detailed Work Plan – Technology Transfer

Background:

USU has stressed the importance of a strong technology transfer component as part of our involvement in the development and implementation of the DSS/DBMS. The ability of the collaborating entities within the WRIA 1 to maintain, extend, and apply the tool beyond the end of this particular phase of the watershed planning is critically important. The efforts of this component are focused on facilitating information exchange within the WRIA 1 Public Involvement and Education (PIE) process and technical training on the components of the DSS/DBMS in their application to watershed planning.

Due to budget limitations, all work elements under Task 11 with the exception of general DSS use training, maintenance, and administration (Task 11.1.1 and Task 11.1.7) have been deferred.

Purpose/Objective:

The overall objective for the Technology Transfer component of the SOW is to ensure adequate training of WRIA 1 participants in the use of each technical module, overall DSS/DBMS system, and DSS System maintenance and administration. Technical training will be provided for the following components:

- Surface Water Quantity
- Surface Water Quality
- Groundwater Quantity
- Groundwater Quality
- Instream Flow/Fish Habitat
- Over all DSS Utilization including
    - Watershed Characterization
    - Data Visualization
    - Scenario Builder
    - Alternatives Comparison
- DSS System Maintenance and Administration
    - Database Management/Structure

The purpose of this training is to facilitate development of resident expertise within the WRIA 1 in the application and maintenance of the DSS. We anticipate that as part of the initial coordination activities under Phase III that issues such as intended audience, required expertise, and potential certification on use of the overall DSS system and/or specific components will need to be resolved.

Technical training will generally entail a workshop format involving lecture and hands on laboratory exercises. Workshop materials will be developed for each module and will represent deliverables under this component of the Phase III SOW. These workshops will cover the underlying technical aspects of the particular module, the function of the module within the DSS/DBMS structure, format and location of data within the database, guidelines for application of the module, and interpretation of module results.

Specific USU Subtasks:

Training workshops will be conducted for each of the following:

- Surface Water Quantity
- Surface Water Quality
- Groundwater Quantity
- Groundwater Quality
- Instream Flow/Fish Habitat
- Overall DSS Utilization including
    - Watershed Characterization
    - Data Visualization

    - Scenario Builder
    - Alternatives Comparison
- DSS System Maintenance and Administration
    - Database Management/Structure

The following section of the SOW provides a brief overview of each intended workshop. However, the specific format and content will be determined based on discussions between USU and Staff Team/Technical Teams. The purpose of these tasks is to provide training with respect to the following aspects of each model/module:

- conceptualization and formulation of management scenarios
- selection of models for management scenario analysis;
- population of models using the existing databases;
- modification of databases;
- using the graphical input data interfaces;
- running the models; and
- simulation result interpretation.

11.1.1 Task 11.1.1: DSS/DBMS

USU will provide two training sessions to the technical teams on the use of the DSS for simulating scenario results based on the existing, historical, and full build-out scenarios. This will not address ground water quantity or quality since these components are not part of the deliverables for the DSS simulation capabilities. Also included will be training on and use of the data visualization plug-ins and their interrelationships. Each training session is targeted for 2-3 days each. On-going consultation on the use of the various analytical models and integrated DSS modules will also be given during this period. A substantially complete beta version of the system with models and other analytical tools will be delivered on December 17, 2004. This version will be capable of being implemented in the watershed planning process and will serve as the major shakedown version. The final DSS (for funded components) will be delivered on September 23, 2005.

Task 11.1.1 will include two training work sessions for WRIA personnel on January 6-7, 2005, with the delivery of the beta DSS (funded components). A second training workshop will be held September 29-30, 2005, with delivery of the draft final DSS (for funded technical components).

Budget:

$ 24,994

11.1.2 Task 11.1.2: Surface Water Quality - Deferred

This task is uniquely identified from other portions of the scope of work because it explicitly only seeks "conditional approval" for its content. There is no request for formal approval of its budget or its specific methodology at this time. Due to budgetary constraints, implementation of this task is deferred until formal approval of its budget and specific methodology occurs from the WRIA 1 Planning Unit and Joint Board.

The purpose of this workshop is to provide training specific to the technical issues involving water quality modeling as implemented in the DSS/DBMS for the WRIA 1. This will include the use of the Data Visualization System and linked analysis module for the water quality data to examine, analyze, and set up specific water quality modeling scenarios. The training will take place over the course of one week. It is presumed that the participants will also have an understanding of the data viewer and other overview/interpretive DSS components. A computer/laptop for each participant with sufficient resources and software to run the DSS is required. The location for the training will be identified by USU in collaboration with WRIA 1 personnel. The training will be a balanced mixture of presentation, discussion, demonstration, and hands-on practice.

Budget:

$ 24,427

11.1.3 Task 11.1.3: Surface Water Quantity - Deferred

This task is uniquely identified from other portions of the scope of work because it explicitly only seeks "conditional approval" for its content. There is no request for formal approval of its budget or its specific methodology at this time. Due to budgetary

constraints, implementation of this task is deferred until formal approval of its budget and specific methodology occurs from the WRIA 1 Planning Unit and Joint Board.

A week-long workshop will be held to provide training for individuals designated by Staff Team in the formulation, content, data requirements, and use of all surface water quantity simulation models.

It is anticipated that the ability to maintain and upgrade the surface water modeling portion of the DSS will require at least the following personnel who will attend the training sessions:

One (1) GIS specialist with proficiency in GIS software and VisualBasic programming. This person must also have broad knowledge of water resources and land use data.
One (1) Hydrologic engineer with extensive rainfall-runoff modeling experience, VisualBasic, and FORTRAN/C++ programming proficiency.

At least one additional person with a broad knowledge of hydrologic processes should be present for the training. This person (in place of one of the specialists noted above) could operate the surface water model for analyzing management options. Although these people would not be expected to modify the source code of the model, they would be required to attend the full workshop to gain adequate understanding of the model to use it appropriately.

It is hoped that these people will be identified early in Phase III work to allow customized documentation written at their level of understanding. This would also allow a more continuous dialogue between the designers at USU and the long-term users.

The training will take place over the course of one week and will include a joint session with the ground water modeling group to cover the interactions between surface water and ground water. It is presumed that the participants will also have an understanding of the data viewer and other overview/interpretive DSS components. A computer/laptop for each participant with sufficient resources and software to run the DSS is required. The location for the training will be identified by USU in collaboration with WRIA 1 personnel. The training will be a balanced mixture of presentation, discussion, demonstration, and hands-on practice.

Budget:
$ 26,980

11.1.4 Task 11.1.4: Ground Water Quantity- Deferred

This task is uniquely identified from other portions of the scope of work because it explicitly only seeks "conditional approval" for its content. There is no request for formal approval of its budget or its specific methodology at this time. Due to budgetary constraints, implementation of this task is deferred until formal approval of its budget and specific methodology occurs from the WRIA 1 Planning Unit and Joint Board.

The purpose of this workshop is to provide training specific to the technical issues involving water quantity modeling as implemented in the DSS/DBMS for the WRIA 1. This will include the use of the Data Visualization System and linked analysis module for the water quantity data to examine, analyze, and set up specific ground water quantity modeling scenarios. The training will take place over the course of one week and will include a joint session with the surface water modeling group to cover the interactions between surface water and ground water. It is presumed that the participants will also have an understanding of the data viewer and other overview/interpretive DSS components. A computer/laptop for each participant with sufficient resources and software to run the DSS is required. The location for the training will be identified by USU in collaboration with WRIA 1 personnel. The training will be a balanced mixture of presentation, discussion, demonstration, and hands-on practice.

Budget:
$ 47,912

11.1.5 Task 11.1.5: Ground Water Quality- Deferred

This task is uniquely identified from other portions of the scope of work because it explicitly only seeks "conditional approval" for its content. There is no request for formal approval of its budget or its specific methodology at this time. Due to budgetary constraints, implementation of this task is deferred until formal approval of its budget and specific methodology occurs from the WRIA 1 Planning Unit and Joint Board.

The purpose of this workshop is to provide training specific to the technical issues involving water quality modeling as implemented in the DSS/DBMS for the WRIA 1. This will include the use of the Data Visualization System and linked analysis module for the water quality data to examine, analyze, and set up specific ground water quality modeling scenarios. The training will take place over the course of one week. It is presumed that the participants will also have an understanding of the data viewer and other overview/interpretive DSS components. A computer/laptop for each participant with sufficient resources and software to run the DSS is required. The location for the training will be identified by USU in collaboration with WRIA 1 personnel. The training will be a balanced mixture of presentation, discussion, demonstration, and hands-on practice.

Budget:
$ 24,791

11.1.6 Task 11.1.6: Instream Flow/Fish Habitat- Deferred

This task is uniquely identified from other portions of the scope of work because it explicitly only seeks "conditional approval" for its content. There is no request for formal approval of its budget or its specific methodology at this time. Due to budgetary constraints, implementation of this task is deferred until formal approval of its budget and specific methodology occurs from the WRIA 1 Planning Unit and Joint Board.

This deliverable will entail three, one week technical training workshops for collaborators on the specific methods and modeling approaches used in the instream flow assessments. Three workshops are required given the complexity of the specific study components required to undertake the instream flow assessments.

The first workshop will focus on the linkage between field data collection strategies and specific modeling approaches (e.g., one-dimensional versus two-dimensional modeling). This will include field data collection, data reduction, and QA/QC procedures.

The second workshop will focus on hydraulic and habitat modeling and include model calibration and simulation procedures.

The final workshop will focus on the integration of physical, chemical, and biological modeling components within the context of instream flow assessment and include use and evaluation of the instream flow extrapolation methodology.

Each training workshop will take place over the course of one week and will include a joint session with the ground water modeling group to cover the interactions between surface water and ground water. It is presumed that the participants will also have an understanding of the data viewer and other overview/interpretive DSS components. A computer/laptop for each participant with sufficient resources and software to run the DSS is required. The location for the training will be identified by USU in collaboration with WRIA 1 personnel. The training will be a balanced mixture of presentation, discussion, demonstration, and hands-on practice.

