ASSESSMENT REPORT
MULTI-PURPOSE WATER STORAGE OPPORTUNITIES
WATER RESOURCE INVENTORY AREA 59
COLVILLE RIVER WATERSHED

June 2, 2003

FUNDED BY: WASHINGTON STATE DEPARTMENT OF ECOLOGY
RECIPIENT: STEVENS COUNTY CONSERVATION DISTRICT
GRANT NO. G0300061
PROJECT TITLE: ASSESSMENT OF MULTI-PURPOSE WATER STORAGE OPPORTUNITIES

June 2, 2003

Stevens County Conservation District
232 Williams Lake Road
Colville, WA 99114

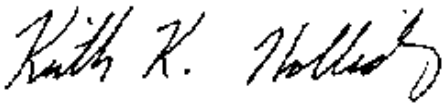
Attention: Victor Kollock

We are pleased to present one unbound and five bound copies of our "Assessment Report" for the WRIA 59, Colville River Watershed. In addition, two compact discs containing electronic copies of the report in PDF format are included. This report is the last deliverable of Contract No. WS-G0300061 as amended. Our services have been conducted in accordance with our proposal dated December 2, 2002.

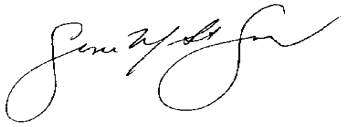
We appreciate being of service to the Stevens County Conservation District. If there are any questions, please feel free to call any of the undersigned.

Respectfully submitted,

GeoEngineers, Inc.



Keith Holliday
Environmental Scientist



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EXECUTIVE SUMMARY

Stevens County Conservation District (SCCD) contracted with the Brown and Caldwell / GeoEngineers, Inc. Consultant Team to conduct an assessment of multi-purpose water storage opportunities within the Colville River Watershed, otherwise known as Water Resource Inventory Area (WRIA) 59. The assessment consisted of five tasks including:

- retrospective analysis;
- water storage alternative development;
- environmental effects analysis; and
- cost analysis;
- water storage recommendations.

The first task of this assessment, termed the retrospective analysis, was to review information on previous water storage proposals identified by the SCCD in WRIA 59. Based on the review results, recommendations were developed to either carry a proposal forward or eliminate the proposal from further study. Recommendations were made to eliminate proposals on Little Pend Oreille River and Mill Creek from further study, however a Chewelah Creek proposal was carried forward.

A Geographic Information System (GIS) was then used to analyze existing data to develop water storage alternatives within WRIA 59. Programmatic approaches, those associated with sustaining current conditions or altering land use practices, were identified and removed from further consideration. Project-specific alternatives were refined and ranked based on the alternative's physical location in the watershed and the alternative's characteristics. Five water storage project alternatives were selected for further analyses. These alternatives are located in the Sheep Creek, Grouse Creek, Cottonwood Creek, Sherwood Creek, and Chewelah Creek sub-basins.

An environmental effects analysis was performed to identify the negative and beneficial environmental impacts anticipated should the water storage project alternatives be constructed and operated at the proposed sites. An effort was made to recognize if and how water storage alternatives and their potential sites might facilitate community and/or economic development through mitigation for other projects or by providing additional opportunities. Alternatives were ranked in ascending order of environmental effects.

To compare project alternative costs, a planning-level cost analysis was conducted utilizing available state and local economic information in a systematic method. A spreadsheet was developed to calculate the approximate cost of additional required studies, permitting, mitigation, and construction for each alternative. Alternatives were then ranked in descending order of cost.

Lastly, the water storage project alternatives recommendation and programmatic opportunities identified while developing these alternatives were documented in the results section of this report. Based on the project alternative development process and the environmental effects and cost analyses, Alternative No. 7-B1 (Horseshoe Lake Storage Enhancement) appears to be the most viable project, followed by Alternative Nos. 1-A, 30-G, 8-K, and 3-P. Programmatic recommendations, such as farm field flooding, land acquisition/

riparian restoration, beaver management, aquifer storage and recovery, and unconfined aquifer recharge, were also included to assist with potential future resource management in WRIA 59.

ASSESSMENT REPORT
MULTI-PURPOSE WATER STORAGE OPPORTUNITIES
WATER RESOURCE INVENTORY AREA 59
COLVILLE RIVER WATERSHED

INTRODUCTION

Stevens County Conservation District (SCCD) contracted with the Brown and Caldwell / GeoEngineers, Inc. Consultant Team (Consultant Team) to conduct an assessment of multi-purpose water storage opportunities within the Colville River Watershed, otherwise known as Water Resource Inventory Area (WRIA) 59. Figure 1-1 displays a map of WRIA 59.

The assessment was conducted for the SCCD on behalf of the WRIA 59 Planning Unit, and in accordance with the Watershed Planning Act, Revised Code of Washington 90.82. A Draft Assessment Report, dated April 10, 2003, was distributed to members of the WRIA 59 Planning Unit and the public on April 11, 2003. Public meetings to present the Draft Assessment Report were held on April 23, 2003 in the City of Chewelah Council Chambers in Chewelah, Washington and on April 24, 2003 in the Stevens County Commissioners' Chambers in Colville, Washington. Responses to comments from the public meetings and review of the Draft Assessment Report can be found in Appendix G, and have been incorporated into this document accordingly.

The assessment consists of five tasks including:

- retrospective analysis;
- water storage alternative development;
- environmental effects analysis;
- cost analysis; and
- water storage recommendations.

An introduction and discussion of approach and results for each task is presented below.

CHAPTER 1: RETROSPECTIVE ANALYSIS

INTRODUCTION

The first task of this assessment, termed the retrospective analysis, was to review previous reports, studies, and investigations identified by the SCCD of assessed, proposed or constructed water storage projects in WRIA 59. The Consultant Team received three files from the SCCD on December 20, 2002 with project proposals for the Mill Creek, Little Pend Oreille River, and Chewelah Creek sub-basins as displayed in Figure 1-2. Table 1 summarizes proposals contained in the files.

Table 1: Storage Proposals Identified in SCCD Files		
Number	**Sub-basin**	**Proposal Location**
R1	Little Pend Oreille River	Proposed Upper Dam Site No. 1 (Figure 1-3)
R2	Little Pend Oreille River	Proposed Middle Dam Site No. 2 (Figure 1-4)
R3	Little Pend Oreille River	Proposed Lower Dam Site No. 3 (Wildlife Refuge Headquarters) (Figure 1-5)
R4	Chewelah Creek	South Fork of Chewelah Creek (Figure 1-6)
R5	Mill Creek	Lower Site (Above Pinkney City) (Figure 1-7)
R6	Mill Creek	Upper Site (South Fork of Mill Creek) (Figure 1-8)

The file titled "Little Pend Oreille Watershed Reservoir Storage Research 1950's – 1960's" contained three proposed dam and reservoir projects in the Little Pend Oreille Wildlife Refuge as shown in Figures 1-3, 1-4, and 1-5. The file titled "Chewelah Creek Watershed Reservoir Storage Research Project, April 7, 1948" contained an engineering report proposing water system improvements for the City of Chewelah including replacement of an existing dam with a new dam as shown in Figure 1-6. The third file titled "Mill Creek Watershed Reservoir Storage Research, 1950's – 1970's" contained two dam and reservoir proposals, with one site located above Pinkney City and the other site on the South Fork of Mill Creek, as shown in Figures 1-7 and 1-8.

The remainder of this chapter describes the approach taken by the Consultant Team in reviewing the files and the proposals therein, presents the results of our review for each proposal, and recommends for each proposal either moving the proposal or a modification thereof forward, or eliminating the proposal from further consideration.

APPROACH

To ensure consistent and systematic review of the materials, a screening process was developed for Consultant Team reviewers. The screening protocol was developed through input from the Consultant Team's senior staff in the disciplines of engineering, hydrogeology, water resources, and ecology. The result is a series of questions specific to these key disciplines.

Reviewers were instructed to only evaluate the information provided the Consultant Team by the SCCD. Each reviewer was asked to document their response to each of the questions identified in their discipline(s). A template was constructed to facilitate consistent and comprehensive responses to the discipline-specific questions and ensure that the reviewer would make and justify a recommendation. The Reviewer Response Templates are included in Appendix A. When insufficient information was available to answer a site-specific question, reviewers were asked to respond accordingly, and then briefly note what information might be required to properly evaluate the proposal, if their recommendation were to carry the proposal forward. Reviewers prepared and submitted a final recommendation with a summary of their evaluation for each proposal. The actual responses have been included in Appendix B.

RESULTS

The results of the Consultant Team's review have been compiled and are presented below by drainage basin. Each section begins with a description of the content and quality of the materials provided to the Consultant Team for review. This was done in an attempt to complete the overall understanding of the information within each file. Each section then documents the reviewer's responses by discipline for each file.

Little Pend Oreille River Watershed Proposals

File Content

The file of information provided for the project proposals in the Little Pend Oreille River drainage (See Figures 1-3, 1-4, and 1-5) consisted primarily of correspondence between and within three agencies. The U. S. Fish and Wildlife Service generated the most correspondence in regard to the proposals developed by the Soil Conservation Service and the Stevens County Public Utility District No. 1. The proposed reservoir for the lower site was located at the western boundary of the Little Pend Oreille National Wildlife Refuge near the Fish and Wildlife Service office. The file of information was found to contain minimal field investigation or report documentation.

