US Army Corps of Engineers

Mill Creek Master Plan

Technical Report - Volume 2

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Section 1 - Mill Creek Flood Control Project

1.01. Mill Creek Flood Control Project

This section contains the legislative authorization, purposes, benefits, and management for the Mill Creek Flood Control Project. An in-depth history of the Mill Creek Flood Control Project up to 1949 (when construction was completed) can be found in section 3, paragraph 3.03(b) of this volume. The Mill Creek Flood Control Project was designed and constructed to protect the city of Walla Walla, Washington. It is composed of the following major units: 1) Mill Creek channel; and 2) the off-channel reservoir (Virgil B. Bennington Lake) and lands referred to as the Mill Creek Project (MCP) in this report.

a. Mill Creek Channel.

The Mill Creek Channel, or Improved Channel, runs through the city of Walla Walla. It is owned, operated, and maintained by a local municipal corporation, the Mill Creek Flood Control Zone District. The Mill Creek Flood Control Zone District is directed by the Walla Walla County Commissioners. This report does not plan for lands that contain the Mill Creek Channel, but the channel is referred to since it is part of the project.

b. Mill Creek Project.

The MCP is the portion of the Mill Creek Flood Control Project that is owned, operated, and maintained by the Federal Government. The Federal agency responsible for the operation and maintenance of MCP is the U.S. Army Corps of Engineers, hereafter referred to as the "Corps."

1.02 Project Authorization

a. General Authority.

(1) Background.

A comprehensive plan of flood protection for the city of Walla Walla, and its immediate vicinity (see photo 1-1), was approved by Congress in 1938, with some minor changes added in 1941. The plan consisted of two major construction projects: 1) the Improved Channel (of Mill Creek) through the city; and 2) the off-channel reservoir now known as Virgil B. Bennington Lake, and the lands surrounding this reservoir.

Photo 1-1. April 1931 flood at Main Street, Walla Walla, Washington

(2) The Corps Report.

In 1937, the Corps completed a report that included a comprehensive plan of flood protection for the city of Walla Walla. The plan included an off-channel reservoir and lands, along with the main channel through town, which was being constructed by Works Progress Administration (WPA) funds, with construction supervision by the Corps. The report recommended that an off-channel reservoir be built to store floodwater so that the city of Walla Walla could be fully protected. That report, and its corresponding letters of endorsement, were sent to Congress, and became House of Representatives Document (HD) 578. This document states:

> "...the channel-improvement works now under construction in and adjacent to the city will afford a substantial measure of relief, but a greater degree of protection is desirable. The flood-detention reservoir and necessary auxiliary works proposed by the district engineer with the channel improvements now under construction will fully protect the city and adjoining lands against practically all flood to be anticipated." (HD 578, 1938, page 3).

(3) Public Law.

(a) Original Authorization.

The plan, including the off-channel reservoir, was approved by Congress and signed into law by President Franklin D. Roosevelt on 28 June 1938. Section 4 of the Flood Control Act of 1938 (Public Law 75-761, 75th Congress, 3d Session) specifically pertaining to Mill Creek, states:

MILL CREEK, WASHINGTON

> "The plan for protection of the city of Walla Walla, Washington, and adjacent lands by means of a reservoir and related works, as set forth in House Document Numbered 578, 75th Congress, third session is approved and for the execution of this plan is hereby authorized $1,608,000."

(U.S. Congress, vol. 52, page 1222).

(b) Project Modifications.

Some minor additions were needed for the Mill Creek Flood Control Project. The Corps sent a report to Congress, along with other recommendations for the Walla Walla River. This report was included in HD 719, dated 24 April 1940, which states:

> "...that it is desirable to make certain modifications in the plans for the existing project on Mill Creek at and in the vicinity of Walla Walla, Wash., authorized by the 1938 Flood Control Act..."

(U.S. Congress, 1940a, page 3.)

The specific recommended modifications to the project, as stated in HD 719, were:

> "(1) ...reconstruction of bridges across Mill Creek in the city of Walla Walla...(2) additional costs of right-of-way, and (3) additional construction measures required to insure safety of the proposed earth dam."

(U.S. Congress, 1940a, page 5.)

The Flood Control Act of 1938 was amended, with the recommendations being adapted under the Flood Control Act of 1941 (Public Law 77-228, 77th Congress, 1st Session, 18 August 1941). The paragraph in the Flood Control Act of 1941 that relates to the project states:

COLUMBIA RIVER BASIN

> "...the project for the protection of the city of Walla Walla, Washington, authorized by the Act approved June 28, 1938 is hereby modified in accordance with the recommendations of the Chief of Engineers in House Document Numbered 719, 76th Congress, third session, at an estimated cost of $754,000."

(c) Virgil B. Bennington Lake.

The off-channel reservoir, authorized in 1938, was referred to by the Corps as Mill Creek Reservoir from 1938 to 1972, and as Mill Creek Lake until 1992. On 31 October 1992, President George Bush signed into law (Public Law 105-580) The Water Resources Development Act of 1992. This act renamed the reservoir, authorized in 1938, as Virgil B. Bennington Lake. The new law states:

SECTION 118. NAMINGS

"(h) Mill Creek Reservoir, Washington. --

(1) Designation.-The Mill Creek Reservoir, authorized by section 4 of the River and Harbor Act of June 28, 1938 (52 Statute 1222), shall hereafter be known and designated as the "Virgil B. Bennington Lake."

(2) Legal References.-A reference in any law, regulation, document, record, map, or other paper of the United States to the reservoir referred to in the Paragraph (1) shall be deemed to be a reference to the "Virgil B. Bennington Lake.""

A biographical sketch of Virgil B. Bennington can be found in section 3, paragraph 3.03(b) of this volume.

b. Recreation Authority.

Recreation development was authorized at MCP under Section 4 of the Flood Control Act of 1944 (Public Law 78-534, 78th Congress, 2d Session). This act was passed on 22 December 1944, and amended by the Flood Control Acts of 1946, 1954, and 1962. This act authorized the Corps:

"...to construct, maintain, and operate public park and recreational facilities at water resource development projects under the control of the Secretary of the Army, and to permit the construction, maintenance, and operation of such facilities."

The Flood Control Act of 1944 provides for the water areas of the project to be open to public use (*i.e.*, boating, fishing, and other recreational purposes). It also provides for ready access to and from areas along the shores of the project that will be maintained for general use when in the public interest (USACE, 1989, page 17-1).

c. Fish and Wildlife Authority.

The Fish and Wildlife Coordination Act of 1958 (Public Law 85-624) states that fish and wildlife conservation will receive equal consideration with other project purposes, and be coordinated with other features of water resource development.

Approximately 60 acres of MCP were purchased as part of the Lower Snake River Fish and Wildlife Compensation Plan, which was authorized by the Water Resource Development Act of 1976 (Public Law 94-587, 94th Congress, 2d Session, 22 October 1976). These lands were transferred to MCP on 7 July 1992.

A synopsis of applicable laws and regulations can be found in Supporting Data, Item 2, in the back of this report.

1.03. Project Purpose.

a. Flood Control.

The original purpose of the Mill Creek Flood Control Project was to control periodic flooding from Mill Creek and, thus, prevent extensive damages to the city of Walla Walla and the agricultural lands in the vicinity. Historically, several damaging floods have had disastrous effects on the city of Walla Walla and the lands lying downstream. The MCP was constructed for the most severe flooding.

b. Recreation.

The Federal Water Project Recreation Act of 1965 (Public Law 89-72, 89th Congress, 1st Session, 9 July 1965), as amended, established recreational potential at Mill Creek Flood Control Project as a full project purpose (see photo 1-2).

Photo 1-2. The MCP provides the public with a variety of recreational opportunities in a scenic setting.

1.04. Project Benefits.

a. General.

The tangible benefits of the Mill Creek Flood Control Project are reduction of flood losses, increase in land use, and recreational use (including hunting and fishing). Intangible benefits include fish and wildlife values (*i.e.*, wildlife viewing, migratory species nesting/feeding and breeding/brooding, and habitat for non-game animals), and the prevention of probable loss of life and property during a major flood event.

b. Flood Control.

Between 1942 and 30 September 1992, the Mill Creek Flood Control Project has prevented $10,818,000 in cumulative flood damages. The channel through the city has prevented $10,761,000 in damages, and the lake project has prevent $57,000 (USACE, 1993).

c. Fish and Wildlife.

Fish and wildlife values are considered an intangible benefit. The MCP provides fish habitat for 22 species of fish, including wild trout and steelhead, hatchery trout and steelhead, non-salmonids, and spiny ray fish. The project also provides habitat for 170 species of wildlife. The fish and wildlife present provide visitors with educational, observational, recreational, and aesthetic experiences.

d. Recreation.

Fishing on the project has been allowed since 1954. Park and recreation facilities were opened to the public on 1 July 1964. Recreational pursuits are served through the maintenance of a well-equipped, day-use park; management of hunting lands; and the development of a trail system for hikers, equestrians, and bicyclists. Over the last 20 years (1973 to 1992), there have been 3.6 million visitors at MCP. The offstream reservoir also provides water-based recreational opportunities. All recreational activities are considered incidental to flood control, and no specific tangible benefits are assigned (USACE, 1992).

1.05. Project Management.

The Mill Creek Flood Control Project is operated in a cooperative agreement between the Corps and the Mill Creek Flood Control Zone District (local authority). The project is operated under written agreement. The MCP is Federally owned, and operated and maintained by the Corps. The Mill Creek Channel portion is owned, operated, and maintained by Mill Creek Flood Control Zone District, but the first mile of the channel is part of MCP. The Corps, in cooperation with the local authority, has developed the water control manual for the operation of the project. Section 3, paragraph e., of this volume contains a more in-depth description of the water resource facilities and operations of the project.

a. General.

(1) Project Office.

Mill Creek is operated under the direction of the Project Manager, who is located at the project office (see photo 1-3). The Project Manager is directly responsible to the Chief, Operations Division, U.S. Army Corps of Engineers, Walla Walla District. The Project Manager coordinates project activities with the District Office's Planning, Engineering, Construction, and Real Estate Divisions. Project personnel are responsible for maintenance, management, and supervision of the project facility, equipment, and the natural resource management program. Project staff are also local representatives for the Corps. They supervise the use of the lands and waters of the project area, protect and maintain Government property, and ensure high standards of public health and safety.

Photo 1-3. The MCP Project Office.

The Project Manager at Mill Creek is concerned with applying the principles of sound resource management, and assuring that the goals for such management are achieved.

(2) District Office.

The Walla Walla District Office, Walla Walla, Washington, is available to support the project as necessary. The Walla Walla District boundaries follow the Snake River Drainage for approximately 115,000 square miles. The District Office is responsible for assuring that the Project Office is fully informed on pertinent policy issues, providing budget support, and assisting in planning, designing, and building facilities. Figures 1-1 and 1-2 illustrate how MCP and other elements are organized within the Walla Walla District. The primary element supporting the project is Operations Division. Other major elements are Planning Division: Hydrology Branch (flood control operations);

Environmental Resources Branch (project master plan, water quality, archaeological and historical resources, and environmental compliance); Engineering Division: Design and Geotechnical Branches (design and technical assistance); and Real Estate Division (land outgrants and real property).

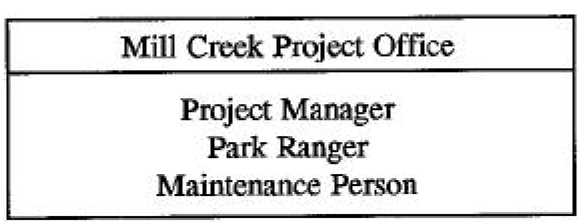

Figure 1-1. Staff Organization at Mill Creek

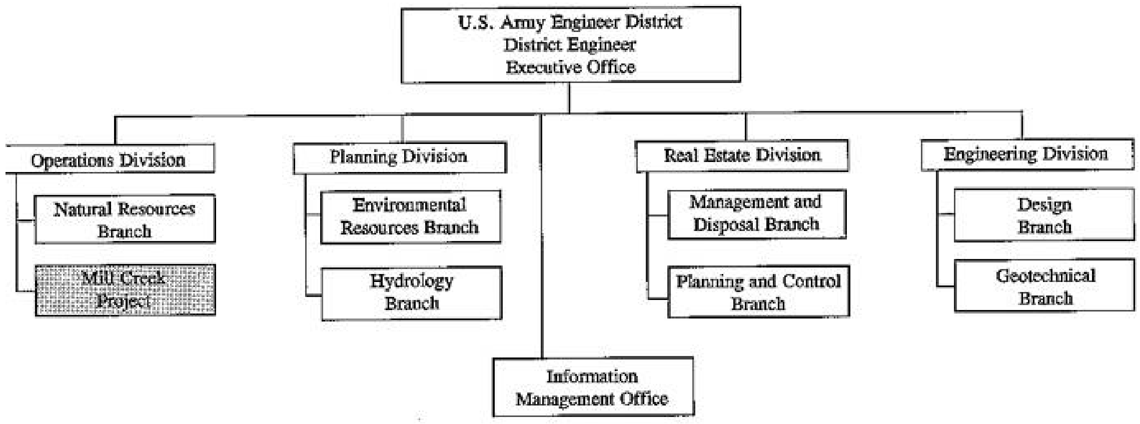

Figure 1-2. Project Organization Management Office

b. Mill Creek Channel

The "improved" channel was constructed using Federal, State, and local funding. The channel is owned by, and located in, the Mill Creek Flood Control Zone District, Walla Walla, Washington. The channel is operated in cooperation with the Corps, per the Water control Manual for the Mill Creek Flood Control Project that was developed by the Corps (USACE, 1991).

The Mill Creek Flood Control Zone District has the authority to collect revenue needed to operate and maintain the channel, as directed by the Board of Directors (County Commissioners) and in agreement with the Corps. As the local sponsor, the Flood Control Zone District is responsible for normal operations and maintenance.

The Corps is authorized to provide rehabilitation for the channel, since it is part of the plan and project, as authorized by the Flood Control Act of 1938.

1.06. References

USACE, 1982

Mill Creek Lake, Washington Design Memorandum No. 7, Main Channel Rehabilitation, Walla Walla, Washington, Walla Walla District.

USACE, 1989

Digest of Water Resources Policies and Authorities, EP 1165-2-1, 15 February 1989, Washington, D.C.

USACE, 1991

Water Control Manual for Mill Creek Flood Control Project, Mill Creek, Washington. Planning Division, Hydrology Branch, Walla Walla, Washington, Walla Walla District.

USACE, 1992

Project Attendance Figures, Personal Communication, Linda Carter, Natural Resources Branch, Operations Division, Walla Walla District, Walla Walla, Washington.

USACE, 1993

Damages Prevented by Existing Projects, Paul C. Fredericks and Gina Trafton, Walla Walla District, Walla Walla, Washington.

United States Congress (USC), 1938

Mill Creek, Washington, House of Representatives Document 578, 75th Congress, 3d Session, Mill Creek, Washington, United States Government Printing Office.

USC, 1938

The Flood Control Act of 1938, Public Law 75-761, 75th Congress, 3d Session, 28 June 1938.

USC, 1940

Walla Walla River and Tributaries, Oregon and Washington, House of Representatives Document No. 719, 76th Congress, 3d Session, 24 April 1940, United States Government Printing Office.

USC, 1941

The Flood Control Act of 1941, Public Law 77-228, 78th Congress, 1st Session, 18 August 1941.

USC, 1944

The Flood Control Act of 1944, Public Law 78-534, as amended by the Flood Control Act of 22, December 1944, 1946, 1954, and 1962.

USC, 1958

Fish and Wildlife Coordination Act of 1958, Public Law 85-624, 85th Congress, 2d Session, 12 August 1958.

USC, 1965

The Federal Water Project Recreation Act of 1965, Public Law 89-72, 89th Congress, 9th Session, 9 July 1965, as amended.

USC, 1976

Water Resource Development Act of 1976, Public Law 94-587, 94th Congress, 2d Session, 22 October 1976.

USC, 1992

Water Resources Development Act of 1992, Public Law 102-580, 102d Congress, 2d Session, 30 October 1992.

Section 2 - Regional Description and Analysis

2.01. General

a. Overview.

The purpose of this section is to present information about the region around MCP. For the purpose of this study, the term "region" is generally an area within a 100-mile radius of MCP (see plate 2-0).

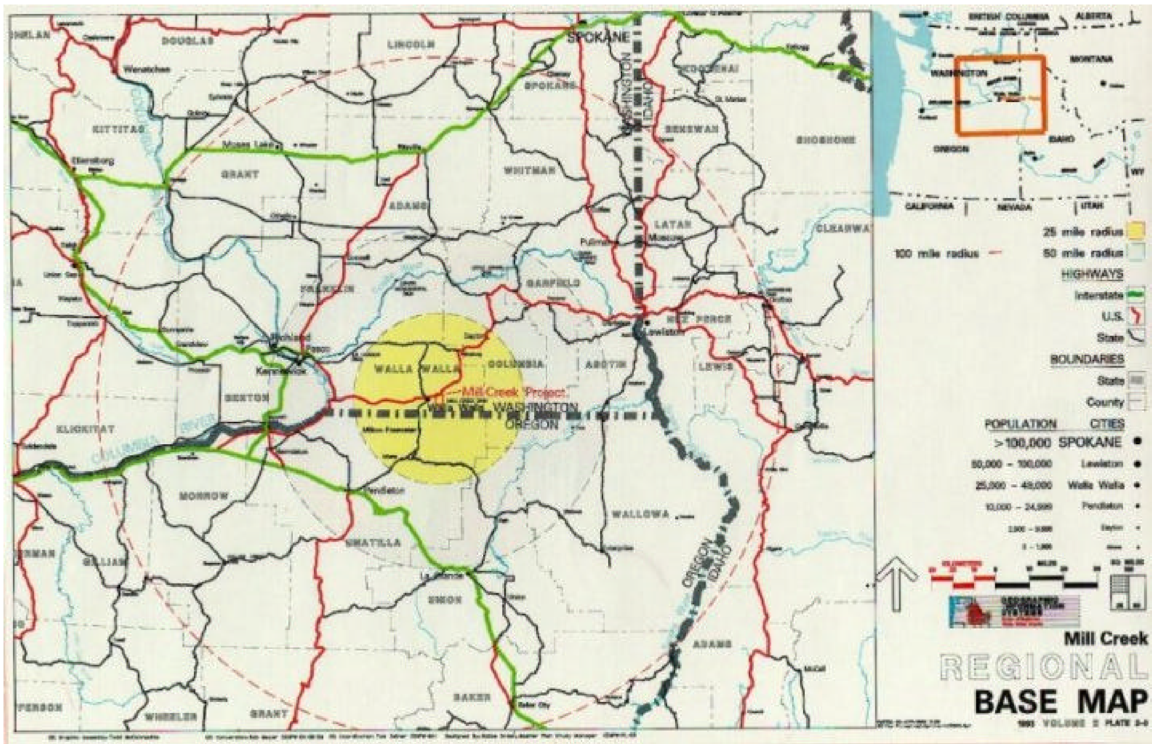

Plate 2-0. Regional Base Map

This section inventories and analyzes ecological and cultural factors within the region. Ecological factors are natural resources; and include geology, vegetation, wildlife, and climate. Cultural factors include all manmade influences (*i.e.*, access to the region, population and economic characteristics, land use, and ownership). Section 3 will discuss these same factors as they relate to MCP.

b. Region Boundaries.

The large area displayed on the plates in this section was used so that a consistent base map could be maintained throughout all of the data themes presented here. For example, physiographic provinces are extremely large and can pass through multiple states, whereas other data themes can be displayed in a much smaller area. As previously mentioned, the term "region" refers to an area generally within a 100-mile radius of MCP. The manner in which the area is discussed varies, depending on the resource under discussion. When discussing ecological factors, the descriptions are centered around either regional physiographic provinces that are very large, broad landscape units; or stream drainages (watersheds). The regions used when describing cultural factors may be physiographic provinces, states, counties, or the MCP market area (MA).

Physiographic provinces, or landscape units, form the conceptual boundaries used in the study of ecological and cultural factors. Cultural factors are primarily a product of manmade development and, as such, also describe the region by states, counties, and local market areas.

c. Mapping--Geographic Information Systems (GIS).

The maps used in this section were extracted from a regional database being developed at the Corps, Walla Walla District. The base mapping was originally digitized of 1:250:000 scale U.S. Geological Survey (USGS) paper maps in the Portland District. This was done utilizing an Intergraph Computer Aided Drafting and Design (CADD) system (see photo 2-1). The Corps, Walla Walla District, reorganized the base data into separate base files (*i.e.*, boundaries, hydrography, cities, and transportation), using GIS. The GIS is a computerized database management system for the capture, storage, retrieval, analysis, and display of spatial data. Data theme files, such as wildlife and vegetation, were then added to GIS. The area displayed on the plates in this section covers 43.41 square miles (mi^2). A 25-mile radius covers almost 2,000 mi^2, while a 50-mile radius covers 7,900 mi^2. The regional data, which will include the entire Walla Walla District (Snake River Drainage, plus the entire State of Idaho), is ongoing, and will continue to be updated when required. This report is the first use of this spatial regional information. Mill Creek Master Plan was Walla Walla District's pilot project for the use of computerized GIS.

Photo 2-1. Walla Walla District used Intergraph® Work Stations and software to implement GIS.

2.02. Ecological Factors

The following paragraphs contain a description of various ecological factors that affect MCP. These ecological factors include the following: a) Landform--Physiography; b) Geology: c) Soils; d) Hydrologic Basins; e) Limnology; f) Climate; g) Air Quality; h) Vegetation; i) Wildlife; and j) Fish. These factors are described within the physiographic areas presented in paragraph 2.02.a., *Landform--Physiography*, or within the hydrologic basins presented in paragraph 2.02.d., *Hydrologic Basins*.

a. Landform--Physiography.

Physiographic provinces are broad homogeneous areas, or landscape units. They are subdivided into sections. Boundaries separate the various provinces and sections, and allow for a gradual transition from one type of landform to another. This use of conceptual boundaries makes the study of complex landscapes much simpler. The physiographic provinces and sections described in this report are a compilation of the work done by many researchers over the past 60 years. These researchers include: Fenneman (1931), Franklin and Dyrness (1973), Bailey (1982), Litton and Tetlow (1978), Hunt (1967), Thornbury (1965), and Arnold (1975).

The MCP is located on Prospect Point Ridge, and lies within the Walla Walla Valley. The MCP is part of the Palouse Section of the Columbia-Snake Intermountain Province (C-S Intermountain), in an area that nearly intersects the Blue Mountain Section (see plate 2-1). The following subparagraphs contain descriptions of the provinces and sections that encompass, or are near to, the MCP.

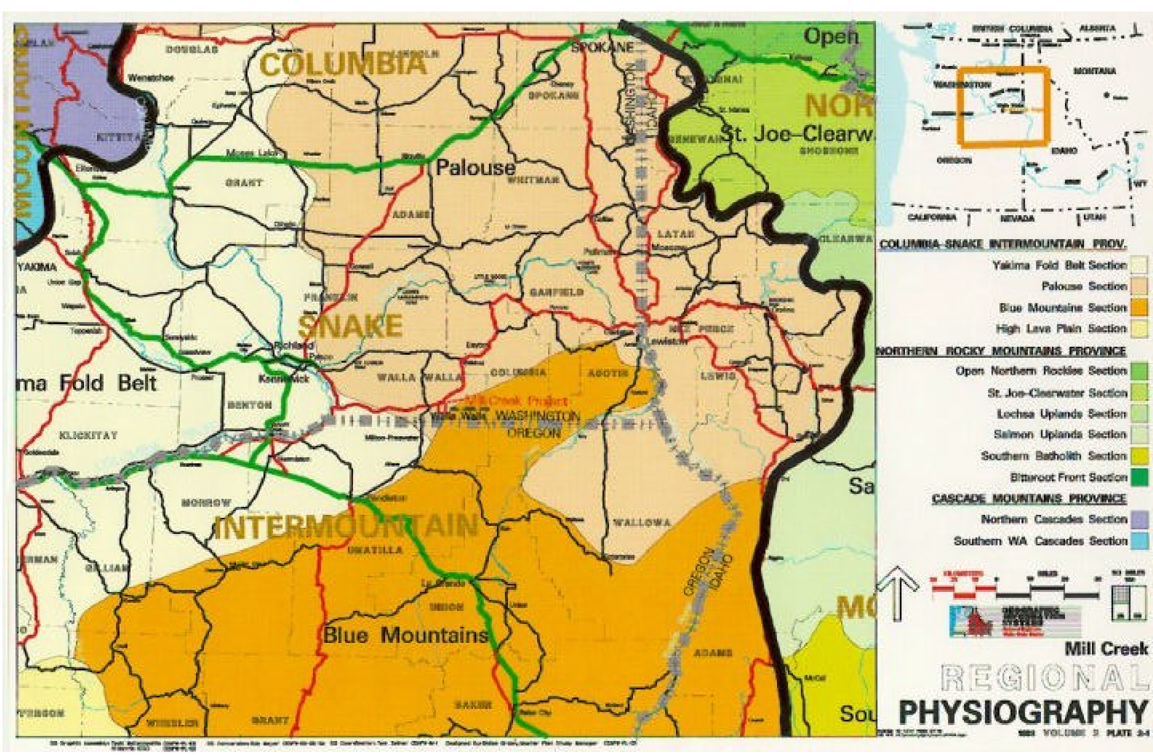

Plate 2-1. Regional Physiography

(1) The C-S Intermountain.

The C-S Intermountain, also known as the Columbia Plateau, covers about 100,000 mi^2 in Idaho, Oregon, and Washington. It is composed of nearly horizontal lava flows (Fenneman, 1931), and extends from the Idaho/Wyoming border to the Columbia Basin in eastern Washington (see figure 2-1). The province is bordered by the Northern and Middle Rocky Mountain Provinces on the north and east, the Basin and Intermountain Range Province in the south, and the Cascade Mountain Province in the west. The C-S Intermountain is subdivided into seven sections. For the purpose of this study, only the Palouse and Blue Mountain Sections are discussed further.

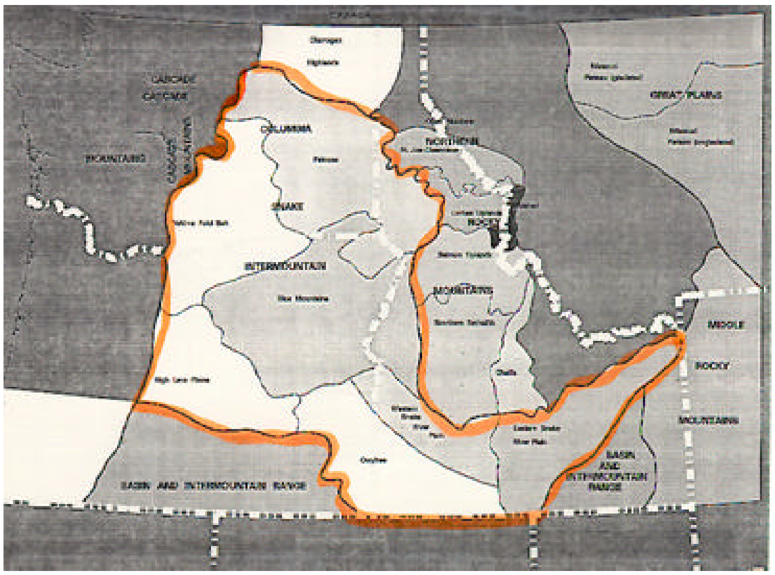

Figure 2-1. Columbia-Snake Intermountain Physiographic Province

(2) Palouse Section.

The Palouse Section lies in the northeast portion of the C-S Intermountain, and is bordered by the Rocky Mountain Province to the north and east. It is also bordered by the Yakima Fold Section on the west, and the Blue Mountain Section on the south, both of which are part of the C-S Intermountain. The section is drained by both the Snake and Clearwater Rivers.

The Palouse Section is characterized by gently rolling hills composed of wind-deposited silt (loess). The loess has been deposited on a thick sequence of flat-lying basalt lava flows. At the point where the Snake and Clearwater Rivers cross the Palouse Section, gently rolling hills give way to canyons. The canyons have been cut into the underlying lava flows, and can be up to 2000 feet in places (see photo 2-2). The average surface elevation of the Palouse Section is 2,500 feet, but the canyon floors of the Snake and Clearwater Rivers average less than 800 feet in elevation.

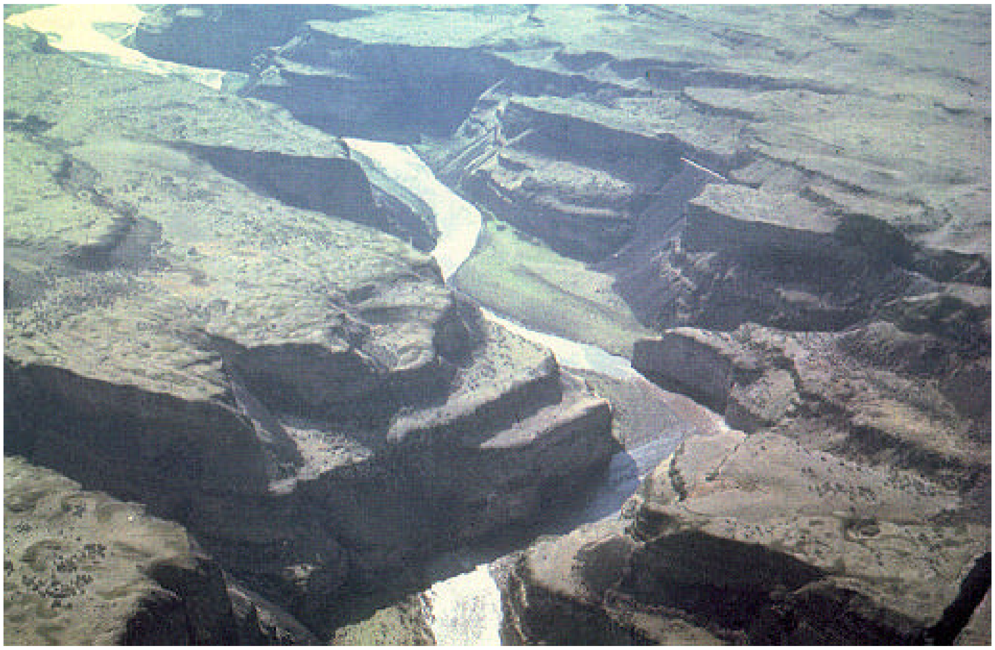

Photo 2-2. Palouse Section. The Snake River cuts through the Palouse Section, exposing basalt lava flows.

(3) Blue Mountain Section.

The Blue Mountain Section is composed primarily of mountain ranges separated by faulted valleys and synclinal basins (Franklin and Dyrness, 1973). The section stretches east from Prineville (in north-central Oregon) to western Idaho. It is bounded by the Palouse and Yakima Fold Belt Sections on the north, the High Lava Plains Section on the west, the Owyhee and Western Snake River Plains Sections to the south, and the Northern Rocky Mountain Province to the east. The Blue Mountain Section consists of a large, asymmetric anticline, with a steep north flank and a gentle south flank. As a result, the Blue Mountain Section rises up sharply from the Columbia Plateau, but merges gradually into the high plateau country to the south.

The Blue Mountain uplift contains many individual mountain ranges. The most notable (from west to east) are the Ochoco, Aldrich, Strawberry, Greentown, Elkhorn, Wallowa, and Seven Devils Mountains. The east end of this uplift contains many varied elevations. The glaciated peaks of the Wallowa Mountains rise as high as 8000 feet above the Snake River, while Hells Canyon is the deepest canyon in North America. The topography of this section is extremely complex, and reflects the varying lithology and structure of the Blue Mountain Range (see photo 2-3).

Photo 2-3. The Blue Mountains and Mill Creek Drainage Basin

(4) Analysis of Physiography.

Each physiographic province or section has distinctly different and unique topography, climate, soils, vegetation, and visual resources (see section 3.04., *Aesthetic Resources*). Since MCP is located near the border of both the Palouse and Blue Mountain Sections, it contains a wide variety of ecological features in a relatively small area. This is an advantage for MCP, because it provides the public with high visual resource quality; and a diversity of landforms, wildlife, and vegetation.

b. Geology.

(1) General.

The MCP is located in the north central portion of the C-S Intermountain (see figure 2-1). The C-S Intermountain formed on the surface of a thick, broad layer of flood basalt (Columbia River Basalt). The Blue Mountain Section of the C-S Intermountain is located to the southeast of MCP, and is a transitional mountain range that separates the structural low plateau to the northwest and the high plains plateau to the southeast.

(2) Columbia River Basalt.

Columbia River Basalt is the underlying bedrock of the entire C-S Intermountain. This basalt is a dense, black-to-brown, hard rock that was extruded in flows, or floods, of liquid rock. These basalt flows are the largest in the world, and cover 62,000 square miles. The basalt flows are divided into formations and members. Individual flows reach thicknesses of from 50 to 100 feet, and are of great lateral extent. The maximum thickness for flow accumulations is around 2½ miles. The flows occurred during the Miocene Epoch of the Tertiary Period [from 6 to 17 million years ago (see figure 2-2)]. Molten lava erupted from northerly-trending, linear vent systems. These vent systems are now [reserved as dikes, both within and cross-cutting the basalt formations.

ERA	PERIOD	EPOCH AGE	YEARS BEFORE PRESENT	LOCAL EVENTS
CENOZOIC	QUARTERNARY	HOLOCENE	11,000	
		PLEISTOCENE	1 - 2,000,000	
	TERTIARY		63,000,000	BASALT LAVA FLOWS 6 - 16 MILLION YEARS AGO
MESOZOIC	CRETACEOUS			2nd Maj. Bldgs. in Blues M.S. Maj.
	JURASSIC			
	TRIASSIC			1st Maj. Mountain Bldg. in Blues
			230,000,000	
PALEOZOIC				Maj. Rock Types Exposed at the West and East Ends of C-S Intermountain Province

Figure 2-2. Time and Events

The intervals between basalt flows varied from only a few years to thousands of years. During quiet intervals of no volcanic activity, erosional and sedimentary processes occurred. These processes created a deposition of silts, sands, and gravels within depressions on the basalt. Later volcanic flows covered these sediments with basalt, and formed sedimentary interbeds within the basalt formations. Today, some of these sedimentary interbeds have proven to be valuable aquifer groundwater sources.

Soon after the lava flows ended (about 6 million years ago), a cover of wind-blown silt began to accumulate on top of the basalt. Rivers began to form in structural lows, and the topography seen today began to form.

The Ice Age began about 2 million years ago. During this period, both erosional and depositional events occurred through the C-S Intermountain. Many river channels were scoured in the province, and the deposition of silt continued in many areas. Flood events scoured the province, and left behind many sand and gravel depositional formations.