Budget:
$ 65,723

11.1.7 Task 11.1.7: Database Management/Structure and DSS System Maintenance and Administration

These two components will be combined given their integrated nature. We anticipate that Terry Holland will spend at least two weeks in Logan working with the USU team early in Phase III to initiate this component of technology transfer. It is anticipated that this effort will focus on the technical aspects of system architecture and system level documentation. We also anticipate that this activity will be ongoing in April or May of 2003 a specific workshop will be conducted with Mr. Holland (or others) specifically to ensure that this component of the technology transfer of the DSS/DBMS is achieved.

The Phase II SOW identified the need to provide systems level documentation for the DSS/DBMS. This is a critical task in that it ensures that the WRIA 1 participants have a complete technical 'map' to the structure and function of all components and function of the DSS/DBMS.

The development of system level documentation for the DSS, DBMS, Scenario Builder, Data Visualization Module, Alternatives Comparison, and Analysis Modeling System. Specific components of the Analysis Modeling System (e.g., surface water quantity model(s)) will be provided within those specific tasks as noted in the task sections above. The documentation developed as part of this specific task will target database structures, query definitions, model linkage routines, etc., necessary for long term systems maintenance. Qualified personnel from the WRIA 1 are expected to spend several weeks at USU in order to be trained on the underlying system architectures and related database structures. This training will also include procedures for updating key database elements such as stream flow or water quality monitoring data to keep the system updated year to year. The documentation will also include a discussion as to what the software and hardware requirements will be to install the

DSS/DBMS. Included will be specifications of suggested CPU speed, RAM, disk storage, and video boards, along with a list of required software (such as Citrix Metaframe) that will be required aside from the DSS software that will be delivered. This effort will include the following:

- Develop system level documentation not covered by specific technical tasks in this section of the SOW.
- Coordinate training opportunity for WRIA 1 individuals on system architecture and function.

Schedule:

- The schedule for each workshop will be determined through discussions between USU and Staff Team/Technical Teams.
- Develop system level documentation. Ongoing throughout project. Final form of documentation will be sent as part of Preliminary Draft of DSS/DBMS on December 17, 2004. This will then follow the review cycle of the full beta documentation.
- Training on system administration and DSS/DBMS upkeep. To be determined based on discussions with the DSS/DBMS technical team lead.

Deliverables:

Deliverables will include conducting the workshops, documentation and training materials for each of the following components:

- Over all DSS Utilization including
  - Watershed Characterization
  - Data Visualization
  - Scenario Builder
  - Alternatives Comparison
- DSS System Maintenance and Administration
  - Database Management/Structure

Note: Technical documentation on database structure and linkages to all DSS/ DBMS components will include, at a minimum, defining usage and variables internal to programs written by USU, as well as normal user help manuals and administrative help manuals.

Budget:

$ 38,360[11]

11.2 Development of a Recommended Integrated Monitoring Plan

- Deferred

Background:

The need for long-term monitoring of water quantity, quality, and other technical components has been identified through the work conducted during Phase II by USU and through the scoping process for Phase III. However, the specific objectives of monitoring must be very clear before a monitoring plan can be designed. For example, the surface water quantity work conducted during Phase II recommended additional monitoring efforts that specifically focused on reducing the uncertainty in the water availability estimates in various drainages within the WRIA 1. These recommendations were not focused, however, on a monitoring plan that would necessarily permit the evaluation of specific management actions implemented through the watershed planning process at a specific location within any particular drainage.

Purpose/Objectives:

The purpose of this Task is to define a process to identify the various monitoring needs of all technical elements (i.e., surface water quantity and quality, groundwater quantity and quality, and instream flow/fish habitat) in terms of reducing uncertainty in each technical component as well as those needs associated with evaluating watershed management options. These monitoring requirements will also have to be evaluated in light of existing monitoring programs. Once the specific objectives for each

[11] USU expects that the Task 11.1.7 budget money has been made available from the previously deferred task 11.1.7 ($38,360)

monitoring need has been clearly defined in the entire context of the WRIA 1 watershed management process, then recommendations for an integrated monitoring plan will be developed. The monitoring program developed under this task will contribute to the strategy for the design and implementation of a WRIA-wide long term monitoring program that is being developed as part of a Centennial Clean Water Fund effort awarded to Whatcom County Water Resources and for the monitoring plan that will be included in the WRIA Project implementation strategy.

Specific USU Subtasks:

Participate in a workshop to identify existing spatial and temporal scope of existing monitoring programs in surface water quantity and quality, ground water quantity and quality, and instream flow/fish habitat.
Participate in technical workshops for each technical component to identify specific monitoring objectives in terms of reducing uncertainty and evaluation of potential watershed management options.
Develop with the WRIA 1 participants, recommendations for an integrated monitoring plan that identifies the spatial and temporal scope of each monitoring element and how these data will be linked to the existing DSS/DBMS and evaluation of future watershed management options.

Schedule:

USU recognizes that certain components of the long-term monitoring plan (e.g., surface water quality) will be expedited in light of WRIA's need to meet grant deadlines.

There need to be dates identified for the technical workshops for each of the technical components to identify monitoring objectives in terms of reducing uncertainty and evaluation of potential watershed management options (to be defined as part of the workshops).

(To be revised)
Long-term monitoring plan general workshop, April 2003
Submit preliminary draft report on long-term monitoring plan to WRIA, August 20 2003
WRIA comments on preliminary draft report on to USU, September 16 2003
USU responses to comments on preliminary draft long-term monitoring plan, October 7 2003
Conference call to resolve comments/responses on long-term monitoring plan, October 21 2003
Draft long-term monitoring plan report, November 17 2003
WRIA comments on draft long-term monitoring plan report, December 15 2003
USU response to comments on draft long-term monitoring plan report, January 15 2004
Conference call to resolve comments/responses to draft final long-term monitoring plan report, January 29 2004
Draft Final 1 long-term monitoring plan report, February 12 2004
Comments on Draft Final 1 long-term monitoring plan report
Response to Comments on Draft Final 1 long-term monitoring plan report
Draft Final 2 long-term monitoring plan report
Comments on Draft Final 2 long-term monitoring plan report
Response to Comments on Draft Final 2 long-term monitoring plan report
Final Product Deliverable

Deliverables:

Long-term Monitoring Plan Report

Budget:

(To be modified to reflect review process)
$

EXHIBIT B-3
COMPENSATION

Summary Budget:

		Budget
Task 3	DSS/DBMS	72812
Task 4	SWQN	123352
Task 5	GWQN	3000
Task 6	SWQL	46066
Task 7	GWQL	25918
Task 8	ISF/FH	125078
Task 9	Watershed Plan	15000
Task 10	Project Mgmt	55019
Task 11	Tech Transfer	63354
		529601

***** USU expects that the Task 11.1.7 budget money has been made available from the previously deferred task 11.1.7**

NOTE: The budgets estimated in September 2003 were based on available project funds. Monthly reports have tracked expenses and accounting adjustments. These numbers may change due to journalizations, etc.

Task 3 Detail Budget:

														Deferred		Removed			
		Task 3.1		Task 3.2		Task 3.3		Task 3.4		Task 3.5		Task 3.6		Task 3.7		Task 3.8		TOTAL	
Personnel	Rate	Mo's	Cost	Mo's	Cost	Mo's	Cost	Mo's	Cost	Mo's	Cost	Mo's	Cost	Mo's	Cost	Mo's	Cost	Mo's	Budget
Dan Ames	5417	0.5	2708	0.5	2708	0.5	2708	0.75	4063	0.5	2708	0.75	4063	0	0	0	0	2.25	18958
Programmer	1820	2	3640	2	3640	2	3640	2.5	4550	1	1820	2	3640	0	0	0	0	8.5	20930
Total Personnel			6348		6348		6348		8613		4528		7703		0		0	10.8	39888
Benefits -Staff 40.05%, Stdts 8.3%			1387		1387		1387		2005		1236		1929		0		0		9330
TOTAL PERSONNEL & BENEFITS			7735		7735		7735		10617		5764		9632		0		0		49218
TRAVEL			2200		0		0		0		0		0		0		0		2200
Other Costs																			
Printing/Xerox/CD's/etc.			100		100		100		100		95		95		0		0		590
TOTAL DIRECT COSTS			10035		7835		7835		10717		5859		9727		0		0		52008
IDC	0.38		4014		3134		3134		4287		2344		3891		0		0		20803
TOTAL BUDGET			14049		10969		10969		15004		8203		13617		0		0		72812

Continued Database Update and Integration
Watershed Characterization Module
Data Visualization Modules
Scenario Builder Module
Database Management System
Analysis Modeling System
DEFERRED - Scenario Comparison Module
ELIMINATED - Web Enabling of DSS

*NOTE: This budget was created in September 2003 based on August 31, 2003 expense reports. This task has expended approximately $36,000 in the period of Sept-Dec 2003

Personnel	Rate	Task 4.1 Mo's	Task 4.1 Cost	Task 4.2 Mo's	Task 4.2 Cost		TOTAL Mo's	TOTAL Budget
PI - DT	9211	0.6	5527	0.4	3684		1	9211
Dan Ames	5417	5	27083	1.5	8125		6.5	35208
Mac	9097	0.25	2274	0.25	2274		0.5	4549
Grad Students	1618	2.24	3616	3.25	5259		5.49	8875
Total Personnel			38500		19342		8	57843
Benefits -Staff 40%, Students 8.3%			14271		6077			20348
TOTAL PERSONNEL & BENEFITS			52772		25419			78191
TRAVEL			6860		1960			8820
Other Costs								
Printing/Xerox/CD's/etc.			1375		1000			2375
TOTAL DIRECT COSTS			61007		28379			89386
IDC	0.38		23183		10784			33967
TOTAL BUDGET			84189		39163			123352

Task 4 Detail Budget:

Personnel	Rate	Task 5 Mo's	Task 5 Cost		TOTAL Mo's	TOTAL Budget
PI - MK		0	0		0	0.00
Grad Student	2000	1	2000		1	2000
Total Personnel			2000		1	2000
Benefits -Staff 40%, Stdts 8.3%			166			166
TOTAL PERSONNEL & BENEFITS			2166			2166
TRAVEL			0			0
Other Costs						
Printing/Xerox/CD's/etc.			8			8
TOTAL DIRECT COSTS			2174			2174
IDC	0.38		826			826
TOTAL BUDGET			3000			3000