Geotechnical Engineering Review

Insufficient information was provided for a geotechnical engineering evaluation of the geology, slope stability and other issues associated with siting the dams and reservoirs proposed in the wildlife refuge. Not enough information was provided to determine if there would be adequate capacity for water and sediment storage if the proposed projects were constructed. No information was provided to approximate or document the rates of erosion, sedimentation or reservoir leakage for the proposed facilities. The materials within the file did not discuss the proposed conveyance of water if the projects were constructed. Consequently, it was not possible to determine if the proposed conveyance system(s) would meet the intent of the projects. The file also did not contain any information identifying suitable construction materials or if any construction materials are in the vicinity of the proposed project sites.

Hydrogeologic Review

Determinations about the hydraulic connection between surface and groundwater, effects on groundwater elevations, and the delivery of recharge to areas of need require a significant amount of hydrologic and hydrogeologic information about the drainage basin. Questions relating to hydrogeologic evaluation of the proposed sites cannot be answered because information needed was not available in the file.

Water Resources Review

Proposed projects such as the ones discussed in this file would require a number of significant permits. First and foremost would be the permitting of water rights. Review of Chapter 173-559

of the Washington Administrative Code (WAC) indicates these types of storage projects might be allowed if they are determined by the Washington State Department of Ecology (Ecology) to be a non-consumptive use. Currently, the WRIA 59 is closed to further consumptive appropriations from July 16 through September 30 of each year. A determination of whether evaporation from a man-made reservoir is a consumptive use may need to be made by Ecology. In addition, the proposed system would need to operate in a manner that ensures base flows established in WAC 173-559 are met and senior water rights downstream of the proposed projects are protected.

Reservoir projects potentially require water quality related permits. An Individual Permit under Section 404 of the Clean Water Act from the U. S. Army Corps of Engineers in conjunction with a Section 401 of the Clean Water Act water quality certification from Ecology may be required for the placement of fill materials below the ordinary high water mark of the Little Pend Oreille River and in the associated and isolated wetlands, if determined to be present. Also, a Hydraulic Project Approval (HPA) permit would need to be issued by the Washington State Department of Fish and Wildlife (WDFW). In addition, a National Pollutant Discharge Elimination System (NPDES) permit may be required from Ecology depending on the conveyance system used and other potential discharges to the stream. These types of projects have potential to affect water temperature and total dissolved gas.

These projects are proposed to be sited on land managed by a federal agency, which raises additional questions. A special use permit by the U. S. Fish and Wildlife Service may be required, and even if it is not, the U. S. Army Corps of Engineers' permit provides the federal nexus for the Endangered Species Act to be considered applicable. At a minimum, it is probable that such projects should consider an Agency Consultation under Section 7 of the Endangered Species Act. In addition, the federal agency involvement and possible alteration of their mission may require satisfying the National Environmental Policy Act (NEPA). Therefore, these types of projects in an U. S. Fish and Wildlife Service wildlife refuge may require an Environmental Impact Statement (EIS). However, NEPA Compliance may potentially satisfy the Washington State Environmental Policy Act (SEPA) requirements.

In addition to the aforementioned potential permits and documents, the proposed projects also may require a Dam Safety permit from Ecology. In light of the geotechnical engineering review, a number of geologic, hydrogeologic, hydrologic, and engineering studies would need to be completed before any judgment could be made about the potential to gain such approval. Also, the Stevens County Critical Areas Ordinance and Shoreline Management Act Master Program may potentially apply to this project because of possible impacts to wetlands and questions about geological hazards.

Ecological Review

From an ecological perspective, the proposals lack the field studies needed to determine if significant impacts to important habitat would occur. While it is understood that the proposed projects would place fill in the Little Pend Oreille River to construct dams and inundate the upgradient meadows near the wildlife refuge headquarters, the actual species of plants and

animals that would be displaced or destroyed in these areas were never determined. Field studies identifying the plant and animal communities of the area that would potentially be impacted by the proposed projects would be required. Also, with no indications of how stored water would be conveyed during operation, the downstream areas would require an assessment in preparation for the potential mitigation that may be required during the numerous permitting processes identified above. Consequently, a determination about the impact to important habitat cannot be made from review of the existing files. In addition without more specific information about the proposed projects, potential beneficial impacts cannot be assessed at this time.

Chewelah Creek Watershed Proposals

File Content

The file of information provided for the project proposal in the Chewelah Creek drainage consisted primarily of a single engineering study of potential sources and methods to augment water supply for the City of Chewelah in 1948. The focus of the Consultant Team's review was on the discussion of a new dam for the existing reservoir (See Figure 1-6 for proposed location). The file did not contain any information indicating if the opportunities outlined in the report for additional appropriation and storage were ever realized. However, upon review of a map of the area, it became apparent the wells (NE ¼, Section 3, T.32N., R.40E.) and tank storage (SE ¼, Section 12, T.32N., R.40E.) proposed as a component of the 1948 engineering report had been developed, although no documents in the file confirmed the construction of these components. The 1948 report identifies the stream proposed for a new dam as the east branch of Chewelah Creek. However, the Consultant Team has assumed from matching the drawings and other descriptive information within the file to a topographic map that the stream referenced is actually the South Fork of Chewelah Creek.

Geotechnical Engineering Review

From a geotechnical engineering perspective, the engineering report did not contain sufficient information for an evaluation of the geology, slope stability and other issues associated with siting a new dam and reservoir. The report did attempt to determine if there would be adequate water storage capacity for the City of Chewelah in 1948. Additional information would be needed to make such a determination for current needs related to the capacity for water and sediment storage in such a reservoir for future needs. For example, little to no information was provided to approximate or document the rates of erosion, sedimentation, or reservoir leakage to be expected at the time of the proposal. The information provided did discuss conveying water through a pipe line if the project were constructed. However, this conveyance system may not meet the purpose and intent of such a project today. Further investigations would be needed to identify feasible methods of conveyance. The file did not identify suitable construction materials or if any construction materials were located in the vicinity of the proposed project site. Additional investigations would be needed to identify such materials in the vicinity of the proposed project.

Hydrogeologic Review

Determinations regarding hydraulic connection between surface and groundwater, effects on groundwater elevations, and the delivery of recharge to areas of need require a significant amount of information about the drainage basin. Questions relating to hydrogeologic evaluation of the site cannot be answered because information needed was not available in the file.

Water Resources Review

This in-stream water storage project has the potential to require a significant number of permits. Of critical importance would be the permitting of water rights. Upon initial review of Chapter 173-559 of the WAC, it appears these types of storage projects might be allowed if they are determined by Ecology to be a non-consumptive use. The WRIA 59 is closed to further consumptive appropriations from July 16 through September 30 during each year. A determination would need to be made by Ecology to assess whether evaporation from a man-made reservoir is a consumptive use. In addition, the system would need to be operated to ensure base flows established in WAC 173-559 are met and more senior rights downstream of the proposed project are protected. The proposed use of the stored water in 1948 was for domestic supply; if this use were determined to still be needed, then the proposed project would have a consumptive use element.

Construction of a new dam and reservoir may also potentially require a number of water quality related permits. An individual Permit under Section 404 of the Clean Water Act from the U. S. Army Corps of Engineers in conjunction with a Section 401 of the Clean Water Act water quality certification from Ecology may be required for the placement of fill materials below the ordinary high water mark of the stream and in the associated and isolated wetlands, if determined to be present. Part of Ecology's Section 401 of the Clean Water Act water quality certification would be to ensure the WDFW has or would issue a HPA. In addition, a NPDES permit may be required from Ecology depending on the conveyance system used and potential discharges to the stream. There are also potential impacts to water temperature and total dissolved gas associated with dam and reservoir operations.

Ecology may require the proposed project to apply for and receive a Dam Safety permit. A number of engineering studies may need to be completed before any judgment could be made about the potential to obtain such approval. The Stevens County Critical Areas Ordinance would also potentially apply to this project because of potential impacts to wetlands and the unanswered questions about geological hazards. Also, the Stevens County Shoreline Management Act Master Program may apply to this project if this reach of the stream has been determined to be a water body of state significance. Finally, a Washington SEPA EIS may be required on a project of this type.

Ecological Review

As previously stated for the Little Pend Oreille River, without field studies assessing plant and animal communities that could be impacted by the proposed storage project, it is difficult to make a determination of the significance of such impact. The actual species of plants and

animals that would be displaced or destroyed in this area was not documented in the report supplied for review. Also, with no indications or engineering plans of how stored water would be conveyed during operation for today's uses, the downstream areas would need to be assessed in preparation for potential mitigation during the numerous permitting processes identified above. Consequently, a determination about significant impacts to important habitat cannot be made. In addition, without more specific information about the proposed project, potential beneficial impacts cannot be assessed at this time.

Mill Creek Watershed Proposals

File Content

The file of information provided for the project proposals in the Mill Creek drainage consisted of several field investigations and numerous agency correspondences. The focus of the Consultant Team's review was on the technical information about the Mill Creek proposals for a dam and reservoir above Pinkney City and on the South Fork of Mill Creek as shown on Figures 1-7 and 1-8 respectively.