(3) Blue Mountain Section.

The Blue Mountain Section contains a complex system of mountain ranges, basins, and valleys; and separates the low plateaus of the northwest and the high plains plateaus of the southeast. The MCP is located in the Walla Walla Basin, and is northeast of the Blue Mountains. These mountains were formed by a northeast-trending anticlinal uplift, and are covered by Miocene basalt. This basalt is generally believed to overlay older rocks from the Tertiary Age (see figure 2-3). The Walla Walla Basin slopes from the Blue Mountains northwards, down through a structural low, and then upwards towards lands adjoining the Columbia and Snake Rivers.

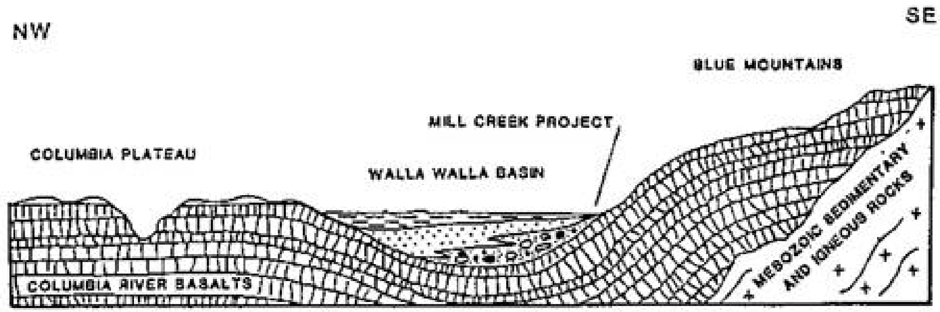

Figure 2-3. Diagram Cross Section

(4) Analysis of Geology.

Geology is one of the factors responsible for the vast variety of the region's landforms, vegetation, wildlife, climate, and many other aspects. Basalt is the most influencing material in the region, which contains the world's largest lava flow. In the geologic time scale, the events that created the present topography in, and around, the MCP happened fairly recently. At the present time, erosion is continually occurring in the Blue Mountains, and deposition is occurring within the Walla Walla Basin. Minor tectonic activity is happening in the vicinity of the MCP, and is recorded as light earthquakes on local seismographs. See section 3 for more geologic information on the MCP.

c. Soils.

Soils are influenced by parent materials, climates, vegetation, aspect (orientation), slope, and man. Soils in the region differ greatly between the mountains and the high desert. The following description of soils was extracted from the U.S. Department of Agriculture (USDA) Forest Service 1973 General Technical Report, *Natural Vegetation of Washington and Oregon*, by J.F. Franklin and C.T. Dyrness. Table 2-1 lists the soils found in the Blue Mountain, Palouse, and Yakima Fold Sections.

Table 2-1 Regional Soils				
	1938 Classification System		1967 Classification System	
Province	Wide-Spread Great Soil Groups	Less Abundant Great Soil Groups	Wide-Spread Great Soil Groups	Less Abundant Great Soil Groups
Blue Mountains	Western Brown Forest Regosol Lithosol	Brown Podzolic Reddish Brown Lateritic Chernozem Chestnut Prairie Alpine Turf Alpine Meadow Humic Gley Alluvial Rockland	Argixerolls Vitrandepts	Fragiorthods Haploxerolls Palexerolls Durixerolls Haplargids Xerorthents (shallow) Rockland
Columbia Basin	Brown Chestnut Chernozem Prairie Sierozem Regosol	Planosol Humic Gley Solonetz Solonchak Alluvial Lithosol Rockland	Haploxerolls Argixerolls Camborthids Torripsamments	Arguidolls Haplargids Xerothents Xerothents (shallow) Rockland Durixerolls Haplaquolls Albaqualfs Haploxeralfs

(1) Blue Mountain Section.

Soils of the Blue Mountain Section can be grouped into two main soil units: 1) those at moderate-to-high elevations that were formed under forest vegetation; and 2) soils at generally lower elevations, formed under grassland or shrub-grassland vegetation. There is also a transitional phase between these two main soil units.

(a) Forested Soils.

Forested soils, developed in volcanic ash, are usually located on large, flat ridge tops, and north-facing slopes. The ash mantel thickness on these ridge tops and slopes varies from 18 to 36 inches. These soils, Vitrandepts (Regosols), are characteristically dark brown, and have a fine, sandy loam texture. Fragiorthods (brown Podzolic soils with fragipans) are also located on mountainside slopes in forest vegetation. These soils are usually derived from loess, are deep, and have a silt loam texture.

(b) Forested-Grassland Transition.

The soils of the forest-grassland transition (moderate to high elevations) are usually within the Mollisol order. The principal groups are Argixerolls (Prairie soils), Haploxerolls (Chestnut and Chernozem), and Palexerolls (Prairie soils). These soils are formed in loess and basic igneous rock materials, with depth-to-bedrock averaging less than 3 feet.

(c) Grassland and Shrub-Grassland.

The most wide-spread soils that support grassland and shrub-grassland vegetation are Argixerolls (Prairie soils and Chernozems). In the eastern portion of the Blue Mountain Section, the Argixerolls were developed from loess and basic igneous rocks. The soils formed in alluvium, along streams, are largely Haploxerolls (Chestnut and Brown soils). The texture of these soils ranges from loam to silt clay loams, and soil drainage varies from well-drained to poorly drained. In bottomland locations, especially in the eastern portion of the Blue Mountain Section, Durixerolls soils (with a hardpan at depths of less than 3 feet) are common (Franklin and Dyrness, 1973).

(2) Desert Soils--Palouse and Yakima Fold Sections.

There are a wide variety of soils in the Palouse and Yakima Fold Sections that have been formed under grassland or shrub-grassland vegetation. The soil differences are directly related to rates of annual participation. Higher amounts of precipitation usually fall along the edge of the deserts in the higher elevations. Precipitation gradually decrease along with the elevation. (See paragraph f., *Climate*.) The four soil regions that appear within the Palouse and Yakima Fold Sections are further described in the following paragraphs:

(a) Argixerolls.

The first soil region is located along the north, west, and southern boundaries of the Palouse Section, and the southern boundary of the Yakima Fold Belt Section. The soils found in the Palouse Hills (near the Washington-Idaho border) are the best example. Argixerolls (Prairie and Chernozem) are the predominant soils. They are deep, dark-colored loess, and have a silt loam texture. These overlay a clay, or silty, loam. Annual precipitation in the area is between 16 and 23.5 inches.

(b) Haploxerolls.

The second soil region is located in the lower elevations. The main soils here are Haploxerolls (Chestnut soils), and are usually moderately thick brown loam. This region has an annual precipitation of 9 to 16 inches.

(c) Haploxerolls Soils.

The third soil region encircles the center of the lower elevations. The most common soils in the area are poorly developed Haploxerolls (Brown soils). They are composed of loess and sandier windblown materials, with smaller amounts of basalt. The area receives 4 to 9 inches of annual precipitation.

(d) Desertic Soils.

The fourth soil region has the lowest elevation of all of the sections, and is composed of desertic soils. The dominant soils are Camborthids (Sierozems), and are located over soils with larger amounts of clay. Annual precipitation in the area is 4 to 9 inches.

(3) Analysis of Soils.

The soils in the region are extremely varied. There are areas with little soil and large basalt rock outcropping, as well as areas with some of the deepest, most productive, agricultural soils in the country. The MCP is located in both shallow soils and productive soil types.

d. Hydrologic Basins.

(1) Columbia River Basin.

This regional area is located within the Mid-Columbia River Hydrologic Basin. This basin is the third largest of the 12 basins in the United States portion of the Columbia River system. The headwaters of the Columbia River are located in the Canadian Rockies. The river flows north, and then south, through British Columbia. Once it reaches the United States, the river flows south through Eastern Washington and then west, along the Oregon-Washington border, on its way to the Pacific Ocean.

(2) Mid-Columbia River Basin.

The Mid-Columbia Basin occupies the central portion of southern Washington along the Columbia River and north central Oregon. The Mid-Columbia River Section (river basin) runs from Kennewick, Washington, to the center of the Columbia Gorge, where the Columbia River passes through the Cascade Mountains. Starting at the upper reach of the mid-Columbia, the major tributaries of the river are the Walla Walla, Umatilla, John Day, Klickitat, Deschutes, and White Salmon Rivers. Average annual runoff generated within the basin is approximately 15,400 cubic feet per second (cfs).

(3) Walla Walla River Basin.

(a) Surface Water.

The Walla Walla River basin is located on the border of Washington and Oregon (see plate 2-4). It is bordered by the Palouse-Snake River basin on the north, the Grande Ronde River basin on the east, and the Umatilla River basin on the south.

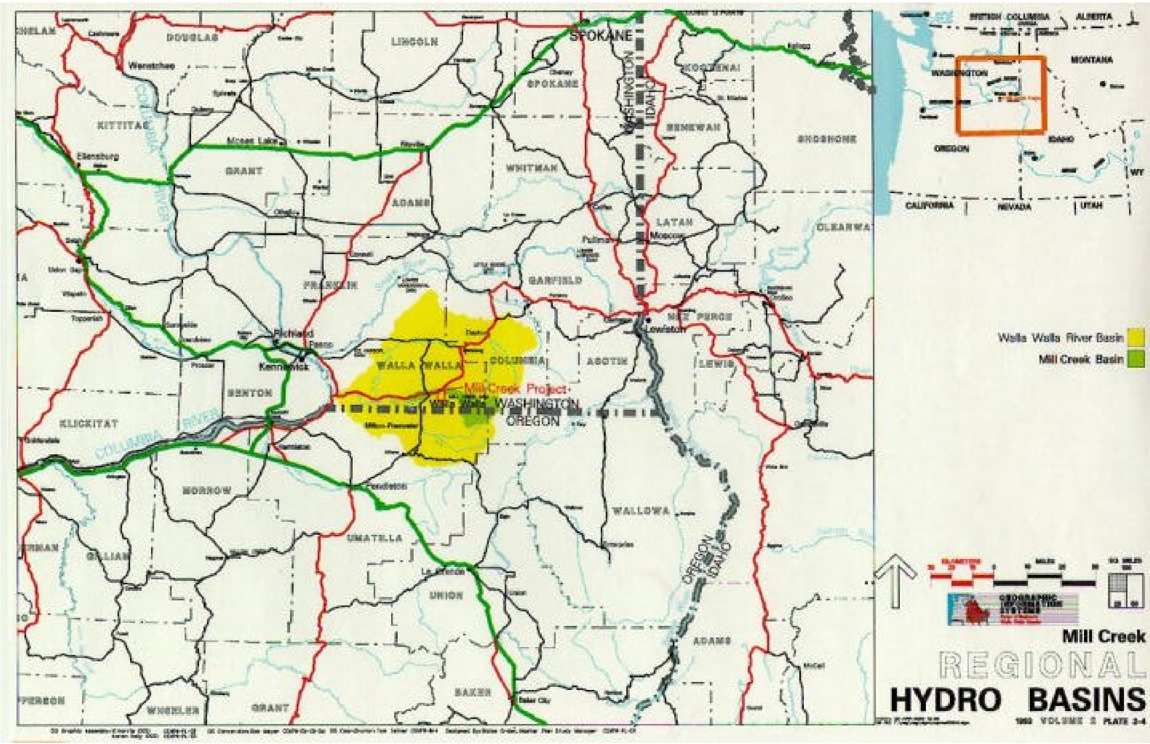

Plate 2-4. Regional Hydro Basins

The Walla Walla River originates in the Blue Mountains, at elevation 6,000 feet, and flows through narrow, well-defined canyons. After it flows out of the mountains, it goes through broad valleys that drain low, rolling lands. Table 2-2 summarizes area and runoff data for major tributaries of the Walla Walla River from the Touchet gaging station.

Table 2-2
Area Distribution and Runoff Contribution for Walla Walla River (Water Years 1970 to 1986)

	Drainage Area		Average Annual Runoff Volume	
Volume Stream Gage	(mi^2)	(Percent)	(AF/Year)	(Percent)
South Fork Walla Walla near Milton, OR	63	4	139,000	30
North Fork Walla Walla near Milton-Freewater, OR	34	2	39,200	9
Mill Creek at Walla Walla, WA	96	6	66,000	14
Touchet River at Bolles, WA	361	22	180,300	39
Local Runoff	1,103	66	37,500	8
Walla Walla near Touchet, WA	1,657	100	462,000	100

On an average, 34 percent of the total drainage area above the Walla Walla River (near the Touchet, Washington, gage) contributes 92 percent of the total runoff.

(b) Ground Water.

1. Basalt Aquifer.

A basalt aquifer underlies the entire Walla Walla Basin, and is part of the layered Columbia River basalt. It is primarily recharged by runoff from the Blue Mountains. This aquifer is a series of interconnected lava flows that conduct water in a horizontal direction. The lava flows are sandwiched between dense flows that do not conduct water very rapidly. The water is slowly moving towards the Columbia and Snake Rivers to the northwest. This aquifer has a storage capacity of 4 million acre-feet (AF), with only 2.6 million AF accessible for use. Annual recharge of the aquifer is approximately 132,000 AF. Of this amount, 97,500 AF discharge laterally to the Columbia and Snake Rivers, 12,000 AF discharge to the gravel aquifer, and 22,500 AF are pumped to the surface, causing water levels to dramatically decline (James, L.G., *et al.*, 1992).

2. Gravel Aquifer.

A gravel aquifer underlies 120,000 acres of the Walla Walla/Milton-Freewater area. This aquifer is located approximately 200 feet above the basalt aquifer. Between these aquifers is a layer of impermeable clay. The storage capacity of this aquifer is 3 million AF, with only 1 million accessible for active use. The aquifer is recharged from surface streams, precipitation, and the basalt aquifer. Annual recharge is 177,000 AF, of which 100,000 AF are lost through direct evapotransporation, 113 AF are returned to streams, and 25,000 AF are pumped to the land surface (James, L.G., *et al.,*, 1992).

(4) Mill Creek Basin.

Mill Creek originates on the western slopes of the Blue Mountains, in southeastern Washington, at an elevation of 5,500 feet. It flows for 15 miles in a relatively deep and narrow canyon, through mountainous terrain, and then enters an alluvial fan a few miles east of Walla Walla. The mean elevation of the Mill Creek basin, upstream from the reservoir, is 3,200 feet. The drainage basin area is 95.7 mi^2 above Mill Creek at the Walla Walla stream gage [river mile (RM) 10.5], and is located just downstream from the division works at MCP. The city of Walla Walla is located on the thick alluvial fan of Mill Creek, and the city limits extend to within approximately 1 mile of the fan's beginning. The chief tributary to Mill Creek is Blue Creek, which drains about 17 mi^2 of mountainous terrain, and joins Mill Creek about 8 miles above Walla Walla (RM 16.8). Yellowhawk and Garrison Creeks are diverted from Mill Creek about 1.75 miles east of the city limits, on MCP lands. Mill, Yellowhawk, and Garrison Creeks flow in a southwesterly direction over the Mill Creek fan, and eventually drain into the Walla Walla River. Mill Creek enters the Walla Walla River about 6 miles west of the city, at RM 33.6. Plate 2-4 is a map of the Mill Creek basin, as well as other adjacent stream basins.

(5) Analysis of Hydrologic Basins.

These river basins serve an important role in meeting the water needs of the region and the Walla Walla Valley. Careful water management for irrigation, food processing, recreation, flood control, fish, wildlife, and potable water is becoming extremely important. Portions of the Walla Walla River and Mill Creek are dry during the summer months, and this has dramatic effects on the fisheries resources. The groundwater is in serious decline, and the primary area of concern in this decline is the basalt aquifer. All surface waters within the Walla Walla basin are closed for appropriation. A study is currently underway to evaluate this problem.

e. Limnology.

(1) Surface Water.

The State of Washington uses a five-level classification system for water quality (State of Washington, undated). The five classes, and the relevant differences between them, are summarized as follows:

- **Class AA (Extraordinary):** Water quality will uniformly exceed requirements for all uses (includes salmonid migration, spawning, and rearing). Dissolved oxygen will exceed 9.5 milligrams per liter (mg/L). Temperature will not exceed 16° Centigrade (C) due to human activities. Fecal coliform bacteria counts will not exceed 50 colonies/100 milliliters (ml).

- **Class A (Excellent):** Water quality will exceed or meet requirements for all uses. Dissolved oxygen will exceed 8.0 mg/L. Temperature will not exceed 18°C due to human activities. Fecal coliform bacteria counts will not exceed 100 colonies/100 ml.

- **Class B (Good):** Water quality will exceed or meet requirements for most uses (excludes salmonid spawning). Dissolved oxygen will exceed 6.5 mg/L. Temperature will not exceed 21°C due to human activities. Fecal coliform bacteria counts will not exceed 200 colonies/100 ml.

- **Class C (Fair):** Water quality will meet or exceed the requirements of selected and essential uses (excludes salmonid spawning and rearing). Specific waters and criteria for this class are limited to marine.

- **Lake Class:** Water quality will exceed or meet requirements for all, or substantially all, uses (includes salmonid spawning and primary contact recreation). Dissolved oxygen will not decrease below natural conditions. Temperature will not change from natural conditions. Fecal coliform bacteria counts will not exceed 50 colonies/100 ml. These restrictions include reservoirs with a mean detention time greater than 15 days.

****NOTE:** Whenever the natural conditions of said waters are of lower quality than the criteria assigned, the natural conditions will constitute the water quality criteria.

Regional streams are classified in table 2-3, and are further described in the following paragraphs.

Table 2-3
Water Quality Classification of Area Streams

Water Class	River, Reach
A	Columbia River, the mouth to Grand Coulee Dam
A	Snake River, mouth to WA/OR/ID border
B	Walla Walla River, mouth to Lowden (Dry Creek), RM 27.2
A	Walla Walla River, Lowden (RM 27.2) to Oregon border
B	Mill Creek, mouth to 13th Street Bridge in Walla Walla (RM 6.4)
A	Mill Creek, 13th Street Bridge to Waterworks Dam (RM 25.2)
AA	Mill Creek, Waterworks Dam to headwaters
LAKE	Virgil B. Bennington Lake

(a) Columbia River.

The Columbia River has an A (Excellent) rating. However, there are concerns about total dissolved gas supersaturation in April through August, agricultural and industrial (*e.g.*, dioxins) pollutants, and high water temperatures/delayed cooling created by impoundments and withdrawals.

(b) Snake River.

The Snake River, from the Washington/Oregon/Idaho border (south of Lewiston, Idaho) to its mouth (at Pasco, Washington) has an A (Excellent) rating. There are concerns about total dissolved gas supersaturation, water temperature, and sediment loading. Blue-green algal blooms occur in Lower Snake River reservoirs.

(c) Walla Walla River.

The Walla Walla River, from its mouth to Lowden, Washington (at the mouth of Dry Creek--RM 27.2), has a rating of B (Good). Although Class B waters are rated "good," this is a misnomer. Only three other streams in eastern Washington have similarly low water quality; Mill Creek (as noted below), the Palouse River, and Crab Creek. This rating is attributed to the intense agricultural use along the Walla Walla River and its tributaries. Heavy sediments loads are the main problem, because of soil characteristics that allow easy erosion by wind and rainfall and poor agricultural practices. Large deposits of sediment at the mouth of the Walla Walla River are the result of this problem (USDA, 1984). During low flows, detectable concentrations of pollutants appear in the mid and lower reaches of the Walla Walla River (James, L.G. *et al.*, 1992).

(d) Mill Creek.

Mill Creek, from its mouth to the 13th Street Bridge in the city of Walla Walla, has a B (Good) rating. This is due to local inputs and low instream flows caused by water withdrawals for municipal, industrial, and agricultural uses. Mill Creek has an A (Excellent) rating from the 13th Street Bridge upstream to Waterworks Dam (city of Walla Walla municipal intake, at RM 25.2). The lower portion of this reach has been channelized, and is dry during the summer. At MCP, First and Second Division Works, water is diverted into alluvial Waterworks Dam to the headwater, has an AA (Extraordinary) rating. The city of Walla Walla removes 22 cfs at Waterworks dam for its municipal and industrial water supply, providing 85 percent of the city water supply. There are limited agricultural and other uses in this reach.

(2) Analysis of Water Quality.

Overall, the water quality in the region is very good. There are large amounts of unpolluted surface water available, but there are some water pollution problems. Soil erosion from croplands in southeastern Washington is a serious problem. Soil erosion from croplands in southeastern Washington is a serious problem. Approximately 1.7 million tons of sediment move from upland areas to streams each year, and severely damage both the water quality and fish habitats (USDA, 1984). The high soil erosion rate is expected to continue unless farming systems change. Sedimentation is also a serious problem in the Walla Walla River, where it has degraded fish habitat. Irrigation return-flow is a major factor in increasing levels of dissolved solids (*i.e.*, salinity and alkalinity), nutrients, and other pollutants. The Snake River faces other problems, including the waste material produced by the pulp and paper industry. Total dissolved gas supersaturation, caused by passing water over spillways at hydroelectric projects, is known to be harmful to fish and other aquatic organisms. All streams in the Walla Walla Basin are closed to further appropriation during the irrigation season.

Water quality degradation in Walla Walla Basin streams is worsened by irrigation withdrawals and lack of base flow caused by groundwater depletion. The water quality in the upper reaches of Mill Creek is excellent, due largely to access restrictions in the upper watershed designed to protect the city of Walla Walla's municipal water supply. This reach supports rainbow trout, bull trout, and some steelhead [U.S. Fish and Wildlife Service (USFWS), 1984]. Although the degradation of water quality increases further downstream, it is still of fairly high quality when the creek reaches the project area. Significant degradation occurs below the Corps' Division works during the dry season, when zero flow exists. The city of Walla Walla exacerbates degradation of water quality through point source loading of municipal sewage treatment plant effluent, cannery waste, and stormwater runoff. There are increases in temperature, pH, turbidity, phosphate, and nitrate-nitrogen farther downstream (Hallsted, 1972), the highest of which occur below Walla Walla. Due to the natural turbulence of the stream, dissolved oxygen concentrations seldom deviate much below 100-percent saturation, except in some pools during low-flow periods.

Mill Creek is a low-alkaline, soft water stream. The land above the project that is drained by the creek generally consists of soils composed of loess and weathered basalt, or loess and silty clay loam, and is underlain by gravels. Algal composition in Mill Creek is limited to free-floating diatoms and attached benthic algae. Below the project area, filamentous green algae, especially Cladophora, are abundant. Aquatic invertebrates found there include mayflies, stoneflies, and caddisflies, all of which require well-oxygenated, coarse-substrate streams.

During the summer low-flow period, most (or all) of the water in the creek is diverted, at the MCP's Division works, to Yellowhawk and Garrison Creeks. Mill Creek remains dry for several miles below this structure. Recharge to the creek is through groundwater, storm drainage return, and irrigation return flow. Flows also increase with point-source discharge through Walla Walla.

f. Climate.

(1) Pacific Northwest.

The climate of the Pacific Northwest is varied. This results from complex interplay between maritime and continental air masses and mountain ranges. This is especially true of the Cascade Mountains, because they divide the Pacific Northwest into two distinct parts. The area west of the Cascades has a maritime climate, characterized by relatively mild temperatures, wet mild winters, dry summers, and a long growing season. The area east of the Cascades combines both the maritime and continental climates. Temperatures are milder than those of the Great Plains, because the Rocky Mountains block many of the continental air masses. Occasionally, polar continental air flows into the area, and causes short periods of extremely cold temperatures. Temperatures fluctuate more on the east side than on the west side of the Cascades, winters are colder, summers are hotter, and frost-free days are shorter. The following paragraphs are a description of the area east of the Cascades and west of the Rockies, which contains the northern part of the C-S Intermountain. The climate division areas are shown on figure 2-4, and the information is graphed for each area shown on figures 2-5 and 2-6. These divisions do not cover the same area as the physiographic regions, which are described in paragraph a., *Landform--Physiography*, above.

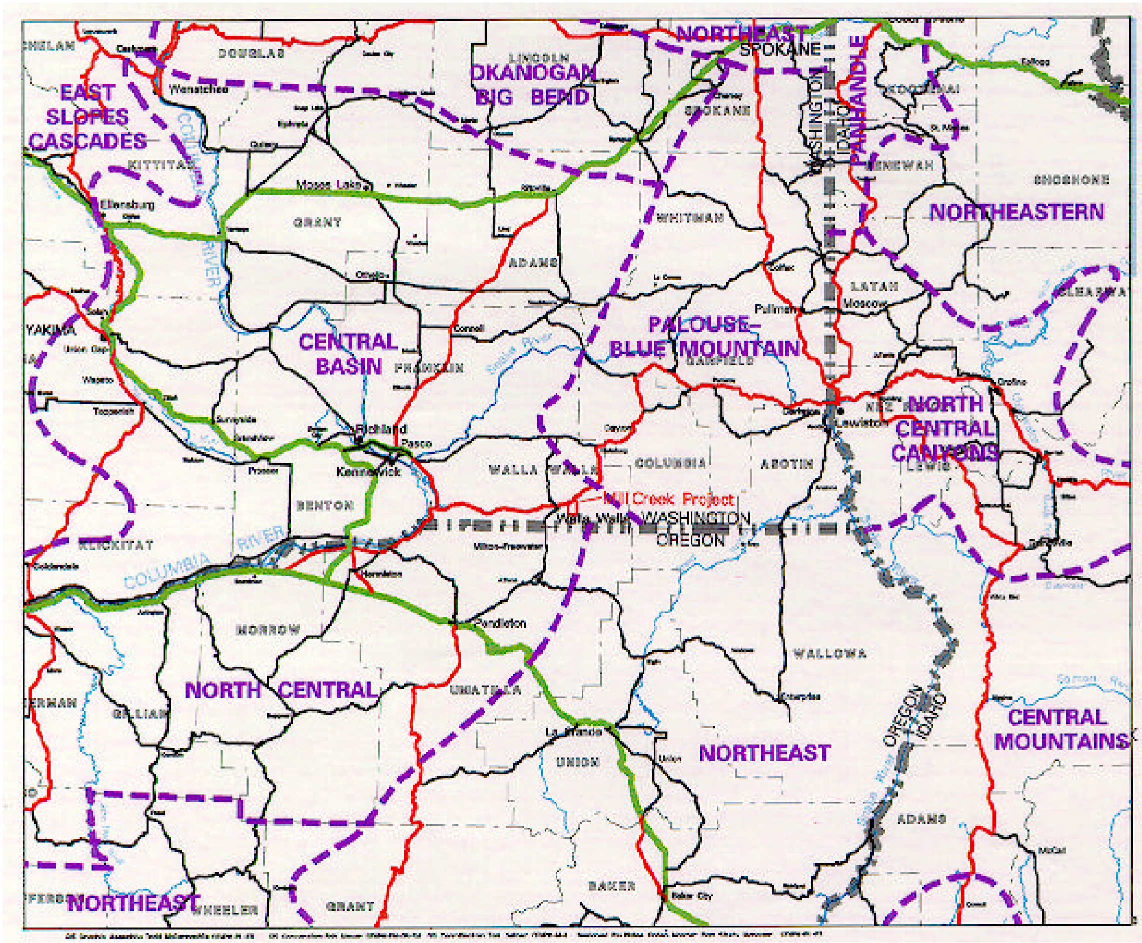

Figure 2-4. Climate Division Areas

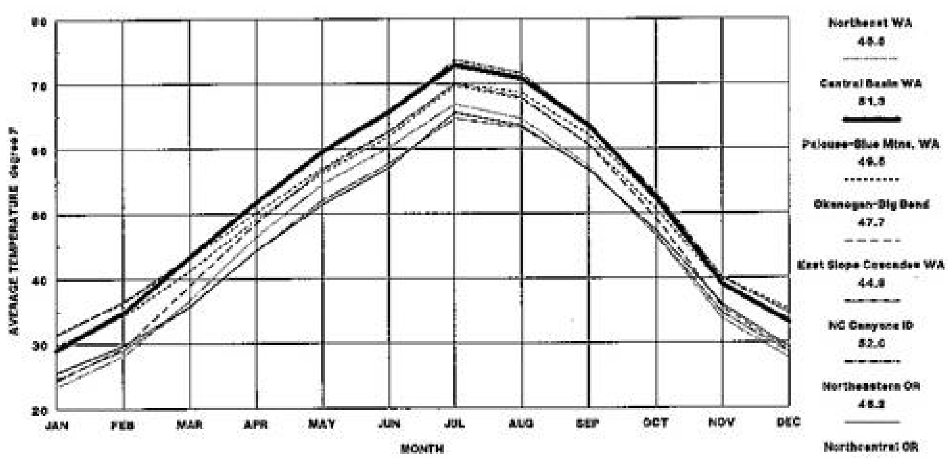

Figure 2-5. Regional Temperatures

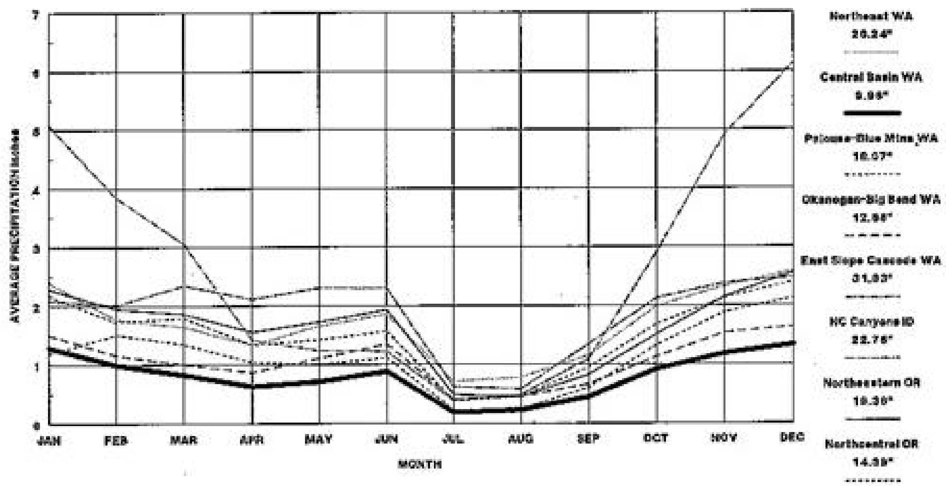

Figure 2-6. Regional Precipitation

(2) Temperature.

(a) Regional.

Temperatures in the region generally follow the elevation above sea level, with the warmest in the low Central Basin, and the coldest along the mountains (Cascade, Blue, Okanogan, and Rockies). The average winter temperatures, in January, range from 23.4° Fahrenheit (F) to 31.6°F. The average summer temperatures, in July, range from 64.7 to 73.7°F. The number of frost-free days ranged from less than 80 in the highest elevations to 240 days at the Washington/Oregon border (along the Columbia). As shown in figure 2-5, the Central Basin (which includes Walla Walla, Tri-Cities, and Ephrata in Washington; and The Dalles, Oregon) has the warmest average monthly temperatures in the region, along with the North Central Canyons in Idaho.

(b) Central Basin.

In the Central Basin, temperatures above 100°F are usually recorded in the summer, while winter temperatures occasionally drop as low as -15°F. Table 2-4 contains a summary of 30-year average temperatures at climatological regions. The Central Basin has between 120 and 240 frost-free days. Figure 2-5 shows the temperature variations by divisions and months.

Table 2-4
Monthly Temperatures
(In Degrees Fahrenheit)

	Washington					Idaho	Oregon	
	Northeast	Central Basin	Palouse Blue Mountains	Okanogan Big Bend	East Slope Cascades	North Central Canyons	Northeast	North Central
Jan	23.4	29.1	29.8	24.4	24.6	31.4	25.6	31.6
Feb	28.2	34.8	34.3	29.4	29.1	36.5	29.8	36.3
Mar	36.7	43.3	41.2	39.0	35.8	43.4	35.8	43.1
Apr	46.5	51.7	49.1	48.6	44.3	51.7	44.3	50.2
May	54.6	59.6	56.3	56.8	52.1	59.3	51.5	57.1
Jun	60.2	65.7	61.9	62.6	57.7	65.4	57.1	62.7
Jul	66.9	72.9	69.7	70.0	64.7	73.7	65.6	70.1
Aug	64.7	70.9	67.8	68.0	63.3	71.7	63.6	70.1
Sep	57.3	63.6	60.7	60.6	56.9	63.7	56.7	68.7
Oct	46.5	52.3	50.6	49.2	46.6	53.1	47.3	62.2
Nov	33.7	39.0	38.7	35.4	34.6	39.9	35.9	52.1
Dec	27.2	33.1	33.6	28.2	28.5	34.6	29.2	40.1
Average	45.5	51.3	49.5	47.7	44.9	52.0	45.2	50.8

(3) Precipitation.

(a) Regional.

The topographic characteristics of the Pacific Northwest have a great influence on precipitation patterns. The Pacific Ocean is the primary source of moisture for precipitation. Maritime air masses are forced to rise over the Coast and Cascade Mountains. This causes relatively heavy precipitation on the western slopes, and reduced amounts on interior areas (from the eastern slopes of the Cascades to the Blue Mountains). Elevations in excess of 5,000 feet receive and retain precipitation, in the form of snow.

The annual precipitation varies from approximately 100 inches (over small areas in the Cascade Range) to less than 6 inches (over portions of the plains area of southeastern Washington). (See plate 2-5.) A large portion of the basin normally receives less than 20 inches of precipitation annually. The majority of precipitation falls during the winter months.