Task 5 Detail Budget:

Personnel	Rate	Task 6.1 Mo's	Task 6.1 Cost	Task 6.2 Mo's	Task 6.2 Cost	Task 6.3 Mo's	Task 6.3 Cost		TOTAL Mo's	TOTAL Budget
PI - DS	9668	0.1	967	0.50	4834	0.22	2127		0.82	7927.76
D. Sorenson	8437	0	0	0.38	3164	0.00	0		0.38	3164
Research Engineer	3588	0.15	538	0.75	2691	0.37	1328		1.27	4557
Student Technicians	2184	1	2184	0.00	0	0.00	0		1.00	2184
Grad Student	3620	0.05	181	1.00	3620	0.20	724		1.25	4525
Total Personnel			3870		14309		4179		4.72	22357
Benefits -Staff 40.05%, Students 8.3%			799		4581		1444			6824
TOTAL PERSONNEL & BENEFITS			4669		18890		5622			29181
TRAVEL			1000		2000		0			3000
Other Costs										
Printing/Xerox/CD's/etc.			1200		0		0			1200
TOTAL DIRECT COSTS			6869		20890		5622			33381
IDC	0.38		2610		7938		2136			12685
TOTAL BUDGET			9479		28828		7759			46066

6.1 SWQL Monitoring for Model Calibration and Validation
6.2 SWQL Model Development
6.3 Integration of SWQL Information with Other Portions of the Study

Task 6 Detail Budget:

This task has expended funds under Task 6.1 for work performed in July-August 2003.

Personnel	Rate	Task 7 Mo's	Task 7 Cost		TOTAL Mo's	TOTAL Budget
PI - GWQL	8765	1	8765		1	8765.00
Graduate Student	1600	3.6	5760		3.6	5760
Total Personnel			14525		4.6	14525
Benefits -Staff 40.05%, Stdts 8.3%			3988			3988
TOTAL PERSONNEL & BENEFITS			18513			18513
TRAVEL			0			0
Other Costs						
Printing/Xerox/CD's/etc.			268			268
TOTAL DIRECT COSTS			18781			18781
IDC	0.38		7137			7137
TOTAL BUDGET			25918			25918

Task 7 Detail Budget:

Task 8 Detail Budget:

Personnel	Rate	Task 8.1 Mo's	Task 8.1 Cost	Task 8.2 Mo's	Task 8.2 Cost	Task 8.3 Mo's	Task 8.3 Cost	Task 8.4 Eliminated	Task 8.5 Mo's	Task 8.5 Cost	Task 8.6 Mo's	Task 8.6 Cost	Task 8.7 Done	Task 8.8 Mo's	Task 8.8 Cost	Task 8.9 Mo's	Task 8.9 Cost	TOTAL Mo's	TOTAL Budget
PI	9831	0.5	4916	0		0.2	1966	0	0.5	4916	0.5	4916	0	0		0		1.7	16713
Research Engineer 1	5994	0.75	4496	0		0.25	1499	0	0.5	2997	0.5	2997	0	0		0		2	11988
Research Engineer 2	4239	1.75	7418	0		0.2	848	0		0		0	0	0		0		1.95	8266
Research Engineer 3	3315	1.75	5801	0		0.2	663	0		0		0	0	0		0		1.95	6464
Research Techniciar	2427	3	7281	0		0.8	1942	0	1.25	3034		0	0	0		0		5.05	12256
Graduate Student	1600	1.6	2560	0			0	0		0	2.75	4400	0	0		0		4.35	6960
Total Personnel			32472	0			6917	0		10946		12313	0	0		0		17.00	62647
Benefits -Staff 40.05%, Stdts 8.3%			9880	0			2154	0		3421		3534	0	0		0			18989
TOTAL PERSONNEL & BENEFITS			42352	0			9071	0		14367		15847	0	0		0			81636
TRAVEL			900	0			0	0		0		3500	0	0		0			4400
Other Costs																			
Printing/Xerox/CD's/etc.			0	0			2500	0		0		2100	0	0		0			4600
TOTAL DIRECT COSTS			43252	0			11571	0		14367		21447	0	0		0			90636
IDC	0.38		16436	0			4397	0		5459		8150	0	0		0			34442
TOTAL BUDGET			59688	0			15968	0		19826		29596	0	0		0			125078

8.1 Data Reduction, Hydraulic and Habitat Model Calibration and Validation
8.2 Habitat Utilization Validation Data
8.3 Updated Basin Stratification for Instream Flow Assessments
8.4 ELIMINATED - Comparative Analysis of WDOE ISF Requirements
8.5 Development of estimated Ecological Flow Regimes
8.6 Development and Validation of Instream Flow Extrapolation Methodology
8.7 COMPLETED - Instream Flow Selection Methodology Workshop
8.8 Invertebrate Sample Processing
8.9 Integration of Instream Flow model Resuluts and Fish Habitat Data into the DSS

Task 9 Detail Budget:

Personnel	Rate	Task 9.1 Mo's	Task 9.1 Cost	Task 9.2 Eliminated		TOTAL Mo's	TOTAL Budget
PI - DSS/DBMS	5688	0.15	853	0		0.15	853.20
PI - SWQN	9211	0.15	1382	0		0.15	1382
PI - GWQN	9350	0.14	1309	0		0.14	1309
PI - SWQL	9668	0.15	1450	0		0.15	1450
PI - GWQL	8765	0.15	1293	0		0.15	1293
PI - ISF/FH	9831	0.15	1475	0		0.15	1475
Total Personnel			7761	0		0.89	7761
Benefits -Staff 40.05%			3108	0			3108
TOTAL PERSONNEL & BENEFITS			10870	0			10870
TRAVEL			0	0			0
Other Costs							
Printing/Xerox/CD's/etc.			0	0			0
TOTAL DIRECT COSTS			10870	0			10870
IDC	0.38		4131	0			4131
TOTAL BUDGET			15000	0			15000

9.1 Technical Assistance and Information Exchange

9.2 ELIMINATED - Specialized Technical Support for Watershed Plan and EIS Development

Task 10 Detail Budget:

Personnel	Rate	**Task 10.1** **Mo's**	**Cost**	Task 10.2 Eliminated		Task 10.3 Eliminated		**Task 10.4** **Included in 10.**		Task 10.5 Eliminated			**TOTAL** **Mo's**	**Budget**
PI - TBH	9831	0.5	4916	0	0	0	0	0	0	0	0		0.5	4916
Staff Assistant	2813	0	0	0	0	0	0	8.25	23206	0	0		8.25	23206
Total Personnel			4916		0		0		23206		0		8.75	28121
Benefits -Staff 40.05%			1969		0		0		9294		0			11263
TOTAL PERSONNEL & BENEFITS			6884		0		0		32500		0			39384
TRAVEL			0		0		0		0		0			0
Other Costs														
Printing/Xerox/CD's/etc.			0		0		0		485		0			485
TOTAL DIRECT COSTS			6884		0		0		32985		0			39869
IDC	0.38		2616		0		0		12534		0			15150
TOTAL BUDGET			9500		0		0		45519		0			55019

10.1 Project Coordination for Study Components
10.2 ELIMINATED - Public Involvement and Education Coordination
10.3 ELIMINATED - Coordination of Independent Review Panel
10.4 Project Tracking
10.5 ELIMINATED - Project Deliverables Technical Writing Support

*NOTE: This budget was created in September 2003 based on the project funds available on August 31, 2003 and an expectation that project management would continue to approximately December 2004. This task has continued to expend funds on project management work throughout the work stop. The task budget for the extended timeline has remained the same; however, the timeline to complete the project has been extended beyond that originally estimated in Sept. 2003. For this reason, as well as the increased level of project management requested, this task budget may be insufficient.

Personnel	Rate	Task 11.1.1 Mo's	Cost	Task 11.1.7 Mo's	Cost	Task 11.2 Deferred			TOTAL Mo's	Budget
PI	9831	0.2	1966	0.25	2458	0	0		0.45	4423.95
mac	9097	0.2	1819	0.2	1819				0.4	3639
DS	9668	0.2	1934	0.5	4834				0.7	6768
Jeff H.	3588	0.2	718	1	3588				1.2	4306
Carri Richards	2813	0	0	0.4	1125				0.4	
Dan Ames	5688	0.3	1701	1	5688	0	0		1.3	7389
Total Personnel			8138		19512		0		4.45	27650
Benefits -Staff 40.05%, Students 8.3%			3259		7815		0			11074
TOTAL PERSONNEL & BENEFITS			11397		27327		0			38724
TRAVEL			6200		0		0			6200
Other Costs										
Printing/Xerox/CD's/etc.			515		470		0			985
TOTAL DIRECT COSTS			18112		27797		0			45909
IDC	0.38		6882		10563		0			17445
TOTAL BUDGET			24994		38360		0			63354

11.1.1 DSS/DBMS
11.1.2 - 11.1.6 Deferred
11.1.7 Database Management/Structure & DSS System Maintenance and Administration
11.2 Development of a Recommended Integrated Monitoring Plan

***** USU expects that the Task 11.1.7 budget money ($38,360) has been made available from the previously deferred task 11.1.7**

Task 11 Detail Budget:

EXHIBIT C-3
TABLE OF DELIVERABLES

Table of Deliverables and Intermediate Work Products for USU Phase III Scope of Work

The table below is a summary checklist for use by the WRIA Staff Team, Tech Team Leads, and Contract Administrators in monitoring status and approval of Phase III deliverables and intermediate work products. It should be used in conjunction with the more detailed Phase III Scope of Work and is not intended to serve as a replacement of the scope. The table is a tool to assist project participants in determining when deliverables or work products are received, whether a deliverable or work product is intended for Peer Review, and when WRIA participants have accepted the delivered product. Note: In most cases for specific deliverables, several deliverables will be combined on a given CD rather than 10 copies of each component deliverable on their own CD.