Geotechnical Engineering Review

It appears from the information provided that geologic conditions at the sites of both projects proposed on Mill Creek are not favorable for siting a dam and reservoir. The Soil Conservation Service noted on two separate occasions the adverse geologic conditions at one or both Mill Creek sites. Both sites were and are believed to be poor locations because of poor foundation and abutment conditions. The materials assessed on these sites were found to have weak mechanical properties, such as low shear strength, plastic clay, and high moisture content. In addition, from the limited information available it appears that slope instability at both sites could be an issue for dam and reservoir construction and operation. However, more information would be required to make a final determination.

While there appears there might be adequate capacity for water and sediment storage, the file lacked information necessary to evaluate rates of erosion and sedimentation. There appears to be potential for significant reservoir leakage, but additional investigations would be required to confirm these observations. The proposed projects do not define the conveyance system to be utilized. Proposed construction materials discussed in the reports appear to be suitable for these projects and locally available.

Hydrogeologic Review

Determinations regarding the hydraulic connection between surface and groundwater, effects on groundwater elevations, and the delivery of recharge to areas of need, require a significant amount of information about the drainage basin. Questions related to hydrogeologic evaluation of the sites cannot be answered because the information needed is not present.

Water Resources Review

Projects such as the ones discussed in the Mill Creek file would likely require a significant number of permits. As previously stated in the Little Pend Oreille and Chewelah Creek Watershed Proposals sections, first and foremost would be the permitting of water rights. Upon initial review of Chapter 173-559 of the WAC, it appears such storage projects might be allowed if they are determined by Ecology to be a non-consumptive use. Currently, WRIA 59 is closed to further consumptive appropriations from July 16 through September 30 during each year. A determination about whether evaporation from man-made reservoirs is a consumptive use would need to be made by Ecology. In addition, operation of such systems would need to ensure base flows of the Colville River established in WAC 173-559 are met and senior water rights downstream of the proposed projects are protected.

Projects of this nature could potentially require a number of water quality related permits. An individual Section 404 of the Clean Water Act Permit from the U. S. Army Corps of Engineers, in conjunction with a Section 401 of the Clean Water Act water quality certification from Ecology, may be required for the placement of fill materials below the ordinary high water mark of Mill Creek and in associated and isolated wetlands, if determined to be present. Also, a HPA may need to be issued by the WDFW. In addition, a NPDES permit may be required from Ecology depending on the conveyance system used and other potential discharges to the stream. These types of projects could also affect water temperature and total dissolved gas levels.

The fact that the South Fork of Mill Creek Project is proposed to be located on land managed by a federal agency raises a number of additional questions. A special use permit by the U. S. Forest Service may potentially be required. The U. S. Army Corps of Engineers' permit provides the federal nexus for the Endangered Species Act to be considered applicable, if the special use permit is not required. An Agency Consultation under Section 7 of the Endangered Species Act would also be highly probable. In addition, federal agency involvement on such a project would likely require satisfying NEPA and may require an EIS. However, compliance with NEPA may satisfy SEPA requirements.

Besides the aforementioned potential permits and documents, the proposed projects may also require Dam Safety permits from Ecology. Considering the previous geotechnical engineering review, there is considerable doubt these projects would attain such an approval based on the existing available information. The Stevens County Critical Areas Ordinance may apply to this project because of the potential impacts to wetlands and the questions about potential geologic hazards. Also, the Stevens County Shoreline Management Act Master Program may apply to these projects if the stream segments hosting the proposed project have been determined to be water bodies of statewide significance.

Ecological Review

Without field studies assessing the plant and animal communities in the area to be impacted by the proposed projects, determining the significance of the impacts (negative or beneficial) to important habitat is impossible. The species of plants and animals that would be displaced or

destroyed in the areas to be impacted were never determined. Also, downstream areas would need to be assessed in preparation for potential mitigation during the numerous permitting processes identified above.

FINDINGS

Based on the review results documented above, recommendations to either 1) carry a proposal forward or 2) eliminate the proposal from further study are presented below. Note that a recommendation to eliminate a reviewed proposal does not mean that an opportunity for a different storage proposal at the same site or other potential projects within the same sub-basin could not be developed or considered.

Little Pend Oreille River Watershed Proposals

The recommendations for the three Little Pend Oreille River proposals are to eliminate them from further study on the basis of a very low probability of obtaining all the government agency approvals identified in the Results Section above. Included in the Consultant Team's recommendation is an understanding from the materials provided that the proposals located on the wildlife refuge were perceived to be in direct opposition to the U. S. Fish and Wildlife Service's mandate to protect the fish and wildlife during the late 1950s and early 1960s, and would still be in conflict today.

In addition, from a technical perspective there appears to be some indication that the proposed sites would have a fatal flaw in terms of geologic conditions. While a geologic investigation report was not included in the materials supplied, there is some evidence such activities did occur. An U. S. Fish and Wildlife Service, Little Pend Oreille Wildlife Refuge Quarterly Report believed to be for January through April 1961 documents the following:

> "Public Utility District No. 1 and the Soil Conservation Service were engaged in a geological investigation for possible reservoir area and dam site near the old railroad trestle on refuge lands in T-34; R-40 EWM, Section 10. A series of test holes were being drilled to determine if the proposed dam site was satisfactory. The reservoir was also surveyed."

Appendix C contains a copy of this Quarterly Report. The lack of a technical report for the aforementioned work and the eventual termination of the project suggest that results were not favorable. In addition, a Trip Report for a geologic reconnaissance of Mill Creek and the Little Pend Oreille River watersheds from May 11th to the 14th in 1959 provides some insight into possible geologic issues. The report states the following:

> "The upper site on Pend Oreille Creek has foundation conditions similar to the south fork site of Mill Creek. Construction problems would be about the same for both sites."

> "The lower Pend Oreille site is located along a fault in heavy jointed granites. Some additional field mapping will be required to outline the geology of the site, but it appears that a concrete arch dam could be safely constructed in the granites."

The similar foundation conditions of the upper site on the Little Pend Oreille River and the South Fork of Mill Creek site are explained in more detail in this same Trip Report referenced above. The report states the following:

> "The south fork site has been formed by glacial till filling the eroded valley and later being bisected by the stream. The abutments are made up of gravelly till to a height above the top of the proposed dam. The swampy floodplain is covered with a finer glacial flour which makes it relatively impervious with the present water head. The construction of a storage reservoir at this site could be both hazardous and expensive."

A copy of this Trip Report has also been included in Appendix C. Without more comprehensive and conclusive geotechnical information, the information referenced above provides some limited evidence that the proposals have some technical flaws and would not be able to satisfy the regulatory burden to bring the proposed projects to completion.

Chewelah Creek Watershed Proposals

The recommendation for the Chewelah Creek Watershed proposal is to carry it forward for further consideration. While the project as proposed would need to attain a number of government agency approvals, this proposal's location may allow for better probability of success in attaining the necessary permits. Based on the file provided by the SCCD, the necessary geotechnical, hydrogeologic, and ecological information to make definite determinations are not currently available. Consequently, any proposal-specific information within these disciplines that may warrant eliminating the proposal from further consideration is not known at this time.

The information needed to better evaluate this proposed project are: water resource yield and needs analysis; soil maps; an ecological survey; a complete geologic report including topographic and geologic maps, corehole logs, and mechanical testing results from the cores; characterization of groundwater conditions including identifying and characterizing all hydrostratographic units, hydraulic properties, aquifer tests, and potentiometric surface maps; seismic analysis; geologic hazard analysis; hydrologic analysis; and identification of the dam construction materials.

Mill Creek Watershed Proposals

The recommendations for the Mill Creek proposals are to eliminate them from further study on a geotechnical basis. While there was little to no hydrogeologic and ecological information available, the geologic investigations we reviewed provide a geotechnical basis for eliminating both proposals. In a number of documents, questions or concerns on suitable geology were recorded for these sites. For example, a Trip Report dated May 25, 1959 for a geologic reconnaissance of Mill Creek and the Little Pend Oreille River watersheds from May 11th to the

14th in 1959 provides some insight into possible geologic suitability issues. The report states the following:

> "On Mill Creek we looked at the lower and the south fork sites. Both sites have been formed by glaciation. The lower site has been formed by terminal moraine closing the valley and forming the left or south side of the reservoir. These moraine deposits are well exposed in a road cut diagonal to the slope. This site also has folded and faulted marbleized dolomites and broken serpentine shales in the abutments at the centerline of the dam. Construction of a safe dam would be expensive and it is doubtful if the moraine could be stabilized within economic limitations against excessive leakage and piping."

> "The south fork site has been formed by glacial till filling the eroded valley and later being bisected by the stream. The abutments are made up of gravelly till to a height above the top of the proposed dam. The swampy floodplain is covered with a finer glacial flour which makes it relatively impervious with the present water head. The construction of a storage reservoir at this site could be both hazardous and expensive."

The Soil Conservation Service prepared a Preliminary Reconnaissance Report for the upper site on the South Fork of Mill Creek on November 30, 1960. The report states the following in a section labeled General:

> "Results of the investigation, particularly that part of the work concerned with the suitability of the foundation, are not conclusive. Further detailed core drilling, vane shear testing and possible pressure testing should be accomplished before construction. On the basis of present information, construction of a high dam is impractical and the construction of a low dam may be quite expensive in proportion to the benefits."

Within the Geology section of the same Preliminary Reconnaissance Report, the Soil Conservation Service documented the following:

> "Foundation is likely to be unstable and compressible, requiring deep excavation and backfill. Considerable water loss from the reservoir might occur under high head."