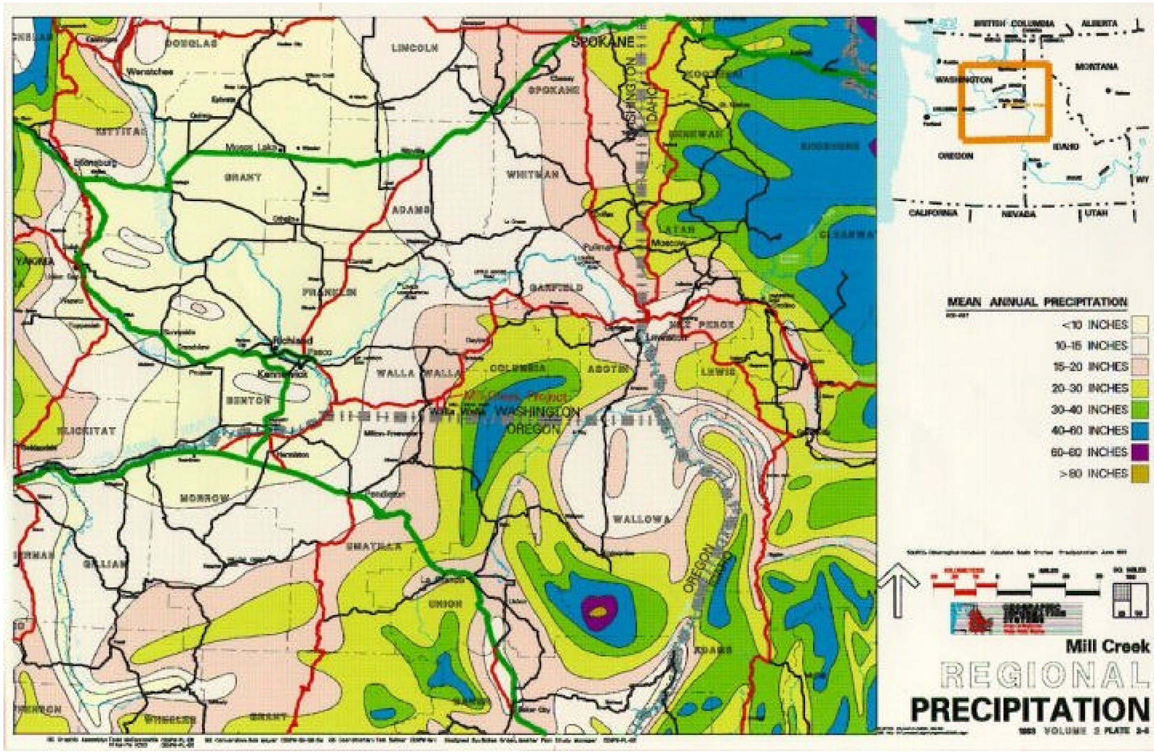

Plate 2-5. Regional Precipitation

Within the area east of the Cascades and west of the Rockies, the highest precipitation occurs on the eastern slope of the Cascades (31.8 inches per year), while the lowest precipitation occurs in the Central Basin (an average of 9.63 inches per year). As indicated in figure 2-6, precipitation is usually highest in the winter, and ranges from over 6 inches on the eastern slope of the Cascades to 1¼ inches in the Central Basin. In the summer, all areas receive less than 1 inch of precipitation.

(b) Central Basin.

The mean annual precipitation at climate stations in the Central Basin ranges from 6 inches at the Sunnyside Weather Service Office to 39 inches at the city of Walla Walla intake along Mill Creek in the Blue Mountains (elevation 2,400). (Refer to table 3-13.) Normal annual precipitation is 9.63 inches in the Central Basin. Precipitation data, by division, is summarized in table 2-5.

Table 2-5 Annual Precipitation								
Washington						Idaho	Oregon	
	Northeast	Central Basin	Palouse Blue Mountains	Okanogan Big Bend	East Slope Cascades	North Central Canyons	Northeast	North Central
Jan	2.40	1.29	2.18	1.51	5.08	2.10	2.29	1.19
Feb	1.77	0.99	1.73	1.16	3.85	2.02	1.96	1.52
Mar	1.65	0.83	1.80	1.01	3.06	2.35	1.87	1.35
Apr	1.34	0.63	1.34	0.87	1.42	2.12	1.56	1.04
May	1.66	0.71	1.43	1.11	1.24	2.31	1.73	1.01
Jun	1.86	0.88	1.57	1.35	1.23	2.30	1.94	1.12
Jul	0.71	0.19	0.39	0.41	0.39	0.62	0.49	0.23
Aug	0.79	0.23	0.46	0.46	0.49	0.59	0.46	0.25
Sep	1.16	0.45	0.95	0.67	1.10	1.35	0.83	0.61
Oct	1.99	0.92	1.69	1.13	2.91	2.13	1.52	1.33
Nov	2.33	1.18	2.13	1.54	4.92	2.38	2.15	1.89
Dec	2.58	1.33	2.40	1.64	6.14	2.48	2.56	2.13

(4) Analysis of Regional Climate.

Due to the extremes in topography, the region has a great diversity of climatic conditions. Seasonal temperatures and precipitation vary greatly in the deserts, valleys, and mountains. These variations contribute to the complex vegetation, soil, and wildlife in the region. Long growing seasons (160 to 240 days) in the lower elevations have contributed to the success of agriculture in the area. Due to high summer temperatures, low precipitation, and low humidity, water is critical for fisheries, vegetation, irrigation, recreation, and navigation.

g. Air Quality.

(1) General.

Air quality varies widely throughout the region, because it is highly influenced by local pollution sources, meteorology, and topography. The following are some of the criteria used to judge air quality: visibility, odors, particulate matter, and chemical emissions. Air quality is governed by Federal, state and, at times, local regulations. Limitations to airshed space can be specified for particulate matter, sulfur dioxide, and ozone. Sources of pollution in the region are both natural and anthropographic (manmade).

(2) Fugitive Dust.

The dry summers and fine land surface materials can create localized high particle concentrations, known as fugitive dust. The highest concentrations usually occur in the late summer and early fall. The region meets Federal air quality standards the majority of the time, with the exception of the western portion of Walla Walla County, and parts of Franklin and Benton Counties.

(3) Odors.

There is no Federal standard for objectionable odors, but the State of Washington Department of Ecology has nuisance regulations. Areas where unfavorable conditions may exist include feed lots, paper and pulp mills, sewage processing plants, and some agricultural areas.

(4) Visibility.

The clarity of the atmosphere is an indicator of the health of the environment. Good visibility makes an area a much more pleasant place to live, and increases its attractiveness to tourists.

(5) Analysis of Air Quality.

The major air quality factors influencing MCP are visibility and odors. The Federal Government has proposed listing parts of Walla Walla (west of Touchet, Washington), Franklin, and Benton Counties as areas that violate Federal air quality standards. However, the area near the city of Walla Walla and the MCP are within compliance. Visibility in the area next to MCP is approximately 20 to 40 miles. When the wind direction is from the west, undesirable odors from the Wallula area may be detected at MCP, but they are not serious enough to present a problem.

h. Vegetation.

(1) General.

The vegetation in southeastern Washington and northeastern Oregon is diverse. The climate and topography have the most profound effects on the local vegetation. Maritime and continental climates are highly influenced by large mountain masses. Precipitation and snowfall increase as elevations rise and temperatures decrease. Since most of the precipitation moves inland from the Pacific Ocean, mountain masses block much of the precipitation. This causes a rain shadow, and allows less precipitation to fall on the eastern side of the Cascade Mountains. The Okanogan Highlands block many of the arctic air masses from the north, and the Cascades block the westerly maritime winds.

The region has four major vegetation zones. These include Shrub-Steppe in the lower elevations, grasslands in the mid-elevations, forest in the high elevations of the mountains, and Alpine meadows and tundra in the highest elevations. The typical vegetation sequence diagram, found in figure 2-7, lists the various types of vegetation in a conceptual order. There are six potential vegetation types in the region. The vegetation type does not always appear in the order shown, however. Vegetation may change from sagebrush-steppe to Grand fir-Douglas fir types without wheatgrass or bluegrass appearing in between. there is usually not a clear break between types but, rather, there is an area of transition or ecotone where the different types overlap.

Figure 2-7 Typical Vegetation Sequence		
Physiographic Province Section	**Vegetation Zones**	**Vegetation Type**
Blue Mountain	Needleleaf Forest	Western Spruce/Fir Forest Grand Fir/Douglas Fir Forest Western Ponderosa Pine
Palouse	Grasslands	Fescue/Wheatgrass Wheatgrass/Bluegrass
Yakima Fold Belt	Shrub and Grass Combination	Sagebrush/Steppe

(2) Potential Natural Vegetation (PNV).

The regional vegetation map, plate 2-6, shows Kuchler's PNV. The vegetation zones are defined by climate or dominant species, but the map does not reflect man's influence on lands (*i.e.*, agricultural or urban-industrial). The PNV reveals the potential of vegetation cover as a biological indicator of the suitability of the land to support various uses (Kuchler, 1967).

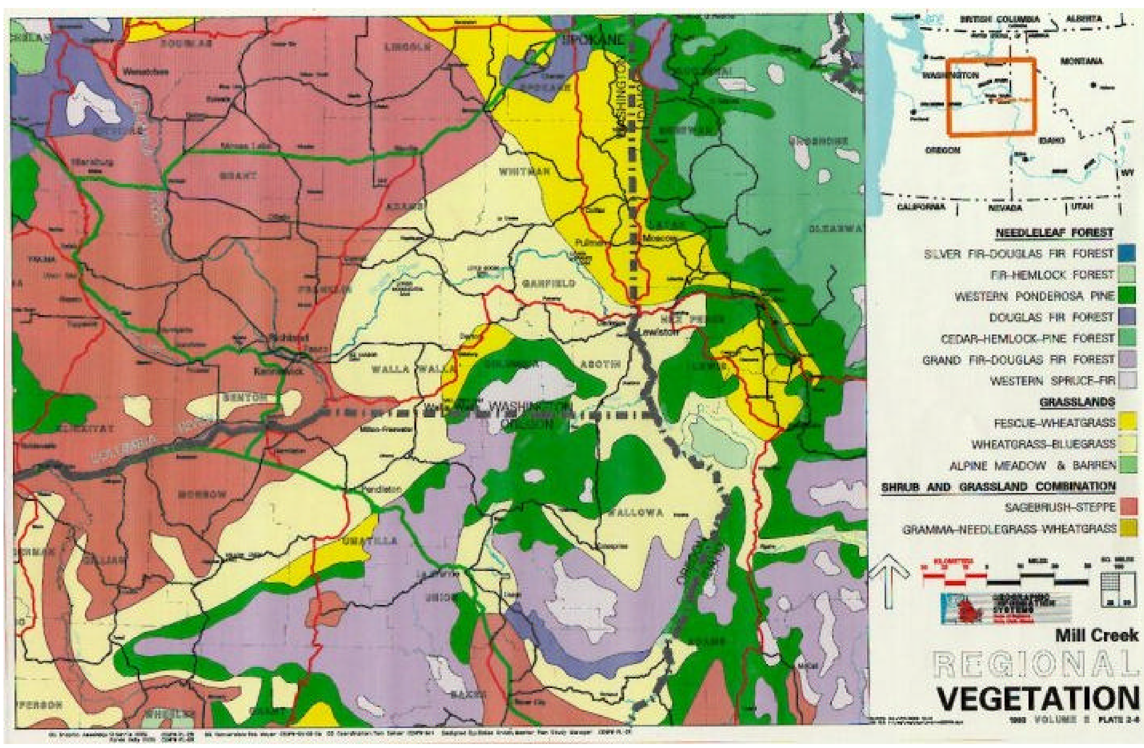

Plate 2-6. Regional Vegetation

(3) The PNV Types Within Physiographic Sections.

The Yakima Fold Section is composed mainly of sagebrush-steppe in the lower elevations, with wheatgrass-bluegrass in the higher elevations. The Palouse Section also has sagebrush-steppe in the lower elevations, with either wheatgrass-bluegrass or fescue wheatgrass in the mid-elevations, and Western Ponderosa Pine at the higher elevations. The Blue Mountain Section has wheatgrass-bluegrass or fescue-wheatgrass at lower elevations, but gradually changes to either Western Ponderosa Pine, Grand fir-Douglas fir forest, or Douglas fir forest. The higher elevations contain Western Spruce. There are also small islands of juniper species in both the Yakima and Palouse Sections.

(4) Analysis of Regional Vegetation.

As listed in figure 2-7, there are six different vegetation types within a 100-mile radius of MCP. The MCP is located on the upper edge of the wheatgrass-bluegrass vegetation types next to the fescue-wheatgrass and within 10 miles of the western ponderosa type. The ecotone where MCP is located offers the potential for a mosaic of vegetation patterns that support wildlife, fisheries, recreation, and excellent scenic quality.

i. Wildlife.

(1) General.

Regional wildlife is composed of indigenous species that live in remote, relatively undisturbed areas, as well as wildlife that has adapted to environments modified by man. Several introduced species also live throughout the region.

(2) Habitat Characteristics.

When early settlers arrived in this region, they encountered two major vegetational ecosystems; steppe (perennial grasslands) and forests. However, due to the influence of farming and grazing practices, a third ecosystem began to dominate the landscape in many areas. This third system, known as shrub-steppe, has an increasing amount of shrubs (see plate 2-6, *Regional Vegetation*).

That portion of the Blue Mountain Section contained within the MCP region is a forest-influenced ecosystem. The climate in the western part of this section is warm and dry, but becomes colder and wetter as the elevation increases. Changes in the forest are notable throughout the section (*i.e.*, changes in plant size, plant leaf surface, understory composition, and canopy closure).

The southeastern Washington and northeastern Oregon forests are primarily Rocky Mountain forests. The lower elevations are characterized by drier, or xerophytic, conditions. The vegetation in these lower elevations is primarily composed of ponderosa pine and Douglas fir. At higher elevations, a more temperate forested zone is found. This zone is characterized by the presence of grand fir and western hemlock. Sub-alpine elevations are characterized by sub-alpine fir.

The characteristic vegetation found in the Palouse and Yakima Fold Belt Sections is shrub-steppe and steppe. Shrub-steppe occupies the center of both sections, and there is a transitional zone, composed of steppe, between the shrub-steppe and forested ecosystems. These two habitats are typically arid-to-semiarid; and have low precipitation, warm to hot summers, and relatively cold winters. Agriculture and grazing patterns, as well as the increased use of irrigation, have drastically changed the natural distribution of the steppe-type vegetation.

Steppe habitats are characterized by a variety of perennial grasses and the absence of woody shrubs. Two steppe vegetation zones, dominated by wheatgrass/bluegrass and by wheatgrass/fescue, have been identified in the region (Daubenmire, 1970). The codominance of shrubs and grasses is characteristic of the shrub-steppe. Soil characteristics and precipitation are responsible for the conspicuous, but discontinuous, layer of shrubs. This, in turn, is responsible for the dominance of grasses, as opposed to shrubs. Seven zonal associations have also been identified in the shrub-steppe region of Washington (Daubenmire, 1970). In this report, these zonal associations have been carried over into Oregon. Many of the steppe and shrub-steppe vegetation zones in the Palouse Section have been replaced by dryland agriculture. This is typical of the area surrounding MCP.

(3) Threatened and Endangered Taxa.

A number of taxa are listed as threatened or endangered, or are candidates for listing under the Endangered Species Act. Each state also has classifications similar to the Federal listings.

The following definitions form the basis for the Federal listings: endangered taxa are those species in danger of extinction throughout all, or a significant portion, of their range; threatened taxa are those species likely to be classified as endangered within the foreseeable future throughout all, or a significant portion, of their range; and candidates for threatened and endangered status are those species that are proposed, or are being studied, to be listed. Table 2-6 lists species of concern in the MCP region.

Table 2-6
MCP Region Species of Concern

	Status			
Common Name	**Federal**	**Washington**	**Oregon**	**Idaho**
Invertebrates				
Bivalvia (Clams and Mussels)	.			
California floater	C2			
Gastopoda (Snails)	.			
Columbia pebblesnail	C2			
Fish				
Salmoniformes (Salmon and Trout)	.	.		.
Chinook Salmon - Spring/Summer and Fall	T	.		T
Sockeye Salmon	E	.		E
Steelhead Trout	.	.		*
Bull Trout	C2	*		*

Amphibians				
Plethodontidae (Lungless Salamanders)	.			.
Coeur d'Alene Salamander	3C			*
Ranidae (True Frogs)	.			
Spotted Frog	C2			
Birds				
Pelecaniformes (Pelicans)	.	.		
American White Pelican	.	E		
Falconiformes (Hawks and Falcons)	.	.		
Northern Goshawk	C2	*		
Golden Eagle	.	*		.
Bald Eagle	E/T	T		*
Osprey	.	*		.
Swainson's Hawk	3C	*		.
Ferruginous Hawk	C2	T		.
Peregrine Falcon	E	E		E
Prairie Falcon	.	*		.
Ciciniformes (Herons)	.	.		.
Great Blue Heron	.	*		*
Great Egret	.	*	.	E
Black-Crowned Night Heron	.	*	.	.
White-Faced Ibis	C2	.	.	.
Gallinaceous (Upland Birds)	.	.	.	.
Columbian Sharp-Tailed Grouse	C2	.	.	.
Western Sage Grouse	C2	.	T	.
Charadriformes (Shorebirds and Gulls)	.	.	.	.
Black-Necked Stilt	.	*	.	.
Long-Billed Curlew	C2	*	.	.
Caspian Tern	.	*	E	.
Forster's Tern	C2	*		.
Strigiformes (Owls)	.	.		.
Burrowing Owl	.	*		.
Great Gray Owl	.	*		.
Flammulated Owl	.	*		.
Boreal Owl	.	.		.
Piciformes (Woodpeckers)	.	.		.
Lewis' Woodpecker	.	*		.
Black-Backed Woodpecker	.	*		.
Passeriformes (Perching Birds)	.	.		*
Sage Thrasher	.	*		
Loggerhead Shrike	C2	*		
Green-Tailed Towhee	.	*		
Sage Sparrow	.	*		
Grasshopper Sparrow	.	*		
Mammals				
Insectivora (Shrews)	.		.	.
Preble's Shrew	C2		.	.
Lagomorpha (Rabbits)	.	.	.	.
Pygmy Rabbit	C2	.	.	.
Rodentia (Rodents)	.	.	.	.
Idaho Ground Squirrel	C1	T	.	*
Washington Ground Squirrel	.	.	.	.
Ord's Kangaroo Rat	.	.	.	.
Carnivora (Carnivores)	.	*	.	.
Gray Wolf	E	*	.	E
Pacific Fisher	C2		.	*
North American Wolverine	C2		T	*

NOTES:
1. Codes:
E - Endangered: Any species that is in danger of extinction throughout all or a significant portion of its range.
T - Threatened: Any species that is likely to become an endangered species within the foreseeable future in all or a significant portion of its range.
C1 - Taxa for which information supports proposing, but rules have not yet been issued.
C2 - Taxa for which biological vulnerability and threat are not currently available to support proposed rules.
3C - Taxa that have proven to be more abundant or widespread than previously believed and/or those not subject to any identifiable threat. New information would allow for reevaluation.
* - Species targeted by a particular state as requiring special attention. 2. Information from the State of Washington was obtained from the Washington Department of Wildlife Nongame Data System (current as of January 21, 1988.
3. Information from the State of Idaho was obtained from Rare, Threatened, and Endangered Plants and Animals of Idaho, as compiled by the Idaho Department of Fish and Game (current as of March 1990).
4. Information from the state of Oregon was obtained from the Oregon List of Threatened and Endangered Species (current as of April 1988).

(4) Birds.

Nongame birds, whose populations are uncertain due to critical habitat loss, or some other outside influence, have been targeted for special management by the states within the region around MCP. See plate 2-14 for the regional distribution of these birds. The long-billed curlew is listed in Idaho as a species of concern, and has been submitted as a candidate for listing under the Endangered Species Act. Long-billed curlew habitat is located along the lower Columbia and Snake Rivers, as well as north of Pullman (along the Idaho border). The American white pelican, whose numbers have dropped in Washington, are listed by the state as threatened. Recent returns into areas previously occupied has generated increased effort by the state to monitor the activities of the pelicans. The American white pelican at one time bred along the shores of Moses Lake in Grant County. They spend summers along the Columbia River, from McNary Dam to Richland (USACE, 1975).

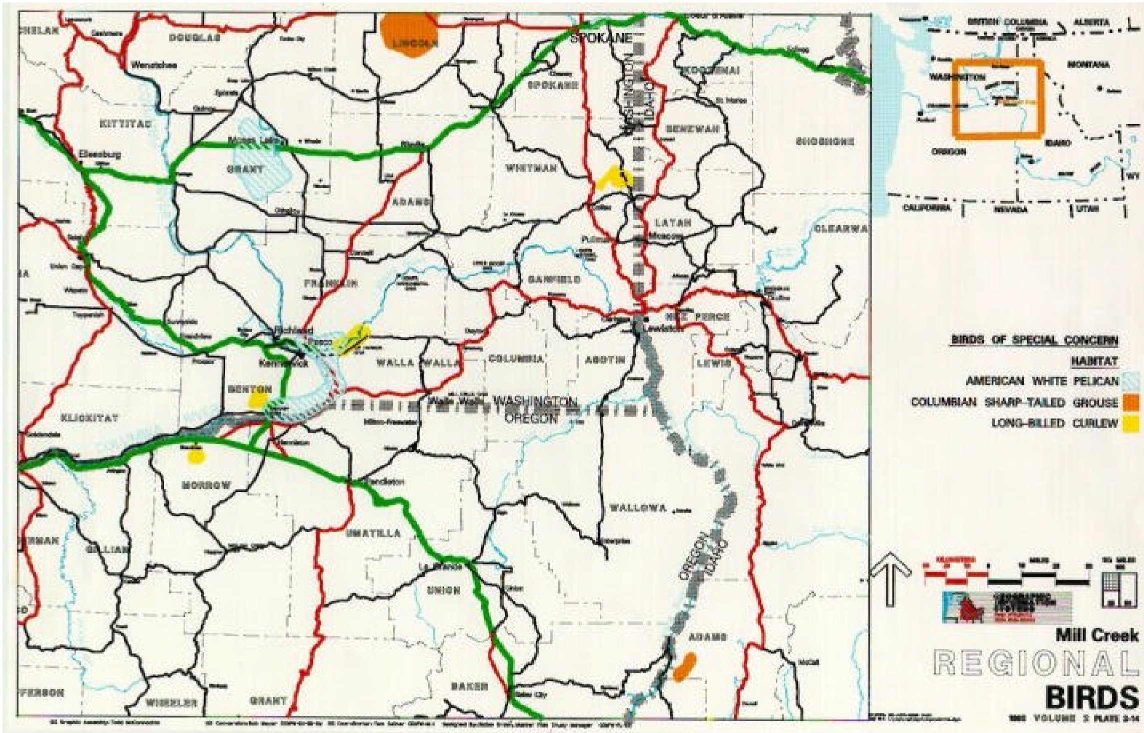

Plate 2-14. Regional Birds

At the time of mapping, detailed spatial data was unavailable for a number of additional non-game birds. Refer to Supporting Data, Item 8, for the status of these birds.

(5) Raptors.

The region supports a large number of raptors. Five falconiformes (hawks and falcons) are candidates for Federal listing. Plates 2-15 and 2-16 show the general location of raptors, but no spatial data was available for Oregon at the time the mapping was produced. The peregrine falcon and the bald eagle are both listed as endangered under the Endangered Species Act of 1973, as amended. Peregrine falcon are found in Idaho, along the Lochsa and Selway Rivers (see plate 2-15). The peregrine falcon has historically nested throughout the area, but only a few active nests are now known. There have been several attempts to reestablish peregrine nest sites through hacking efforts. Bald eagles winter along the major river corridors in the region, but there are no known nests (see plate 2-16).

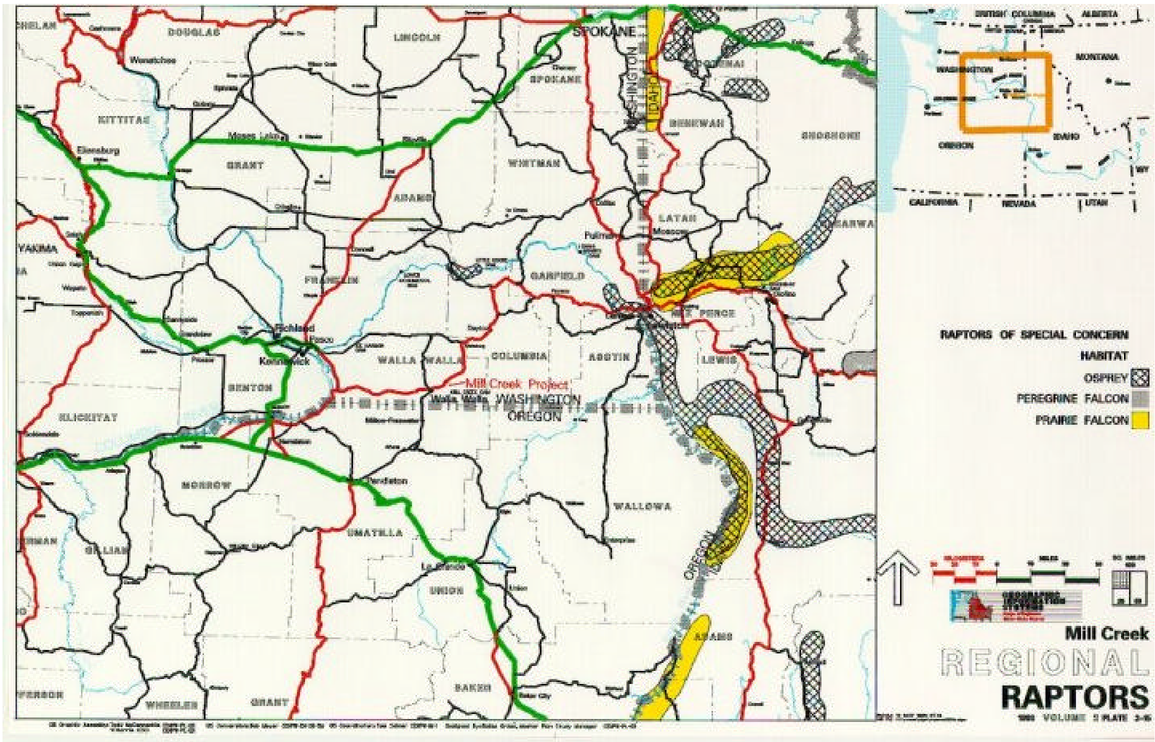

Plate 2-15. Regional Raptors

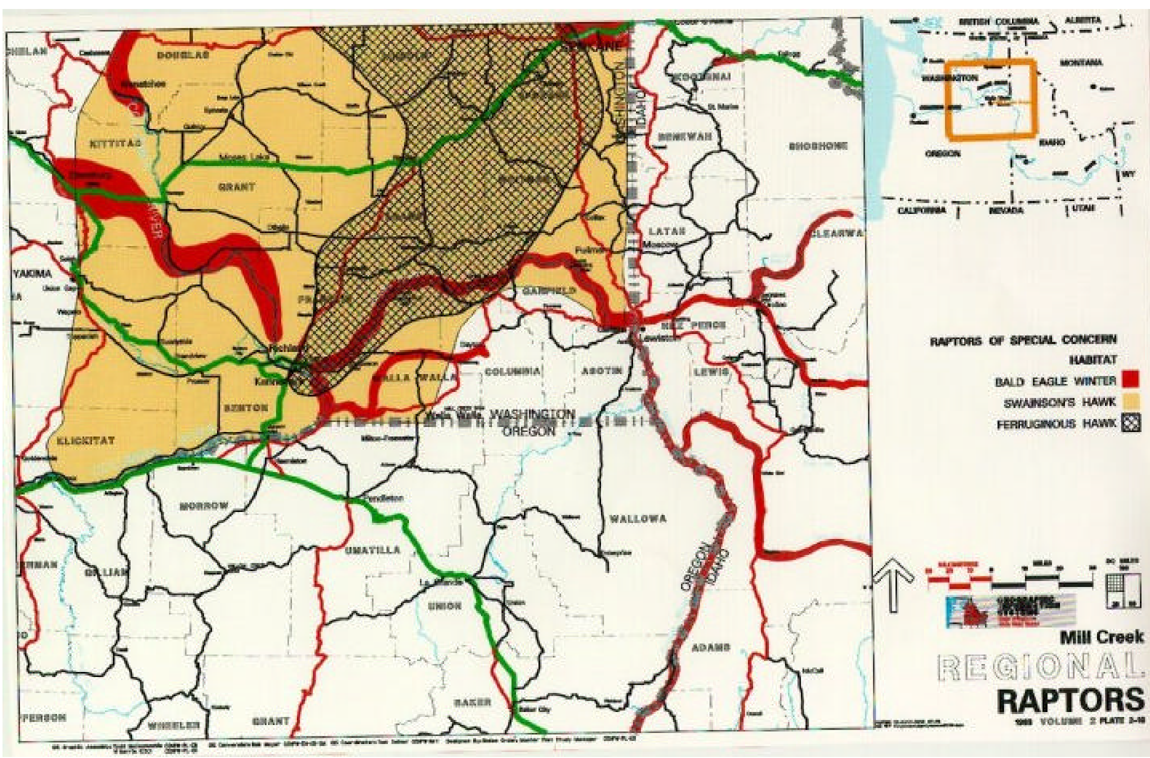

Plate 2-16. Regional Raptors

Swainson's and ferruginous hawks have been submitted as candidates for listing on the Federal Register but, to date, have not been listed. Swainson's hawk is a sensitive species in Washington, and ranges throughout southeastern Washington. The ferruginous hawk is considered threatened by the State of Washington, and is managed as a species of concern in Idaho. The ferruginous hawk range is located in the central portion of the Palouse Hills Section, within the grasslands where the ecotone exists between sagebrush-steppe, wheatgrass-bluegrass, and fescue-wheatgrass.

Ospreys and prairie falcons are both species of high visibility in Washington, but are without any type of listing. Ospreys are starting to move into water courses not recently utilized. They are located along major water courses in Idaho, and central portions of the lower Snake River in Washington. Prairie falcons are also located along the lower elevations of the water courses in Idaho.

(6) Waterfowl.

During the migratory and winter seasons, there are large numbers of waterfowl that reside along the Columbia and Snake Rivers, and their tributaries. The southerly movement of many species of waterfowl (*i.e.*, mallards, widgeon, and Canada geese) is dependent upon climatic conditions. As colder temperatures reduce the amount of open water to the north, the birds move further south. The lacustrine, open areas, created by the various dam projects along the Columbia and Snake Rivers, are used by ducks and geese for loafing areas. These areas are also adjacent to rich agricultural areas used by the waterfowl as feeding grounds (Columbia-North Pacific Region Comprehensive Framework Study, 1971).

Local nesting, encouraged by habitat modification and enhancement by various state and Federal agencies, has increased the numbers of Canada geese and mallard ducks in the region. During 1992, the breeding duck population increased according to USFWS, but it is still below the long-term average. Duck populations have been 8 percent below the average population since 1955 (Wildlife Management Institute, 1992). However, geese populations have been increasing. There is also a resident population of Canada geese that live along the Snake and Clearwater Rivers. Plate 2-17 depicts production areas and wintering areas, and plate 2-18 displays migration corridors within the region for selected waterfowl.

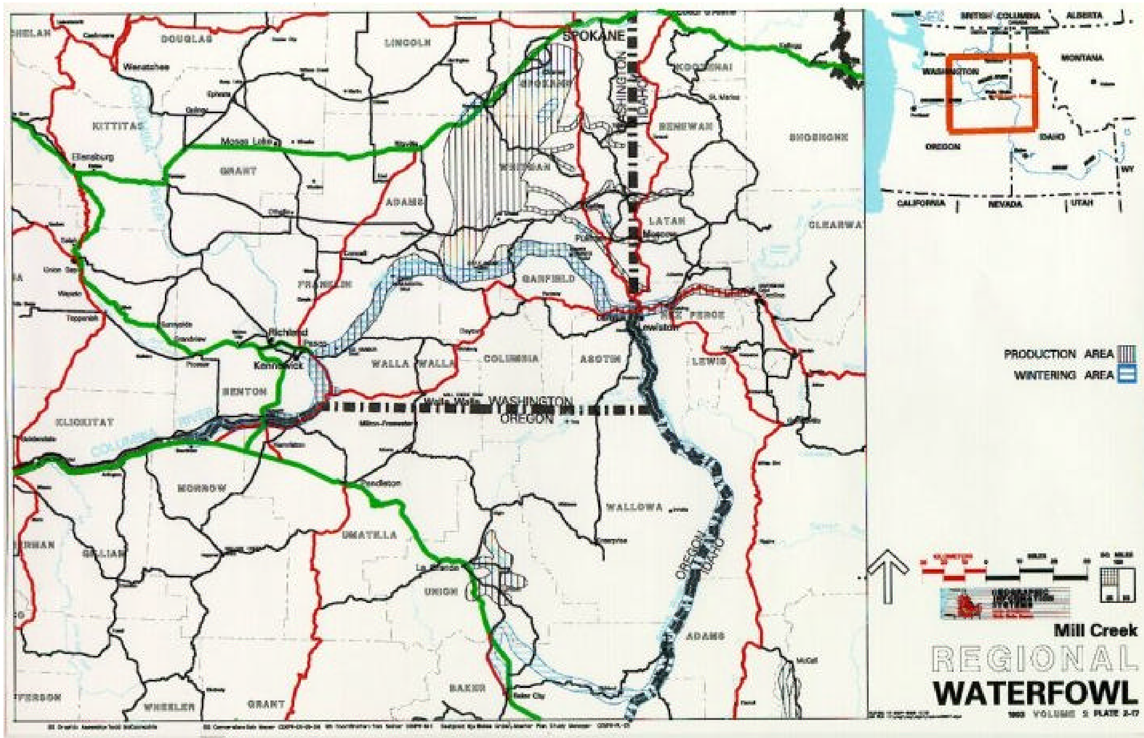

Plate 2-17. Regional Waterfowl

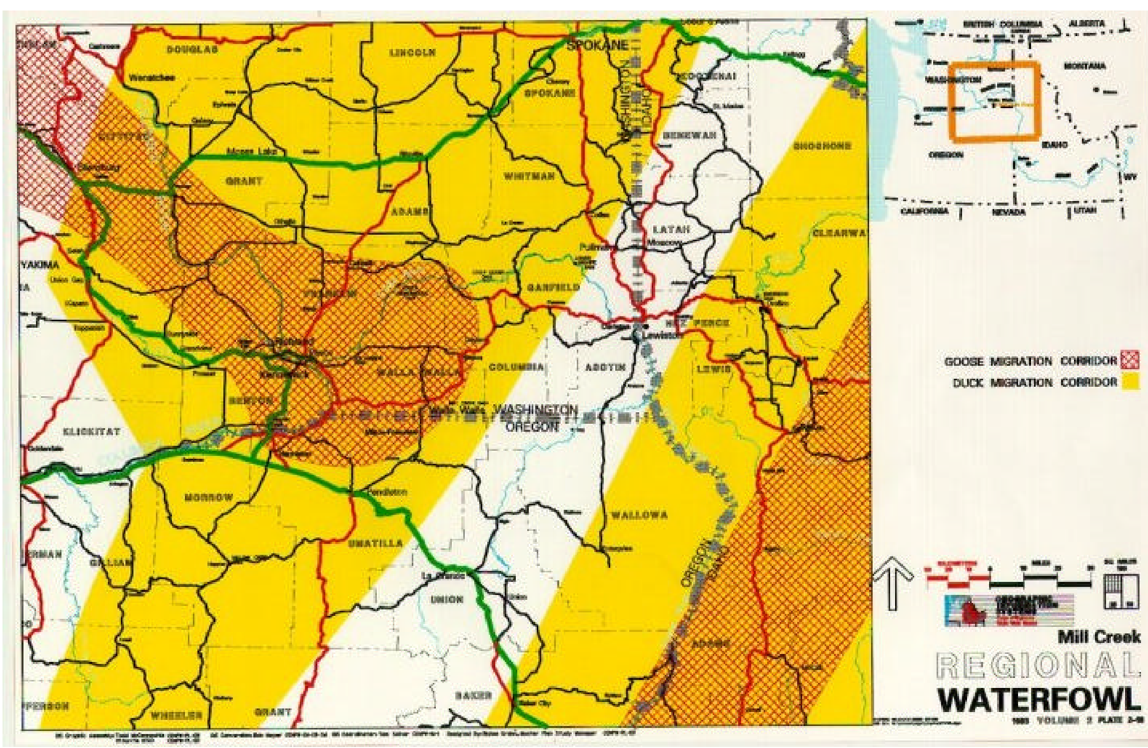

Plate 2-18. Regional Waterfowl

(7) Upland Game Birds.