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
	Section 3	DSS/DBMS	Delivery of software associated with task 3 will be as follows: Alpha Releases: 4) During software development prior to the beta release date, USU may choose to release alpha release software to WRIA through the DSS/DBMS web-based auto-update system and/or through CDs to get feedback on design issues or functions. WRIA may supply feedback through the Elelemtool bug-tracking system or by e-mail to USU. 5) In cases when WRIA response is essential to completing a task, a formal memo will be sent to WRIA indicating the needed information and last date by which it would be required to be received in order to meet the beta deliverable deadline. 6) All data and information provided by WRIA to USU in the requested format and within the requested time frame will be included in the databases that are delivered with the Beta deliverable. Beta: 4) USU will indicate in writing which if any data and information required by the DBMS/DSS were not received and were therefore not included in the beta deliverable. 5) USU will deliver one complete set of installation CDs (as many as needed to hold all of the software) for beta review. 6) Binary software components will also be available through the web-based update system. Final: 4) For the final product deliverable, all task 3 related software components will be delivered as part of a single set of installation CDs. 5) Because this deliverable may require as many as 10 or more CDs for a single install, USU will not be required to produce 10 copies of the full set. 6) The auto-updating function on the web-site is being provided in lieu of USU sending multiple copies of the CDs.		5/20/2005		Approval 10/31/05	
	Task 3.1	Continued Database Update and Integration						
1			• Preliminary Draft Reports/Databases o Delivered to WRIA ▪ 3.1A - Master DSS data repository including databases and data files on a central server ▪ 3.1B - DSS data repository including databases and data on installation CDs ▪ 3.1C - Data and file archive server ▪ 3.1D - Metadata for GIS and non-GIS data sets included in the master DSS data repository ▪ 3.1E - Final database structure document ▪ 3.1F - Database of citations o WRIA comments on Preliminary Draft Reports/Databases to USU ▪ (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU). o Conference call to discuss Preliminary Draft Reports/Databases		12/17/2004 2/17/2005		1/28/2005 2/17/2005	
2			• Draft Reports/Databases o Draft of above delivered to WRIA o WRIA Comments on Draft Reports/Databases to USU o Conference call to discuss comments on Draft Reports/Databases		3/11/2005 5/5/2005		4/8/2005	
3			• Final Draft 1 Reports/Databases (Full Beta) for Peer Review o Final Draft 1 of above delivered to WRIA o WRIA and Peer Review comments on Final Draft 1 Reports/Databases o Conference call to discuss comments on Final Draft 1 Reports/Databases	x	5/20/2005 9/1/2005	x	8/5/2005 9/1/2005	
4			• Final Draft 2 (Full Release version of DSS) Reports/Databases o Final Draft 2 of above delivered to WRIA		9/23/2005			

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			o WRIA approval of products				10/31/2005	
	Task 3.2	Watershed Characterization Module						
5			• Alpha Releases o Alpha releases delivered to WRIA ▪ 3.2A – Alpha Watershed Characterization module o WRIA comments on Watershed Characterization module o Conference call to discuss comments on Watershed Characterizations module and final date for resolving features		4/1/04 5/26/04		 5/7/04 5/26/04	
6			• Preliminary Draft Reports/Databases o Preliminary draft of the following delivered to WRIA ▪ 3.2A - Watershed Characterization plug-in for generating summary watershed reports ▪ 3.2B - WC plug-in technical specifications document ▪ 3.3C - WC plug-in source code with low-level documentation ▪ 3.3D - End-user WC plug-in user's manual o WRIA comments on Preliminary Draft Reports/Databases to USU ▪ (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU). o Conference call to discuss Preliminary Draft Reports/Databases		12/17/2004 2/17/2005		 1/28/2005 2/17/2005	
7			• Draft Reports/Databases o Draft of above delivered to WRIA o WRIA Comments on Draft Reports/Databases to USU o Conference call to discuss comments on Draft Reports/Databases		3/11/2005 5/5/2005		 4/8/2005 5/5/2005	
8			• Final Draft 1 Reports/Databases (Full Beta) for Peer Review o Final Draft 1 of above delivered to WRIA o WRIA and Peer Review comments on Final Draft 1 Reports/Databases o Conference call to discuss comments on Final Draft 1 Reports/Databases	x	5/20/2005 9/1/2005	x	 8/5/2005 9/1/2005	
9			• Final Draft 2 (Full Release version of DSS) Reports/Databases o Final Draft 2 of above delivered to WRIA o WRIA approval of products		9/23/2005		 10/31/2005	
	Task 3.3	Data Visualization Module						
10			• Alpha Releases o April 1, 2004 Alpha Releases delivered to WRIA ▪ 3.3A – Alpha Map Window module ▪ 3.3C – Alpha Stream Flow Data Analyst plug-in ▪ 3.3G – Alpha Water Quality Analyst plug-in o WRIA comments for 3.3A, 3.3C, 3.3G modules to USU o Conference call to resolve comments on 3.3A, 3.3C, 3.3G modules, and final date to resolve features for these components o June 3, 2004 Alpha Releases to WRIA ▪ 3.3S – Alpha Photoviewer plug-in o WRIA comments for 3.3S module to USU o Conference call to resolve comments on 3.3S module, and final date to resolve features for this module o August 6, 2004 Alpha Releases delivered to WRIA ▪ 3.3W – Alpha ISF/FH Data Viewer ▪ 3.3AA – Alpha Macroinvertebrate Data Viewer o WRIA comments for 3.3W and 3.3AA modules o Conference call to resolve comments on 3.3W and 3.3AA modules and final date to resolve features for these modules		4/1/04 5/26/04 6/3/04 7/14/04 8/6/04 9/15/04		 5/7/04 5/26/04 7/1/04 7/14/04 9/3/04 9/15/04	
11			• Preliminary Draft Reports/Documentation		12/17/2004			

[12] GWQN and GWQL modules are non-reviewable

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			o Preliminary Draft of the following to WRIA ▪ 3.3A - MapWindow GIS data visualization application ▪ 3.3B - MapWindow GIS end user's manual ▪ 3.3C - Streamflow data analyst plug-in ▪ 3.3D - Streamflow data analyst plug-in source code and low-level documentation ▪ 3.3E - Streamflow data analyst plug-in technical specifications ▪ 3.3F - Streamflow data analyst plug-in end user manual ▪ 3.3G - Water quality data analyst plug-in ▪ 3.3H - Water quality data analyst plug-in source code and low-level documentation ▪ 3.3I - Water quality data analyst plug-in technical specifications ▪ 3.3J - Water quality data analyst plug-in end user manual ▪ 3.3K - Well-log data viewer plug-in[12] ▪ 3.3L - Well-log data viewer plug-in source code and low-level documentation[1] ▪ 3.3M - Well-log data viewer plug-in technical specifications[1] ▪ 3.3N - Well-log data viewer plug-in end user manual[1] ▪ 3.3O - Groundwater head contour viewer plug-in[1] ▪ 3.3P - Groundwater head contour viewer plug-in source code and low-level documentation[1] ▪ 3.3Q - Groundwater head contour viewer plug-in technical specifications[1] ▪ 3.3R - Groundwater head contour viewer plug-in end user manual[1] ▪ 3.3S - Digital photo viewer plug-in ▪ 3.3T - Digital photo viewer plug-in source code and low-level documentation ▪ 3.3U - Digital photo viewer plug-in technical specifications ▪ 3.3V - Digital photo viewer plug-in end user manual ▪ 3.3W - Instream flow data viewer plug-in ▪ 3.3X - Instream Flow data viewer plug-in source code and low-level documentation ▪ 3.3Y - Instream Flow data viewer plug-in technical specifications ▪ 3.3Z - Instream Flow data viewer plug-in end user manual ▪ 3.3AA - Macroinvertebrate data viewer plug-in ▪ 3.3BB - Macroinvertebrate data viewer plug-in source code and low-level documentation ▪ 3.3CC - Macroinvertebrate data viewer plug-in technical specifications ▪ 3.3DD - Macroinvertebrate data viewer plug-in end user manual o WRIA comments on Preliminary Draft Reports/Databases to USU ▪ (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU). o Conference call to discuss Preliminary Draft Reports/Databases		2/17/2005		No Review for Ground Water elements 3.3K, L, M, N, O, P, Q, R 1/28/05 2/17/2005	
12			• Draft Reports/Databases o Draft of above delivered to WRIA o WRIA Comments on Draft Reports/Databases to USU o Conference call to discuss comments on Draft Reports/Databases		3/11/2005 5/5/2005		4/8/2005 5/5/2005	
13			• Final Draft 1 Reports/Databases (Full Beta) for Peer Review o Final Draft 1 of above delivered to WRIA o WRIA and Peer Review comments on Final Draft 1 Reports/Databases o Conference call to discuss comments on Final Draft 1 Reports/Databases	x	5/20/2005 9/1/2005	x	No Review for Ground Water elements 8/5/2005 9/1/2005	
14			• Final Draft 2 (Full Release version of DSS) Reports/Databases o Final Draft 2 of above delivered to WRIA o WRIA approval of products		9/23/2005		10/31/2005	
	Task 3.4	Scenario Builder Module						
15			• Alpha Releases o September 2, 2004 Alpha Releases delivered to WRIA ▪ 3.4A – Alpha Scenario Builder ▪ 3.4E – Alpha Land Cover Change module ▪ 3.4I –Alpha Best Management Practice module ▪ 3.4M – Storage Change module ▪ 3.4Q – Climate Change module ▪ 3.4U – Population Change module		9/2/2004			