Appendix C contains a copy of these documents. Our recommendations are summarized in Table 2, below. The Consultant Team's professional opinion is related to the concerns about the foundation and abutments documented in these two reports, and justifies eliminating these proposals from further consideration. Of further support to this recommendation for the upper site on the South Fork of Mill Creek is the fact that the proposal would have to overcome a regulatory burden similar to that of the Little Pend Oreille River Wildlife Refuge sites because of its location in the Colville National Forest.

The Consultant Teams recommendations regarding proposals from all three files are summarized in Table 2 below.

Table 2: Summary of Recommendations from Retrospective Analysis of SCCD Files			
Number	**Sub-basin**	**Proposal Location**	**Recommendation**
R1	Little Pend Oreille River	Proposed Upper Dam Site No. 1 (Figure 1-3)	Eliminate
R2	Little Pend Oreille River	Proposed Middle Dam Site No. 2 (Figure 1-4)	Eliminate
R3	Little Pend Oreille River	Proposed Lower Dam Site No. 3 (Wildlife Refuge Headquarters) (Figure 1-5)	Eliminate
R4	Chewelah Creek	South Fork of Chewelah Creek (Figure 1-6)	Carry Forward
R5	Mill Creek	Lower Site (Above Pinkney City) (Figure 1-7)	Eliminate
R6	Mill Creek	Upper Site (South Fork of Mill Creek) (Figure 1-8)	Eliminate

CHAPTER 2: WATER STORAGE ALTERNATIVE DEVELOPMENT

INTRODUCTION

The second task of this assessment involved spatial analysis of existing data using a Geographic Information System (GIS) to develop new water storage alternatives within WRIA 59. Figure 2-1 displays the process used.

APPROACH

Water storage methods were identified through a comprehensive literature and project search. An effort was made to not limit the boundaries of the search in hopes of encompassing both standard methods, and new or unconventional methods. The list of methods developed was grouped by the applicability of the method to in-stream and off-stream storage as shown in Table 3.

Table 3: Water Storage Methods

Water Storage Category	Storage Frequency	Water Storage Infrastructure
In-Stream	Continuous	Earthen dams
	Continuous	Concrete dams
	Continuous	Run of river dams
	Seasonal	Inflatable dams
	Seasonal	Beaver management
	Seasonal	Diversion
	Continuous	Diversion
Off-Stream	Continuous	Earthen dams
	Continuous	Concrete dams
	Seasonal	Inflatable dams
	Seasonal	Closed depressions
	Seasonal	Wetlands
	Seasonal	Agricultural fields
	Seasonal	Tanks
	Seasonal	Infiltration areas
	Seasonal	Hyrdropower facility
	Seasonal	Dryland water capture

IDENTIFICATION OF POTENTIAL WATER STORAGE AREAS

The next step was to identify potential water storage areas. Sites proposed and/or volunteered by WRIA 59 Planning Unit participants were recorded and included in the initial area search, as was the Chewelah Creek proposal from the Retrospective Analysis. Table D-1 in Appendix D displays the information provided by the WRIA 59 Planning Unit participants. The initial search for additional potential areas for water storage was accomplished by using a GIS with the available WRIA 59 data. Utilizing the ranked beneficial use information provided by the WRIA

59 Water Quantity Committee (See Appendix F), desirable attributes, such as well-drained soils, were identified and used to locate potential areas. The GIS was also used to locate areas with undesirable attributes, such as sensitive or priority species habitat. Areas possessing undesirable areas were eliminated from further consideration. The result of this GIS analysis was the identification of 35 potential water storage areas shown in Figure 2-2. These areas have been determined to possess attributes supporting one or more beneficial uses of stored water.

DEVELOPMENT OF PRELIMINARY WATER STORAGE ATTRIBUTES

These 35 areas were then associated with the previously identified water storage methods to develop preliminary water storage alternatives. These alternatives were then screened to assess whether or not they met the purpose and need communicated by the SCCD on behalf of the WRIA 59 Planning Unit. Relatively small projects on the tributaries and outside the agricultural lands of the Colville River Watershed were identified as the desired objective. This initial screening also resulted in designation of the alternatives as either programmatic or project alternatives. Table D-2 in Appendix D presents all 35 alternatives sorted by category. Programmatic alternatives were those alternatives that involve sustaining current conditions or altering land use practices. Figure 2-3 displays those areas for which associated alternatives were classified as programmatic and removed from the screening process.

PROJECT ALTERNATIVE RANKING AND FIELD VERIFICATION

Those alternatives determined to be project-specific were then further refined with the Screening Questionnaire developed and used during the Retrospective Analysis. Figure 2-4 displays the results of this process. However, instead of focusing on eliminating alternatives, the focus was to rank the alternatives. The ranking of the developed project alternatives was completed in two steps.

The first step was largely driven by the ranked beneficial use information provided by the WRIA 59 Water Quantity Committee. Because recharge of groundwater is so integral to the highest ranked beneficial uses, the first step in ranking the developed project alternatives was to sort the sub-basins by their physical location in the watershed. The further the sub-basin was located from the outlet of the basin the higher the ranking it received. This approach was taken to affect the timing of water movement through the basin and provide multiple opportunities for using the stored water. The ranking also was approached in this manner to reduce the probability of missing an area where water supply and demands might be identified in the Technical Assessment currently underway.

The second step in ranking the refined project alternatives was to sort them within their respective sub-basin by overall rank as developed with the Screening Questionnaire. This sorting was needed to prioritize field verification activities. Thus, if a field visit showed a top-ranking alternative to be a poor choice, the next best likely alternative was pre-determined for easy follow-up. The ranking process and the reviewer's responses to the Screening Questionnaire are included in Appendix D. The areas screened and prioritized for project alternatives are displayed

in Figures 2-5 through 2-14. To better understand actual area conditions, the highest ranking project areas were visited. The results of the field visits are included in Appendix E.

Based on the information developed and collected during the field visits, each project alternative was further delineated to provide as much information as possible for the environmental effects and cost analyses.

PROJECT ALTERNATIVES PROPOSED FOR FURTHER ANALYSIS

Five water storage project alternatives in five different sub-basins were developed and selected for further analyses as shown in Table 4 and displayed in Figure 2-15. Each of the selected water storage project alternatives is described below.

Table 4: Selected Water Storage Project Alternatives

Project				
Area	**Alternative**	**Water Storage Objective**	**Storage Infrastructure**	**Sub-basin**
1	A	Infiltration	Seasonal diversion, with off channel seasonal storage	Sheep
30	G	Seasonal Storage	In-Stream storage using roadbed	Grouse
8	K	Continuous Storage	Continuous Storage with permanent structure	Cottonwood
7	B-1	Seasonal Storage	Increase storage on Horseshoe Lake	Sherwood
3	P	Infiltration	Seasonal Storage with Seasonal Structure	Chewelah

Alternative 1-A (Infiltration below Loon Lake)

Alternative 1-A would include seasonal (e.g., during the spring) diversion of high flows to off-channel storage in infiltration areas within the boundary of the site, as shown on Figure 2-16. The purpose of the storage structure would be to retain the spring runoff from Loon Lake long enough to allow infiltration for groundwater recharge. Low flows during other seasons would pass through freely. Earthen structures would be constructed to convey and contain water to and within the infiltration areas.

Alternative 30-G (SR-395 Impoundment)

Alternative 30-G would achieve seasonal or continuous in-channel storage by constructing an earthen dam to control flow on Grouse Creek (see Figure 2-17). A control structure would regulate the release of stored water to augment low flows in Grouse Creek and eventually the Colville River. The alternative would result in up to 20 feet of ponding upstream of Highway 395.

Alternative 8-K (Lake Bussard Storage)

This project would involve increasing the capacity of Bussard Lake as shown in Figure 2-18 with use of the additional stored water to augment low flows. This alternative has storage add-ons that could be implemented after the initial development of water storage on the lake. These options include additional infrastructure to redirect flows from drainages to the north through a constructed channel or conduit into the storage area providing additional water for storage. Stored water could then be used for groundwater recharge or released to Grouse Creek to augment low flows. The release of stored water to the Grouse Creek sub-basin would, in essence, move water higher in the Colville River watershed.

Alternative 7-B1 (Horseshoe Lake Storage Enhancement)

There appears to be an opportunity to reconstruct a past storage site, Horseshoe Lake, as shown on Figure 2-19. Horseshoe Lake was formerly impounded, until the natural embankment at the south end of the lake was breached several years ago. A private party has undertaken a design and received a Dam Safety permit from Ecology to construct a dam on the site of the former embankment. This would provide storage with a controlled release to the south. There may be some potential to increase overall storage capacity by increasing the height of the dam. This alternative would increase the capacity of the impoundment currently being proposed.

Alternative 3-P (Burnt Valley Road Infiltration)

The project would divert spring flows for off-stream infiltration to the west along the Burnt Valley Road. The project would include seasonal storage with permanent structures, low earthen berms, and a series of infiltration areas as shown in Figure 2-20. Low flows during other seasons would continue to pass through to the South Fork of Chewelah Creek.

FINDINGS

Three of the five selected project alternatives happen to be on sites proposed and/or volunteered by WRIA 59 Planning Unit participants. The selection of these three sites was not biased by the fact that they had been proposed or volunteered. The sites were selected based on their physical attributes. However, the results of the water storage alternative development were influenced by the preference communicated by the WRIA 59 Planning Unit and the information supplied by the WRIA 59 Water Quantity Committee. The guidance provided establishes relatively simple criteria for developing and selecting opportunities. The result of these criteria limited the outcome of the project alternative development.