Upland game birds in the region represent an important recreational resource of significant economic value. They include ring-necked pheasant, chukar (see plate 2-19), Gray (Hungarian) partridge, California quail, mountain quail, blue grouse, Western sage grouse (see plate 2-19), Columbian sharp-tailed grouse (see plate 2-14), Merriam's turkey (see plate 2-20), and mourning doves.

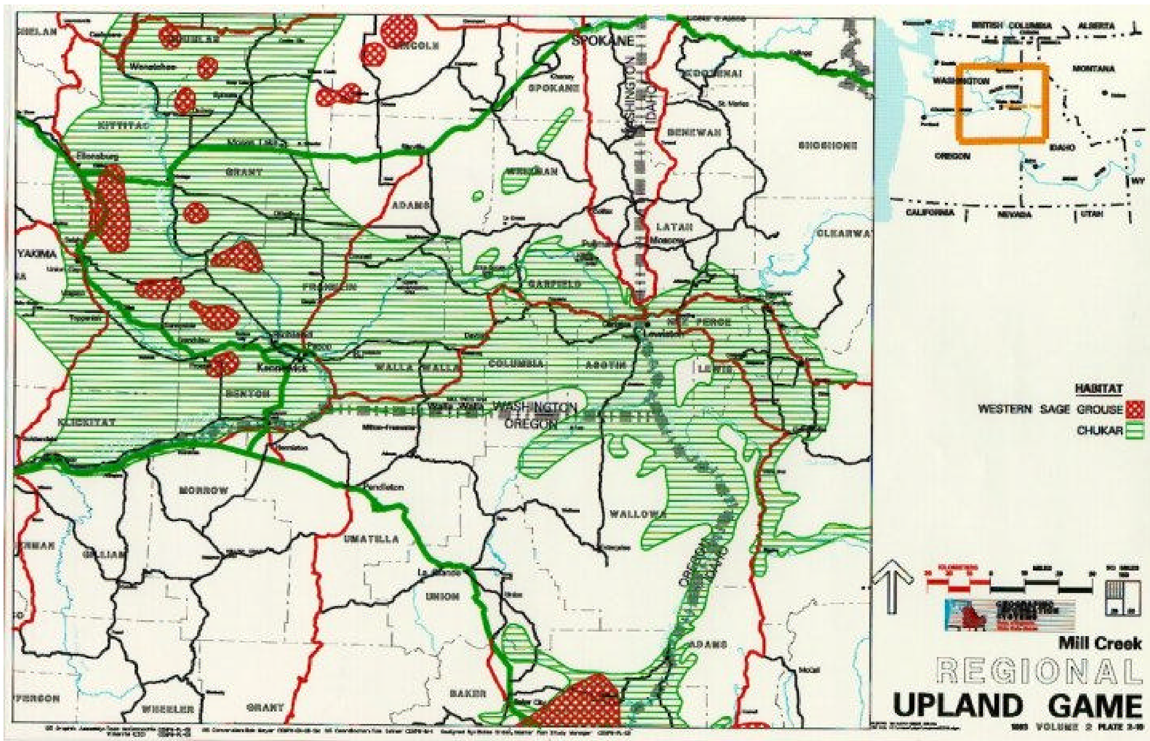

Plate 2-19. Regional Upland Game

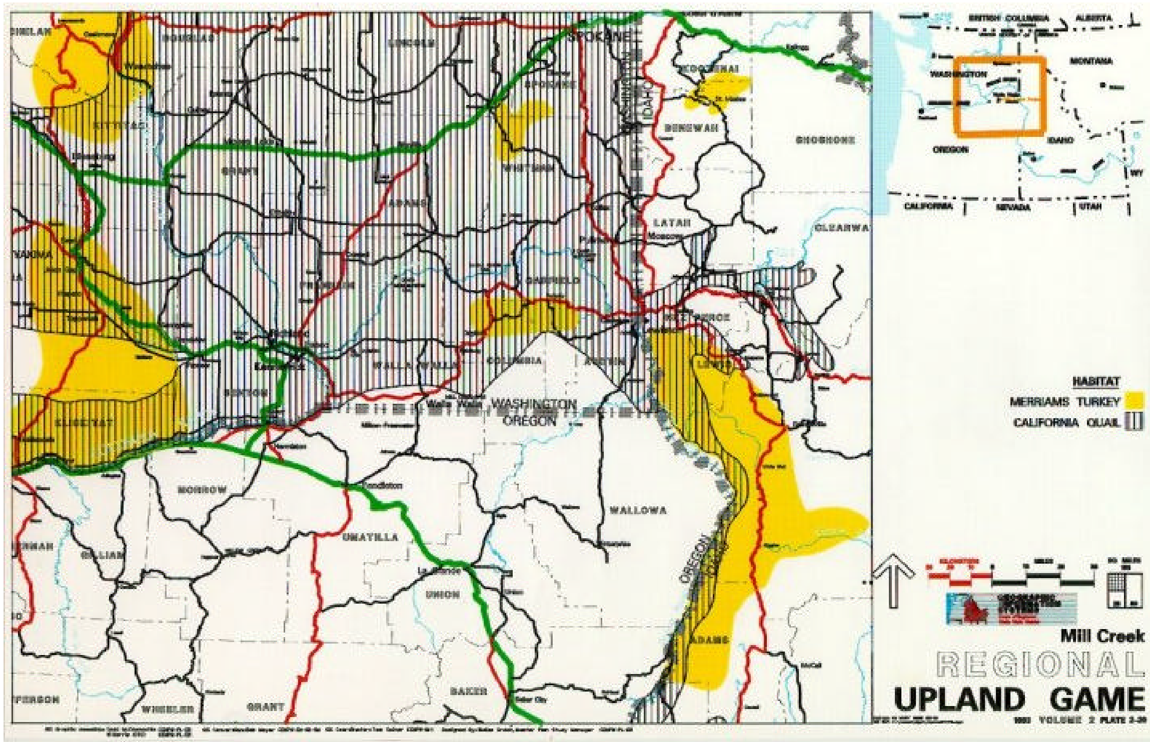

Plate 2-20. Regional Upland Game

The range for ring-necked pheasant and mourning doves is ubiquitous and, therefore, is not shown on the maps. Western sage grouse are located in the sagebrush-steppe vegetation predominantly found in the Yakima Fold Section. Chukar are located throughout the Yakima Fold Section and the southern portion of the Palouse Section, in both sagebrush-steppe and wheatgrass-bluegrass vegetation. These lands are used for rangeland and other agricultural uses. Blue grouse are located in the Blue Mountain Section, in western ponderosa pine and western spruce-fir vegetation. Plate 2-19 shows the regional distribution of Western sage grouse, chukar, and blue grouse.

California quail range throughout southeastern Washington, as well as along the Snake and Clearwater drainages in Idaho. The wild turkey has not only been reintroduced in recent years throughout its former breeding range, but has also been introduced and established throughout the MCP region. The particular subspecies found here is Merriam's turkey. No spatial data was available for Oregon during mapping. Plate 2-20 displays the distribution of California quail and Merriam's turkey in both Washington and Idaho.

Columbian sharp-tailed grouse range only in a limited area of the region (see plate 2-14). No detailed spatial data was available for mountain quail and blue grouse at the time of mapping. Both the mountain quail and the blue grouse range in the Cascade and Rocky Mountain portions of the Blue Mountain Section (Rue, 1973). Both Columbian sharp-tailed grouse and western sage grouse are candidates for listing on the Federal register, because modern day land practices have significantly altered the habitats upon which these two grouse species depend.

(8) Mammals.

Mammal populations that are considered sensitive species and receive special management consideration include the pygmy rabbit, Washington ground squirrel, Idaho ground squirrel, and the wolverine. The pygmy rabbit is considered threatened by the State of Washington. The Washington ground squirrel and the Ord's kangaroo rat are considered species of concern in Washington, too. The Idaho ground squirrel and the Pacific fisher are both species of concern in Idaho. The Pacific fisher is also a candidate for listing on the Federal register. The North American wolverine is a threatened species in Oregon, and a species of concern in Idaho.

The pygmy rabbit habitat is located in the Palouse Section, at the junction of Grant, Adams, and Lincoln Counties; and is primarily located in sagebrush-steppe vegetation. This area is used for rangeland and other agricultural practices. The fisher is located in the Blue Mountain Section, from lower to intermediate elevations near water (Larrison, 1976; and USDA, 1979). The Washington ground squirrel lives near the border of the Palouse and Yakima Fold Sections in Washington, and in the southern area of the Yakima Fold Section in Oregon. The Ord's kangaroo rat, although typically found in great expanses of desert in the southwestern United States, has actively expanded its range in the more arid habitats found where Benton, Franklin, and Walla Walla Counties meet. The habitat of the Idaho ground squirrel is located in the Northern Rocky Mountain Physiographic Province, in Idaho. The habitat range of the wolverine is scattered irregularly throughout the northwest, except in the desert areas of Washington and southern Idaho. Wolverines are resident to the Cascades, Okanogan areas, the western Palouse Hills, and northern Idaho (Larrison, 1976).

In the State of Idaho, the gray wolf is listed as endangered on the Federal listings. The distribution of the gray wolf just barely extends into the MCP region, but will have an influence on management of the region if it is included in the Idaho Recovery Area. See plate 2-21 for the regional distribution of mammals.

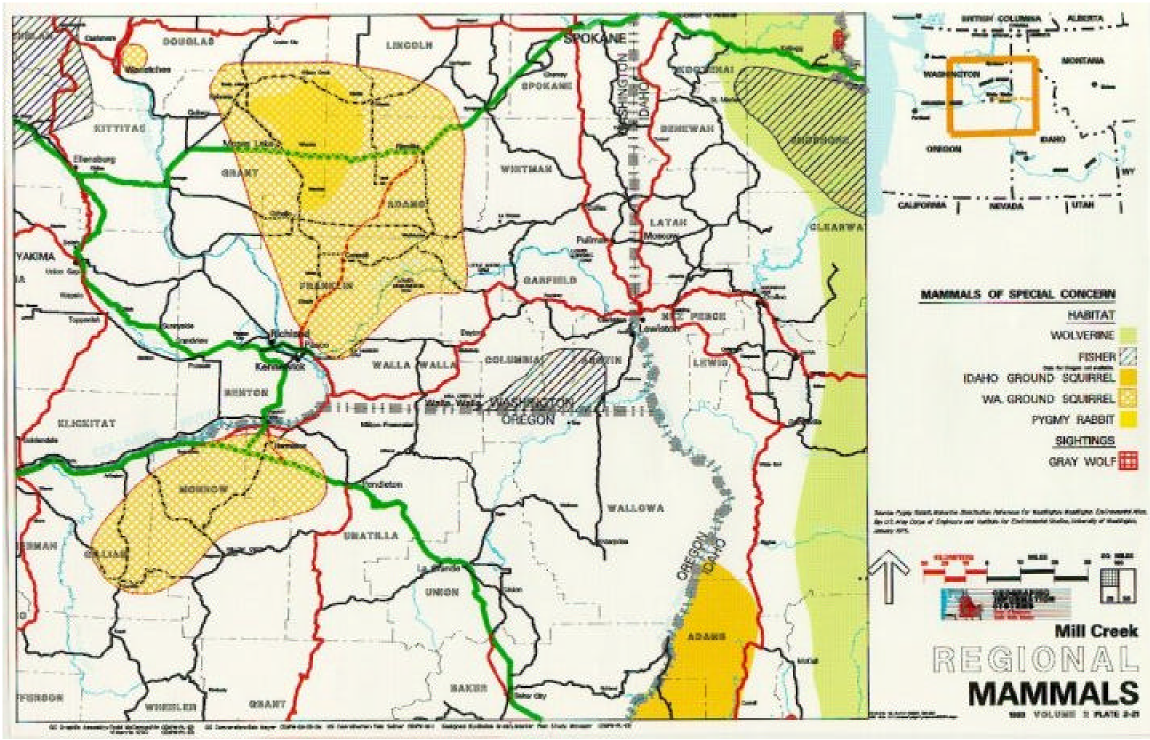

Plate 2-21. Regional Mammals

(9) Big Game.

Big game species (*i.e.*, mule deer, white-tailed deer, elk, and black bear) are the most significant species in terms of hunter activity and annual harvest. Mountain lion are hunted as well, but for their skin rather than for their food value. Pronghorn antelope and bighorn sheep are also present, but their populations are just being established and, therefore, consumptive use of these animals does not exist at the present time.

Deer habitat is found throughout the entire region, with the exception of urban areas. During the winter months, deer populations are located at lower elevations, along stream corridors (see plate 2-22).

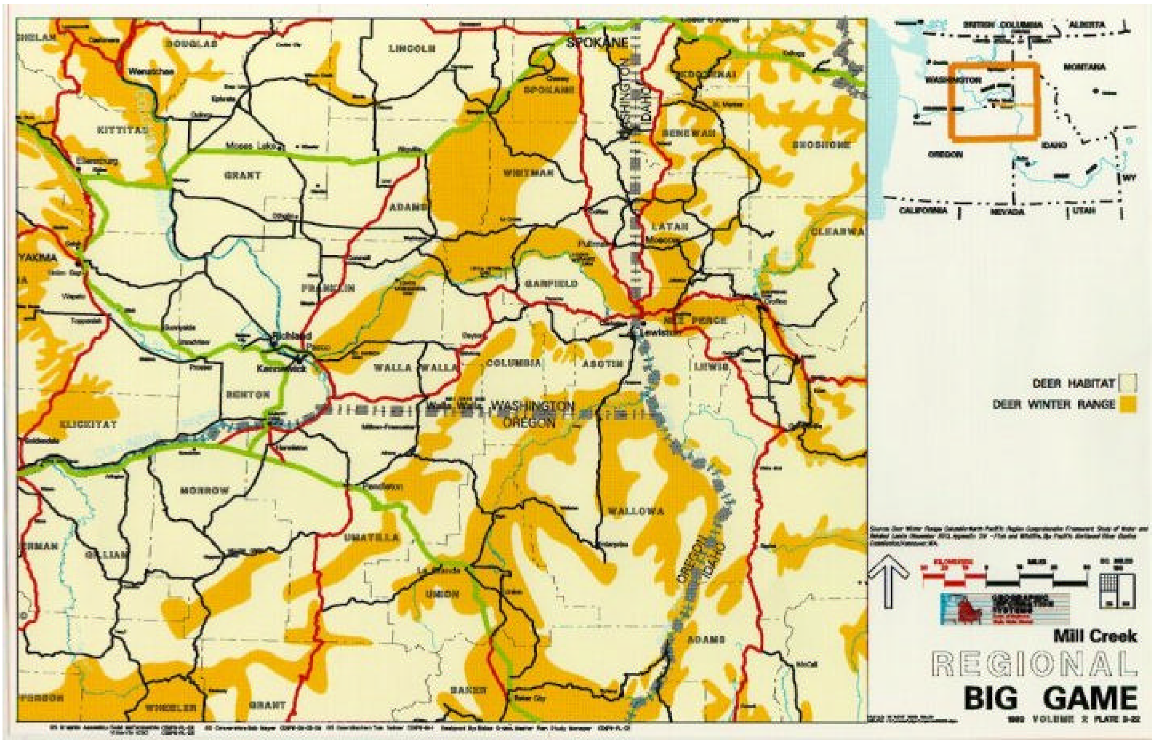

Plate 2-22. Regional Big Game

Elk winter range historically covered much of the shrub-steppe vegetation areas but, due to agricultural development, is now generally confined to the lower mountain elevations along stream corridors. Pronghorn range is in the sagebrush-steppe vegetation of the Palouse and Yakima Fold Sections; in the Columbia Basin in Grant, Adams, and Lincoln Counties, and along the Columbia River between Richland and Wenatchee. Bighorn sheep are located in Washington along the eastern slope of the Cascade Mountains and the northern area of the Blue Mountains south of Pomeroy; and along the Salmon River in Idaho. See plate 2-23 for the distribution of elk winter pronghorn and bighorn sheep.

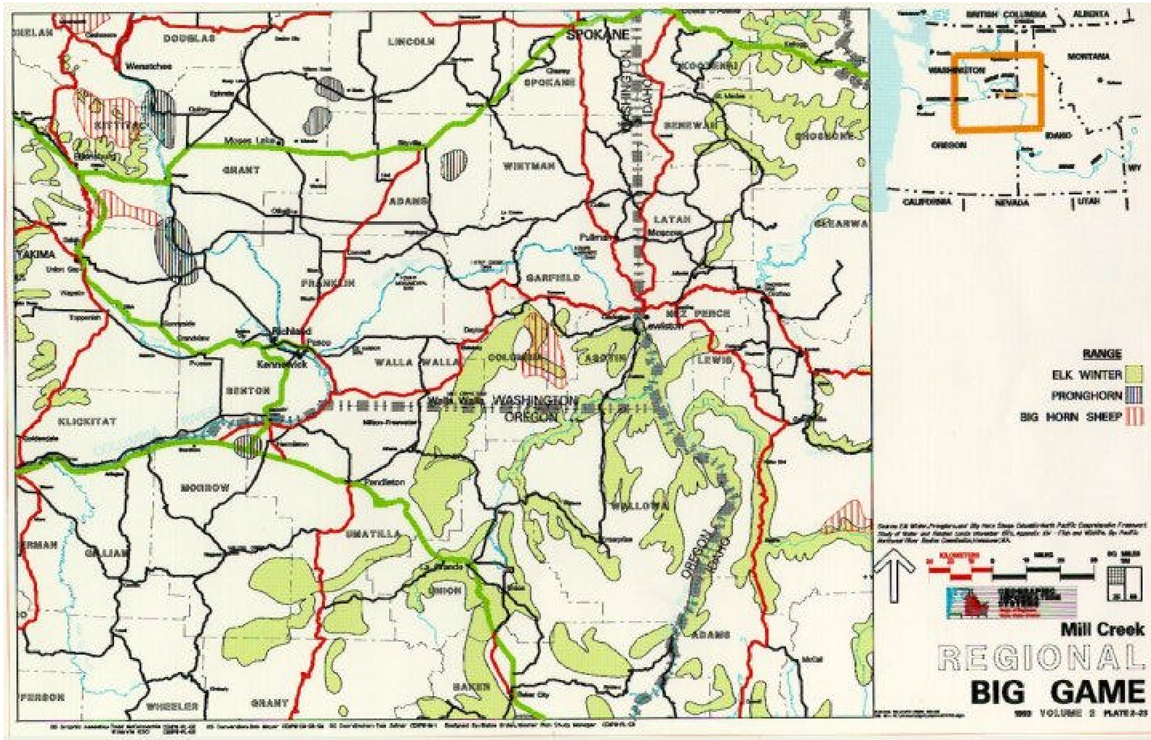

Plate 2-23. Regional Big Game

Black bear and mountain lion habitats are located in the mountains of Washington, Oregon, and Idaho. See plate 2-24 for distributions. No geographic data for the black bear and mountain lion was available for the State of Oregon at the time of mapping.

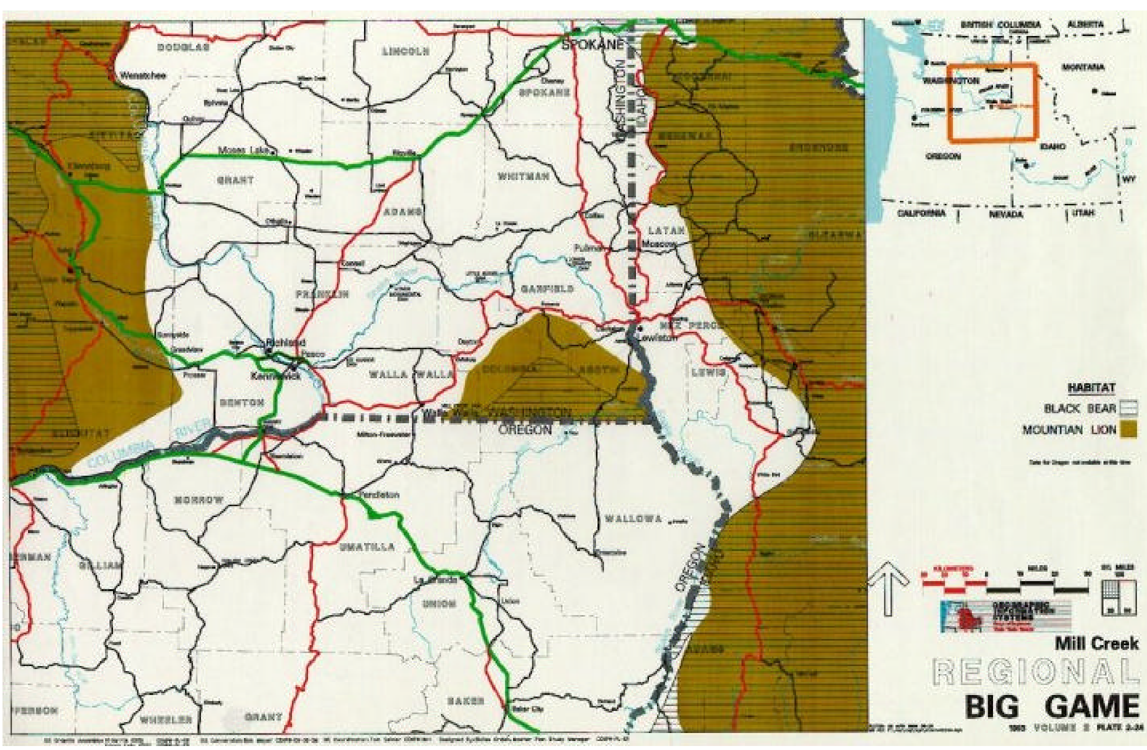

Plate 2-24. Regional Big Game

(10) Analysis of Wildlife.

The region supports an abundance of aesthetically and economically important wildlife species. Recreational hunting contributes substantially to the economic base of the region, and is expected to increase in importance and value in the future. The most significant economic benefits come from the hunting of elk, deer, waterfowl, and upland game. Nonconsumptive use of wildlife can also bring economic returns, primarily resulting from visitors to the numerous National Wildlife Refuges and state wildlife areas in the region. In addition, other public lands along the Columbia and Snake Rivers that fall under the administration of the Forest Service and the Corps provide wildlife viewing opportunities.

The MCP is located at the juncture of three physiographic sections, and four vegetational zones. The resulting natural variety makes the area very important to wildlife. The juxtapositioning of this wide array of physiographic and vegetational features tends to link species known for their migrational habitats. This migration may be elevational, as well as latitudinal. The MCP is home, for at least a brief period, to many species during migration. However, of all the regional species valuing Mill Creek, the ubiquitous upland game, small mammals, migratory waterfowl, raptors, songbirds, and a handful of less mobile herptiles, are most dependent on the habitat being provided by MCP. Even though a number of other species of concern (*i.e.*, Swainson's hawk, northern goshawk, loggerhead shrike, *etc.*) may use the project, they do not depend on it for their existence.

j. Fish.

(1) Anadromous Fish.

Anadromous fish are those fish that spend most of their lives in saltwater, but spawn and rear in freshwater. They travel up to 900 miles through the Snake River and its major tributaries to reach spawning grounds in Washington, Oregon, and Idaho.

The anadromous fish in the Pacific Northwest can be divided into two groups: salmonids and non-salmonids. The salmonid family includes chinook, coho, sockeye, pink, and chum salmon; steelhead and cutthroat trout; and Dolly Varden. Non-salmonids include American shad, white sturgeon, and Pacific lamprey.

The Columbia River Basin, as well as most of the rest of the Pacific Northwest, has substantial, though depleted, anadromous fish resources. These resources support many sport, commercial, and tribal fisheries; but harvest above Bonneville Dam has been sharply curtailed in the last few decades because of a dwindling abundance of species.

(2) Resident Fish.

(a) Coldwater Gamefish.

Trout (rainbow, cutthroat, brook, and bull) and mountain whitefish are the principal resident coldwater gamefish in the region. Kokanee (landlocked sockeye salmon) can be found in some lakes and reservoirs. All of these species, with the exception of the brook trout, are native to the Pacific Northwest.

(b) Warmwater Gamefish.

Smallmouth and largemouth bass, walleye, yellow perch, crappie, sunfish, and channel catfish are the most numerous warmwater gamefish species in the region. All of these species reside in reservoirs or larger streams and rivers, and have been introduced from outside the region. White sturgeon, which are resident in some parts of the region, are the only native warmwater gamefish.

(c) Non-Gamefish.

There are many non-game warmwater fish species that are native to the Pacific Northwest. These include suckers, northern squawfish, chiselmouth, peamouth, redside shiner, dace, and sculpin.

(3) Endangered and Threatened Taxa.

Under the Endangered Species Act of 1973, as amended, the National Marine Fisheries Service (NMFS) listed the Snake River sockeye salmon as endangered on November 20, 1991, effective December 20, 1991. The Snake River fall chinook salmon and Snake River spring/summer chinook salmon were listed as threatened effective April 22, 1992.

The USFWS received a petition to list the bull trout in October 1992. They determined, on May 17, 1993, that substantial information existed to conduct a status review of the bull trout. The USFWS has 12 months from the date of the petition to publish their findings. If the USFWS findings indicate that a listing action is warranted, a notice must be published in the Federal Register along with the text for the proposed regulation. A determination must be made at the end of the 12 months following publication of the notice on whether to adopt or withdraw the regulation.

Numerous factors have been identified as causes of diminishing fish resources in the Pacific Northwest. These factors include hydropower development, the degradation of spawning habitats, irrigation diversions, hatchery production (which causes competition and disease), and over-harvest. There are studies under way to address the approaches needed to rebuild the various salmon populations.

(4) Analysis of Fish.

The region supports an abundance of important fish resources. Fishing has been important throughout modern history, and recreational fishing continues to contribute heavily to the economic base of the region. This is expected to increase in the future. Historically, significant economic benefits came from salmon. Recent significant economic benefits come from trout, bass, and panfish. The recent listing of migratory fish species under the Endangered Species Act will have impacts on the region. The MCP is not expected to be affected by the current listings, but may be affected if the bull trout is listed under the Endangered Species Act.

2.03. Cultural Factors

The following paragraphs are a description of regional cultural factors [*i.e.*, population, market area (MA), access, economy, land use and cover, regional planning, land ownership, and regional recreation]. These cultural factors are described by the area's physiographic province, states, counties, and the MCP MA.

a. The MCP MA.

The MA for MCP is the area where the majority of people who visit the project live. Based on a visitor survey of distance, population location, and visitor origin, the MA can be divided into primary, secondary, and tertiary MA's (refer to plate 2-25).

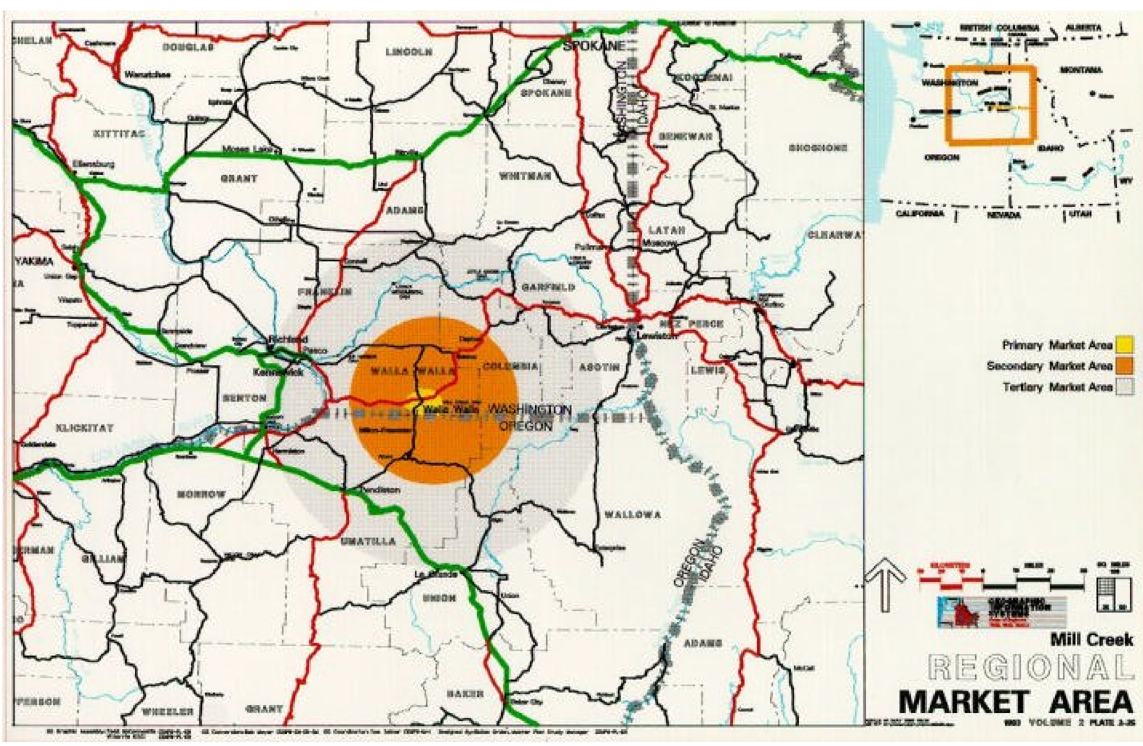

Plate 2-25. Regional Market Place

(1) Primary MA--Walla Walla Valley.

The primary MA is the area within 1/2-hour traveling time from MCP. This area includes the cities of Walla Walla and College Place, as well as the unincorporated urban areas surrounding these two cities. This primary MA accounts for approximately 90 to 95 percent of all visitors to the project (USACE, 1985). This portion of Walla Walla County contains 84 percent of the population within the county. The area is defined by the Census Bureau as a subdivision of Walla Walla County, and is labeled the "Walla Walla - College Place Division" [U.S. Department of Commerce (USDC), 1990]. Refer to paragraph 2.0.3.c., *Population*, for further information.

(2) Secondary MA--25-Mile Radius.

The secondary MA for MCP is the area within a 25-mile radius of the project that is not included as part of the PMA. This area accounts for approximately 4 percent of the visitors, and is within 45-minutes traveling time from the project. This area includes the cities (and unincorporated areas) of Dixie, Prescott, Touchet, Waitsburg, Washington; and Milton-Freewater, Oregon. This area of Walla Walla County accounts for a small percent of the total county population.

(3) Tertiary MA.

The tertiary MA is outside of the 25-mile radius, up to 50 miles. Less than 1 percent of the visitors to MCP are from the tertiary MA, and approximately 4 percent of the visitors come from areas farther than 100 miles away. This area includes the tri-cities of Richland, Kennewick, and Pasco, Washington, which have a combined population in excess of 100,000. The tertiary market area, and other areas outside of the 25-mile radius, have only a small direct influence on MCP. Some of the growth in Walla Walla County and the Walla Walla Valley is a result of Hanford Site cleanup projects.

(5) Analysis of the Mill Creek MA.

Because of the population concentration, access and the location of other recreational sites within the primary MA will determine the future demands of MCP. Because of their populations and the availability of similar recreational opportunities, the secondary and tertiary MA's will have less influence. This analysis is also based on the relatively limited recreational opportunities available at MCP.

b. Access.

(1) Tri-State Area (Washington/Oregon/Idaho).

The region is served by national cross-county highways (see plate 2-26). The east-west highways are Interstate 90 and 84, as well as U.S. 12. Major north-south highways are U.S. 97, U.S. 395, U.S. 195, and U.S. 95. The region is also served by many state and country roads. Commuter airports are located in Walla Walla, Pasco, Pendleton, Pullman-Moscow, and Lewiston. The Pasco Airport also has a small number of major airlines.

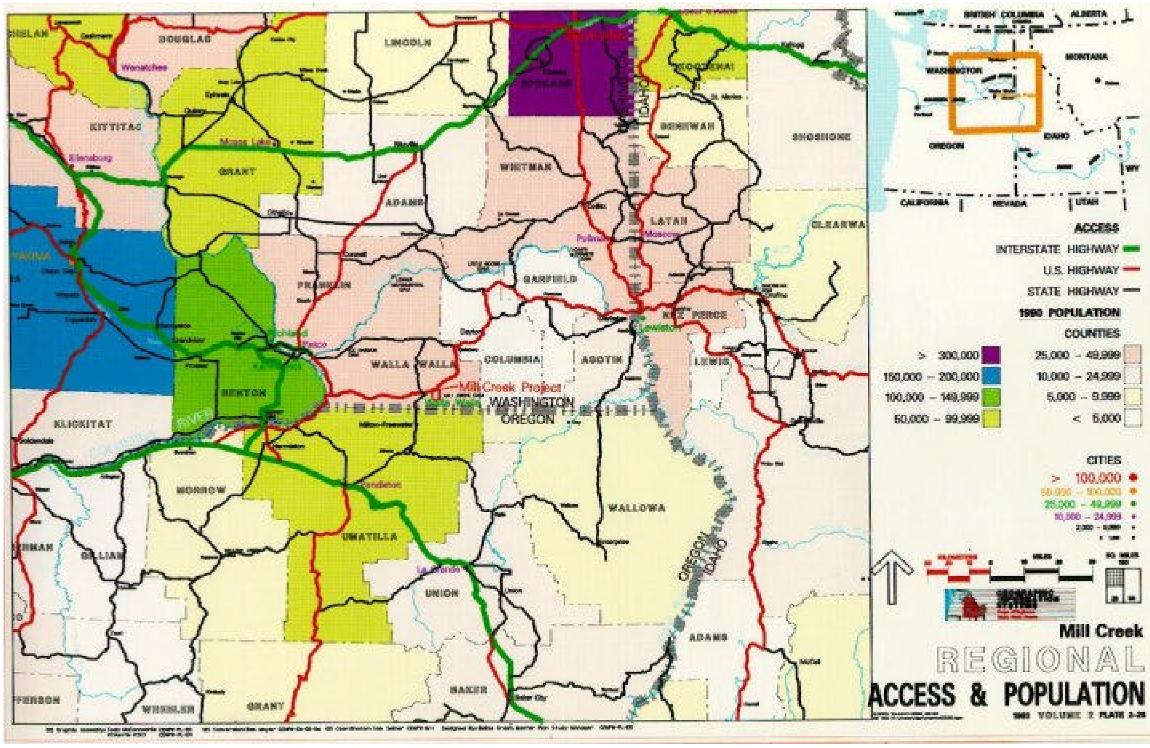

Plate 2-26. Regional Access & Population

(2) Primary MA.