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			▪ 3.4Y – Diversion/Transfer module o WRIA comments for 3.4A, 3.4E, 3.4I, 3.4M, 3.4Q, 3.4U, 3.4Y modules to USU o Conference call to resolve comments on 3.4A, 3.4E, 3.4I, 3.4M, 3.4Q, 3.4U, 3.4Y modules, and final date to resolve features for these components		 10/20/2004		10/1/2004 10/20/2004	
16			• Preliminary Draft Reports/Documentation o Preliminary Draft of the following to WRIA ▪ 3.4A - Scenario builder functions in the DSS Model Manager plug-in ▪ 3.4B - Scenario builder functions source code and low-level documentation ▪ 3.4C - Scenario builder functions technical specifications ▪ 3.4D - Scenario builder functions end user manual ▪ 3.4E - Land cover change scenario element ▪ 3.4F - Land cover change scenario element source code and low-level documentation ▪ 3.4G - Land cover change scenario element technical specifications ▪ 3.4H - Land cover change scenario element end user manual ▪ 3.4I - Best management practices scenario element ▪ 3.4J - Best management practices scenario element source code and low-level documentation ▪ 3.4K - Best management practices scenario element technical specifications ▪ 3.4L - Best management practices scenario element end user manual ▪ 3.4M - Storage change scenario element ▪ 3.4N - Storage change scenario element source code and low-level documentation ▪ 3.4O - Storage change scenario element technical specifications ▪ 3.4P - Storage change scenario element end user manual ▪ 3.4Q - Climate change scenario element ▪ 3.4R - Climate change scenario element source code and low-level documentation ▪ 3.4S - Climate change scenario element technical specifications ▪ 3.4T - Climate change scenario element end user manual ▪ 3.4U - Population change scenario element ▪ 3.4V - Population change scenario element source code and low-level documentation ▪ 3.4W - Population change scenario element technical specifications ▪ 3.4X - Population change scenario element end user manual ▪ 3.4Y - Diversion and inter-basin transfer scenario element ▪ 3.4Z - Diversion and inter-basin transfer scenario element source code and low-level documentation ▪ 3.4AA - Diversion and inter-basin transfer scenario element technical specifications ▪ 3.4BB - Diversion and inter-basin transfer scenario element end user manual o WRIA comments on Preliminary Draft Reports/Databases to USU, January 28, 2005 ▪ (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU). o Conference call to discuss Preliminary Draft Reports/Databases		12/17/2004 2/17/2005		 1/28/2005 2/17/2005	
17			• Draft Reports/Databases o Draft of above delivered to WRIA o WRIA Comments on Draft Reports/Databases to USU o Conference call to discuss comments on Draft Reports/Databases		3/11/2005 9/1/2005		 4/8/2005 9/1/2005	
18			• Final Draft 1 Reports/Databases (Full Beta) for Peer Review o Final Draft 1 of above delivered to WRIA o WRIA and Peer Review comments on Final Draft 1 Reports/Databases o Conference call to discuss comments on Final Draft 1 Reports/Databases	x	 5/20/2005 9/1/2005	x	 8/5/2005 9/1/2005	
19			• Final Draft 2 (Full Release version of DSS) Reports/Databases o Final Draft 2 of above delivered to WRIA o WRIA approval of products		9/23/2005		 10/31/2005	
	Task 3.5	Database Management System						
20			• Alpha Releases o April 1, 2004 Alpha Releases delivered to WRIA ▪ 3.5A – DBMS Utility		4/1/2004			

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			o WRIA comments for 3.5A module to USU o Conference call to resolve comments on 3.5A module, and final date to resolve features for this component o September 2, 2004 Alpha Releases delivered to WRIA ▪ 3.5E – Model Manager module o WRIA comments for 3.5E module to USU o Conference call to resolve comments on 3.5E module, and final date to resolve features for this components, October 20, 2004		5/26/2004 9/2/2004 10/20/2004		5/7/2004 5/26/2004 10/1/2004 10/20/2004	
21			• Preliminary Draft Reports/Documentation o Preliminary Draft of the following to WRIA ▪ 3.5A - DBMS Utility ▪ 3.5B - DBMS Utility source code and low-level documentation ▪ 3.5C - DBMS Utility technical specifications ▪ 3.5D - DBMS Utility end user manual ▪ 3.5E - DBMS functions in within the DSS Model Manager plug-in ▪ 3.5F - DBMS functions source code and low-level documentation ▪ 3.5G - DBMS functions technical specifications ▪ 3.5H - DBMS functions end user manual o WRIA comments on Preliminary Draft Reports/Databases to USU ▪ (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU). o Conference call to discuss Preliminary Draft Reports/Databases		12/17/2004 2/17/2005		1/28/2005 2/17/2005	
22			• Draft Reports/Databases o Draft of above delivered to WRIA o WRIA Comments on Draft Reports/Databases to USU o Conference call to discuss comments on Draft Reports/Databases		3/11/2005 5/5/2005		4/8/2005 5/5/2005	
23			• Final Draft 1 Reports/Databases (Full Beta) for Peer Review o Final Draft 1 of above delivered to WRIA o WRIA and Peer Review comments on Final Draft 1 Reports/Databases o Conference call to discuss comments on Final Draft 1 Reports/Databases	X	5/20/2005 9/1/2005	X	8/5/2005 9/1/2005	
24			• Final Draft 2 (Full Release version of DSS) Reports/Databases o Final Draft 2 of above delivered to WRIA o WRIA approval of products		9/23/2005		10/31/2005	
	Task 3.6	Analysis Modeling System						
25			• Preliminary Draft Reports/Documentation o Preliminary Draft of the following to WRIA ▪ 3.6A - Model manager interface for surface water quantity model ▪ 3.6B - Surface water quantity model interface source code and low-level documentation ▪ 3.6C - Surface water quantity model interface technical specifications ▪ 3.6D - Surface water quantity model interface end user manual ▪ 3.6E - Model manager interface for Lake Whatcom model ▪ 3.6F - Lake Whatcom model interface source code and low-level documentation ▪ 3.6G - Lake Whatcom model interface technical specifications ▪ 3.6H – Lake Whatcom model interface end user manual ▪ 3.6I - Model manager interface for coarse surface water quality model ▪ 3.6J - Coarse surface water quality model interface source code and low-level documentation ▪ 3.6K - Coarse surface water quality model interface technical specifications ▪ 3.6L - Coarse surface water quality model interface end user manual ▪ 3.6M - Model manager interface for instream flow model ▪ 3.6N - Instream flow model interface source code and low-level documentation ▪ 3.6O - Instream flow model interface technical specifications ▪ 3.6P - Instream flow model interface end user manual ▪ 3.6Q - Data filters to convert data to formats needed for each model ▪ 3.6R - Data filters source code and low-level documentation ▪ 3.6S - Data filters technical specifications		12/17/2004			

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			o WRIA comments on Preliminary Draft Reports/Databases to USU ▪ (Note: Final date for addition of any new data to be delivered to USU from WRIA for integration into the DSS by USU). o Conference call to discuss Preliminary Draft Reports/Databases		2/17/2005		1/28/2005 2/17/2005	
26			• Draft Reports/Databases o Draft of above delivered to WRIA, March 11, 2005 o WRIA Comments on Draft Reports/Databases to USU o Conference call to discuss comments on Draft Reports/Databases		3/11/2005 5/5/2005		4/8/2005 5/5/2005	
27			• Final Draft 1 Reports/Databases (Full Beta) for Peer Review o Final Draft 1 of above delivered to WRIA, May 20, 2005 o WRIA and Peer Review comments on Final Draft 1 Reports/Databases o Conference call to discuss comments on Final Draft 1 Reports/Databases	x	5/20/2005 9/1/2005	x	8/5/2005 9/1/2005	
28			• Final Draft 2 (Full Release version of DSS) Reports/Databases o Final Draft 2 of above delivered to WRIA o WRIA approval of products		9/23/2005		10/31/2005	
	Section 4	Surface Water Quantity						
	Task 4.1	Dev. & Implement SWQN Model Components& Integrate into DSS						
29			▪ Calibration Technical Memo		Delivered March 12, 2004		The third revision to this memo has been rec'd by QnTT. Date is for final approval.	
30			▪ Evapotranspiration Memo		Delivered March 12, 2004		The second revision to this memo has been rec'd by QnTT. Date is for final approval.	
31			▪ Water Use, Management and Water Rights technical memo Memo includes: ___ Approach/description of water use component design, diversion/storage accounting, and land use/land cover modifier ___ Screen-shots of the various interfaces and recommendations for changes to the information content and organization		Draft 3/26/04 Final 5/14/04		Comments due 4/15/04 Conf call 4/22/04 Approval 6/4/04	
32			▪ Preliminary draft report on model development and calibration results Deliverable includes: ___ Technical material related to defining calibration data sets and model parameters ___ Summary descriptions of each model and any modifications made to the underlying model structures ___ Detailed summary comparisons between predicted and observed model performance that specifically targets model uncertainty in terms of input data and model output results as assessed through the semi-quantitative sensitivity analysis. This is not the formal uncertaintly and sensitivity analysis that would follow the beta model reviews. ___ Explicit documentation on model-to-model communication in terms of data and time-step resolution ___ Description of the range of uncertainty of data inputs and model parameters from the semi-quantitative sensitivity analysis. ___ 10 CDs and 2 hard copies		12/17/04		Comments due 1/28/05 Conf call 2/15/05	
33			▪ Draft report Deliverable includes: ___ Above listed items and addresses/incorporates comments from preliminary review draft ___ 10 CDs and 2 hard copies		3/11/05		Comments due 4/8/05 Conf call 5/3/05	
34			▪ Final Draft 1 Report Deliverable includes: ___ Above listed items and addresses/incorporates comments from draft 1 including Peer Review comments ___ Above listed items and addresses/incorporates comments from preliminary review draft ___ 10 CDs and 2 hard copies	x	5/20/05	x	Comments due 8/5/05 Conf call 8/30/05	
35			▪ Final Report Deliverable includes:		9/23/05		Approval 10/31/05	