CHAPTER 3: ENVIRONMENTAL EFFECTS ANALYSIS

INTRODUCTION

This section identifies the negative and beneficial environmental impacts anticipated should the water storage project alternatives be constructed and operated at the proposed sites. The alternatives also have been assessed for potential secondary or indirect impacts. An effort was made to recognize if and how water storage alternatives and their potential sites might facilitate community and/or economic development through mitigation for other projects or by providing additional opportunities.

APPROACH

The water storage project alternatives have been evaluated for significant impacts in the short-term during construction, and in the long-term during operation and maintenance. On-going impacts of the project on the environment after initial construction and site stabilization are considered long-term. Impacts have been presented as either beneficial or negative. The alternatives also have been evaluated for their potential to mitigate other non-water storage project impacts within the same sub-basin. Project alternatives were evaluated specifically for potential to mitigate wetland impacts, alleviate stormwater issues, and reuse treated wastewater.

Although the effort of Ecology to establish a wetland banking rule has been terminated, the opportunity for establishing a wetland bank is still viable. The lack of a formal rule simply requires the proponent of such a project to take some additional steps in gaining agency approvals and documenting the agreed upon terms. While a wetland bank might initially appear as an unfunded expense, it can conceptually be a beneficial investment. The presence of an established recognized wetland bank could attract business development that might normally be perceived as improbable. A wetland bank also may provide for relatively rapid construction of new community infrastructure by state and federal agencies.

Stormwater management has become an important issue related to land development and planning. The water storage project alternatives have been evaluated for opportunities to lessen current and future regulatory burdens on development with regard to stormwater. Generally speaking, none of the alternatives identified offered significant stormwater management opportunities. This is due to the fact that recharge of stormwater for water quality treatment typically requires amended soil and accompanying slower infiltration rates to avoid contamination of groundwater. The intent of groundwater recharge for this project is to recharge clean water as quickly as possible. Also, treatment of stormwater in detention systems to improve water quality is typically performed off-line prior to discharge to receiving waters. Consequently, none of the selected alternatives are likely to be viewed as stormwater quality mitigation measures by Ecology. Opportunities to reuse treated wastewater in water storage projects have been identified when potentially applicable.

IMPACTS ANALYSIS

Alternative 1-A (Infiltration below Loon Lake)

Alternative 1-A would result in beneficial long-term impacts to the drainage, and quantity and quality of the water resources in the watershed. Due to the nature of the storage method, evaporation should not be a significant issue for this alternative.

Alternative 1-A appears to result in long-term impacts to biological resources in the area. Based on the likelihood of extensive terrestrial wildlife habitat in the watershed, the potential to increase the quantity of aquatic and riparian habitat for wildlife and vegetation appears to be beneficial. In those areas of terrestrial threatened or endangered species, the change in habitat would be considered negative. This does not appear to be the case for Alternative 1-A.

Long-term negative impacts of Alternative 1-A would be the removal of this area from potential timber production. The flooding of the area would likely result in the selection of non-commercial tree species adapted to a wetter environment.

The long-term impacts to socioeconomic conditions and resource use patterns do not appear to be clearly beneficial or negative. For instance the long-term negative impact related to socioeconomic conditions of funding the maintenance of the storage structure is offset to varying degrees by the short-term construction and long-term maintenance employment income in the area. As for the short-term impacts associated with Alternative 1-A, construction of the storage structure would likely negatively impact air quality and visibility. However, short-term air quality impacts can be mitigated during construction with a relatively small incremental increase in cost.

Depending on the design and operation of Alternative 1-A, there appears to be some potential to create or add to existing wetlands. The actual amount of wetlands created or added would depend upon the resulting conditions. An increase of overall wetland acreage in this sub-basin presents an opportunity to mitigate impacts to wetlands upstream or downstream of the site. Lastly, there appears to be some potential to augment recharge of Sheep Creek by disposing of the treated wastewater from the surrounding area near the high infiltration areas of the site. However, any wastewater discharged for such purposes may potentially need to be treated to higher than normal standards.

Alternative 30-G (SR-395 Impoundment)

Alternative 30-G would result in beneficial long-term impacts to drainage, and the quantity and quality of the water resources in the watershed. It should be expected that some water loss might occur from evaporation. The amount of water lost to evaporation would be a function of the resulting surface area of the water impoundment.

Alternative 30-G also would result in long-term impacts to biological resources in the area. Based on the likelihood of extensive terrestrial wildlife habitat in the watershed, the potential to increase the quantity of aquatic and riparian habitat for wildlife and vegetation appears to be beneficial. In those areas of terrestrial threatened or endangered species the change in habitat would be negative. This does not appear to be the situation for Alternative 30-G.

A negative long-term impact of Alternative 30-G would be the removal of an area currently surrounding the existing storage area from potential timber production. The flooding of the area would likely result in the selection of non-commercial tree species adapted to a wetter environment.

The long-term impacts to socioeconomic conditions and resource use patterns do not appear to be clearly beneficial or negative. For instance the long-term negative impact related to socioeconomic conditions of funding the maintenance of the storage structure is offset to varying degrees by the short-term construction and long-term maintenance employment income to the area. As for the short-term impacts associated with Alternative 30-G, construction of the storage structure would likely negatively impact air and water quality and visibility.

The impact of this alternative on wetlands depends on the design and operation. While this alternative would not appear to fill wetlands with earthen materials, the detention of water would inundate the area to a depth that would potentially change or eliminate some or all of the existing wetlands and their functions and values. If the alternative was designed and operated so existing wetlands were protected, than there appears to be some potential to create or add to the overall wetland acreage. An increase of overall wetland acreage in this sub-basin presents an opportunity to potentially mitigate impacts to wetlands upstream or downstream of the site. However, if construction of the project resulted in a decrease in the overall wetland acreage (i.e., due to inundation of existing wetlands to a level that changes the area to an aquatic environment), then additional mitigation may be required for the loss of wetlands by this project.

Alternative 8-K (Lake Bussard Storage)

As with Alternatives 1-A and 30-G, Alternative 8-K would result in beneficial long-term impacts to drainage, and the quantity and quality of the water resources in the watershed. Related to water resources, there is potential for negative impacts to downstream water right holders if stored water were released to the Grouse Creek drainage and not to Cottonwood Creek. Conversely, the new release of water to the Grouse Creek drainage appears to benefit the watershed by moving water higher in the watershed for meeting current and future demands. The negative effect on water rights in the Cottonwood Creek drainage is potentially more significant than the actual beneficial impact on water supply to the watershed. In addition, it should be expected that some water loss might occur from evaporation. The amount of water lost to evaporation would be a function of the resulting surface area of the water impounded in the new reservoir. Any effort to quantify these impacts would require several additional investigations.

Alternative 8-K would appear to result in long-term impacts to biological resources in the project area. Based on the likelihood of extensive terrestrial wildlife habitat in the watershed, any potential to increase the quantity of aquatic and riparian habitat for wildlife and vegetation appears to be beneficial. In those areas of terrestrial threatened or endangered species the change in habitat would be considered negative. This does not appear to apply to Alternative 8-K.

A negative long-term impact of Alternative 8-K would be the removal of the area surrounding the existing storage area from potential timber production. The flooding of the area

would likely result in the selection of non-commercial tree species adapted to a wetter environment.

The long-term impacts to socioeconomic conditions and resource use patterns appear to be beneficial. While the long-term negative impact related to funding the operation and maintenance of the storage structure is offset to varying degrees by the short-term construction and long-term operation and maintenance employment income to the area. One should keep in mind there would be a significant short-term negative socioeconomic impact with the acquisition of private property and homes in the area where the project would be constructed. However, in the long-term the project appears to be a benefit in the form of an opportunity to increase the capacity for recreation, hunting and fishing, and new waterfront real estate opportunities within the project area. As for the short-term impacts associated with Alternative 8-K, construction of the storage structure would likely negatively impact air and water quality.

Depending on the design and operation of this alternative, there appears to be some potential to create or add to existing wetlands. As previously stated for the other alternatives the actual amount of wetlands created or added would depend upon the resulting site conditions. An increase of overall wetland acreage in this sub-basin presents an opportunity to mitigate impacts to wetlands upstream or downstream of the site.

Alternative 7-B1 (Horseshoe Lake Storage Enhancement)

Alternative 7-B1 would result in beneficial long-term impacts to drainage, and the quantity and quality of water resources in the watershed. In addition, some water loss might occur from evaporation. The amount of water lost to evaporation would be a function of the resulting surface area of the water impounded in the new reservoir.

Alternative 7-B1 would also appear to result in beneficial long-term impacts to biological resources in the area. Based on the likelihood of extensive habitat for terrestrial wildlife in the watershed, the potential to increase the quantity of aquatic and riparian habitat for wildlife and vegetation would appear to be beneficial. In those areas of terrestrial threatened or endangered species the change in habitat would be considered negative. This does not appear to be the case for Alternative 7-B1.