East-west access to the MCP is provided in southeastern Washington by U.S. 12, which runs west through Lewiston, Idaho, to Walla Walla, Washington, and continues west through the Tri-Cities. The MCP is located 1 mile from U.S. 12. There are two directional signs for Bennington Lake and Rooks Park along U.S. 12 that lead to the county roads accessing the project. The lake and Rooks Park are also identified on signs along Tausick Way, Isaacs Avenue, and Mill Creek Road.

Oregon State Highway 11/Washington State Highway 125 is the north-south highway connecting Walla Walla with Interstate 84. Refer to section 3.02.d., *Transportation*, for access to MCP from the city of Walla Walla.

c. Demographics.

(1) Tri-State Region (Washington/Oregon/Idaho).

(a) General.

Population patterns are important to understand trends, as well as secondary effects on the MA. The Palouse and Yakima Fold Sections house almost the entire population in the area, and the majority of people reside in the State of Washington (see plate 2-26).

(b) Metropolitan Areas.

The Federal Government defines metropolitan areas as areas with a large population nucleus. Each metropolitan area must contain either a place with a minimum population of 50,000, or a Census Bureau-defined urbanized area and a total metropolitan area population of at least 100,000. There are three metropolitan areas found in the region, and they are all located within the State of Washington, in the Palouse and Yakima Fold Sections. These metropolitan areas are: 1) Spokane; 2) Richland-Kennewick-Pasco (Tri-Cities); and 3) Yakima. The metropolitan area includes the county where each city is located. The largest urban area is Spokane-Coeur d'Alene, which has a population of over 333,000 people. Spokane is the second largest city in the State of Washington, with 177,000 people living inside the incorporated area. The second largest urban area is the Tri-cities, with a population of 100,000 people. The Tri-Cities are located in both Benton and Franklin Counties, and are adjacent to the southern boundary of the Hanford Site. The third largest urban area is Yakima, with a population of 63,000 within its incorporated limits. The fourth urban area, in size, is the Walla Walla Valley, which extends into Oregon, and contains over 42,000 people. Pullman-Moscow is home to Washington State University and the University of Idaho, and has approximately the same population. The Lewiston-Clarkston area, at the confluence of the Snake and Clearwater Rivers, has a population of 35,000. None of the last three areas mentioned is large enough to warrant distinction as a metropolitan area. They are mentioned here only for reference purposes. Figure 2-8 shows the largest metropolitan and urban areas.

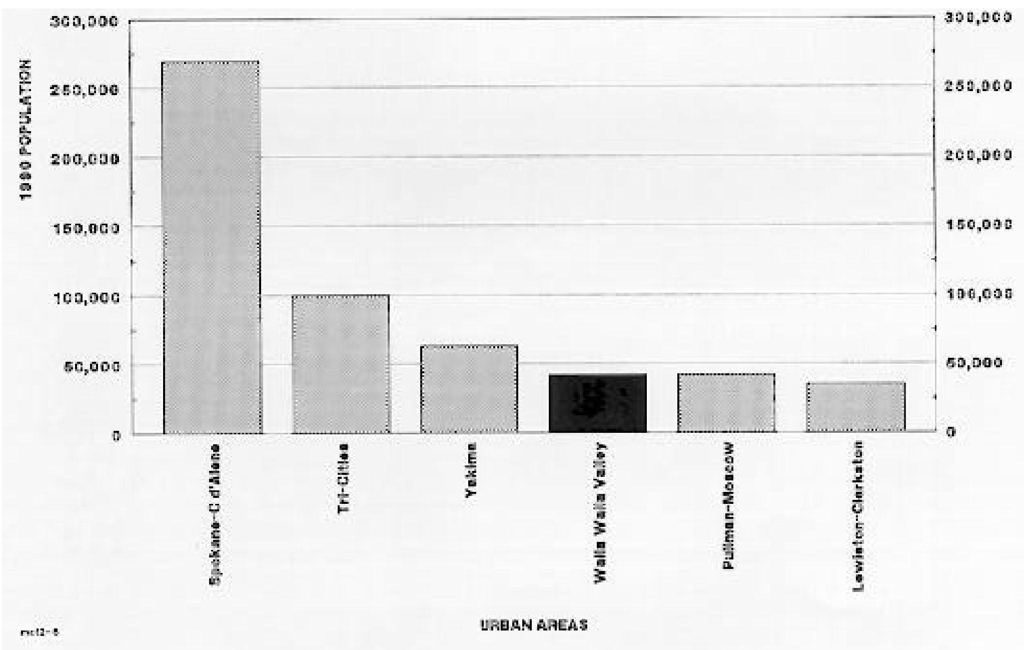

Figure 2-8. Regional Population Urban Areas

(c) County Populations.

County populations can be deceiving, because each county is a different size (mi^2). This affects density and the percentage of urban versus rural populations. For example, Lewis County, Idaho (just east of Lewiston, Idaho) covers only 478 mi^2, while Idaho County (which it borders) contains 8,497 mi^2. Lewis County has a population of 3,516, and a density of 7.4 people per mi^2. Idaho County has a population of 13,783, and a density of 1.6 people per mi^2. Generally, counties with the largest urban populations have the largest overall populations, but there are exceptions. Grant County, Washington, has a population of 54,758, but the largest city is Moses Lake (population 11,500). On the other hand, Walla Walla County has a population of 48,439, but the city of Walla Walla has a population of 26,478 (55 percent of the county). In the larger counties, the incorporated versus unincorporated populations range from 44-percent incorporated in Chelan County to 70-percent incorporated in Walla Walla County.

Eight of the ten counties with the largest population in the region are located in the State of Washington. The two counties not in Washington are Umatilla County in Oregon, and Kootenai County in Idaho. The counties, in order of population, are: Spokane County (population 361,364), followed by Yakima County (188,823), Benton County (112,560), Kootenai County (69,795), Umatilla County (59,249), Grant County (54,758), Chelan County (52,250), Walla Walla County (48,439), Whitman County (38,775), and Franklin County (37,473). (Refer to figure 2-9 and plate 2-26.)

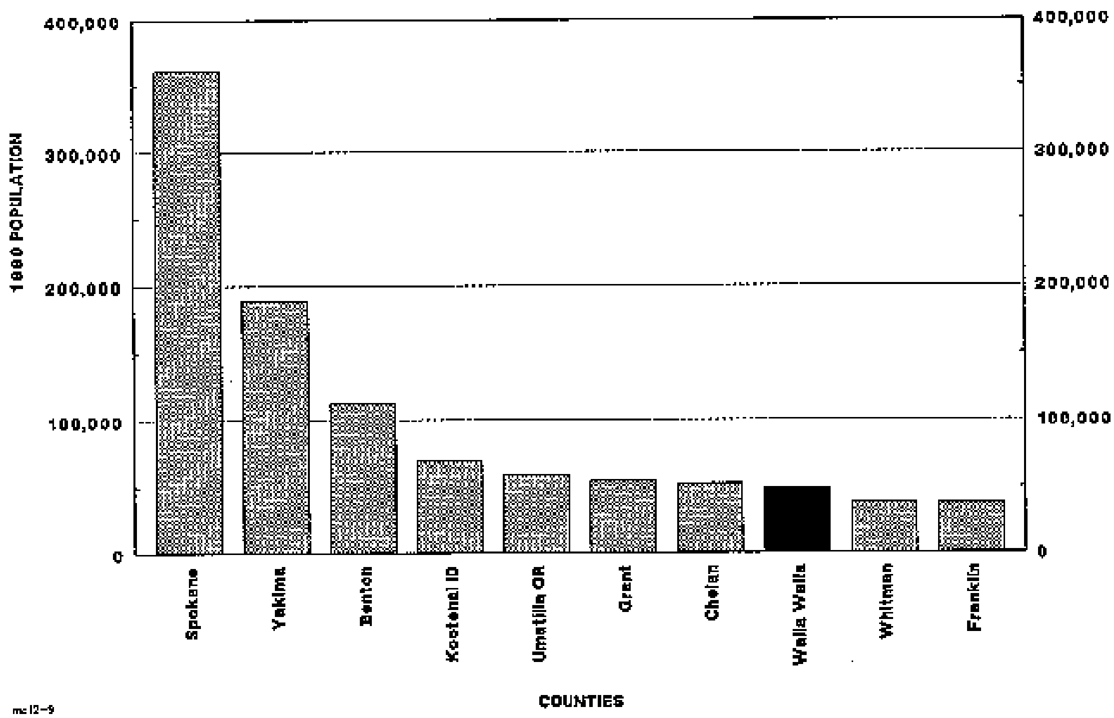

Figure 2-9. Regional Population Ten Large Counites

(d) Population Change.

The largest growth ever recorded in the region occurred between 1970 and 1980. During this period, Morrow, Benton, and Stevens Counties grew over 60 percent. Franklin, Klickitat, and Umatilla Counties all grew over 30 percent. These growth rates are well above the averages in the States of Washington and Oregon (21 and 26 percent, respectively). However, between 1980 and 1990, the growth rate slowed considerably. Grant, Stevens, and Franklin Counties grew at rates between 7 and 13 percent. These were generally below the averages for the States of Washington and Oregon (18 and 8 percent, respectively). Population declined in approximately half of the counties (four counties in each state) during this period (see table 2-8).

Table 2-8
Population Characteristics of Counties, Distributed By State

County	Square Miles	1990	Percent Change 1980 to 1990	1980	Percent Change 1970 to 1980	1970	1990 Density	Percent Change 1989 to 2000	2000
IDAHO									
Adams	1,362	3,254	(2.78)	3,347	16.34	2,877	2.4		4,110
Benewch	784	7,937	(4.2)	8,292	33.00	6,230	10.1		10,570
Clearwater	2,236	8,505	(18.14)	10,390	(4.42)	10,871	3.8		8,830
Idaho	8,497	13,783	(6.68	14,769	(14.57)	12,891	1.6		14,340
Kootenai	11,240	69,795	16.7	59,770	69.1	35,332	56.3		89,730
Latah	1,077	30,617	6.4	28,749	15.4	24,8908	28.4		31,810
Lewis	478	3,516	(14.62)	4,118	6.50	3,867	7.4		3,640
Nez Perce	845	33,754	1.61	33,220	9.36	30,376	390.9		35,030
Valley	3,670	6,109	9.0	5,604	55.2	3,609	1.7		8,100
Union	2,035	23,598					11.6		
OREGON									
Baker	3,072	15,317	(5.06)	16,134	8.14	14,919	5.0		16,620
Gilliam	1,213	1,717	(16.52)	2,057	(12.17)	2,342	1.4		
Grant	4,525	7,853	(4.3)	8,210	1.7	6,996	1.7		
Jefferson	1,789	13,676	17.9	11,599	35.6	8,548	7.6		
Morrow	2,044	7,625	1.41	7,519	68.40	4,465	3.7		
Wallowa	3,150	6,911	(4.98)	7,273	16.42	6,247	2.2		
Umatilla	3,218	59,249	0.66	58,861	31.03	44,923	18.4		
WASHINGTON									
Adams	1,921	603	4.65	13,267	21.91	12,014	7.2	8	13,800
Asotin	635	605	5.8	16,823	21.9	13,799	28.0	6	17,800
Benton	1,715	112,560	2.85	109,444	62.04	67,540	66.9	2	114,800
Chelan	2,916	52,250	15.9	45,061	9.6	41,103	17.9	14	4,000
Columbia	865	4,024	(0.81)	4,057	(8.61)	4,439	4.6	1	25,500
Douglas	1,817	25,205	15.1	22,144	31.9	16,787		16	
Franklin	1,243	37,473	6.99	35,025	35.67	25,816		1	
Grant	2,660	54,758	12.85	48,522	15.86	41,881		9	
Garfield	1,918	2,248	(8.91)	2,468	(15.22)	2,911		10	
Kittitas	2,308	26,725	7.4	24,877	(0.6)	25,039		0	
Klickitat	1,880	16,616	5.02	15,822	30.35	12,138		2	
Lincoln	2,310	8,864	(7.71)	9,604	0.33	9,572		0	
Spokane	1,762	361,364	5.7	341,835	18.9	287,487		2	
Walla Walla	1,261	48,439	2.12	47,435	12.47	42,176		0	
Yakima	4,267	188,823	9.4	172,508	18.9	144,971		10	
Whitman	2,151	38,775	(3.31)	40,103	5.81	37,900		5	

(e) Regional Population Projections.

According to the 1990 projection, the State of Washington, as a whole, is expected to grow by 15 percent during the years between 1990 and 2000. Douglas, Chelan, Yakima, Grant, Garfield, and Adams Counties have a projected growth rate of between 8 and 16 percent. All other counties within the state are expected to increase by 0 to 6 percent. Walla Walla County will probably increase by 1 percent.

(2) The MA.

(a) General.

Population characteristics are presented for MA's where discrete data is available. In some cases, information is presented for Walla Walla County, and is representative of the urban MA.

According to the 1990 census, approximately 70 percent of the residents of Walla Walla County lived in the Walla Walla urban area. The Walla Walla urban area is defined as the incorporated cities of Walla Walla and College Place, and two Census Designated Places (CDP). The CDP are closely settled population centers not legally incorporated, and must have populations of 1000 or more if they are outside of an urbanized area (USDC, 1990).

(b) Current Population Levels.

Table 2-9 shows population levels for the various components of the Mill Creek MA for the period from 1940 to 1990. As shown in figure 2-10, the area has experienced slow, continuous growth. As shown in figure 2-9, approximately 65 percent of the population within the primary MA is in the city of Walla Walla, 15 percent is in College Place, 10 percent is in unincorporated urban areas surrounding Walla Walla and College Place, and 10 percent is in rural areas.

Table 2-9
Population of Mill Creek MA Components

	1940	1950	1960	1970	1980	1990	2002*
Walla Walla County	30,547	40,135	42,195	42,176	47,435	48,439	61,583
Walla Walla Division	--	--	36,414	36,817	39,545	40,691	N/A
City of Walla Walla	18,109	21,102	24,536	23,619	25,619	26,478	34,337
City of College Place	1,272	3,174	4,031	4,510	5,771	6,308	7,740
Garrett CDP	--	--	1,641	1,586	1,134	1,004	N/A
Walla Walla East CDP	--	--	--	2,840	3,285	2,959	N/A

- Unit did not exist during these census years
*Walla Walla County, 1993

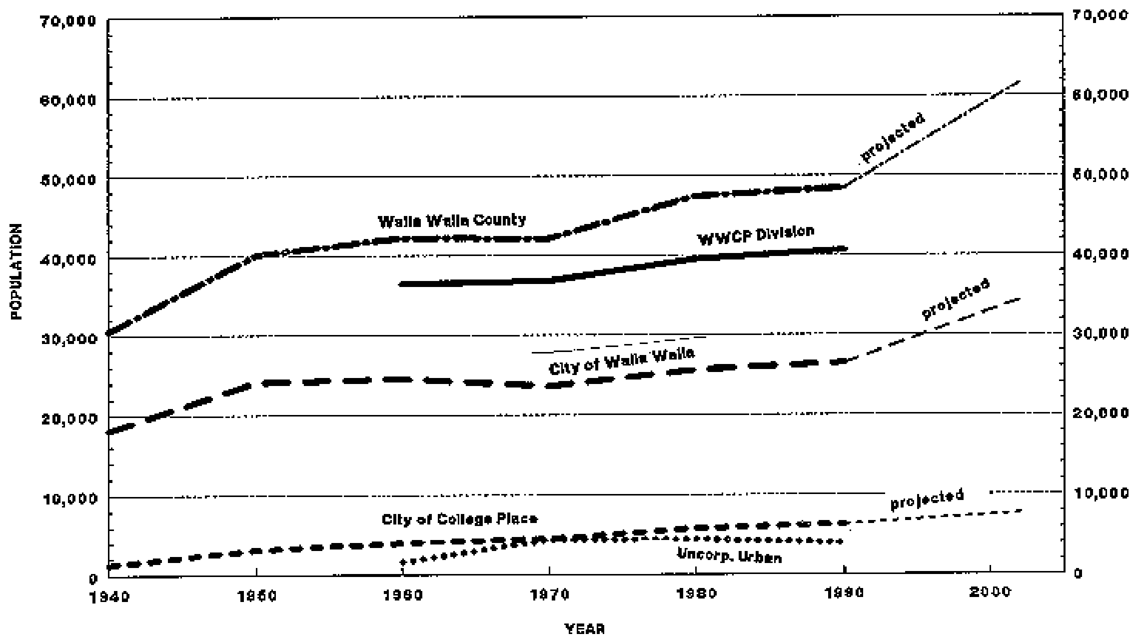

Figure 2-10. Population and Forecasts, Mill Creek Market Area, 1940 to 2002

(c) The MA Population Projections.

The MA around Walla Walla is expected to increase in population by 1.3 to 2.0 percent *per year* for the next 10 years (see table 2-10), while Walla Walla County is based on figures from the Walla Walla County Planning Department and the city of Walla Walla [Walla Walla County (WWC), 1993]. Table 2-9 displays the projected growth. Newer housing to the east of Walla Walla has shifted the population center nearer to the project than when construction was completed in 1942, or when the Rooks Park recreation facilities opened in 1964 (WWC, 1985). Figure 2-10 depicts projected population trends for the various components of the Mill Creek MA (USDC, 1940, 1950, 1960, 1970, 1980, and 1990), while figure 2-11 displays urban and rural population distribution.

Table 2-10
Population Forecast

	Walla Walla Urban Area Per Year			Percent Growth	
	1990 Population Census	1993 Estimated Population	2002 Estimated Population	Per Year	12 Year
Walla Walla	26,478	28,820	34,337	2.0%	
College Place	6,308	6,530	7,740	1.2%	29%
Garrett CDP	1,004	N/A	N/A	N/A	23%
Walla Walla East CDP	2,959	N/A	N/A	N/A	
Totals	36,749	N/A	N/A	N/A	
Walla Walla County	48,439	51,800	61,583	1%	27%

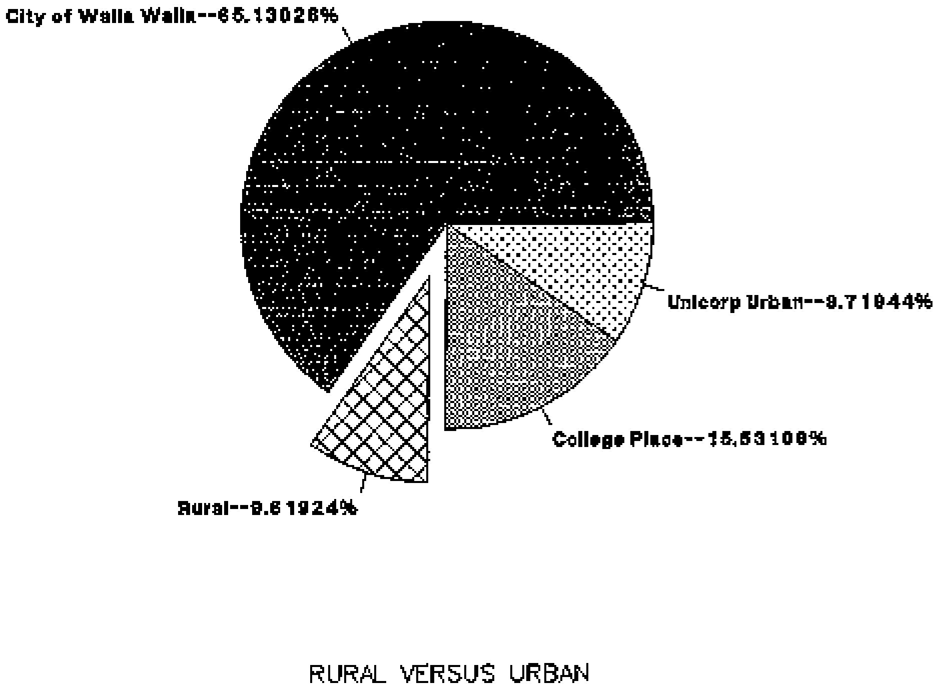

Figure 2-11. Urban--Rural Population Distribution, 1990, Walla Walla--College Place Division

(d) Age Distribution.

The median age (half of the population is younger and half is older) of residents in Walla Walla County is 33.6 (USDC, 1990). Figure 2-12 depicts the projected changes in age groups between 1975 and the year 2000. It is expected that the population will age. The general population is growing older. The age category between 40 and 59 will increase the most. The distribution of persons from ages 15 to 25 will increase. This demonstrates the impact of the presence of three colleges in the area: Walla Walla Community College, Walla Walla College, and Whitman College. These colleges primarily attract persons in the 17- to 25-year-old age bracket, who then move from the area after graduation (WWC, 1985).

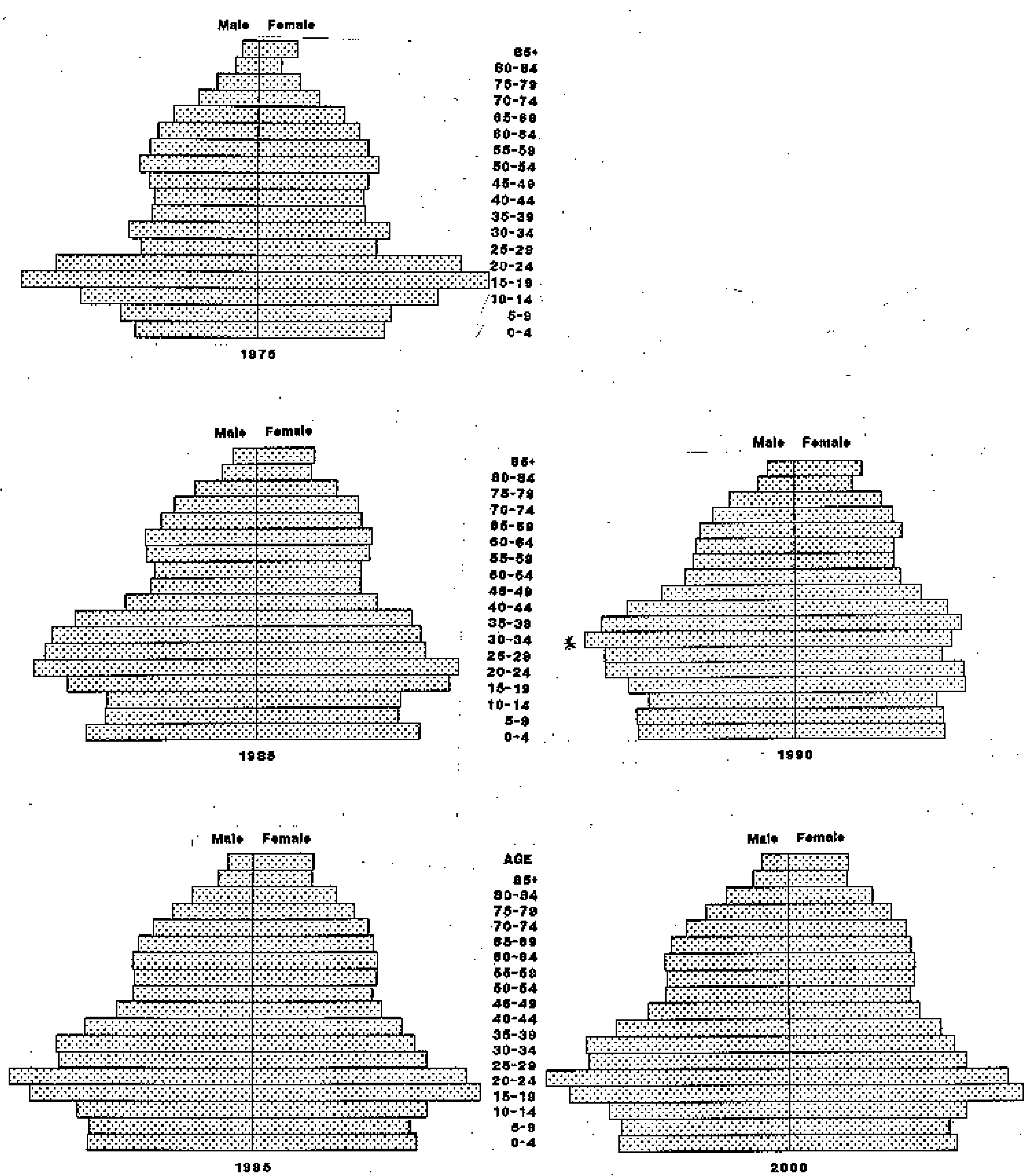

Figure 2-12. Age Distribution

(e) Per Capita Income.

Real personal income growth (due in large part to the effects of inflation, economic recession, and reduced farm produce prices) has been slow. Since 1979, the gap between Walla Walla County and the State of Washington has continually increased: in 1979, the difference was less than 1 percent, while in 1990, there was a 21-percent difference. As shown in figure 2-13, per capita income also continues to trail national averages. Income throughout the county demonstrates a similar relationship to state levels [U.S. Bureau of Economic Analysis (USBEA), 1992; and Washington Office of Financial Management (WOFM), 1992].

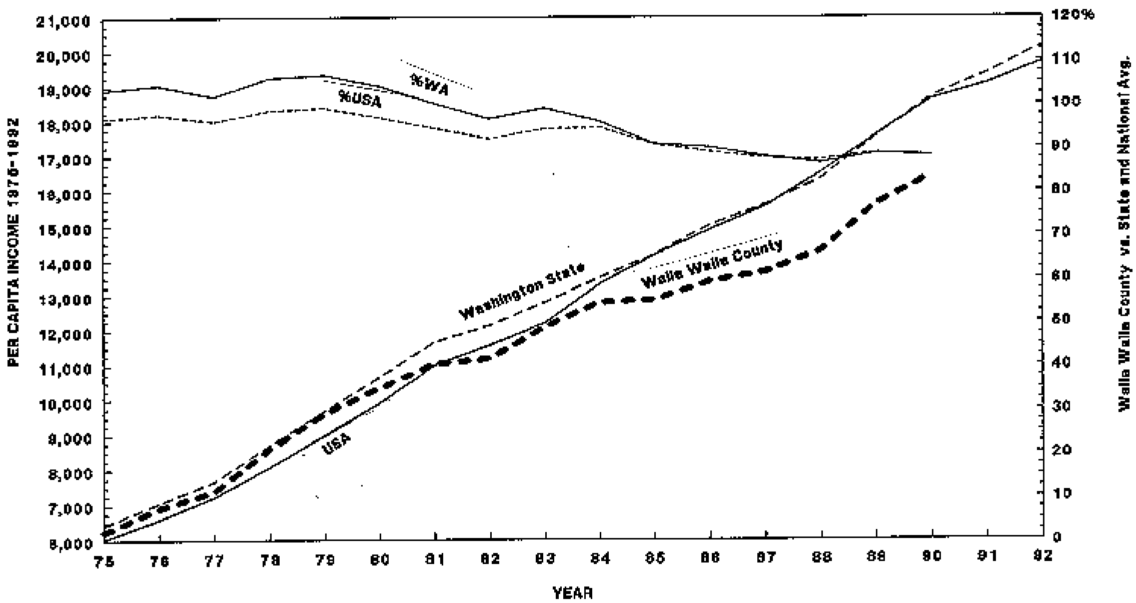

Figure 2-13. Per Capita Income, 1975 to 1990

(f) Analysis of Population Characteristics.

Recently, the MCP MA has been experiencing a population rate increase that is twice the rate of Walla Walla County. This will place additional pressure on MCP. The project will also be affected as more of the population have increased leisure time and/or lifestyle changes.

Recent population estimates show that, for the period of 1990 to 1993, the city of Walla Walla (8.8 percent) is growing faster than the State of Washington (7.7 percent).

d. Economy.

(1) Regional.

The regional economic base in almost all of eastern Washington and eastern Oregon is agriculture. The majority of Washington counties also include food processing as a major economic activity, as well as manufacturing (*i.e.*, publishing, apparel and textile manufacturing, machinery and metal products and fabrication). In Oregon and Idaho, lumber (and lumber products) is one of the most important economic activities.

(2) Employment Market Area.

The city of Walla Walla, and the surrounding urban area, serves a highly productive agricultural region. The total value of crops and livestock sold in the county has increased from $28.6 million in 1964 to $152.6 million in 1984. Evidence exists to indicate that this growth has now leveled, and will remain sluggish for the foreseeable future (WWC, 1987). As a result, unemployment in 1985 was higher than the state and national averages, and this trend will probably continue. Figure 2-14 indicates unemployment levels for 1980 through 1989.

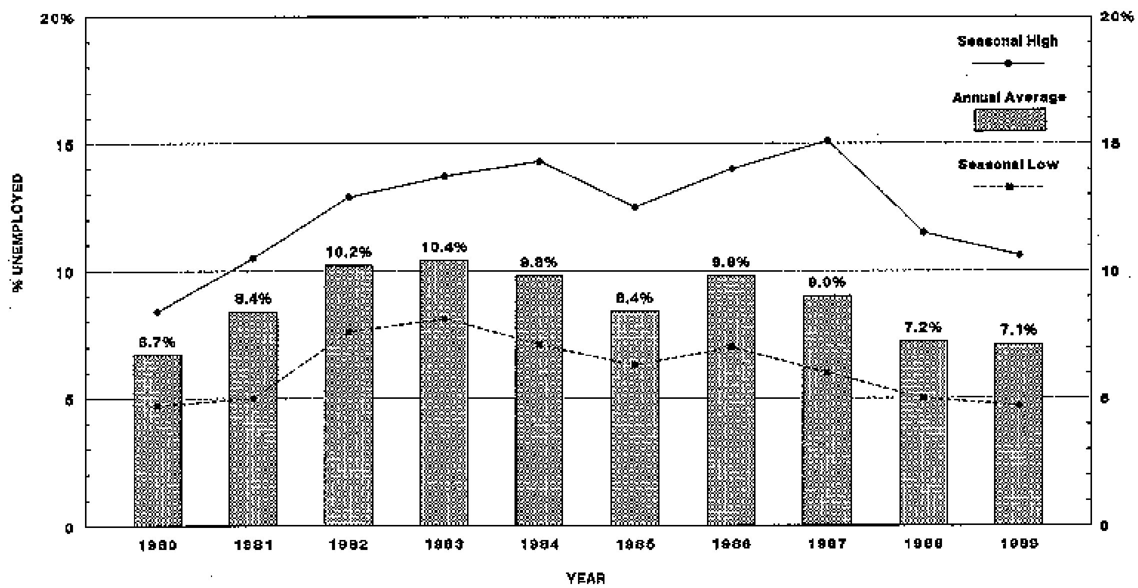

Figure 2-14. Unemployment, Walla Walla County, 1980 to 1989

The manufacture of food (and kindred products) accounts for approximately 10 percent of all nonagricultural jobs in the county. This industry varies seasonally by great extremes, as does the agricultural sector of the economy. Unemployment is typically 150 percent of the annual average during the winter months.

The city has experienced notable growth and industrial expansion since the original project was constructed. Figure 2-15 depicts the distribution of jobs among various industries in Walla Walla County during the period from 1980 to 1990. Since 1980, the percent of agricultural jobs has declined, while all others have increase. This fact has moved the ranking of agricultural jobs from first to last. Figure 2-16 graphically depicts the distribution between agricultural and nonagricultural employment, and the shrinking percentage of agricultural jobs.

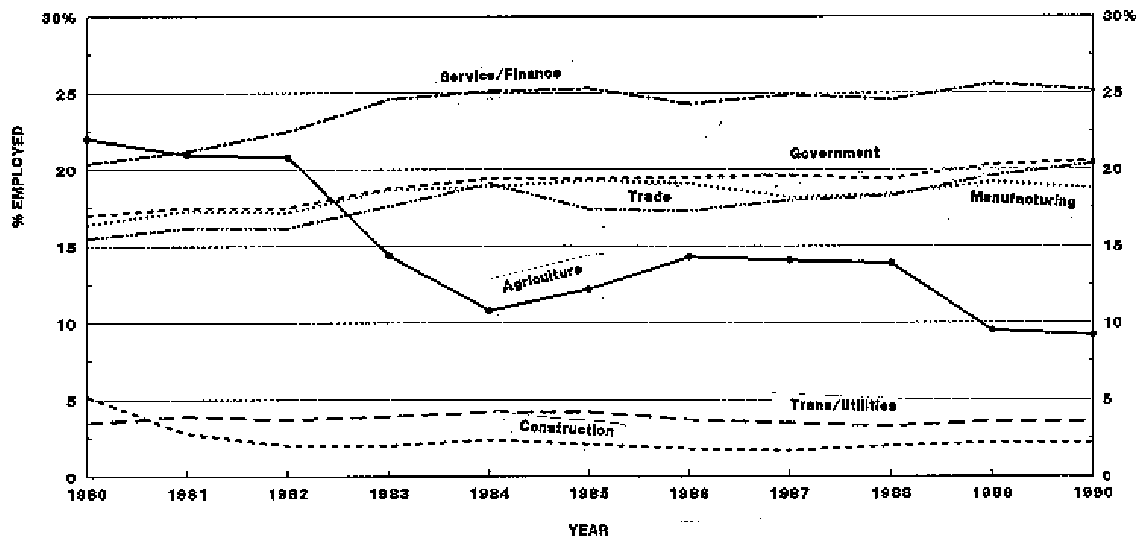

Figure 2-15. Job Distribution, Walla Walla County, 1980 to 1990

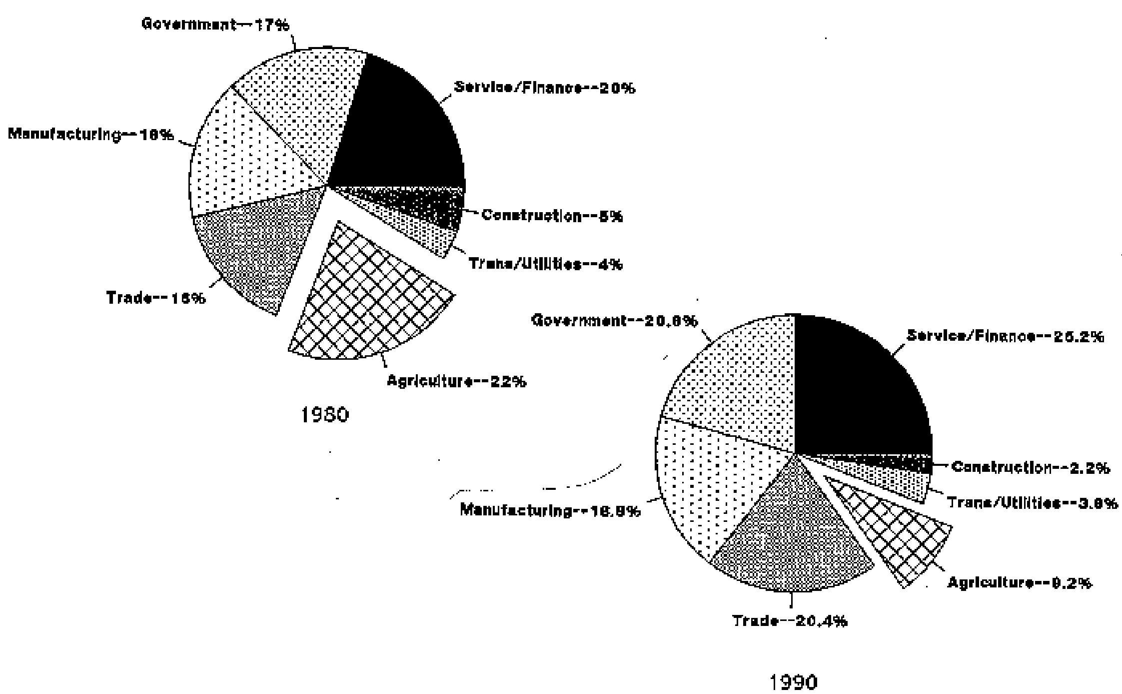

Figure 2-16. Job Distribution, Walla Walla County, 1980 to 1990

(3) Analysis of Economy.