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			___ Above listed items and addresses/incorporates comments from draft 2 ___ 10 CDs and 2 hard copies					
36			▪ SWQN model (beta version) Deliverable Includes: ___ 10 Installation CDs (part of full DSS install and not a separate set) Executable model that contains all model components described in the SOW including those with the following functionality: ___ Rainfall-runoff transformation using TOPNET framework recommended in Phase II Task 4 report, TOPMODEL representation for hillslopes, and representations for lowland drainages using current hydrologic modeling principles or existing code. Internal time step will be hourly while daily averages will be used in calibration and most DSS applications. ___ Evapotranspiration calculation ___ Water use calculation determined by per unit area rate for each land use/water use type ___ Ecological flow and water rights accounting that provides information on amount of water available to fulfill each water right under each management scenario ___ Diversion, transfers and surface storage accounting that tracks water for the listed purposes and applies user-specified rules or responds to water rights limitations. Graphical Interfaces needed for the DSS with the following functionalities including: ___ Land-use/land cover modifier that for management options that involve changing land use to determine impacts on surface and ground water. ___ Diversion/inter-basin transfer locator and associated parameters such as volumes and schedule for diversions or water rights priority date ___ Surface storage locator that allows user to identify characteristics of storage components such as volume-area curves and operating policies or water rights priority date.	x	5/20/05	x	Comments due 8/5/05 Conf call 8/30/05	
37			▪ SWQN model (final version) Deliverable includes: ___ Above listed items and addresses/incorporates comments from beta review ___ 10 Installation CDs		9/23/05		Approval 10/31/05	
38			▪ Final Draft 1 User manual (may be packaged with previously identified report) Deliverable includes: ___ Description of inputs accessible to the DSS for developing scenarios and provides explanation of outputs necessary for review of modeling results. Manual is not required to provide details on how to recalibrate the model. ___ 10 CDs and 2 hard copies	x	5/20/05	x	Comments due 8/5/05 Conf call 8/30/05	
39			▪ Final User Manual Deliverable includes: ___ Above listed items and addresses/incorporates comments from beta review ___ 10 CDs and 2 hard copies		9/23/05		Approval 10/31/05	
	Task 4.2	Validation of Model through Analyses of Scenarios						
40			▪ Scenario definition technical memo (cross-technical elements) Deliverable includes: ___ Definition of historical, existing, and future build out scenarios including recommendations for data sets and other parameters necessary to describe the scenarios		3/12/04		initial existing submitted	
41			Preliminary draft report on analysis of scenarios Deliverable includes: ___ Detailed analysis of the three scenario runs (historic, existing and FBO conditions) ___ Model validation will compare and test the model predicted existing conditions with actual data for existing conditions ___ Detailed descriptions of all assumptions and data input used to obtain the scenario results ___ 10 CDs and 5 2 hard copies		12/17/04		Comments due 1/28/05 Conf call 2/15/05	
42			▪ Draft report on analysis of scenarios Deliverable includes: ___ Above listed items and addresses/incorporates comments from preliminary draft ___ 10 CDs and 2 hard copies		3/11/05		Comments due 4/8/05 Conf call 5/3/05	
43			▪ Final Draft 1 report on analysis of scenarios ___Above listed items and addresses/incorporates comments from draft	x	5/20/05	x	Comments due 8/5/05 Conf call 8/30/05	

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			___10 CDs and 2 hard copies					
44			▪ Final report on analysis of scenarios Deliverable includes: ___ Above listed items and addresses/incorporates comments from draft and Peer Reviewers ___ 10 CDs and 2 hard copies		9/23/05		Approval 10/31/05	
45			▪ Uncertainty and Sensitivity Methods Memo		Draft 4/16/04 Final 7/2/04		Comments due 5/14/04 Conf call 6/17/04 Approval 7/16/04	
46			▪ Uncertainty and Sensitivity Technical Memo Deliverable includes: ___Documents the semi-quantitative uncertainty and sensitivity analyses results		Draft 10/21/05 Final 12/2/05		Comments due 11/4/05 Conf call 11/18/05 Approval 12/16/05	
	Section 5	Ground Water Quantity						
47	N/A	GWQN Task Documentation	▪ GWQN Model Status- Technical Memo Deliverable includes: ___ Explicit documentation on the existing status of the GWQN model development ___ Description of existing data file structure(s) necessary to implement the five-layer model ___ Documents the agreed to assumptions and input parameters for the multi-layer model ___ Documents any existing linkages between completed ground water quantity work (model and/or databases) and the Data Visualization module of the DSS ___ Brief description of tasks to complete the GWQN model as provided in the 6/16/03 SOW reduced effort version.		5/28/04		NO REVIEW	
48			▪ GWQN Files and Software Deliverable includes: ___ Existing, actual data files related to the project tasks ___ MODFLOW software and source code developed to date		5/28/04		NO REVIEW	
49	Task 5.3	DSS Module for a Single Well Water Right Application	▪ Single Well Water Right Application DSS Module Deliverable includes: ___ Existing data files related to the project tasks ___ CD of model source code ___ One set of CDs with executable software developed to date (most current version)		Delivered		NO REVIEW	
	Section 6	Surface Water Quality						
	Task 6.1	Surface Water Quality Monitoring						
50			▪ Final Data Analyses Technical Memo Deliverable includes: ___ Data presentation and analysis for data collected under the EDNs using graphical representations, summary tables, statistical analyses, and narrative analyses.		Conf call 3/4/04 Final 4/2/04		Conference call to define memo, then final only	
51			▪ Final QA/QC Technical Memo Deliverable includes: ___ Documentation of data quality for both field and laboratory analysis		Conf call 4/1/04 Final 5/7/04		*Conference call to define memo, then final only*	
52			▪ Surface Water Quality database Deliverable includes: ___ Access database updated with data up to November 14, 2003 ___ Description for how to add new data to the database once it is turned over to WRIA ___ 10 CDs only		5/28/04		Reviewed as part of DSS documentation review process	
	Task 6.2	Surface Water Quality Model Dev						
53			▪ Scenario Definition Technical Memo (cross-technical elements) Deliverable includes:		Draft 4/9/04 Final 5/28/04		Comments 4/23/04 Existing conf call 4/29/04	

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			___ spatial data inputs for historical, existing, and future build out scenarios				Hist. conf call 5/6/04 FBO conf call 5/13/04	
54			▪ Uncertainty/Sensitivity Methods Technical Memo		Draft 4/16/04 Final 7/2/04		Comments due 5/14/04 Conf call 6/17/04	
55			▪ Preliminary Draft of Surface Water Quality Beta Model Documentation package (Report I) Deliverable includes: ___ Technical material related to defining calibration data sets and model parameters (summarized from previously approved) ___ Summary description of each model and any modifications made to the underlying model structures ___ Explicit documentation on the water quality model-to-model communication in terms of data and time-step resolution. ___ Description of the range of uncertainty of data inputs and model parameters ___ Draft 'user manual' for the DSS that focuses on development of scenarios and review of modeling results for the water quality components ___ 10 CDs and 2 hardcopies containing the above deliverables		12/17/04		Comments due 1/28/05 Conf call 2/14/05	
56			▪ Draft of Report I Deliverable includes: ___ Above listed items and addresses/incorporates comments from preliminary review draft ___ 10 CDs and 2 hardcopies containing the above deliverables		3/11/05		Comments due 4/8/05 Conf call 5/2/05	
57			▪ Final Draft 1 of Report I Deliverable includes: ___ Above listed items and addresses/incorporates comments from draft 1 including Peer Review comments ___ 10 CDs and 2 hardcopies containing the above deliverables	x	5/20/05	x	Comments due 8/5/05 Conf call 8/29/05	
58			▪ Final Draft 2 of Report I Deliverable includes: ___ Above listed items and addresses/incorporates comments from draft 2 ___ 10 CDs and 2 hardcopies containing the above deliverables		9/23/05		Approval 10/31/05	
59			▪ Uncertainty and Sensitivity Analysis Technical Memo Deliverable includes: ___ Details of the quantitative sensitivity and uncertainty analysis for L. Whatcom and a qualitative sensitivity and uncertainty analysis on the coarse and medium resolution models		Draft 10/21/05 Final 12/2/05		Comments due 11/4/05 Conf call 11/18/05 Approval 12/16/05	
60			▪ SWQL Model (beta version) Deliverable includes: ___ Coarse resolution model WRIA-Wide as described in EDN13 ___ Medium resolution model for Dakota drainage as described in EDN 13 ___ Databases to support the coarse and medium resolution models ___ Lake Whatcom Model ___ Databases to support the Lake Whatcom model ___ 1 CD set of source code for coarse and medium resolution models and Lake Whatcom model ___ 10 installation CDs	x	5/20/05	x	Comments due 8/5/05 Conf call 8/29/05	
61			▪ SWQL Model (final version) Deliverable includes: ___ Above listed items and addresses/incorporates comments from beta review including Peer Review comments ___ 1 CD set of source code for coarse and medium resolution models and Lake Whatcom model ___ 10 installation CDs		9/23/05		Approval 10/31/05	
62			▪ SWQL Fine Resolution Files and Software Deliverable includes: ___ Existing, actual data files related to development of the South Fork and Fishtrap models ___ software and documentation developed to date including source code (non-reviewable deliverables)		8/27/04		NO REVIEW	
	Task 6.3	Integration of Surface Water Quality Information with Other Portions of the Study						
63			▪ Water Quality Model integrated in Beta and final DSS deliverables (Section 3)	x	12/17/04	x		

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
	Section 7	Ground Water Quality						
	Task 7.1	Development of Nitrogen Fate and Transport Ground Water model						
64			▪ Stand-Alone Single Layer Nitrogen Model Deliverable includes: ___ Existing preliminary visual displays for data input and output with executable and original source codes		4/30/04		NO REVIEW	
65			▪ User Document for Single Layer Nitrogen Model Deliverable includes: ___ Minimum details necessary to describe the model and its structure, data entry, and output gathering		5/28/04		NO REVIEW	
66			▪ Groundwater Quality Database Deliverable includes: ___ Access database with basic documentation necessary to use/update the database		4/16/04		NO REVIEW	
67			▪ Model Report Deliverable includes: ___ Complete report of the nitrogen models (on-ground nitrogen loading, soil nitrogen dynamics, and fate and transport), model calibration and verification data and results.		5/14/04		NO REVIEW	
	Task 7.4	Heavy Metals Report						
68			▪ Heavy Metals analysis Report Deliverable includes: ___ Report will be provided “as is” at 75% completion		5/14/04		NO REVIEW	
	Section 8	Instream Flows and Fish Habitat						
	Task 8.1	Data Reduction, Hydraulic and Habitat Model Calibration and Validation						
69			▪ Reduced field data in electronic format Deliverable includes: ___ re-analysis of intensive field sites to reflect changes and corrections to substrate/cover coding and revision to Habitat Suitability Curves (HSC)s		3/31/04			
70			▪ Calibrated hydraulic and habitat models and supporting documentation Deliverable includes: ___ Model software ___ Model documentation that includes input and output files for each site, final habitat suitability curves, ___ ___ Documentation/summary of field methods used for intensive and rapid assessment sites ___ 10 CDs and 2 hardcopies of the above deliverables. Hard copies of the model documentation memo only.	x	3/31/04 12/17/04	x	Follows Prelim Draft review schedule	
71			▪ Photocopies of field notes (Only for FY 2003 field sites under the DOE Grant as other field notes have already been provided to WRIA under completed and WRIA approved EDN work.		3/31/04			
	Task 8.2	Habitat Utilization Validation Data						
72			▪ digitized fish location data – USU was provided copies of WRIA field notes and photographs and these will not be given back as a deliverable. Only the electronic copies of the digitized fish locations developed at USU will be provided on CD.		12/17/04			
73			▪ Habitat Suitability Curves Deliverable includes: ___ Technical memo describing extent that fish utilization data was used or could be used to validate habitat suitability criteria ___ 10 CDs (digitized fish observation data and technical memo) and 2 hardcopies of the technical memo.		12/17/04			
	Task 8.3	Updated Basin Stratification for ISF Assessments						
74			▪ Final Draft 1[13] Basin Stratification Report		10/22/04	x	Comments 11/5/04	

[13] This report has already been through the WRIA Preliminary Draft and Draft review phases.