The long-term impacts to socioeconomic conditions and resource use patterns appear to be beneficial. While the long-term negative impact related to funding the operation and maintenance of the storage structure is offset to varying degrees by the short-term construction and long-term operation and maintenance and recreation employment income to the area. In the long-term the project appears to be a benefit in the form of an opportunity to increase the capacity for recreation, hunting and fishing, and new waterfront real estate opportunities within the project area. As for the short-term impacts associated with this alternative, construction of the storage structure would likely negatively impact air and water quality.

As with the preceding alternatives, depending on the design and operation of Alternative 7-B1, there appears to be some potential to create or add to existing wetlands. The actual amount of wetlands created or added would depend upon site conditions. An increase of overall wetland

acreage in this sub-basin presents an opportunity to mitigate impacts to wetlands upstream or downstream of the site.

Alternative 7-B1 could result in negative short-term impacts to water quality. These impacts are associated with elevating or moving the county road that would be inundated by the proposed project and could be mitigated with stormwater best management practices.

Alternative 3-P (Burnt Valley Road Infiltration)

Alternative 3-P would result in beneficial long-term impacts to drainage, and the quantity and quality of the water resources in the watershed. Due to the nature of the storage method, evaporation should not be a significant issue for this alternative. Alternative 3-P would also appear to result in significant long-term impacts to biological resources in the area. Based on the likelihood of extensive terrestrial wildlife habitat in the watershed, the potential to increase the quantity of aquatic and riparian habitat for wildlife and vegetation would appear to be beneficial. Alternative 3-P does not appear to be in an area of a terrestrial threatened or endangered species. So, there does not appear to be a biological resources problem for Alternative 3-P.

A potential negative long-term impact of Alternative 3-P would be the inundation of agricultural production in this area. The flooding of the area would likely limit crop selection and/or future land uses.

The long-term impacts to socioeconomic conditions and resource use patterns do not appear to be clearly beneficial or negative. For instance, the long-term negative impact related to socioeconomic conditions of funding the maintenance of the storage structure is offset to varying degrees by the short-term construction and long-term maintenance employment income in the area. As for the short-term impacts associated with Alternative 3-P, construction of the storage structure would likely negatively impact air and water quality.

Depending on the design and operation of this alternative, there appears to be potential to create or add to existing wetlands. The actual amount of wetlands created or added depends upon site conditions. An increase of overall wetland acreage in this sub-basin presents an opportunity to mitigate impacts to wetlands upstream or downstream of the site.

Alternative 3-P appears to result in negative short-term impacts to water quality during construction. The impacts associated with clearing and constructing the infiltration areas could be mitigated through implementation of stormwater best management practices. However, because of the size of the site, permitting would likely be a complex effort.

STUDIES, PERMITS/PROCESSES, AND MITIGATION

Studies

Most of the project alternatives would need several additional studies to facilitate conceptual design, permitting, construction, and operation of the project. All of the project alternative sites would need a biological assessment, wetland delineation and assessment, and environmental site assessment. All but one project alternative would need a geotechnical study.

A biological assessment is intended to document the existing plant and animal communities in the area of the proposed project. The wetland delineation identifies the wetlands in the area

and quantifies their size and classification. The wetland assessment documents the functions and values the existing wetlands provide. An environmental site assessment provides the purchaser of the land to be used for water storage some assurance the area has not had hazardous substances released on-site. These aforementioned studies help to determine the scope of the mitigation that may be required to permit the project.

The geotechnical study provides the basis for the conceptual design and construction permitting of the storage structure. Alternatives designed to recharge groundwater would require a hydrogeological analysis to ensure that the recharge expected to occur at each location would actually contribute to downstream base flows.

Permits/Processes

The project alternatives are expected to require similar permits and involve similar processes. The complexity of these permits would vary based on the alternative's specifics. The studies previously discussed would provide the specifics required to permit each project. The following permits or documents may be required for all of the project alternatives:

- Washington State Environmental Policy Act Environmental Impact Statement
- Washington State Department of Ecology Secondary Surface Water Permit
- Washington State Department of Ecology Reservoir Permit
- U. S. Fish and Wildlife Service Endangered Species Act Consultation
- U. S. Army Corps of Engineers Section 404 of the Clean Water Act Permit
- Washington State Department of Ecology Section 401 of the Clean Water Act Certification
- Washington State Department of Ecology Dam Safety Permit
- Washington State Department of Fish and Wildlife Hydraulic Project Approval
- Stevens County Critical Areas Ordinance Approval
- Stevens County Shoreline Management Substantial Development Permit.

Mitigation

The level of effort required to obtain these permit and process approvals may be simple or very involved. Until studies and conceptual project designs have been conducted, it is difficult to determine when permitting would be straightforward or when it would be onerous. This makes estimating the amount of mitigation required to construct and operate the proposed projects extremely difficult. Those alternatives proposing the placement of new fill in waters of the state would require mitigation based on the size and quality of the area impacted. To some degree all of the water storage project alternatives would require mitigation. Depending on project specifics, an alternative may be capable of mitigating its negative impacts with its associated beneficial impacts.

RESULTS

Based on an analysis of the environmental effects, additional required studies, permits needed, processes required, and potential mitigation mandated for the project alternatives, Alternative 7-B1 (Horseshoe Lake Storage Enhancement) would appear to rank the highest. This

alternative appears to impact the environment the least of all of the alternatives, partly because of its current situation. Horseshoe Lake was formerly impounded, until a breach of the natural embankment at the south end of the lake occurred several years ago. A private party has undertaken a design and received a Dam Safety permit from Ecology to construct a dam on the site of the former embankment. The studies and permits needed appear to be simple and straightforward. In addition, the property owner has a recent geotechnical study and an approved Dam Safety Permit for reconstruction of the dam. However, Alternative 7-B1 proposes increasing the dam height and water level in the reservoir an additional seven feet above the currently permitted proposal.

The rank of the remaining alternatives in ascending order of environmental effects is 3-P, 1-A, 30-G, and 8-K. Because the environmental impacts identified for these types of projects are so similar, the need for additional studies and the level of effort expected to permit an alternative drove the ranking. Several of the alternatives resulted in very similar ranks. Alternative 3-P has been ranked lower than Alternative 7-B1 because of the complexity expected in the additional studies to support permitting and construction. Alternative 3-G was ranked lower than Alternative 1-A because of the additional efforts expected in addressing potential to impact the roadbed under Highway 395. Alternative 8-K has been ranked the lowest because of the water right implications should the project attempt to convey water from the Cottonwood Creek Basin to the Grouse Creek Basin, and the potentially limited drainage area contributing to Lake Bussard. In addition, there appears to be more short-term socioeconomic implications with Alternative 8-K than any other.

CHAPTER 4: COST ANALYSIS

INTRODUCTION

The cost analysis for the five water storage project alternatives for the Colville River Watershed is discussed below.

APPROACH

To compare the selected alternatives, a planning-level cost analysis has been prepared utilizing available state and local economic information in a systematic method. A spreadsheet was developed to calculate the approximate cost of additional required studies, permitting, mitigation, and construction for each alternative. The construction cost portion of the spreadsheet applied similar items or steps when appropriate for calculating the expense to construct the alternative. Assumptions made on a unit basis during construction have been applied consistently when applicable to the design described for the alternative. The additional studies, permits/processes and mitigation that might be required to construct an alternative were categorized as simple or complex in nature during the analysis conducted in Chapter 3 (see Table 5 below).

Table 5: Permits/Processes, Studies, and Mitigation

PERMIT/PROCESS	Alt 1-A	Alt 30-G	Alt 8-K	Alt 7-B1	Alt 3-P
Water Right Change	S	S	C	S	S
Hydraulic Project Approval	C	C	C	S	S
404 Permit	S	S	C	S	S
401 Certification	S	S	C	S	S
Dam Safety Permit				C	
NEPA EA					
NEPA EIS					
SEPA Checklist	C	C	C	C	C
SEPA EIS	C	C	C	S	S
Stormwater Permit	S	S	S	S	C
ESA Consultation	S	S	S	S	S
STUDY					
Biological Survey	S	S	S	S	S
Wetland Delineation	S	S	S	S	S
Wetland Assessment	S	S	S	S	S
Geotechnical Study	C	C	C	S	C
Hydrogeologic Study	C	S	S	S	C
Environmental Site Assessment	S	S	C		S
*** MITIGATION**	S	C	C	S	S

S = Simple
C = Complex
* = Mitigation for impacts to natural resources, not personal property. Amount indicated does not include land acquisition or lease.

Based on the above determinations, monetary costs were assigned for simple and complex efforts for additional studies, permitting, and mitigation as shown in Tables 6 and 7. A simple effort would be a situation where mitigation or specialized studies would not be expected to be

required to receive approval, while a complex effort would be expected to require mitigation and/or specialized studies. These aspects may prove to be highly variable in actuality. This approach allows for a simple comparison of one alternative to another.

Table 6: Permit/Process Costs		
Permit	**Simple**	**Complex**
Water Right Change	$5,000	$50,000
Hydraulic Project Approval	$2,500	$25,000
404 Permit	$1,000	$25,000
401 Certification	$1,000	$25,000
Dam Safety Permit	$1,000	$30,000
NEPA EA	$10,000	$50,000
NEPA EIS	$100,000	$500,000
SEPA Checklist	$500	$1,000
SEPA EIS	$10,000	$100,000
Stormwater Permit	$2,500	$50,000
ESA Consultation	$10,000	$50,000

Table 7: Study and Mitigation Costs		
Study	**Simple**	**Complex**
Biological Survey	$2,500	$20,000
Wetland Delineation	$2,000	$20,000
Wetland Assessment	$2,500	$20,000
Geotechnical Study	$3,000	$45,000
Hydrogeologic Study	$5,000	$50,000
Environmental Site Assessment	$1,500	$25,000
Mitigation	$20,000	$100,000

RESULTS

The remainder of this chapter presents the itemized planning level costs for each selected alternatives. Included with each cost estimate is a brief description of the project alternative and associated design assumptions.