As shown in figure 2-17, recent increases in manufacturing, services, transportation, utilities, and Federal employment reflect a diversification in the county's economic base. This much needed diversification is expected to continue, and will help to keep the local economy stable.

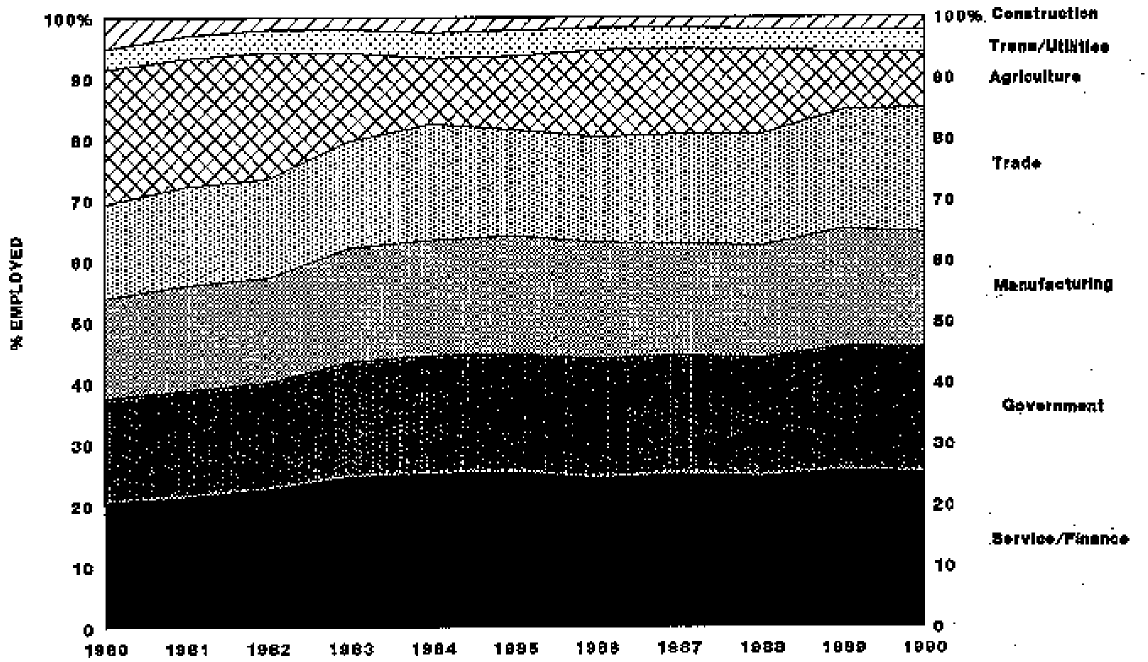

Figure 2-17. Employment Diversification, Walla Walla County, 1980 to 1990

e. Land Use and Cover.

(1) Description.

Rangeland, forest land, and agriculture are the major uses for land in the region. The Cascade and Northern Rocky Mountain Physiographic Provinces, as well as the Blue Mountain Section of the C-S Intermountain, are predominantly forest land. These lands provide timber products, recreation, and watershed. The Yakima Fold and Palouse Sections of the C-S Intermountain are made up of agricultural lands and rangeland. The areas under agricultural use are dryland, and are irrigated. These agricultural areas have suitable soil, gentle slopes, and high numbers of frost-free days; and generally receive from 8 to 18 inches of precipitation. Dryland areas are planted predominantly in wheat and peas. Irrigated areas are planted with miscellaneous crops (*i.e.*, vegetables, corn, wheat, potatoes, hay, and seed crops), and are also host to orchards and vineyards. Rangelands are located in areas that are too dry for crops, have unsuitable soil, or slopes that are too steep. Rangeland usually borders forest cover areas in soil, or slopes that are too steep. Rangeland usually borders forest cover areas in the lower elevations, and shallow rocky areas and steep slopes are interspersed among the croplands. Urban areas occupy a very small percentage of the available land. See plate 2-27 for the location of land use and cover.

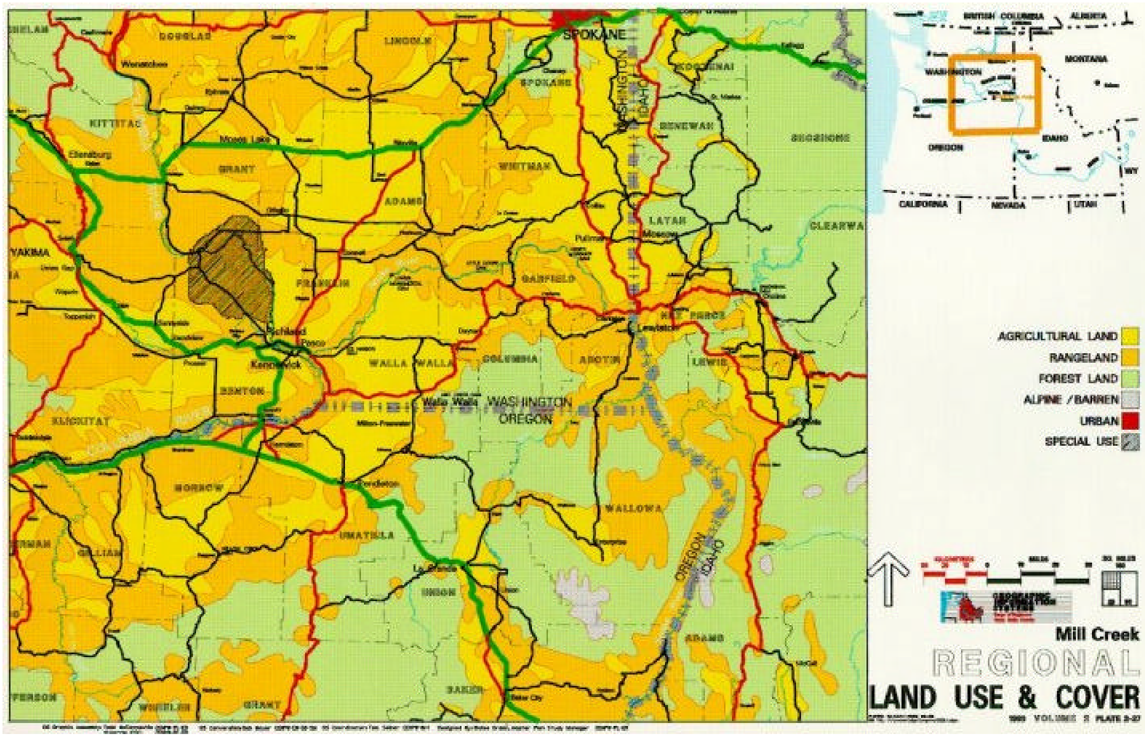

Plate 2-27. Regional Land Use and Cover

(2) Analysis of Land Use/Cover.

Major land use and cover is interrelated with other ecological and cultural factors. Current land use/cover patterns are expected to remain stable in the future. Urban land use will increase as the population areas expand. Land use in Walla Walla County is predominantly agricultural, with over 25,000 acres (68 percent) in the county used for this purpose. The MCP is located near the edge of agriculture lands and forest lands, and these lands can be seen from the project. See figure 2-18 for the distribution of land use in Walla Walla County.

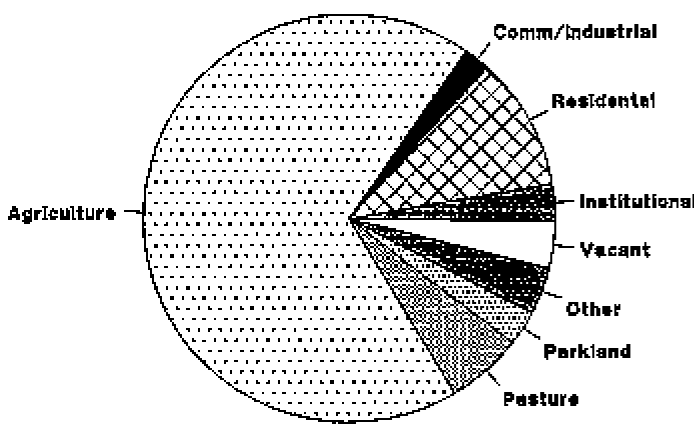

Figure 2-18. Land Use, The MCP MA (Walla Walla--Colleg Place Urban Area)

f. Regional Planning.

(1) General.

All counties and cities in Oregon are required by law to adopt comprehensive land use plans. Oregon has the most progressive land use planning laws in the United States. The standards are set forth in 19 state-wide planning goals that include the preservation of agricultural land, natural and scenic resources, forest land, coastal resources, economic development, housing, recreation, transportation, energy conservation, and orderly urban development (Young *et al*., 1988). The State of Washington has recently begun to require certain counties to have comprehensive plans.

(2) Mill Creek MA.

All counties and cities in the Mill Creek MA (Umatilla County, Walla Walla County, Walla Walla, and College Place) have a comprehensive plan. These plans have no features that would limit or inhibit MCP development. A significant feature of the Walla Walla County Urban Area Comprehensive Plan, which is also addressed in the city of Walla Walla Comprehensive Plan, is a desire to control non-agricultural development of the boundaries of the urban area in an effort to prevent the inefficient use of prime agricultural land. As a result, the agricultural lands surrounding Virgil B. Bennington Lake are expected to remain agricultural.

The Urban Area Comprehensive Plan does not directly address recreational resources. Within the city of Walla Walla Comprehensive Plan, the stated Parks and Recreation Goal is "to provide the citizens of Walla Walla with an adequate and diversified park system." The plan further describes a city policy to "encourage the Park and Recreation Board to study long-term feasibility of development of Mill Creek as an urban recreational resource." The city of Walla Walla has also adapted the *Walla Walla Parks and Recreation Comprehensive Plan*. The goal of promoting bike trails throughout the community has directly influenced MCP. Refer to section 3.03.c.(2)(d), *City/County Planning*, for more detailed information.

g. Land Ownership.

(1) General.

Plate 2-28 shows the major public-owned lands in the region. The U.S. Government is the largest single public land owner in the region. The U.S. Government is also the largest landholder in the Blue Mountain Section of the C-S Intermountain, and the Northern Rocky Mountain Province. The U.S. Forest Service is the Federal agency responsible for managing most of these lands. The majority of lands in the Yakima Fold and Palouse Sections are private lands in agricultural production, but there are state and Federal lands in both of these sections. The Hanford Site is administered by the U.S. Department of Energy (DOE). This 560-mi^2 reservation is closed to the public. The

Corps, Walla Walla District, manages approximately 120,000 acres along the Columbia, and along the Snake River from Pasco, Washington, to Lewiston, Idaho (*not* shown on plate 2-20). The State of Washington Department of Lands also manages lands throughout both sections. The Washington Department of Game manages lands in the Yakima Fold Section around Moses Lake and Ellensburg, and in the Palouse Section near the Blue Mountain Section border.

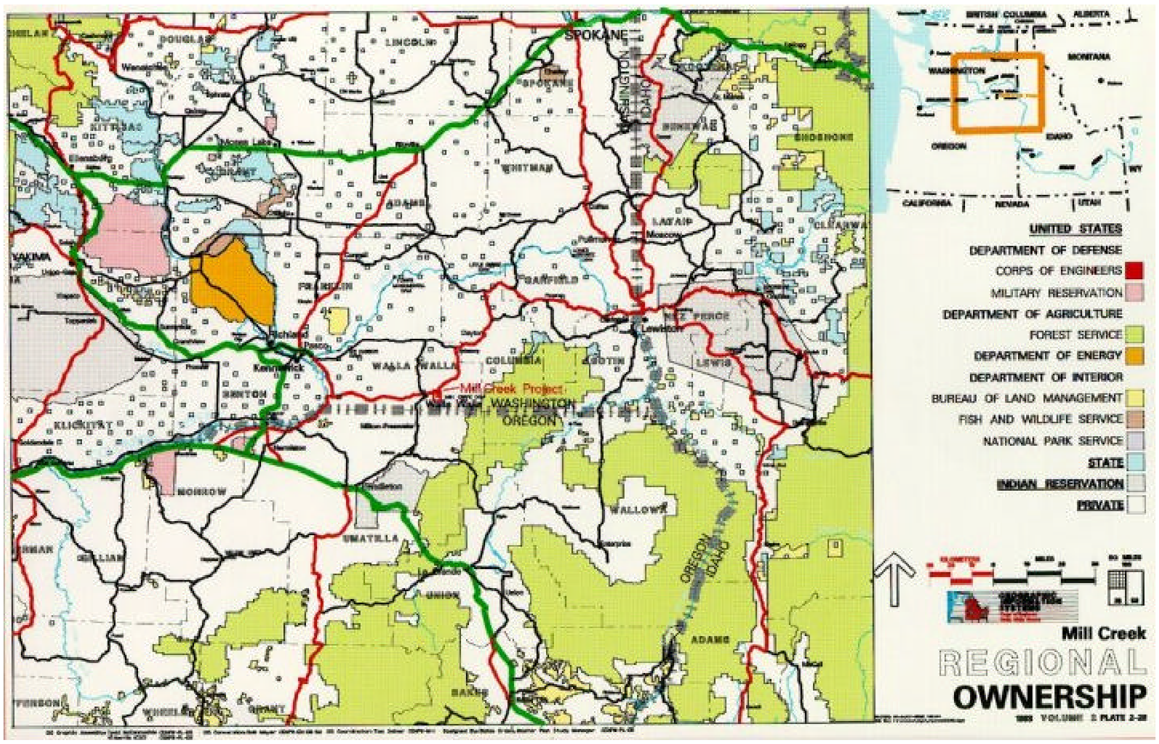

Plate 2-28. Regional Ownership

(2) Analysis of Land Ownership.

The quality of life in the region is partly attributed to the large percentage of public-owned lands, and the recreational opportunities they present. The presence of large tracts of public land contributes to the lowering demands made on the MCP.

h. Regional Outdoor Recreation.

(1) Regional Overview.

Outdoor recreation plays a significant role in the quality of our lives. Residents are active outdoor recreationalists, and demand a variety of recreation opportunities [Washington Interagency Committee for Outdoor Recreation (WICFOR), 1990]. Major natural recreation resources in the region are the Snake River (to the north) and the Blue Mountains (to the south and east). Most developed recreation sites are located at one or the other of these resources. The river provides a wider variety of recreational activities, on a much larger scale, than Virgil B. Bennington Lake. Activities include boating, sailboarding, water-skiing, fishing, hunting, swimming, picnicking, and camping.

The Blue Mountains provide numerous opportunities for a wide variety of recreational activities, including hunting, fishing, snow-skiing, camping, backpacking, and picnicking. Large portions of the mountains lie in Umatilla National Forest, which has developed sites to provide recreational opportunities. Water-related recreation is limited to Langdon and Jubilee Lakes, as well as numerous small streams. Both lakes are located in Umatilla National Forest. Langdon Lake is surrounded by private cabins, while Jubilee Lake is a public lake.

The MCP is primarily used by residents of the local urban area because of alternative, competing recreational opportunities provided by the river and the mountains. For most residents, from both Umatilla County in Oregon and Walla Walla County in Washington, these alternate resources provide recreational opportunities. Plate 2-29 depicts the relationship of MCP to these regional recreational opportunities.

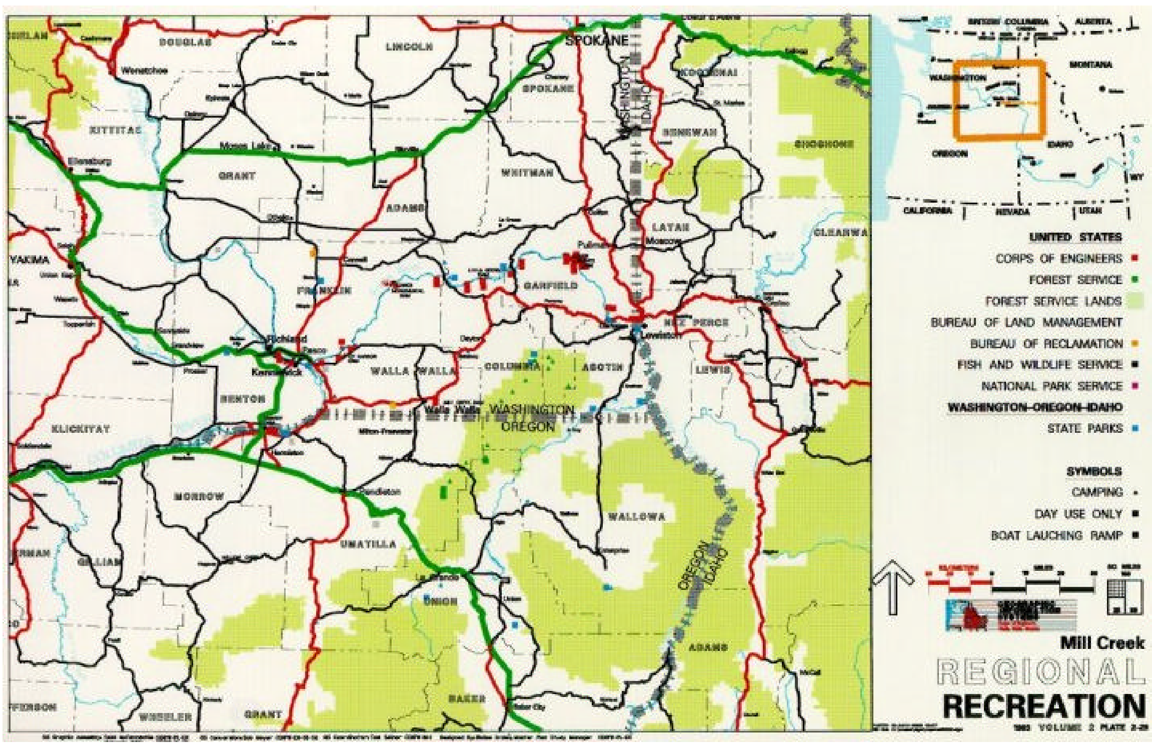

Plate 2-29. Regional Recreation

(2) The MCP MA Recreation.

Local recreation opportunities are most important to the day-to-day lives of the residents. Recreation opportunities are well used when they are close to where the population lives. Three-fourths of the residents in the State of Washington use a park within 15 minutes of their home. State-wide figures of the awareness of a facility and its uses are shown in figure 2-19 [Washington State Interagency Committee for Outdoor Recreation (WICFOR), 1990]. These figures show the importance of outdoor recreation opportunities to the local population.

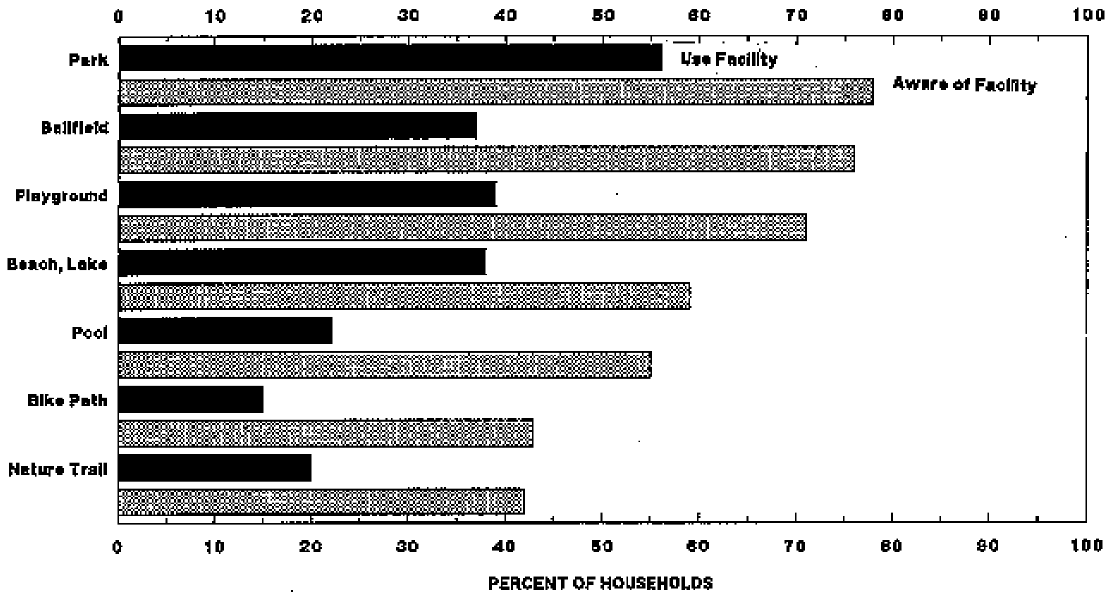

Figure 2-19. Recreation Facilities Within 15 Minutes of Residence

Table 2-11 lists the recreational sites within the Mill Creek MA. The locations of these sites are illustrated on plate 2-29. Within the city limits of both Walla Walla and College Place, there are several parks and recreational facilities that satisfy many of the needs of local inhabitants. In addition, the three local colleges, as well as the public schools, provide a variety of recreational facilities, many of which are open to the general public. In the urban area outside the city limits, limited facilities are available, due in part to the large percentage of agricultural land, which satisfies some of the varied functions of parks.

RECREATION AREA	ACRES	Restrooms	Shelter	Picnic Tables	Playground	Tennis Court	Basketball	Soccer Field	Ball Field	Horse Trail	Bike Trail	Hiking/Walking Trail	Campground	Hunting	Fishing	Boating	Swimming	Display	Nature Study	Snow Activities
Pioneer*	58.2	●	●	●	●	●		●	●								●		●	●
Fort Walla Walla*	208.0	●	●	●	●					●	●	●	●					●	●	
Memorial Athletic Complex*	17.5	●			●	●		●	●								●			●
Eastgate Lions**	11.8	●			●		●	●	●		●									
Evergreen**	1.1				●															
Howard Tietan**	19.2	●		●	●		●	●	●											
Jefferson**	8.0	●	●	●	●		●										●	●		
Memorial Pool**	10.3	●		●	●		●										●			
Menlo**	2.0			●	●	●	●													
Vista Terrace**	6.7			●	●	●	●		●		●									
Washington**	9.3	●	●	●	●		●	●	●											
Wildwood**	6.3	●	●	●	●															
Lions**	6.5	●			●															
Kiwanis (College Place)	7.1	●			●															
Whitman Mission National Historic Site	98.0	●		●								●						●	●	
Mill Creek Project	612.0	●		●	●					●	●	●		●	●	●	●		●	●
WA Dept of Wildlife	57.0														●					
Public Schools	466.1				●	●	●	●	●											

City of Walla Walla Parks

* Community

** Neighborhood

Table 2-11. Recreation Sites

As displayed in figure 2-20, MCP is the largest, in total acreage, of all public-owned recreation open space in the MCP MA. The MCP makes up approximately 33 percent of the total area. Walla Walla city parks make up approximately 29 percent of the public-owned lands, while public schools consist of 25 percent of the total. The MCP contains the only area with a lake for boating, and is the only public open space containing access to Mill Creek. The MCP is also the only open space in the MA open to hunting. The proposed WDW lands [part of the Corps' Lower Snake River Fish and Wildlife Compensation Plan (LSRFWCP)] would also have access to Mill Creek in order to provide fishing access. The closest bodies of water are the Columbia River (28 miles away), Langdon Lake (40 miles away), and Jubilee Lake (52 miles away).

(3) Current and Future Demand.

State-wide and regional recreation participation, as well as future demands, have been identified in the report entitled *Washington Outdoors: Assessment and Policy Plan 1990-1995*, compiled by WICFOR. Much of the information on demand and participation was based on research done by the Pacific Northwest Recreation Committee (PNRC). The following paragraphs are extracted from that report:

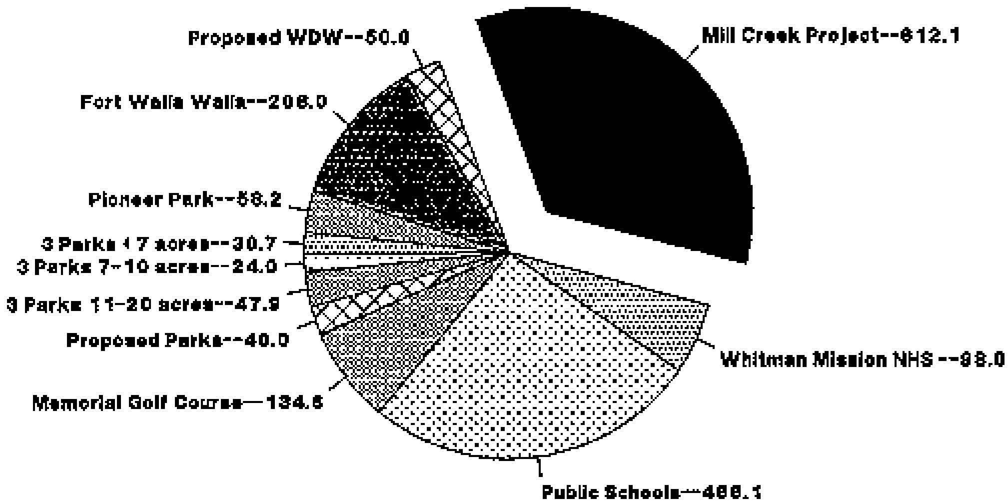

Figure 2-20. Public Recreation Lands, 1993, Mill Creek MA (Walla Walla--College Place Urban Area)

(a) Participation.

Participation in outdoor recreation activities are grouped into 11 broad categories. The recreation activities, by category, are shown on figure 2-21. The most popular activity categories include sightseeing, picnicking, and operating a motorized vehicle (on the road, for pleasure), with 89 percent of all Washington households participating in these activities. Figure 2-22 shows the percent ofrecreation participation by activity category.

Recreation Activities by Category

Fishing
Fishing from a Boat, Bank, Dock or Jetty (freshwater and saltwater)
Crabbing, Clamming, Oyster Gathering, etc.

Water Activities
Swimming or Wading in an Outdoor Pool or at a Beach
Scuba/Skin Diving
Water Skiing
Sailing
Windsurfing/Sailboarding
Lake, River, and Ocean Power Boating
Lake, River, and Ocean Non-motorized Boating (kayak, canoe, rowboat, etc.)
Visiting the Beach/Beachcombing

Nature Study, Food Gathering
Visiting Interpretive Centers and Displays
Nature Study and Wildlife Observation
Outdoor Photography
Mushrooming, Berry Picking and Other Food Gathering
Collecting Objects and Materials in Natural Settings (rocks, agates, seashells, driftwood, etc.)

Hiking, Walking, Climbing
Walking Along Neighborhood Sreets and Roads
Walking in Neighborhood Parks
Day Hiking on Trails
Overnight Hiking/Backpacking
Climbing and Mountaineering

Camping
Organinzed Group Camping (Scouts, Mazamas, YMCA)
Tent Camping with Motorized Vehicles (excludes sleeping in a trailer, pick-up, camper, etc.)
Recreation Vehicle Camping (camper trailer, motor home, van, pick-up, etc.)
Camping by Boat
Horse Camping

Snow Activities
Downhill Skiing, Cross-Country Skiing, Snowshoeing
Sledding, Snowboarding, General Snow Play
Ice Skating
Snowmobiling
All-Terrain Vehicle (ATV) Riding in Snow

Riding or Driving Motorized Vehicle Off-Road for Recreation
Motorcycling Off the Road
All-Terrain Vehicle (ATV) Driving (3 & 4 wheel)
4-Wheel Drive Vehicles Off the Road
Dune Buggy Driving

Non-Motorized Riding for Recreation
Bicycle Riding On the Road
Bicycling Off the Road
Horseback Riding

Sightseeing, Picnicking, Operating Motorized Vehicle on Road for Pleasure
Sightseeing and Exploring
Picnicking
Operating Car/Truck/Motorcycle on the Road for Pleasure

Hunting and Shooting
Hunting Big Game, Waterfowl, Upland Birds, and Small Game
Rifle/Pistol and Skeet/Trap Shooting, Archery

Sports, Games, Other
Football, Rugby, and Soccer
Baseball and Softball
Outdoor Basketball, Tennis, and Other Outdoor Court Games (badminton, shuffleboard, volleyball, etc.)
Using Park Playground Equipment
Jogging/Running
Roller Skating Outdoors
Golf
Attending Outdoor Sporting Events (spectator) or Outdoor Cultural Events (concerts, plays, etc.)
Visiting Amusement Parks, Fairs, Rodeos, Zoos, etc.

Figure 2-21. Recreation Activities by Category

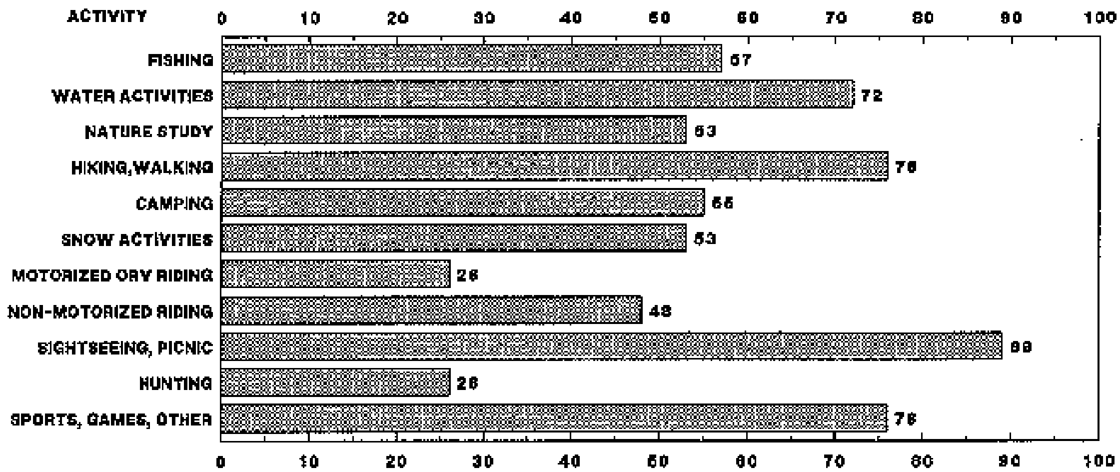

Figure 2-22. Recreation Participation of Activity Category

State-wide, the most popular activities ranked by the number of household trips are jogging, walking, photography, sightseeing, visiting the beach, bicycling, and swimming (see table 2-12).

Table 2-12
57 Outdoor Recreation Activities
Ranked by 1987 Household Trips (in 1000's)

1.	Jogging/Running	11,604	30.	Tent Camping with Motorized Vehicles	1,091
2.	Walking in Neighborhood Park	8,756	31.	Saltwater Fishing from a Boat	1,052
3.	Outdoor Photography	8,524	32.	Lake Non-Motorized Boating	1,008
4.	Sightseeing and Exploring	6,723	33.	Water Skiing	961
5.	Visiting the Beach/Beachcombing	6,077	34.	Hunting Big Game	738
6.	Bicycle Riding on the Road (day trip or shorter)	5,527	35.	4-Wheel Drive Vehicle Driving Off Road	737
7.	Swimming/Wading at a Beach	5,341	36.	Horseback Riding	707
8.	Swimming/Wading in an Outdoor Pool	4,584	37.	Motorcycling Off the Road	691
9.	Using Park Playground Equipment	4,057	38.	Hunting Upland Birds, Small Game, and Waterfowl	674
10.	Picnicking	3,785	39.	Saltwater Fishing from a Bank, Dock, or Jetty	643
11.	Softball	3.660	40.	River Power Boating	639
12.	Day Hiking	3,216	41.	Sailing	494
13.	Sledding and General Snow Play	3,152	42.	All-Terrain Vehicle Driving	467
14.	Golf	3,144	43.	Train or Bus Touring	436
15.	Freshwater Fishing from a Bank or Dock	3,124	44.	River Non-Motorized Boating	427
16.	Nature Study and Wildlife Observation	2,868	45.	Cross-Country Skiing	379
17.	Baseball	2,122	46.	Ocean Power Boating	335
18.	Freshwater Fishing from a Boat	1,936	47.	All-Terrain Vehicle Driving in Snow	299
19.	Soccer	1,859	48.	Climbing and Mountaineering	254
20.	Recreation Vehicle Camping	1,741	49.	Organized Group Camping	245
21.	Visiting Interpretive Centers/Displays	1,679	50.	Backpacking (no trails)	198
22.	Lake Power Boating	1,564	51.	Snowmobiling	192
23.	Downhill Skiing	1,538	52.	Ocean Non-Motorized Boating	172
24.	Outdoor Basketball	1,381	53.	Windsurfing/Sailboarding	131
25.	Other Outdoor Court Games	1,282	54.	Dune Buggy Driving	97
26.	Backpacking (along trails)	1,273	55.	Bow Hunting	93
27.	Outdoor Tennis	1,264	56.	Horse Camping without Pack Stock	49
28.	Football, Rugby	1,133	57.	Horse Camping with Pack Stock	37
29.	Bicycling Off the Road	1,096			

(b) Future Demand.