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			Deliverable includes: ___ Updated stratification ___ Revised statistical analyses of data sets (includes Ecology grant sites)				Conf call 11/19/04	
75			▪ Final Draft 2 Basin Stratification Report Deliverable includes: ___ Above items ___ Comments from draft Basin Stratification report addressed		12/17/04		Approval 1/28/05	
76			▪ Preliminary Draft Field Collection Methodology Report Deliverable includes: ___ Data collection and analyses protocols.		12/17/04		Comments 1/28/05 Conf call 2/16/05	
77			▪ Draft Field Collection Methodology Report *Deliverable includes* ___Above items ___Comments from Preliminary Draft Field Collection Methodology Report addressed		3/11/05		Comments 4/8/05 Conf call 5/4/05	
78			▪ Final Draft 1 Field Collection Methodology Report Deliverable includes: ___Above items ___Comments from Draft Field Collection Methodology Report addressed		5/20/05	x	Comments 8/5/05 Conf call 8/31/05	
79			▪ Final Draft 2 Field Collection Methodology Report Deliverable includes: ___ Above items ___ Comments from Final Draft 1 Field Collection Methodology Report addressed		9/23/05		Approval 10/31/05	
	Task 8.5	Development of Estimated Ecological Flow Regimes						
80			▪ Scenario Definition Technical Memo (cross-technical elements) Deliverable includes: ___ Spatial data inputs for historical, existing, and future build out scenarios (defines scenarios) ___ Specific recommendation for technical approach to address the scaling issue for channel lengths		Draft 4/9/04 Final 5/28/04		comments 4/23/05 conf calls 4/29, 5/6, 5/13/04 approval 6/11/04	
81			▪ Framework for use of Instream Flow Technical Information in developing instream flow recommendations Deliverable is a technical memo that describes: ___ Framework for interpretation and application of site-specific and extrapolated methodologies to assess instream flow recommendations including identification/quantification of aquatic base flows, channel, habitat, and riparian maintenance flows and general ecological flows that integrate physical, chemical, and biological processes		10/1/04			
82			▪ Calibrated hydraulic and habitat model components contained within the DSS Deliverable includes: ___ Documentation for this element will be the report for Task 8.1 incorporated in Task 8.6	x	12/17/04	x		
	Task 8.6	Development and Validation of ISF Extrapolation Methodology						
83			▪ Preliminary Draft Extrapolation Methodology Report Deliverable includes: ___ Final extrapolation methodology ___ Validation results ___ Identification of uncertainty in the extrapolation method linked to specific strata ___ Recommendations for future efforts to reduce uncertainty where feasible ___ Incorporates Final Draft 2 report from Task 8.3 ___ 10 CDs and 2 hardcopies		12/17/04		Comments due 1/28/05 Conf call 2/16/05	
84			▪ Draft Extrapolation Methodology Report Deliverable includes: ___ Above listed items and addresses comments from preliminary draft ___ Appendix that includes Draft Field Collection Methodology Report (Task 8.3) ___ 10 CDs and 2 hardcopies		3/11/05		Comments due 4/8/05 Conf call 5/4/05	
85			▪ Final Draft 1 Extrapolation Methodology Report		5/20/05	x	Comments due 8/5/05	

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			Deliverable includes: ___ Above listed items and addresses comments from drafts ___ 10 CDs and 2 hardcopies				Conf call 8/31/05	
86			▪ Final Extrapolation Methodology Report Deliverable includes: ___ Above listed items and addresses comments from previous drafts ___ 10 CDs and 25 hardcopies		9/23/05		WRIA approval 10/31/05	
87			▪ Uncertainty and Sensitivity Methods Memo		Draft 4/16/04 Final 7/2/04		Comments 5/14/04 Conf call 6/17/04 Approval 7/16/04	
88			▪ Uncertainty and Sensitivity Analysis Technical Memo Deliverable includes: ___ Documents the semi-quantitative uncertainty and sensitivity analyses results		Draft 10/21/05 Final 12/2/05		Comments due 11/4/05 Conf call 11/18/05 Approval 12/16/05	
	Task 8.8	Invertebrate Sample Processing						
89			▪ Macroinvertebrate database and data presentation Deliverable includes: ___ Updated database with macroinvertebrate information ___ Integrate database into data visualization module of DSS to display where invertebrate sampling occurred and data available. ___ E-mail notification of availability on auto-update web site	x	12/17/04		Follows prelim draft review schedule	
	Section 9	Watershed Plan, EIS & Socio-economic Coordination						
	Task 9.1	Technical Assistance and Information Exchange						
90			▪ Review of Technical Assessment Sections of WRIA 1 Watershed Management Plan (WMP) Deliverable includes: ___ Review of draft technical sections for the WMP for each technical element by the appropriate PI ___ Provide written comments and edits to technical assessment drafts to ensure that USU material is accurately characterized and applied		2/20/04			
91	Section 10	Project Management	Section 10 of the USU Phase III Scope of Work describes the process that will be used by USU for project management and project tracking. The project deliverable for this task is successful project management including delivery of products identified throughout the Phase III Scope of Work on time and within budget.		12/16/05			
	Section 11	Technology Transfer						
	Task 11.1.1	DSS/DBMS Training						
92			▪ 2 Technical Training Sessions (one at beta delivery of the DSS and one at final delivery) Deliverable includes: ___ The use of the DSS for simulating scenario results based on the existing, historic and future build out scenarios ___ The use of the Data visualization plug-ins and their interrelationships ___ Consultation on the use of the various analytical models and integrated DSS modules	x	1/6–1/7/04 9/29– 9/30/05			
	Task 11.1.7	DBMS and DSS System Maintenance and Administration						
93			▪ System level documentation not covered by specific technical tasks in this section of the Phase III scope Deliverable documentation includes: ___ Complete technical 'map' to the structure and function of all components and functions of the DSS/DBMS ___ Database structures ___ Query definitions ___ Model linkage routines	x	12/17/04			

	Section/ Task	Title	Deliverable/Intermediate Work Products	*Beta Product*	*USU Due Date*	Peer Review Item	TTL Notations	Accepted (date)
			___ One set of CDs					
94			▪ Personnel Training Deliverable includes: ___ Several weeks training of qualified WRIA personnel at USU on the underlying system architectures and related database structures ___ Training will include procedures for updating key database elements such as stream flow or water quality monitoring data. ___ Documentation of software and hardware requirements necessary to install the DSS/DBMS including CPU speed, RAM, disk storage, video boards, and software requirements aside from the DSS software that will be delivered.		TBD			

EXHIBIT D-3
CALENDAR

February 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16 Holiday (Presidents' Day)	17	18	19	20 9.1 Watershed Management Plan Technical Review comments to WRIA	21
22	23	24	25	26	27 8.2 ISF/FH – Fish observation data to USU[14]	28
29						

*Note: According to USU WRIA approval has been received for SWQL and SWQN calibration and Evapotranspiration memos.

[14] The ISF/FH Technical Teams were notified of this date in the Fall of 2003 as part of authorized on-going work.

March 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4 SWQN – Startup conf call w/TT[2] 6.1 SWQL – Conf call w/TT on Data Analysis tech memo[15]	5	6
7	8	9	10	11	12 SWQN - ·Model Calibration memo approval by WRIA SWQN - Evapotranspiration memo approval by WRIA	13
14	15	16	17	18	19	20
21	22	23	24	25	26 4.1 SWQN - Submit draft memo on water use management and rights to WRIA	27
28	29	30	31 8.1 ISF/FH – WRIA approval of hydraulic model calibrations 8.1 ISF/FH - Field data reduction QA/QC 8.1 ISF/FH – Hydraulic model calibration/ validation 8.1 ISF/FH – Copies of field notes for DOE grant sites			

[15] Contingent on written notification of WRIA Contract Administrator pending signed Phase III Revised SOW Contract Amendments

April 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1 3.2A DSS/DBMS – Alpha Watershed Characterization to WRIA 3.3A DSS/DBMS – Alpha Map Window module to WRIA 3.3C DSS/DBMS – Alpha Stream Flow Analyst to WRIA 3.3G DSS/DBMS – Alpha Surface Water Quality Analyst to WRIA 3.5A DSS/DBMS – Alpha DBMS Utility to WRIA 6.1 SWQL – Conf call with TT to define contents and structure of QA/QC memo	2 6.1 SWQL – Technical memo - Final data analysis of data collected as part of EDN 8 & 13) submitted to WRIA	3
4	5	6	7	8	9 *SWQN, SWQL, ISF/FH – Preliminary Existing (complete), Historical and Full Buildout memo to WRIA*	10
11	12	13	14	15 4.1 SWQN – WRIA comments on water use management and rights memo	16 SWQN, SWQL, ISF/FH - Uncertainty/Sensitivity methods memo to WRIA GWQL – Deliver Microsoft Access files & doc providing basic details – NO REVIEW	17
18	19	20	21	22 4.1 SWQN – Conf call to resolve comments regarding water use management and rights memo	23 SWQN, SWQL, ISF/FH – WRIA comments on E/H/FBO memo	24
25	26	27	28	29 SWQN, SWQL, ISF/FH – Conf call to resolve comments on existing conditions scenario datasets	30 8.1B ISF/FH – Conceptual development of habitat models GWQL – Deliver stand-alone single-layer nitrogen model with executable and original source code – NO REVIEW	