Alternative 1-A (Infiltration below Loon Lake)

The project consists of five infiltration ponds constructed downstream of Loon Lake along Sheep Creek and an unnamed tributary. Water from the creek is diverted into each pond via a culvert and overflow returns to the creek via an armored channel. The facility would provide approximately 5 ac-ft of storage for infiltration. Excess excavated material is assumed to be stockpiled around the site. This project provides an opportunity for riparian plantings and other habitat enhancement associated with the construction of the ponds.

Table 8: Alternative 1-A Cost

Operation and Maintenance: Periodic cleaning or scraping of the ponds may be required to remove silt and maintain infiltration capacity.

	Bid Item	Unit Price	Unit	Quantity	Amount
1	Mobilization/Demobilization	10%	LS	1	$25,700
2	Erosion Control	2%	LS	1	$5,100
3	Traffic Control	2%	LS	1	$5,100
4	Clearing and Grubbing	$2,000	AC	6	$12,000
5	Excavation	$5	CY	14400	$72,000
6	Import Fill	$12	CY	0	$0
7	Embankment	$3	CY	14400	$43,200
8	Diversion Structure with Fish Screens	$50,000	EA	1	$50,000
9	24" Diameter Culvert (1)	$80	LF	500	$40,000
10	RipRap	$50	CY	400	$20,000
11	Access Roadway	$25	LF	1600	$40,000
12	Riparian Plantings	$10,000	LS	1	$10,000
13	Adjust Utilities	$5,000	LS	0	$0
14	Relocate Utilities	$10,000	LS	0	$0
15	Hydroseed	$0.50	SY	19360	$9,680
16	Restoration and Cleanup	$10,000	LS	1	$10,000
			Subtotal		$342,780
		WSST	8%		$27,422
	Estimated Construction Cost Total				**$370,202**
	Permitting	$145,500	LS	1	$145,500
	Studies	$103,500	LS	1	$103,500
	Mitigation	$20,000	LS	1	$20,000
	Land Acquisition	$2,500	AC	0	$0
	Survey and Design Engineering	10%	LS		$37,020
	Construction Administration	10%	LS		$37,020
	Contingency	20%	LS		$74,040
			Subtotal		$787,282
	Project Administration	5%	LS		$39,364
	Total Estimated Project Cost				**$826,646**

(1) Culvert unit cost is lower than culvert costs for other alternatives due to shallow depth.

Alternative 30-G (SR-395 Impoundment)

This project consists of constructing an earthen dam in front of an existing roadway embankment (approximately 80 feet high) to allow impoundment of approximately 20 feet of water. A weir structure with an overflow would control the release of water from the storage and discharge to an existing culvert. The facility is estimated to provide 70 ac-ft of storage. Additional study is needed to determine the extent of the impoundment and its impact to existing roads and other improvements.

Table 9: Alternative 30-G Cost

Operation and Maintenance: Periodic maintenance of the overflow and outlet pipe will be required. Periodic inspection of the roadway embankment is recommended to check for seepage or deterioration of the embankment.

Item No.	Bid Item	Unit Price	Unit	Quantity	Amount
1	Mobilization/Demobilization	10%	LS	1	$42,900
2	Erosion Control	2%	LS	1	$8,600
3	Traffic Control	2%	LS	1	$8,600
4	Clearing and Grubbing	$2,000	AC	1	$2,000
5	Excavation	$5	CY	0	$0
6	Import Fill	$12	CY	11900	$142,800
7	Embankment	$3	CY	11900	$35,700
8	36" Diameter Culvert	$120	LF	200	$24,000
9	Control Weir/Outlet Overflow Structure	$40,000	EA	1	$40,000
10	Raise Roadway Grade	$150	LF	850	$127,500
11	AC Paving	$15	SY	2300	$34,500
12	Adjust Utilities	$5,000	LS	1	$5,000
13	Relocate Utilities	$5,000	LS	1	$5,000
14	Hydroseed	$0.50	SY	4444	$2,222
15	Restoration and Cleanup	$10,000	LS	1	$10,000
			Subtotal		$488,822
		WSST	8%		$39,106
	Estimated Construction Cost Total				**$528,000**
	Permitting	$175,500	LS	1	$175,500
	Studies	$58,500	LS	1	$58,500
	Mitigation	$100,000	LS	1	$100,000
	Land Acquisition	$2,500	AC	45	$112,500
	Survey and Design Engineering	10%	LS		$52,800
	Construction Administration	10%	LS		$52,800
	Contingency	20%	LS		$105,600
			Subtotal		$1,185,700
	Project Administration	5%	LS		$59,285
	Total Estimated Project Cost				**$1,244,985**

Alternative 8-K (Lake Bussard Storage)

This project consists of building berms at both ends of an existing pond at the headwaters of Grouse and Cottonwood Creeks. The pond outlet to Grouse Creek would divert flows, which are higher in the watershed than the discharge to Cottonwood Creek, to the south. The impoundment would provide approximately 60 ac-ft of storage. This alternative could also include a conveyance pipe to divert flows from Cottonwood Creek into the pond to further augment flows into the Grouse Creek drainage.

Table 10: Alternative 8-K Cost

Operation and Maintenance: Periodic maintenance of the weir and outlet pipe will be required. Periodic inspection of the berms is recommended although little maintenance is expected.

Item No.	Bid Item	Unit Price	Unit	Quantity	Amount
1	Mobilization/Demobilization	10%	LS	1	$32,900
2	Erosion Control	2%	LS	1	$6,600
3	Traffic Control	2%	LS	1	$6,600
4	Clearing and Grubbing	$2,000	AC	1	$2,000
5	Excavation	$5	CY	0	$0
6	Import Fill	$12	CY	2700	$32,400
7	Embankment	$3	CY	2700	$8,100
8	24" Diameter Culvert	$100	LF	100	$10,000
9	Control Weir/Outlet Structure	$10,000	EA	1	$10,000
10	Raise Roadway Grade	$150	LF	1000	$150,000
11	Rip Rap Emergency Overflow	$50	CY	90	$4,500
12	Access Roadway	$10	LF	450	$4,500
12	18" Diameter HDPE Diversion Pipe	$100	LF	800	$80,000
12	Diversion Structure	$10,000	LS	1	$10,000
13	Adjust Utilities	$5,000	LS	0	$0
14	Relocate Utilities	$5,000	LS	0	$0
15	Hydroseed	$0.50	SY	5000	$2,500
16	Restoration and Cleanup	$15,000	LS	1	$15,000
			Subtotal		$375,100
		WSST	8%		$30,008
	Estimated Construction Cost Total				**$405,000**
	Permitting	$238,500	LS	1	$238,500
	Studies	$82,000	LS	1	$82,000
	Mitigation	$100,000	LS	1	$100,000
	Land Acquisition	$2,500	AC	1	$2,500
	Survey and Design Engineering	10%	LS	1	$40,500
	Construction Administration	10%	LS		$40,500
	Contingency	20%	LS		$81,000
			Subtotal		$990,000
	Project Administration	5%	LS		$49,500
	Total Estimated Project Cost				**$1,039,500**

Alternative 7-B1 (Horseshoe Lake Storage Enhancement)

This project consists of raising the height of reconstruction of a natural berm to restore Horseshoe Lake. The dam would be approximately twenty feet high and impound water approximately 16 feet in depth, which is approximately 8 feet deeper than the original plan. A weir structure with an overflow would control the release of water from the storage to the creek. The facility is estimated to provide an additional 200 ac-ft of storage to the currently permitted proposal.

Table 11: Alternative 7-B1 Cost

Operation and Maintenance: Periodic maintenance of the weir and outlet pipe will be required. Periodic inspection of the berm is recommended although little maintenance is expected.

Item No.	Bid Item	Unit Price	Unit	Quantity	Amount
1	Mobilization/Demobilization	10%	LS	1	$28,700
2	Erosion Control	2%	LS	1	$5,700
3	Traffic Control	2%	LS	1	$5,700
4	Clearing and Grubbing	$2,000	AC	1	$2,000
5	Excavation	$5	CY	1190	$5,950
6	Import Fill	$12	CY	12690	$152,280
7	Embankment	$3	CY	12690	$38,070
8	24" Diameter Culvert	$100	LF	200	$20,000
9	Modify Control Weir/Outlet Structure	$30,000	EA	1	$30,000
10	Rip Rap Emergency Overflow	$50	CY	300	$15,000
11	Access Roadway	$10	LF	150	$1,500
12	Adjust Utilities	$5,000	LS	1	$5,000
13	Relocate Utilities	$5,000	LS	0	$0
14	Hydroseed	$0.50	SY	3600	$1,800
15	Riparian Plantings	$5,000	LS	1	$5,000
16	Restoration and Cleanup	$10,000	LS	1	$10,000
			Subtotal		$326,700
		WSST	8%		$26,136
	Estimated Construction Cost Total				**$353,000**
	Permitting	$63,000	LS	1	$63,000
	Studies	$15,000	LS	1	$15,000
	Mitigation	$20,000	LS	1	$20,000
	Land Acquisition	$2,500	AC	0	$0
	Survey and Design Engineering	10%	LS		$35,300
	Construction Administration	10%	LS		$35,300
	Contingency	20%	LS		$70,600
			Subtotal		$592,200
	Project Administration	5%	LS		$29,510
	Total Estimated Project Cost				**$621,810**

Alternative 3-P (Burnt Valley Road Infiltration)

This project consists of a series of infiltration ponds terraced into the slope on the north side of Burnt Valley Road. Water from the creek would be diverted during high flows into the upper pond and then overflow into the lower ponds; overflow from the lowest pond would return to the creek. Each infiltration pond would be approximately 150 feet wide. The upgradient side of the pond would be cut into the slope approximately 5 feet and a 3 foot-high berm on the downhill side would impound 2 feet of water in the ponds. The facility would provide approximately 55 acre-feet of storage for infiltration.