Assuming that the current relationship between users and resources (or supply and demand) is desirable or tolerable, the amount of participation in the future will impact current recreation resources, the experiences of the visitor, and the amount of new recreation resources needed. The projections were based on knowledge of current recreation behavior, and the factors that influence this behavior. For example, as our society has become more complex, the demand for greater outdoor recreation diversity has increased. The trend is for more recreation opportunities closer to home. In order for the models to predict future activities, assumptions had to be made regarding population growth, age structure, income, and recreation supply opportunities. The model showed that significant growth will occur in all activities between 1987 and the year 2000. Most activities will grow at a higher rate than the population. Table 2-13 shows state growth for recreation activities, ranked by growth rate and project growth in household trips. Visiting interpretive centers, photography, walking in neighborhood parks, one-man non-motorized boating, picnicking, and day hiking are predicted to be among the fastest growing activities. The report projected growth in four regions in the State of Washington, from the year 1987 to the year 2000. Walla Walla County is located in Region 4. Region 4 is composed of nine counties in Eastern Washington: Asotin, Columbia, Garfield, Walla Walla, Spokane, Whitman, Ferry, Pend Oreille, and Stevens. Figure 2-23 shows the growth percentage of different recreation activities in Region 4. The figure shows that some activities are increasing faster than others. The model used a population growth rate of 2 percent. This is considerably slower than the projected growth (29 percent) for the Mill Creek primary MA (see paragraph c., *Population*). Figure 2-24 shows the same activities for Region 2, which is increasing at a rate (19 percent) closer to the current rate of the Mill Creek primary MA. Region 2 is composed of 12 counties in western Washington: King, Kitsap, Pierce, Snohomish, Lewis, Mason, Thurston, Clark, Cowlitz, Klickitat, Skamanish, and Wahkiahum.

57 Outdoor Recreation Activities Ranked by Projected Growth Rate, and Projected Growth in Household Trips, 1987-2000

Activity	Growth Rate (Percent)	Growth in Household Trips (in 1000s)
Visiting Interpretive Centers/Displays	44	746
Outdoor Photography	44	3,755
Walking in Neighborhood Park	44	3,889
Ocean Non-Motorized Boating	41	70
Picnicking	40	1,522
Day Hiking	37	1,201
Bicycling Off the Road	37	401
Visiting the Beach/Beachcombing	36	2,224
Downhill Skiing	36	551
Sightseeing and Exploring	35	2,348
4-Wheel Drive Vehicle Driving Off Road	35	246
Bicycle Riding On the Road (day trip or shorter)	35	1,943
Nature Study and Wildlife Observation	35	1,028
Jogging/Running	35	4,102
Climbing and Mountaineering	35	69
Sailing	34	172
Sledding and General Snow Play	34	1,074
Tent Camping with Motorized Vehicles	33	365
River Non-Motorized Boating	33	144
Lake Non-Motorized Boating	33	332
Recreation Vehicle Camping	33	584
Swimming/Wading in an Outdoor Pool	33	1,535
Motorcycling Off the Road	32	223
Golf	32	1,002
Soccer	32	596
Saltwater Fishing from a Boat	31	326
Saltwater Fishing from a Bank, Dock, or Jetty	31	200
Backpacking (no trails)	31	62
All-Terrain Vehicle Driving in Snow	31	92
Backpacking (along trails)	30	376
Other Outdoor Court Games	29	369
Outdoor Tennis	28	351
All-Terrain Vehicle Driving	28	132
Swimming/Wading at a Beach	28	1,532
Train or Bus Touring	28	125
Softball	28	1,008
Cross-Country Skiing and Snowshoeing	27	105
Using Park Playground Equipment	26	1,040
Water Skiing	26	251
Windsurfing/Sailboarding	26	35
Football, Rugby	26	291
Organized Group Camping	25	64
Lake Power Boating	24	388
Baseball	24	499
Outdoor Basketball	23	316
River Power Boating	22	143
Horse Camping without Pack Stock	21	11
Ocean Power Boating	20	68
Freshwater Fishing from a Boat	20	388
Freshwater Fishing from a Bank or Dock	19	601
Dune Buggy Driving	19	19
Hunting Big Game	18	132
Horse Camping with Pack Stock	18	7
Horseback Riding	17	120
Snowmobiling	16	32
Bow Hunting	15	14
Hunting Upland Birds, Small Game, and Waterfowl	8	52

Table 2-13. 57 Outdoor Recreation Activities Ranked by Projected Growth Rate, and Projected Grown in Household Trips, 1987 to 2000

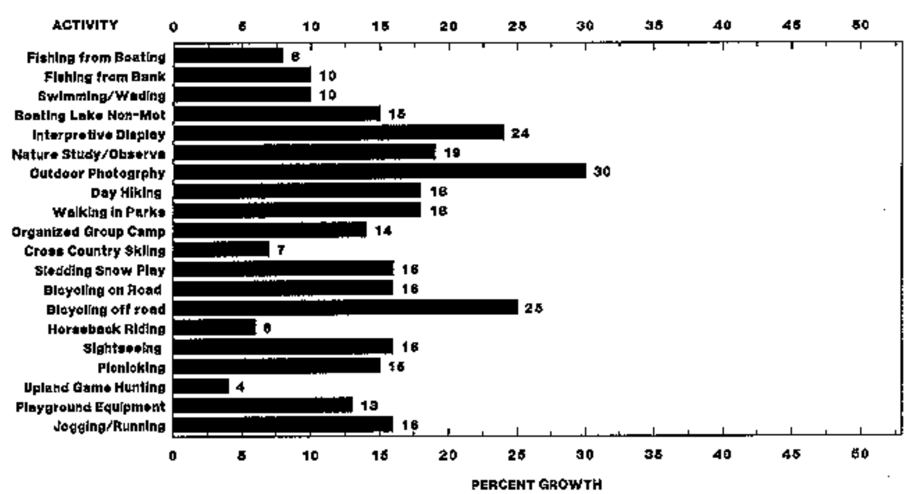

Figure 2-23. Activity Percent Growth Region 4

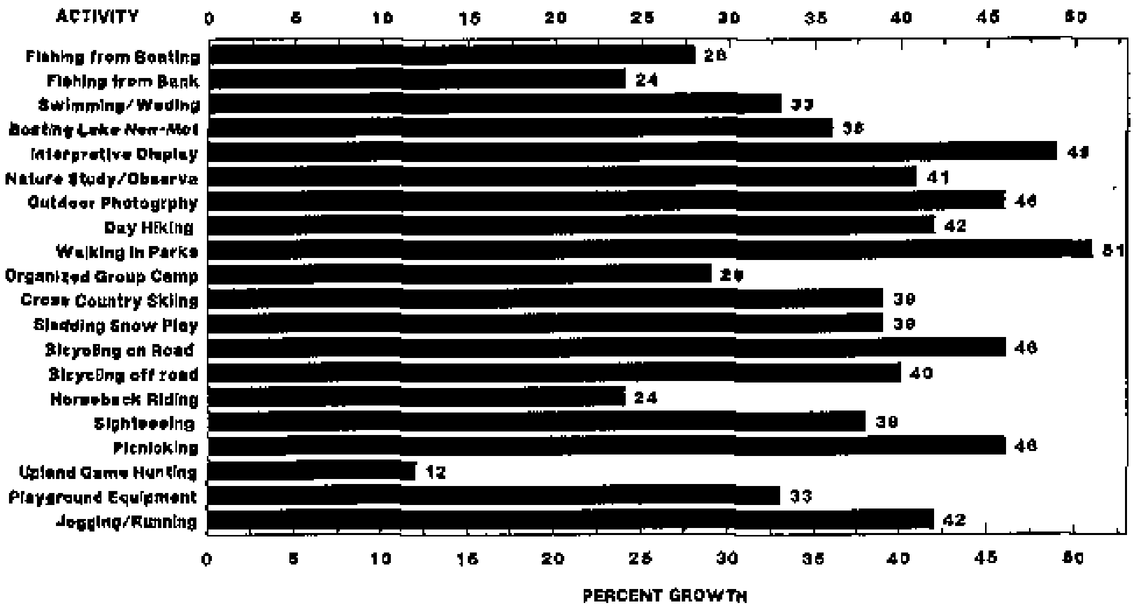

Figure 2-24. Activity Percent Growth Region 2, 1987 to 2000

(c) Future Resource Needs.

To meet increased demands, more access to water, trails, and open spaces will be required. Recreation settings perceived as primitive and natural, as well as in close proximity to residential areas, need to be identified and preserved. The resource has to increase at the levels shown in figure 2-23 if the system is to function at current levels.

(4) Analysis of Regional Recreation.

(a) General.

Recreation demands are growing faster than the population. If the supply of recreation facilities does not keep pace, the demand on the facilities and resources will be impacted. This fact alone will place greater demand on facilities such as MCP. The fastest growing activities will place strains on the current recreation system. Also, some of the new types of activities are creating new management challenges, such as integrating off-road bicyclists with other trail users. If additional facilities are not provided and appropriate management actions are not taken, there will be a different relationship between users and resources. There will be more recreationalists, pursuing a greater variety of activities, and using the same resource base. This will result in increased conflict and resource degradation. This requires that current resources be optimized, and additional resources be committed (Washington, 1990).

(b) The MCP.

The MCP provides very unique outdoor recreation opportunities within the MA. It is the largest public open space, provides the only public access to Mill Creek, is the only public lake open to boating, contains the only public lands open to hunting, is the only natural area along Mill Creek, is the only area that provides horse trails, and is the only area that provides a primitive and natural setting close to the population. Many of the fastest growing activities are already being used at MCP. The demands are going to increase in the future. The attributes of MCP (that provide such unique recreation opportunities) make MCP an extremely valuable resource to the MA. The identified need and demands provide a guide for future resource development and management at MCP. In meeting these needs, the physical limitations of the resources, and Competing recreation also have to be considered in the planning process. These needs, plus those identified by the local MA population, are a significant part of the planning process for the development and management of MCP.

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Section 3 - Project Inventory and Analysis

3.01. General

a. Overview.

This section contains background material that relates to the ecological, cultural, and aesthetic aspects of MCP and its environs. This information identifies the various factors that influence, or constrain, land usage and management. The information here, and in section 2, has been synthesized in section 4 and in volume 1, section 2, in order to aid in the formulation of sound land use, management, and development decisions.

b. Mapping.

The base map used for this inventory was based on aerial photography taken in February 1988 (see plate 3-0). The information was converted to digital information using a Zeiss C-120 Plancomp Analytical Stereo Plotting System. The information then was transferred to an Intergraph® GIS. It was then separated into base files (*i.e.*, transportation, hydrography, boundaries, *etc.*). Themes were added by processing existing information (*e.g.*, topography), or added from other sources (*e.g.*, land ownership from the County Assessor's office). All of the information was digitized from existing maps, or from field work (*e.g.*, as cover types). The area shown on the base map covers almost 3,977 acres, or 6.2 mi^2.

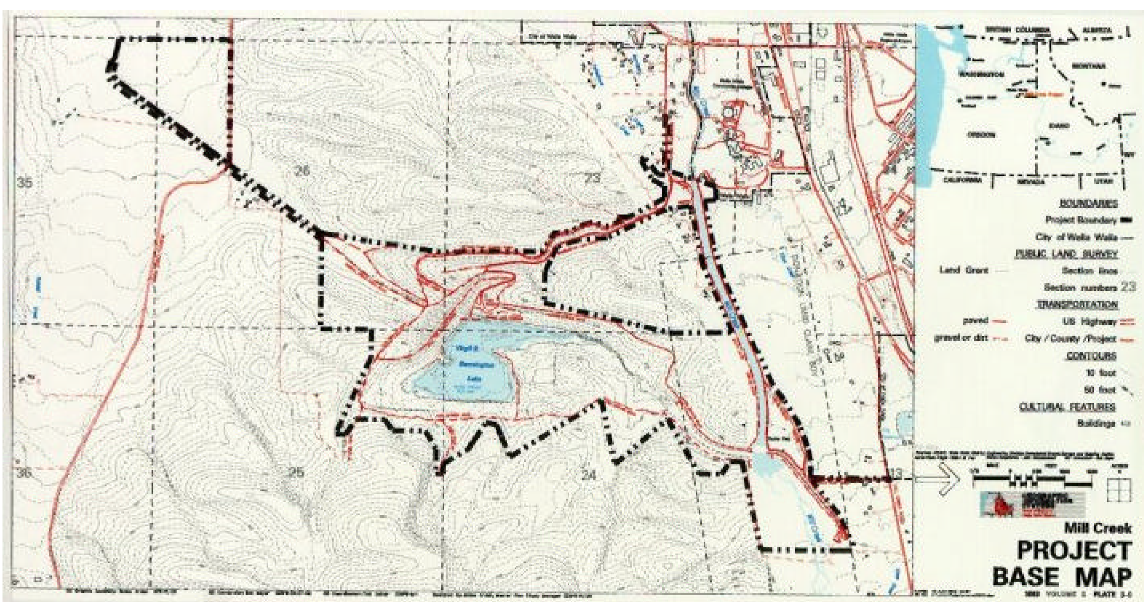


Plate 3-0. Project Base Map

c. The GIS.

After the mapping was completed, a database was attached to each of the features (*i.e.*, roads or buildings) at MCP. Each of the features has a table of attributes that contains fields. Much of the inventory in this section was based on information stored in GIS. The GIS has the ability to query information, by feature or field, in the database. All of the work was accomplished by the Corps, Walla Walla District. The standards designed for MCP will be used for the Walla Walla District's other water resource projects. Also, the standards developed during this study are being used by other Corps Districts and are also incorporated in the Tri-Service Spatial Data Standards being developed at Tri-Service CADD/GIS Technology Center, Waterways Experiment Station.

3.02. Ecological Factors

a. Landform--Physiography.

The following paragraphs contain a description of the project landform in terms of topography, slope steepness, and aspect.

(1) General (Mill Creek Watershed).

The MCP is located within the Mill Creek watershed, a subbasin of the Walla Walla River watershed. Mill Creek is 37 miles long, and drains 165 mi2 within the Walla Walla watershed. Mill Creek originates on the western slopes of the Blue Mountains, at elevation 5500. The creek flows through 15 miles of mountainous terrain before it enters the Walla Walla Valley about 2 miles east of the city of Walla Walla. Downstream of this point (RM 11.5), a diversion dam (elevation 1261) diverts water from the creek into Virgil B. Bennington Lake. The Mill Creek watershed elevations range from 5,500 feet (at the headwaters) to 590 feet (at the mouth of Mill Creek, where it enters the Walla Walla River). The mean elevation of the basin, upstream from the diversion dam, is 3,200 feet. The headwaters are located on the forested slopes of the Blue Mountains. The lower reaches of the creek extend through rolling grasslands primarily used for farming purposes (USACE, 1975).

(2) Topography.

(a) Setting.

The MCP is located 3.5 miles east of downtown Walla Walla, Washington, at the eastern city limits. It is primarily located on Prospect Point Ridge, and at the edge of the Blue Mountain foothills (see plate 3-1 and photo 3-1). The MCP stores water from Mill Creek, in an effort to prevent flooding in Walla Walla. Virgil B. Bennington Lake is located approximately 1 mile south of Mill Creek, in a draw that drains into Russell Creek (a tributary of the Walla Walla River). A small ridge, to the northwest of the project (elevation 1270), separates the lake area from the Walla Walla Valley. Elevations on the fee-owned project lands range from approximately 1,122 feet along the Russell Creek Canal, to 1,365 feet on the bluff south of Rooks Park (see plate 3-1).

From the lake area, the foothills continue to rise parallel to Mill Creek, until it reaches the higher elevations of the Blue Mountains. The conservation elevation (the level that the Corps attempts to maintain for as long as possible) of the lake is 1,205 feet. The flowage easement along Russell Creek has the lowest elevation of the easements (1,060 feet). The mean elevation of MCP is approximately 1,240 feet. Exactly 56.2 percent of the project lies between elevations of 1,122 feet (lowest elevation on MCP) and 1,250 feet.

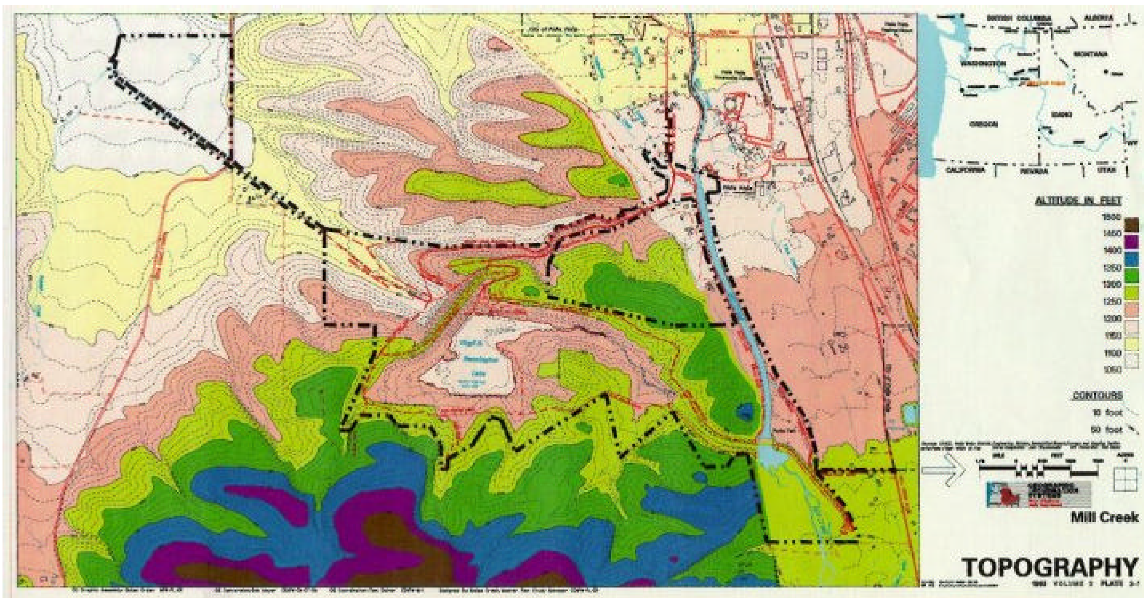


Plate 3-1. Topography

Photo 3-1. Aerial view of MCP and its environs.

(b) The MCP.

Over two-thirds of MCP is located in two elevation zones. These zones are 1200 to 1250, and 1250 to 1300. Both of these zones are in the mid-range of the elevation zones found at MCP (refer to table 3-1 and figure 3-1). Approximately 43 percent of MCP (263 acres) is located between elevation 1200 and 1250. This percentage includes the lands surrounding the lake, Rooks Park (and the area that continues downstream along Mill Creek), and the lands below Mill Creek Dam. Close to 36 percent (220 acres) of the project lands lie between elevation zone 1250 and 1300. Most of these lands surround the lake. The remaining 21 percent of the project lands lie as follows: the 3.6 percent (22 acres) located below the dam on both sides of the Russell Creek Outlet channel fall in elevation zone 1100 to 1150; the 17.4 percent (60 acres) in the lake, below the dam (along the Russell Creek Outlet channel), and the Project Office Area, lie in elevation zone 1150 to 1200.

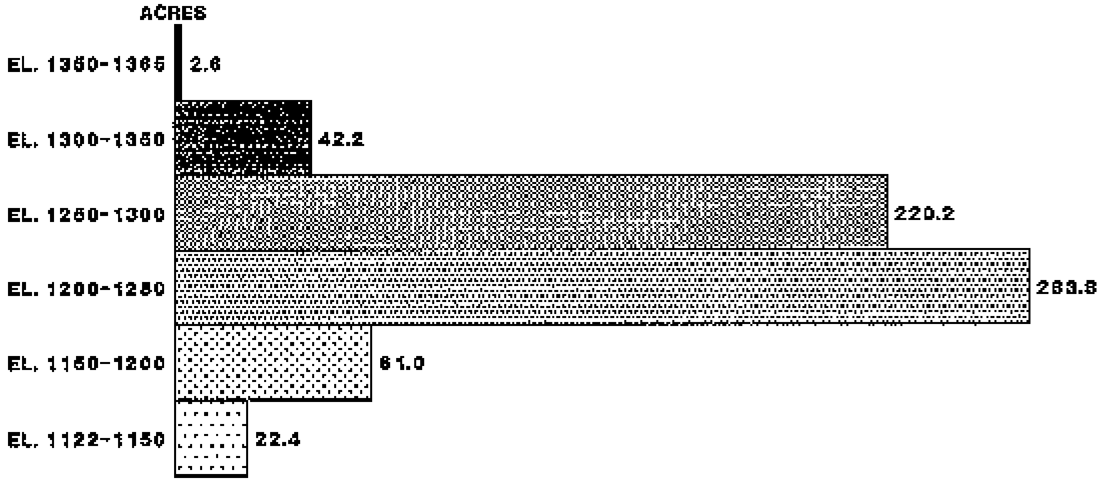


Figure 3-1. Mill Creek Project Altitude (feet)

Table 3-1 The MCP Elevation Zones		
Fee Lands		**Altitude (Feet)**
Highest Point	Bluff South of Rooks Park	1,365
Lowest Point	In Russell Creek Outlet Canal	1,122
Altitude Range	**MCP Acreage**	**Percent of MCP**
1350-1365 (1400)	2.56	0.4
1300-1350	42.16	6.8
1250-1300	220.20	35.9
1200-1250	263.83	43.1
1150-1200	60.34	9.9
1122-1150	22.37	3.6
	611.46	99.7

(c) Analysis of Topography.

The project location was chosen because of its close proximity to Mill Creek, and the elevation changes that allowed for the construction of the dam. The 250-foot elevation change on the project lands serves as an interesting visual resource for visitors, as well as an excellent habitat for various forms of wildlife.

(3) Slope Steepness.

(a) The MCP.

Approximately 44 percent of the project (268 acres) is flat, or moderately flat (0- to 7-percent slope). (See table 3-2, figure 3-2, and plate 3-2.) These are the flat lands that lie along Mill Creek and surround Virgil B. Bennington Lake and the Russell Creek Outlet. Another 31 percent of the project is moderate slopes (8- to 15-percent slope). These portions are located below the dam, along the lake access road, and around the lake.

Also included in this grouping is a recently purchased 63-acre parcel that lies between Upper Service Road and Mill Creek. Approximately 15 percent of the project is steep slopes (16- to 25-percent slope). The majority of lands in this grouping are located below the Mill Creek Dam and along Upper Service Road. Approximately 10 percent (63 acres) is very steep slopes (greater than 25-percent slope). These lands are located along the steep banks south of Mill Creek, and on the face of Mill Creek Dam.

Table 3-2
Mill Creek Project Steepness of Slope

Slope	Slope Percent	MCP Acreage	Percent of MCP
Flat*	0	28.04	4.6
Mod Flat	0-7	239.57	39.2
Moderate	8-15	187.99	30.7
Steep	16-25	92.84	15.2
Very Steep	25	63.02	10.3
		611.46	

*Lake Elevation 1187

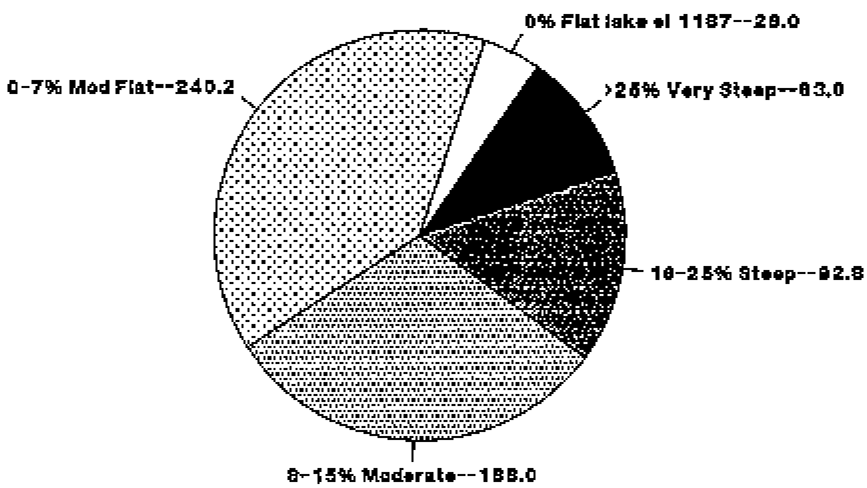


Figure 3-2. Mill Creek Project Steepness of Slope

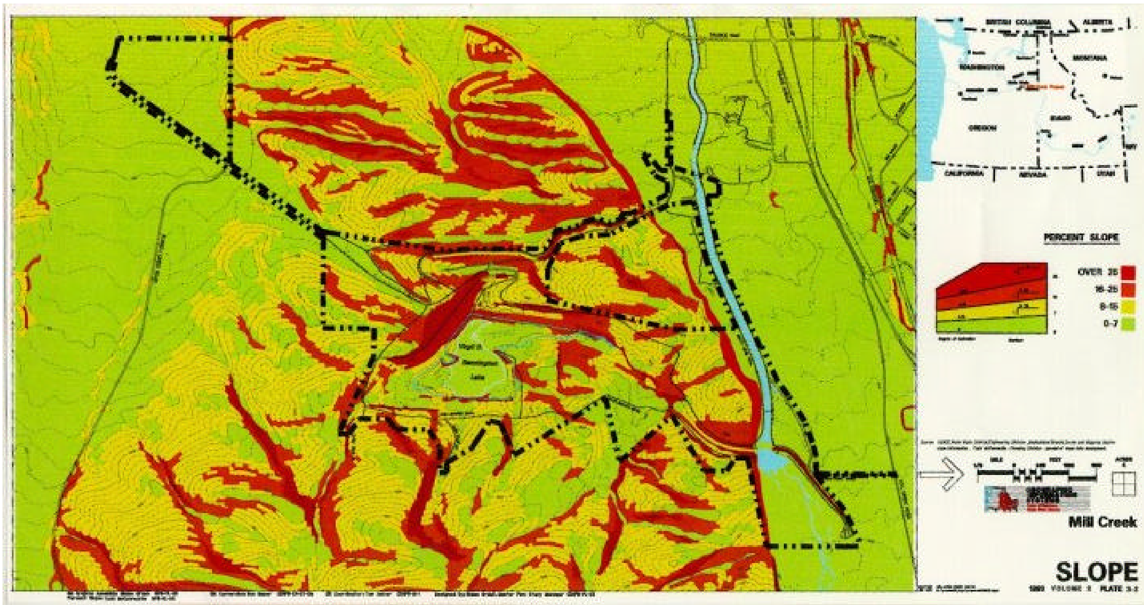


Plate 3-2. Slope

(b) Analysis of Slope.

Development is usually limited to slopes of less than 25 percent. Slopes of less than 16 percent are considered easily developed. Three-fourths of MCP (456 acres) has slopes of less than 16 percent. Therefore, steepness of slope will not hinder, or limit, development on the project. However, development should be avoided in steep areas because of the erodibility of soils, and the prohibitive costs incurred in such development.

(4) Aspect.

(a) General.

Aspect is the specific direction a slope faces. Aspect, combined with slope, can be used to determine the evaporation and solar radiation an area will receive. Aspect has a tremendous influence on vegetation, as can be seen from the heavy shrub development on the north and northwest steep slopes at MCP. The project lands have been divided into nine aspect zones, which are listed in table 3-3 and figure 3-3.

Table 3-3
The MCP Aspect

Aspect	MCP Acreage	Percent of MP
Flat*	259.36	42.5
North	36.88	6.0
Northeast	23.60	3.9
East	46.87	7.7
Southeast	53.74	8.8
South	16.33	2.7
Southwest	56.06	9.2
West	73.41	12.0
Northwest	45.22	7.4
	611.46	100.2

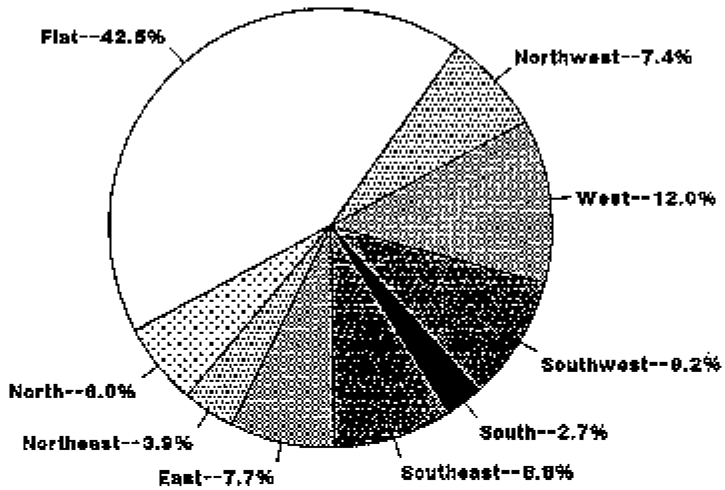


Figure 3-3. The MCP Aspect

(b) Analysis of Aspect.

The MCP has a variety of aspect angles that can be used for locating developments. These different aspects, in combination with soils and slope percentage, can be used during the location analysis (see plate 3-3).

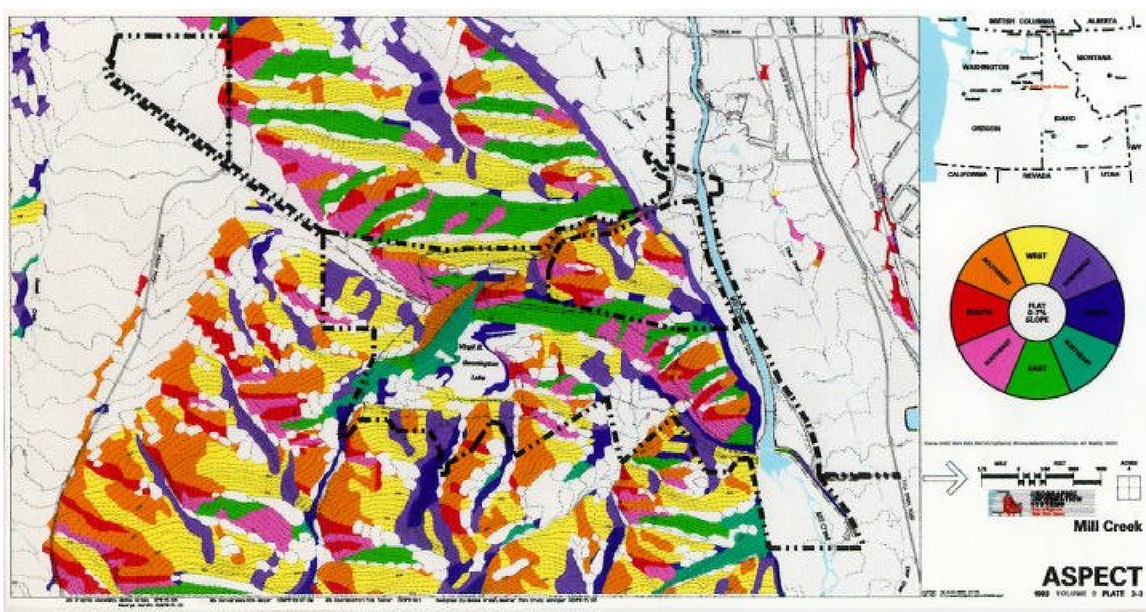


Plate 3-3. Aspect

b. Geology.

(1) General.

The MCP is located on the edge of the Walla Walla Valley, on Prospect Point Ridge. The oldest rocks at MCP are basalts similar to those of the Columbia River Basalt Group. These rocks underlie the entire project, but are exposed only in the southern and eastern portions of the project lands. Overlying the basalt bedrock is a 30- to 160-foot-thick sequence of semiconsolidated gravel and clay that has been referred to as either "the conglomerate" or "the older gravels" (Newcomb, 1965). Loess overlies this conglomerate, and forms the present ground surface. The relationship between the basalt, the conglomerate, and the loess is illustrated in figure 3-4. Faults, which have been identified in the vicinity of the project, are known to have offset all of the layers discussed above (see figure 3-5) (USACE, 1984a). The existence of these faults indicates a significant potential for future seismic events.