May 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6 SWQN, SWQL, ISF/FH – Conf call to resolve comments on historical scenario datasets	7 3.2A DSS/DBMS – WRIA comments on Alpha Watershed Characterization to USU 3.3A DSS/DBMS – WRIA comments on Alpha Map Window Module to USU 3.3C DSS/DBMS – WRIA comments on Alpha Stream flow Analyst to USU 3.3G DSS/DBMS – WRIA comments on Alpha Surface Water Quality Analyst to USU 3.5A DSS/DBMS – WRIA comment on Alpha DBMS Utility to USU 6.1 SWQL – Final QA/QC technical memo submitted to WRIA	8
9	10	11	12 DSS/DBMS – 3.2A, 3.3A, 3.3C, 3.3G, 3.5A – Conference call to resolve comments on these DSS/DBMS components. (*NOTE: Final date for resolving features for these components)	13 SWQN, SWQL, ISF/FH – Conf call to resolve comments of FBO scenario datasets	14 4.1 SWQN – Final water use memo submitted for WRIA review SWQN, SWQL, ISF/FH – WRIA comments on Uncertainty/Sensitivity memo GWQL – Deliver Heavy Metals Report as is (75% complete) – NO REVIEW **GWQL** – Complete report of nitrogen models providing details and verification data & results to WRIA – NO REVIEW	15
16	17	18	19	20	21	22
23	24	25	26	27	28 GWQN – Deliver technical memo, data files & MODFLOW software developed to date – NO REVIEW GWQL – Deliver user doc. providing details of nitrogen model to WRIA – NO REVIEW 6.1 SWQL – Final Product – updated SWQL database with incorp of EDN 8 & 13 data and SWQL data from var. agencies listed in SOW. (Reviewed as part of DSS documentation review process, Task 3.1.A) 6.1 SWQL – Final Product – document describing how to add data to the SWQL database(Reviewed as part of DSS documentation review process, Task 3.1.A) 8.1 ISF/FH – Preliminary habitat model results to WRIA SWQN, SWQL, ISF/FH – Final E/H/FBO memo to WRIA	29
30	31					

June 2004

Sun	Mon	Tues	Wed	Thurs	Fri	Sat
		1	2	3 3.3S DSS/DBMS – Alpha Photo Viewer module to WRIA.	4 4.1 SWQN – WRIA provides final approval of water use management and rights memo	5
6	7	8	9	10	11 SWQN, SWQL, ISF/FH - Final approval of E/H/FBO memo from WRIA	12
13	14	15	16	17 SWQN, SWQL, ISF/FH – Conf call to resolve comments on Uncert/Sens methods memo	18	19
20	21	22	23	24	25	26
27	28	29	30			

July 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1 3.3S DSS/DBMS – WRIA comments on Alpha Photo Viewer to USU	2 SWQN, SWQL, ISF/FH – Final Uncert/Sens. methods memo	3
4	5 4th of July USU holiday	6	7	8	9	10
11	12	13	14 3.3S DSS/DBMS – Conference call to resolve comments on Alpha Photoviewer. (*NOTE: Final date for resolving features for this component)	15	16 SWQN, SWQL, ISF/FH – WRIA approval of Uncert/Sens. methods memo	17
18	19	20	21	22	23 Pioneer Day – USU holiday	24
25	26	27	28	29	30	31

August 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6 3.3W DSS/DBMS – Alpha ISF/FH Data Viewer to WRIA 3.3AA DSS/DBMS – Alpha Macroinvertebrate Data Viewer to WRIA	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27 6.2 SWQL –Data files, software developed to date and other documentation for the S. Fork and Fishtrap Creek fine resolution models. (Not continued under modified Phase III SOW – NO REVIEW).	28
29	30	31				

September 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2 3.4A DSS/DBMS – Alpha Scenario Builder to WRIA 3.4E DSS/DBMS – Alpha Land Cover Change Module to WRIA 3.4I DSS/DBMS – Alpha Best Management Practice Module to WRIA 3.4M DSS/DBMS – Alpha Storage Change Module to WRIA 3.4Q DSS/DBMS – Alpha Climate Change Module to WRIA 3.4U DSS/DBMS - Alpha Population Change Module to WRIA 3.4Y DSS/DBMS – Alpha Diversion/Transfer Module to WRIA 3.5E DSS/DBMS – Alpha Model Manager Module to WRIA	3 3.3W DSS/DBMS – Comments on Alpha ISF/FH Data Viewer to USU 3.3AA DSS/DBMS – Comments on Alpha Macroinvertebrate Viewer to USU	4
5	6 Labor Day – USU holiday	7	8	9	10	11
12	13	14	15 DSS/DBMS – 3.3W, 3.3AA – Conference call to resolve comments on these DSS/DBMS components (*NOTE – Final date to resolve features for these components)	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Comment [TBH3]:

October 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1 DSS/DBMS – 3.4A, 3.4E, 3.4I, 3.4M, 3.4Q, 3.4U, 3.4Y, 3.5E – WRIA comments on these Alpha modules to USU 8.5 ISF/FH – Submit ISF Framework technical memo	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20 DSS/DBMS – 3.4A, 3.4E, 3.4I, 3.4M, 3.4Q, 3.4U, 3.4Y, 3.5E – Conference call to resolve comments on these DSS/DBMS components (*NOTE: Final date to resolve features for these components)	21	22 8.3 ISF/FH – Revised stratification report to WRIA	23
24	25	26	27	28	29	30

November 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
Oct 31	1	2	3	4	5 8.3 ISF/FH – WRIA comments on revised stratification report to USU	6
7	8	9	10	11	12	13
14	15	16	17	18	19 8.3 ISF/FH – Conference call to resolve comments on revised stratification report.	20
21	22	23	24	25 Thanksgiving Holiday	26 Thanksgiving Holiday	27
28	29	30				

December 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17 All – Preliminary Draft Report to WRIA (Includes Task 3, 4.1, 4.2, 6.2, 6.3, 8.1, 8.2, 8.3, 8.6B, 8.8, 8.9 and Land Cover Report[16])	18
19	20	21	22	23 USU Holiday	24 USU Holiday	25
26	27	28	29	30	31 USU Holiday	Jan 1

[16] The Land Cover Report is a cross pod report deliverable and will cover existing, historical, and full build out scenarios as defined by the agreed upon technical memos. Note that the existing conditions is defined according to the existing contract amendment to the Phase III contract.

January 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
2	3 DSS – Server installation and DSS configuration	4 DSS – Server installation and DSS configuration	5 DSS – Server installation and DSS configuration	6 *11.1 DSS/TT All pods* Tech training workshop - DSS Training	7 *11.1 DSS/TT All pods* Tech training workshop - DSS Training	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28 All – WRIA comments on Preliminary Draft Report to USU 8.3 ISF/FH – WRIA approval of Basin Stratification Report *(Cutoff date for new DSS/DBMS data).[17]	29
30	31					

[17] GWQN & GWQL are not included since these work elements have been deferred.

February 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14 SWQL – Conference call to discuss Preliminary Draft Report comments	15 SWQN - Conference call to discuss Preliminary Draft Report comments	16 ISF/FH - Conference call to discuss Preliminary Draft Report comments	17 DSS - Conference call to discuss Preliminary Draft Report comments	18	19
20	21	22	23	24	25	26
27	28					

March 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11 All – Draft Report to WRIA	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

April 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8 All – WRIA comments on Draft Report	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

May 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2 SWQL – Conference call to discuss comments on Draft Report	3 SWQN - Conference call to discuss comments on Draft Report	4 ISF/FH - Conference call to discuss comments on Draft Report	5 DSS - Conference call to discuss comments on Draft Report	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20 All – Submit Final Draft 1 (Full Beta) for Peer Review	21
22	23	24	25	26	27	28
29	30	31				

June 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

July 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4 4th of July Holiday	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

August 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5 All – WRIA & Peer Review comments to USU for Final Draft 1	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29 SWQL – Conference call to discuss comments on Final Draft 1	30 SWQN - Conference call to discuss comments on Final Draft 1	31 ISF/FH - Conference call to discuss comments on Final Draft 1			

September 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1 DSS/DBMS - Conference call to discuss comments on Final Draft 1	2	3
4	5 Labor Day – Holiday	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23 All – Submit Final Draft 2 Report and written responses to Final Draft 1 comments (Full release version of DSS)	24
25	26	27	28	29 11.1 DSS/TT All pods - Tech training workshop - DSS Training[18]	30 11.1 DSS/TT All pods - Tech training workshop - DSS Training[7]	Oct 1

[18] GWQN & GWQL are excluded.

October 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21 SWQN, SWQL, ISF/FH – Submit Uncertainty/Sensitivity memo	22
23	24	25	26	27	28	29
30	31 All – Final approval from WRIA on products					

November 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4 SWQN, SWQL, ISF/FH – WRIA comments on Uncertainty/Sensitivity memo	5
6	7	8	9	10	11	12
13	14	15	16	17	18 SWQN, SWQL, ISF/FH – Conference call to resolve comments on Uncertainty/Sensitivity memo	19
20	21	22	23	24 Thanksgiving Holiday	25 Thanksgiving Holiday	26
27	28	29	30			

December 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	1	2 SWQN, SWQL, ISF/FH – Submit final Uncertainty/Sensitivity memo	3
4	5	6	7	8	9	10
11	12	13	14	15	16 SWQN, SWQL, ISF/FH – WRIA approval of Final Uncertainty/ Sensitivity memo Task 10 – Project Management complete	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31