Table 12: Alternative No. 3-P Cost

Operation and Maintenance: Periodic cleaning or scraping of the ponds will be required to remove silt and maintain infiltration capacity.

Item No.	Bid Item	Unit Price	Unit	Quantity	Amount
1	Mobilization/Demobilization	10%	LS	1	$86,900
2	Erosion Control	2%	LS	1	$17,400
3	Traffic Control	2%	LS	1	$17,400
4	Clearing and Grubbing	$500	AC	60	$30,000
5	Excavation	$5	CY	112000	$560,000
6	Import Fill	$12	CY		$0
7	Embankment	$3	CY	20000	$60,000
8	Diversion Structure w/ fish screens	$50,000	EA	1	$50,000
9	36" Diameter Culvert	$120	LF	200	$24,000
10	RipRap Overflows	$50	CY	1190	$59,500
11	Adjust Utilities	$5,000	LS		$0
12	Relocate Utilities	$10,000	LS		$0
13	Hydroseed	$0.50	SY	71111	$35,556
14	Restoration and Cleanup	$50,000	LS	1	$50,000
		Subtotal			$990,756
		WSST	8%		$79,260
	Estimated Construction Cost Total				**$1,070,000**
	Permitting	$80,500	LS	1	$80,500
	Studies	$103,500	LS	1	$103,500
	Mitigation	$20,000	LS	1	$20,000
	Land Acquisition	$2,500	AC	70	$175,000
	Survey and Design Engineering	10%	LS		$107,000
	Construction Administration	10%	LS		$107,000
	Contingency	20%	LS		$214,000
		Subtotal			$1,877,000
	Project Administration	5%	LS		$93,850
	Estimated Total Project Cost				**$1,970,850**

Project Alternative Ranking by Cost

The results of the cost analysis were used to rank the alternatives. The highest-ranking alternative on the basis of the lowest cost is Alternative 7-B1. Table 13 presents the cost rankings for all five alternatives.

Table 13: Alternative Ranking by Cost

Rank	Alternative	Cost
1	Alternative No. 7-B1 – Horseshoe Lake Storage Enhancement	$621,810
2	Alternative No. 1-A – Infiltration below Loon Lake	$826,646
3	Alternative No. 8-K – Lake Bussard Storage	$1,039,500
4	Alternative No. 30-G – SR-395 Impoundment	$1,244,985
5	Alternative No. 3-P – Burnt Valley Road Infiltration	$1,970,850

CHAPTER 5: WATER STORAGE RECOMMENDATIONS

INTRODUCTION

This chapter documents the recommendations developed as a result of assessing the multipurpose water storage opportunities in the Colville River Watershed. The resulting recommendations are based on the process used to assess the information collected and developed.

APPROACH

The recommendations specific to the water storage project alternatives and the programmatic issues identified while developing these alternatives are documented below. The programmatic approaches became evident as a result of the guidance provided from the WRIA 59 Planning Unit and the WRIA 59 Water Quantity Committee. The information supplied by the WRIA 59 Planning Unit was utilized to create criteria to select desirable areas for water storage based on physical attributes and local opinion. The result of this effort eliminated the mainstem of the Colville River's floodplain and/or the crop producing lands of the watershed from consideration for water storage. As a result, none of the programmatic approaches in these areas were analyzed for potential environmental effects or cost. However, the potential for these types of approaches is documented in this chapter for future consideration or analysis.

RESULTS

Project Recommendations

The project alternatives developed all appear to meet the primary goal of slowing spring runoff water to varying degrees. The alternatives appear to work towards the desired outcome of enhancing water supplies including dry season low flows in the Colville River and the lower portions of some of its tributaries. The projects typically achieve this through a combination of surface water impoundments with groundwater recharge of seasonally high flows in the winter and spring.

The primary challenge with these measures is their likely high cost, and the uncertainty of their potential to contribute significantly toward the desired outcome. Each of these projects would likely require significant studies to determine whether they would truly benefit base flows (e.g., a study to determine if the infiltration facilities recharge deep aquifers or shallow aquifers connected to the river system).

Based on the selection process undertaken to develop the project alternatives and the resulting analyses for environmental effects and costs, Alternative 7-B1 (Horseshoe Lake Storage Enhancement) appears to be the most viable project at this time, followed by Alternatives 1-A, 30-G, 8-K, and 3-P. Although Alternative 3-P was ranked high for its lack of environmental effects, its high cost decreased its overall ranking. The relatively small amount of water stored or infiltrated does not appear to justify the cost estimated to construct the project.

PROGRAMMATIC RECOMMENDATIONS

The Consultant Team suggests that a number of programmatic water storage measures could have potential benefits and should continue to be considered as the WRIA 59 Planning Unit works through the feasibility and desirability of proceeding with individual projects. At times it may be difficult to demonstrate significant impacts to base flow from these types of measures, but programmatic approaches typically offer the advantage of lower overall costs, both initially and for long-term operation and maintenance, with multiple benefits. The remainder of this section discusses three examples of programmatic approaches to water resource management that would likely enhance base flows while also providing benefits to water supply, wildlife, recreation, and other uses.

Farm Field Flooding

Flooding of fallow farm fields along the Colville River corridor during the late fall, winter, and spring seasons has potential to recharge shallow aquifers which may contribute to base flow. This approach has secondary benefits of providing waterfowl habitat and potential recreation (e.g., hunting). A location where this approach has been successfully implemented is along the Sacramento River in central California. Each year, about 140,000 acres of rice fields are flooded to dispose of straw and create waterfowl habitat. This approach largely evolved out of a desire to improve air quality that was negatively affected by the annual burning of residual straw. While the California approach was implemented for different reasons, landowners may wish to consider this approach with their crop rotations in Stevens County.

Land Acquisition / Riparian Restoration

Whatcom County is currently looking at water storage opportunities involving off channel/old river channel enhancements, wetland restoration, and reconnecting streams and rivers to their floodplain. These measures have similar goals to farm field flooding, but typically require the outright acquisition of land or farming/development rights along a river corridor as the opportunity arises. The Pierce County Conservation Futures program is also currently supporting this approach.

This alternative can be especially rewarding to producers located in the floodplain of the Colville River looking for ways to increase their incomes during retirement, particularly if there are water rights included in the acquisition.

Beaver Management

Personal reports from the WRIA 59 Planning Unit participants indicated that beaver populations in the watershed were much more substantial in the past, and that extensive trapping, combined with a historic bounty system, has resulted in significant reduction in beaver populations. Because beaver dams amount to small water storage impoundments (one of the goals of this project), it may make sense to look at strategic areas in the Colville River Watershed where beaver could be re-introduced or allowed to proliferate. Special care would have to be taken to ensure the activity was compatible with current land use and property ownership.

Aquifer Storage and Recovery

The selected projects typically achieve increased storage through a combination of surface impoundments and groundwater recharge. Groundwater recharge occurs primarily within surficial unconfined aquifers located adjacent to the drainage ways of the Colville River tributaries. Our research and review indicate a relatively continuous lower confined aquifer occurs at depth within the mainstem Colville River Valley. The confined aquifer is overlain by relatively impermeable glaciofluvial sediments and, in most areas, would not have an efficient hydraulic connection with surface water. The confined aquifer, however, may have potential for future aquifer storage and recovery projects. This may involve injection of available surface water and/or wastewater during high flow periods for subsequent groundwater withdrawal.

Unconfined Aquifer Recharge

The selected projects generally augment groundwater recharge through surface impoundments that extend a short distance from the centerline of the existing drainage ways. Hydrogeologic investigations, including determination of hydraulic conductivity, hydraulic gradient, and groundwater velocity will be required to determine the timing and extent of groundwater discharge during low flow periods. Groundwater discharge timing generally can be extended by transporting surface water a greater distance before allowing it to recharge groundwater. This can be achieved by piping surface water to the recharge location via gravity flow or, more likely, via pumping. Infiltration can be achieved by ponding, drainfield construction, and/or injection. Suitable locations for such projects would contain relatively thick unconfined aquifer materials in hydraulic connection with the target drainage way and a relatively large depth to the static groundwater table. Based on our review, likely locations for such conditions occur north of Loon Lake, west of Deer Lake, northwest of Jump-Off Joe Lake, along Cottonwood Creek, along the north fork of Chewelah Creek, in various locations along the Little Pend Oreille River, and east of the City of Colville.

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