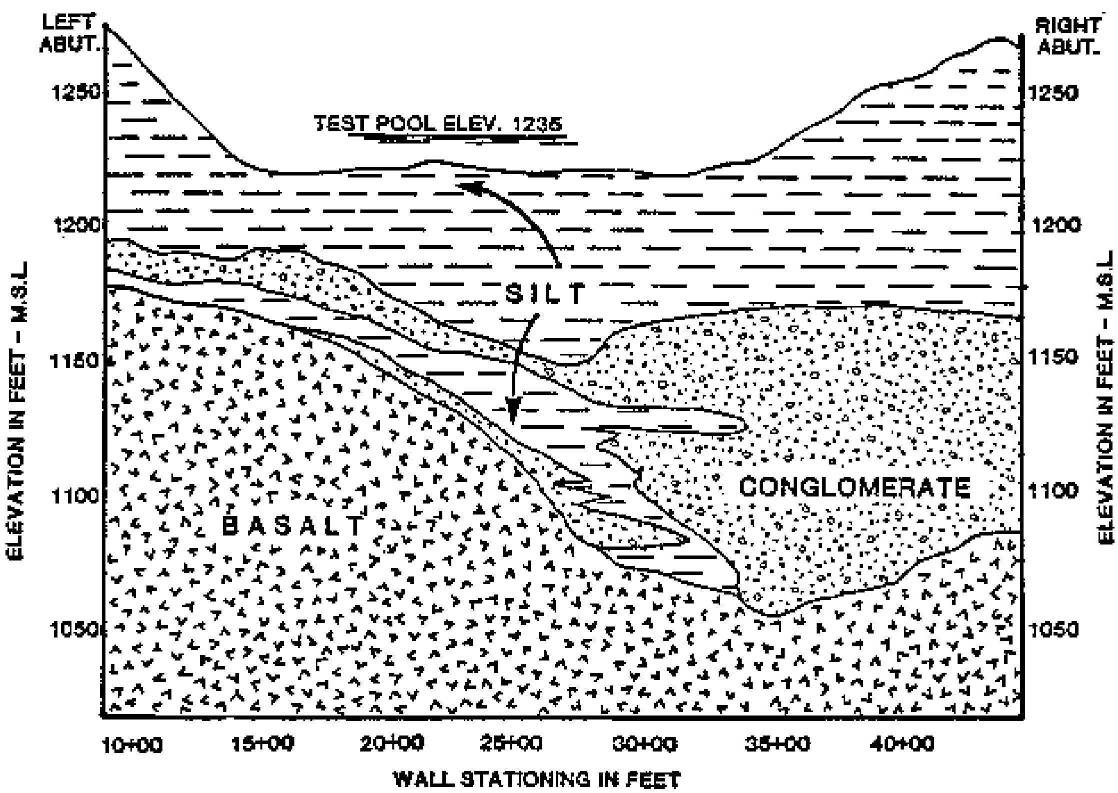


Figure 3-4. Geologic Cross-Section Illustrating the Relationship Between the Basalt Bedrock, the Conglomerate, and the Wind-Deposited Loess

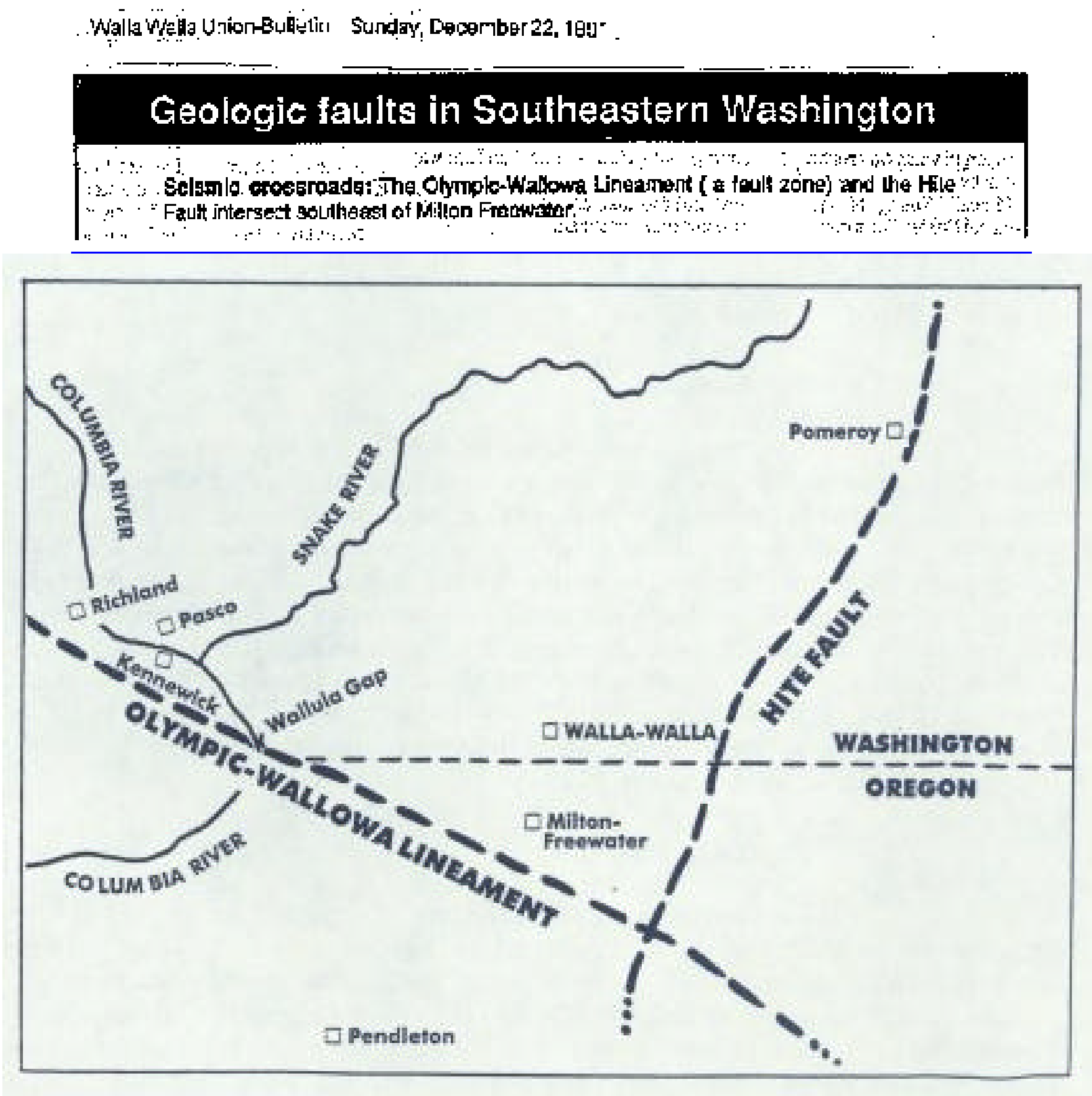


Figure 3-5. Major Geologic Faults

(2) Historic.

The basalts that form the bedrock of the MCP are a result of basalt lava flows from the Columbia River Basalt Group. These lava flows erupted between 17 and 6 million years ago, and formed one of the world's largest lava plateaus. In southeast Washington and northeast Oregon (Blue Mountain Physiographic Province), these basalt flows have, through the process of uplifting and erosion, become mountainous terrain. Due to forces within the earth's crust, this area began rising before the first flows of the Columbia River Basalts ever occurred, and it continues to rise today (Hooper *et al*., 1981).

As the mountains rose, the basalt gravels of the Walla Walla Basin were deposited. Loess was then deposited over the entire region. Uplift in the Blue Mountain Region has, and continues to, produce folds and faults in the bedrock. The faults discussed in the previous section are probable products of this uplift.

(3) Faults.

(a) Walla Walla Environs.

Walla Walla is located in the most seismically-active area in eastern Washington. Two major faults intersect just south of Milton-Freewater, Oregon (see figure 3-6). However, no earthquake has ever been measured above 6.0 on the Richter scale, and the area is not in close proximity to the convergence zone for a large earthquake (WWUB, 1991).

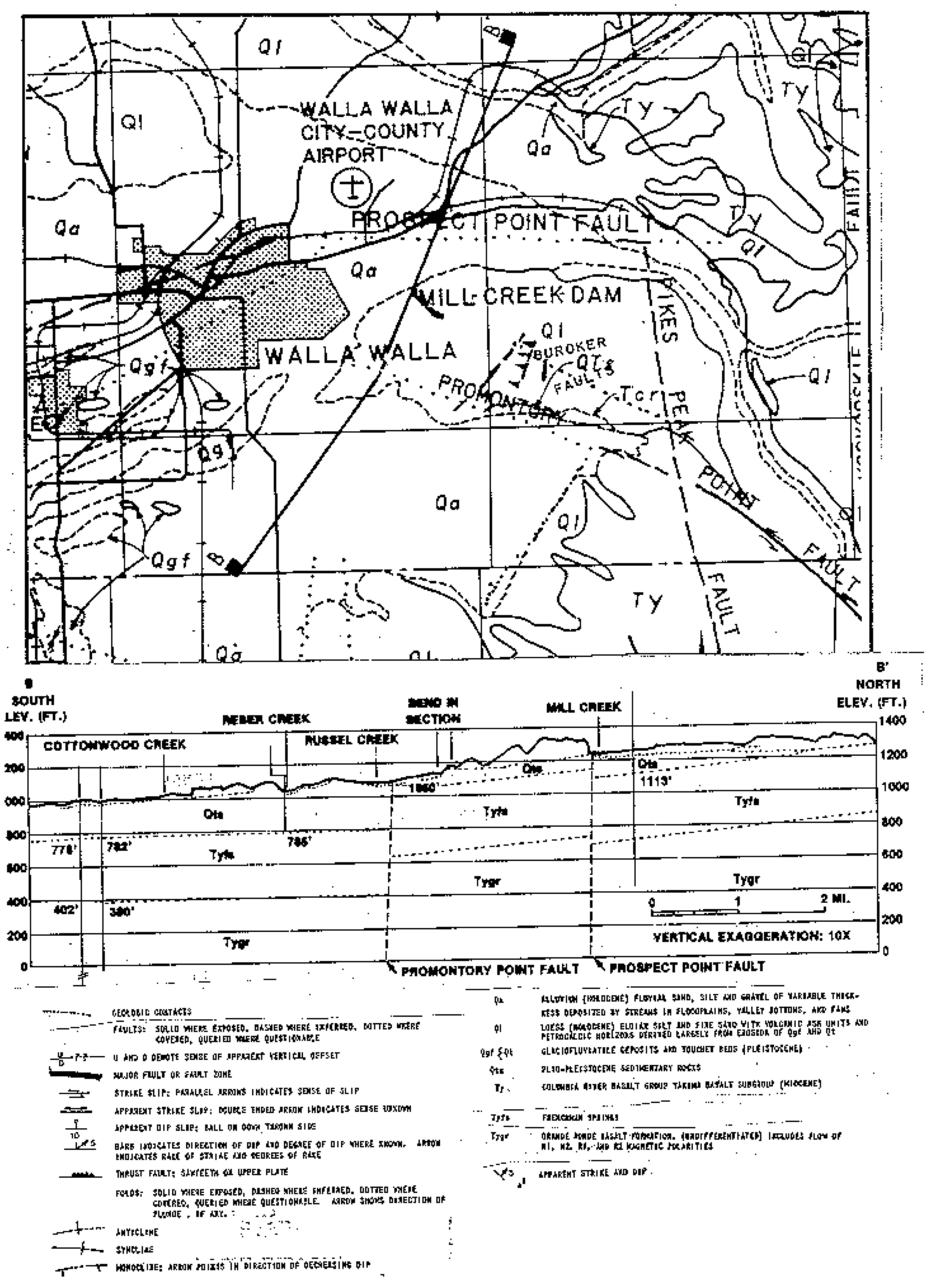


Figure 3-6. Geology in the MCP Environs

(b) The MCP.

Two faults are located within the project. The Prospect Point Fault runs along Mill Creek and Prospect Point Ridge (see plate 3-4 and figure 3-5). The Promontory Point Fault follows Russell Creek Road, and passes under the Russell Creek Outlet Canal easement. The Buroker Faults, related to the Promontory Point Fault, lie about 1-1/8 mile southeast of Mill Creek Dam (USACE, 1948a).

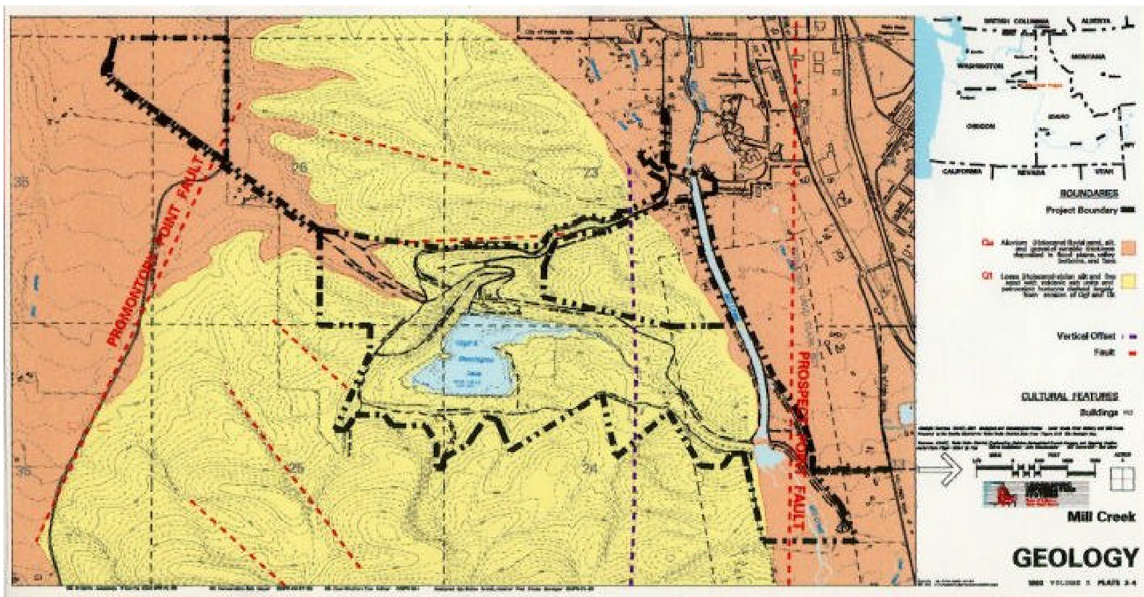


Plate 3-4. Geology

(4) Earthquakes.

The largest recorded earthquake in the area occurred near Milton-Freewater on 15 July 1936, and measured 6.0 on the Richter scale. The earthquake caused approximately $100,000 in damages (Bennett, 1988). Recently, there have been several small earthquakes in the Walla Walla area. The Geophysics Department at the University of Washington, in Seattle, reported four measurable earthquakes in the Walla Walla area between 27 November and 15 December 1991. None of these earthquakes have caused significant damage, and are simply considered normal movement for the area. The earthquakes ranged from 1.8 to 4.8 on the Richter scale. They were all centered just south of Walla Walla, between Baker-Langdon Road and the Washington-Oregon state line (Powerline Road)(USACE-Stidham, 1991).

(5) Analysis of Geology.

No serious structural hazards exist that would inhibit further development at MCP. However, due to the geologic structure, the reservoir has had a seepage problem since its completion in 1942. The problem has been studied, and solutions have been engineered that have slowed the rate of loss. The seepage has been concentrated to the right abutment, where it escapes to the end of the cutoff wall. Most of the water appears to escape from the lake between elevations 1,205 and 1,215 (USACE, 1989). There have been proposals to line the lake, but costs have always been considered to be too high.

c. Soils.

(1) General.

This section defines the type, extent, and engineering properties of the surface soils that exist at MCP. Much of the data contained in this section was obtained from a U.S. Soil Conservation Service (SCS) soil survey of Walla Walla County (SCS, 1964). Land slopes were taken from the Corps 1983 topography survey, and depths-to-gravel and bedrock were taken from Corps exploration drill logs. The SCS soil survey provides an excellent reference for information on the additional properties of project soils. Soil capabilities definitions and a matrix are located in Supporting Data 12.

(2) Soil Inventory of MCP.

(a) Overview.

Most of the Walla Walla Valley and its environs is mantled with a deep, loam-textured soil, known as loess. Using the SCS method of soil classification, the soils that exist within project boundaries are divided into three series: 1) Athena; 2) Walla Walla; and 3) Yakima series. Also included in this section are existing and possible borrow pits (Bp). The first two series are loess. Within these series, subclassifications exist that further distinguish soils of different texture and slope. The paragraphs that follow describe each classification. The map symbol, a 2- to 4-character alphanumeric code, is included with each soil heading (*e.g.*, AtE2). Definitions of nomenclature are included in table 3-4, which also summarizes characteristics of the soils, and provides additional data. Plate 3-5 provides the location and extent of each soil classification, while figure 3-7 shows the percentage of the soils compared to the total.

Table 3-4
Description of MCP Soils

Map Symbol	Series, Texture	Slope Percent	MCP Acreage	Percent Project	Depth (feet) to gravel	Depth (feet) to bedrock	pH	Permeability (inches/hour)	Available Water Cap (inches/ foot)
AtE2	Athena Silt Loam, Eroded	30 to 45	11.5	1.9	3-120	200-300	7.4-7.8 Mildly alk	--	--
Bp	Borrow Pit	--	33.4	5.5	--	--	--	--	--
Ma	Manmade Land (Dam)	--	32.7	5.3	--	--	--	--	--
WaB	Walla Walla Silt Loam	0 to 8	51.5	8.4	3-25	20-150	6.6-7.3 Neutral	0.8-2.5	2.0-2.4
WaD	Walla Walla Silt Loam	8 to 30	303.9	49.7	3-100	20-200	7.4-7.8 Mildly alk	0.8-2.5	2.0-2.4
W1B	Walla Walla Silt Loam								
	Lacustrine Substratum	0 to 8	46.8	7.6	0-70	5-110	6.6-7.4 Neutral	0.8-2.5	2.0-2.4
W1D	Walla Walla Silt Loam								
YKA	Lacustrine Substratum	8 to 30	11.4	1.9	10-60	10-90	8.5-9.0 Strongly alk	0.8-2.5	2.0-2.4
	Yakima Gravely Silt Loam	0 to 3	18.2	3.0	1-15	150-200	6.6-7.3 Neutral	5.0-10.0	1.0-1.4
YmA	Yakima Silt Loam	0 to 3	102.1	16.8	1-30	40-200	6.6-7.3 Neutral	0.8-2.5	2.0-2.4
MC Dam									

Map Symbol	Series, Texture	Erodibility	Shrink Swell	Site Develop	Sanitary Facility	Construct Materials Improving	Capability of Soils Dryland	Unified	Wildlife Habitat Potential	AASHO
AtE2	Athena Silt Loam, Eroded	High	Low	Severe	Severe	Poor	IVe-2	ML	Good	A-4
Bp	Borrow Pit	--	Mod	Severe	Severe	Pr/Imp	VIIs-7	*	--	--
Ma	Manmade Land (Dam)	--	--	--	--	--	--	--	--	--
WaB	Walla Walla Silt Loam	Slight	Low	Sgt-Mod	Sgt-Mod	Good/Imp	IIc-2	ML	Excellent	A-4 (8)
WaD	Walla Walla Silt Loam	Moderate	Low	Sgt-Mod	Sgt-Mod	Good/Imp	IIIe-7	ML	Excellent	A-4 (8)
W1B	Walla Walla Silt Loam									
	Lacustrine Substratum	--	--	--	Severe	--	--	--	Poor	A-4 (8)
W1D	Walla Walla Silt Loam									
	Lacustrine Substratum	--	--	--	Severe	--	--	--	Good	A-4 (8)
YKA	Yakima Gravely Silt Loam	Slight	Low	Fair	Fair	Good/Poor	VIs-2	ML	Good	A-4
YmA	Yakima Silt Loam	Slight	Low	Fair	Fair	Good/Poor	VIs-2	ML	Good	A-4--A-1
MC Dm										

*GM, SM, GMGC, CL
Drainage: All Soils Within Project Drain "Well."
NOTES:

Series, soil: A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface soil, are similar in different characteristics and in arrangement in the profile.

Texture, soil: The relative proportions of the various size groups of individual soil grains in a mass of soil. Specifically, the proportions of sand, silt, and clay. Following definitions for project soils. Silt loam - Soil material (1) 50 percent or more of silt and 12 to 27 percent of clay, or (2) 50 to 80 percent silt and less than 12 percent clay.

Slope: The incline of the surface of a soil, expressed in percent, which equals the number of feet of fall per 100 feet of horizontal distance.

Depth to gravel/bedrock:

pH (reaction): The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral. Acid soils are pH value below 6.5, neutral soils range from 6.6 to 7.3, and alkaline soils are pH values above 7.4. The soils at MCP range from neutral (6.6-7.3) to strongly alkaline.

Permeability: The quality of a soil horizon that enables water or air to move through it. Relative Terms--very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

Available Water Capacity: The amount of water available to plants that is held in a soil after a good rain or irrigation. It is the amount of water in excess of the wilting coefficient, held in a soil against the force of gravity.

Erodibility or Erosion Hazard: The probable susceptibility to the wearing away of the land surface by detachment and transport of soil and rock material through the action of moving water, wind, or other geological agents. Relative terms are--none, slight, moderate, high, and very high.

Shrink Swell: Rating that indicates the volume change to be expected of the soil material along with changes in moisture content.

Capability Unit for Dryland: This classification is grouping of soils that shows in a general way how suitable soils are for agriculture. The classifications are based on limitations, the risk of damage when used, and the response to treatment. Class II--Soils that have some limitations that reduce the choice of plants or required moderate conservation practices. Capability unit IIe-2--Deep, medium-textured soils that have formed in loess and slopes up to 8 percent; precipitation, 19 to 24 inches per year. Class III-Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both. Subclass IIIe--Soils subject to severe erosion if they are cultivated and not protected. Capability unit IIIe-7--Medium-textured soils that have formed in loess and have slopes up to 30 percent; most soils have a hardpan, a hard columnar subsoil, or overlie calcareous lake sediment; precipitation, 12 to 16 inches per year. Subclass IIIs--Soils that have severe limitations of moisture capacity or tilth. Capability unit IIIs-1--Medium-textured soils over gravel. Class VI--Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both. Subclass VIx--Soils generally unsuitable for cultivation and limited for other uses by their moisture capacity, stones, or other features. Capability unit VIs-2--Gravely and cobbly, medium-textured, very gently sloping soil underlain by gravel at shallow depths; precipitation, 6 to 12 inches per year.

Unified Classification: Engineering classification described in the United Soil Classification System.

AASHO: Engineering classification approved by the American Association of State Highway Officials, published in Standard Specifications for Highway Materials and Methods of Sampling and Testing. In this system, the materials are classified in seven principal groups. The groups range from A-1, which consists of gravely soils of high bearing capacity, to A-7, which consists of clay soils having low strength when wet. In each group, relative engineering value of the soil material can be further indicated by a group index number. Group index numbers range from 0 for the best materials to 20 for the poorest. The group index number is shown in parentheses, following the group symbol.

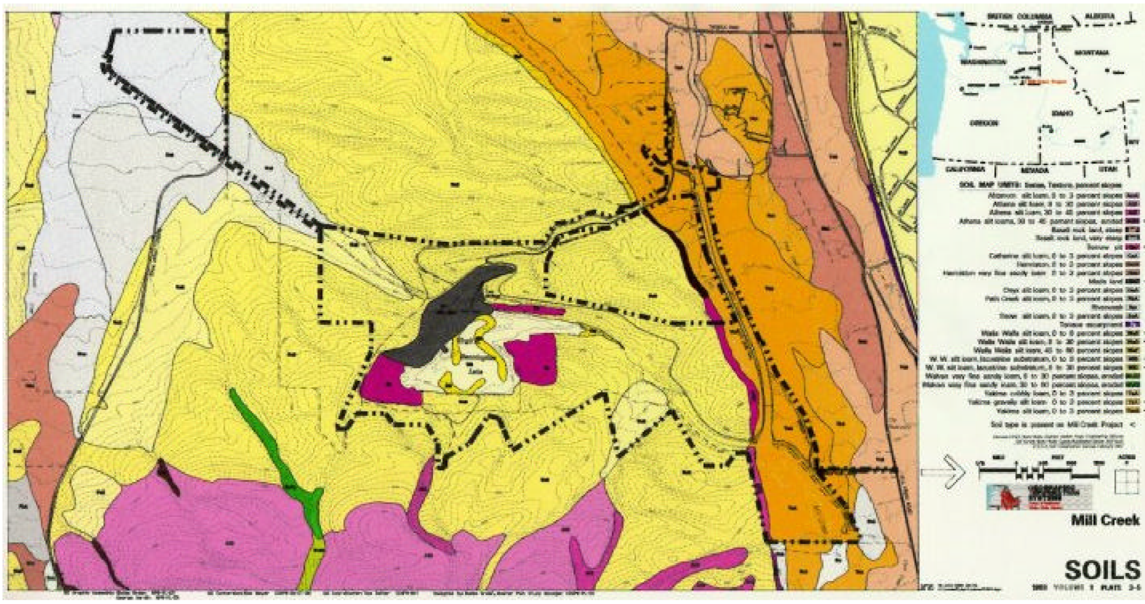


Plate 3-5. Soils

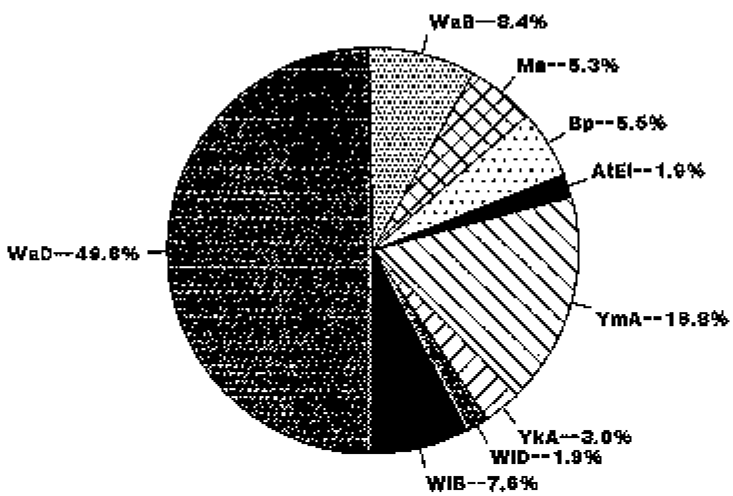


Figure 3-7. Mill Creek Project Soils

(b) Athena Series (A).

1. General Description.

This soil series is the least extensive at the project (1.9 percent), and only one subclassification of this series is found here. The Athena series consists of deep, well-drained soils that are noncalcareous to a depth of approximately 4 feet. They have formed under thick stands of bunchgrasses.

2. Athena Silt Load I (AtE2), 30- to 45-Percent Slopes, Eroded.

This soil subclassification covers 11.5 acres, or 1.9 percent of the project. It has a profile similar to that of Athena silt loam (AtD), 8- to 30-percent slope (located just east of MCP), except that all of the original surface layer has been lost through erosion. This soil usually occupies slopes that face south. However, at MCP, these soils are located on a slope that faces north and is located just south of Mill Creek (across from Rooks Park and the forebay area parallel to Mill Creek). The two areas are divided by the inlet canal. The soils are covered with shrubs and a few trees. Runoff is rapid in this area, and the danger of erosion is great. Plant roots penetrate deeply into the soil, making it easy to supply water to the vegetation. This soil is not recommended for cultivation, however, because the surface layer slakes when it gets wet and becomes hard as it dries.

(c) The Bp.

1. General Description.

A total of three sites, comprising 33 acres of MCP, are located outside the normal lake area. These sites were used as silt-borrow sources during the construction of Mill Creek Dam in 1941. These areas were originally Walla Walla silt loam. Each of these three sites will be discussed in more detail in the following paragraphs.

2. The Bp, 0- to 2-Percent Slope.

This 3.7-acre site, located west of the lake, has been used as a borrow source on several occasions since the original dam construction. It now serves as a parking lot for visitors coming to the lake. In 1983, the site was used to mix silt and lime for dam rehabilitation activities. This usage made the upper 2 feet extremely hard and impervious. Drainage is very poor here, the water-supplying capacity is low, and the erosion hazard is nonexistent on the flat surface area. Most of the area has been graveled. As a result of the borrow excavation, a near-vertical slop remains on the northern boundary of the site. This slope has proved to be very stable, and erosion is slight.

3. The Bp, 2- to 30-Percent Slope.

There were two other sites used for borrow sources during dam construction. One of the sites is located adjacent to the left abutment of the dam, and the other is located just north of Virgil B. Bennington Lake. These sites have both been identified as future possible sources of silt, if they are expanded northward. The original top soil has already been removed from the pits, but the remaining soil is similar in makeup to the original soil, discounting compaction caused by heavy equipment. The engineering properties, of both the original and the remaining soil, are the same.

4. The Bp, Potential Site [Walla Walla Silt Loam, 8- to 30-Percent Slope (WaD)].

A potential borrow site has been identified by the Corps, Geotechnical Branch, as a source of silt. The potential site is located just north of an already existing Bp that is north of, but adjacent to, Virgil B. Bennington Lake. The need for material from this site does not currently exist, but the location should be considered in future planning. The potential pit is located in WaD soil.

(d) Walla Walla Series.

1. General Description.

The Walla Walla series covers over 67 percent (414 acres) of the project. It consists of well-drained, and somewhat excessively-drained, medium-textured soils that have formed in loess. These soils are neutral to moderate alkaline, to a depth of 50 to 60 inches. At that depth, lime is encountered. The Walla Walla soils contain less clay than the Athena soils. Vegetation native to these soils includes bluebunch wheat grass, Idaho fescue, Sandberg bluegrass, balsamroot, yarrow, and lupine.

2. Walla Walla Silt Loam (WaB), 0- to 8-Percent Slope.

The WaB soil covers 52 acres, and is the second most extensive soil type at MCP. The soil is deep, well-drained, and moderately permeable. Its water-supplying capacity is high, and its fertility is moderate to high. This soil has the same engineering properties as WaD except that runoff is slow, and the potential for erosion is small provided the soil is covered with native grasses. However, in cultivated areas that are left bare, there is considerable runoff, and a great amount of erosion occurs. The soil does, however, respond well to management.

3. The WaD, 8- to 30-Percent Slope.

This soil is the most prevalent soil in Walla Walla County, as well as at MCP. The WaD soil covers 50 percent (304 acres) of the project. On south- and southwest-facing slopes, the surface layer is lighter than WaB, while it is darker on north-facing slopes. The depth of lime ranges from 3.5 feet (on the ridges) to 6 feet (on the top of the north-facing slopes). Runoff is slow to medium, and there is a moderate erosion hazard. Runoff and soil loss are less for those soils that are protected. Soil loss is high in unprotected fields.

4. Walla Walla Silt Loam (W1B), Lacustrine Substratum, 0- to 8-Percent Slopes.

The W1B soils and Walla Walla Silt Loam, Lacustrine Substratum, 8- to 30-percent slopes (W1D) cover 7.6 percent (46.8 acres) of the project, and are located below the normal lake level (elevation 1205). Much of the original topsoil was removed during construction of the dam in 1941. Saturation has changed the texture of the original Walla Walla silt loam that existed in the area. In the early 1940's, a layer of compacted silt was constructed in this area in an effort to reduce seepage. Since that time, approximately 2 feet of silt sediment have deposited on the lake floor. The existing surface materials have a high organic content, low water-supplying capacity, and low erosion hazard. When the lake is dry, a network of cracks form on the surface. These cracks are about 1 foot deep and 1 inch wide. The material can easily be tilled. Sediments in the catchment basin of the diversion structure on Mill Creek have successively been used as topsoil for lawn grass. The sediments in the lake area are similar, and should support vegetation. This soil is underlain by lake deposits at a depth of 3 to 4 feet. All horizons contain fine basalt and granite gravel. The soil is well drained but, due to the underlain lake deposits, salt problems may develop.

5. The W1D, Lacustrine Substratum, 8- to 30-Percent Slopes.

This soil is also located below the normal lake level and, while it is similar to W1B, the underlying sediment is closer to the surface, and the lime is frequently within 2 feet of the surface. This soil responds well to the use of fertilizer, as well as to soil-building crops.

(e) Yakima Series.

1. General Description.

These soils are located along Mill Creek, and cover 20 percent (120 acres) of MCP. The series consists of excessively-drained to somewhat excessively-drained, medium-textured soils formed in alluvium. The alluvium consists of basaltic material washed down from the Blue Mountains, and loess from the soils of the uplands. The soils are shallow and unlined by loose pebbles and cobbles on the surface. They are not recommended for cultivation. The native vegetation consists of willow and black cottonwood along the streams, and beardless wheatgrass and wildrye on the bottom areas. Sagebrush and sumac grow in the more cobbly areas.

2. Yakima Gravely Silt Loam (YkA), 0- to 3-Percent Slope.

The YkA soil is located along Mill Creek, and covers 3 percent (18 acres) of MCP. The soil is somewhat excessively drained. It is low in fertility, as well as in water-supplying capacity. It is moderate-to-rapidly permeable above the gravel, and very rapidly permeable in the gravel. Root penetration is shallow. Runoff is very slow, and the erosion hazard is slight. The soils contain enough gravel to make tillage difficult, and irrigation is required for the growth of lawngrass.

3. Yakima Silt Loam (YmA), 0- to 3-Percent Slopes.

The YmA soil is medium-textured, and covers 16.8 percent (102 acres) of MCP. It is underlain by coarse stream gravel at a depth of 15 to 24 inches. It is noncalcareous, and neutral in reaction. There is little danger of erosion, except when overflow during high water causes streambank cutting. Crops raised in this soil require irrigation, but the soil responds well to management.

(3) Analysis of Project Soils.

(a) General Engineering Aspects of Soil Behavior.

Loess soils make up 70 percent of MCP. All of the loess soils at MCP have basically the same engineering properties. The most significant engineering property of this soil is its tendency to settle excessively under load when it becomes wet. Because of the way it was deposited, loess typically has a permeability 15 times greater in the vertical direction than in the horizontal direction. Vertical permeability lies between 1 x 10(-3) to 1 x 10(-5) feet per minute, while horizontal permeability is between 1 x 15(-3) to 1 x 15(-5) feet per minute. These loess soils are moderately susceptible to frost action.

(b) Building Site Development.

In spite of the settlement problems described above, project soils will adequately support conventional building loads if footings are designed properly and surface water is drained away from the foundation area. Compaction of the soil removes any potential settlement problem.

(c) Sanitary Facilities.

The loess soil in the project area is not very good for septic tank absorption fields because of its low rate of absorption. However, absorption fields have been created that work adequately with only a slight increase in cost during construction. The YmA soils found in the Rooks Park area currently support restroom facilities with absorption fields. This area is well suited for such facilities, because depth-to-gravel is only a few feet. A similar facility exists near the lake, in the parking lot area that was formerly used as a Bp. Because of the lime and bentonite materials that remained at this borrow site after construction, special gravel beds had to be constructed to make an adequate absorption field for this facility. This Bp is the only site at the project that required this degree of effort.

(d) Construction Materials.

The loess soils of the project are generally good for embankments and dikes, and poor to fair for roadfill. Their compaction characteristics are good to fair, but it is essential to exercise proper moisture control. Loess is unsuitable as a source of sand and gravel, and is generally poor as a road subgrade. The YmA soils are an excellent source of road-building materials.

(e) Wildlife Habitat Potential.

Grains, crops, native trees, shrubs, grasses, forbs, and legumes grow well in WaB and WaD soils, making these areas excellent potential wildlife habitats. These upland soils comprise 54 percent (294 acres) of the project. The YkA and YmA also support riparian vegetation.

d. Hydrology (Mill Creek Basin.

(1) Streamflow/Runoff Characteristics.

(a) General.

The streamflow pattern for Mill Creek consists of moderate to high flows from November through June, and low flows from July through October. When precipitation during the autumn months is low and winter temperatures are below normal, the low flow period may stretch as late as February. Major floods may be caused by any one of the following conditions: 1) intensive rainstorms; 2) a combination of rainfall and snowmelt; or 3) summer "cloudburst" thunderstorms. Winter floods are primarily flash-type floods. They are relatively short in duration, and peak discharges occur in December through February. Mill Creek has had several floods of damaging magnitude in the past. Historically, these floods have usually occurred in the winter, and have primarily been caused by intense warm rain falling on frozen and snow-covered ground. The largest flood ever recorded in the area occurred on 1 April 1931 (see photo 3-2), and had an estimated peak discharge of 6,000 cfs. The spring snowmelt flood period generally extends from March through May. Peak discharges from spring snowmelt runoff rarely result in severe flooding. During the period of record from 1942 to 1987, the maximum daily discharge below the division works (RM 10.5) often reaches zero in the summer. This occurs just below the dam, and is due to irrigation withdrawals channeled into Yellowhawk and Garrison Creeks.

Photo 3-2. Flood in Downtown Walla Walla, Washington

(b) Runoff Contribution and Distribution.

1. Mill Creek at Walla Walla, WA Gaging Station.

Figure 3-8 shows the location of all gauging stations, while figure 3-9 shows summary hydrographs for the Mill Creek gauging station (No. 14015000) at Walla Walla, Washington, for water years 1942 through 1987. This station is located near the MCP office (RM 10.5). During this period, runoff reached a maximum of 131,800 AF in water year 1974. The minimum runoff, 12,900 AF, occurred in water year 1977. The mean annual runoff for the 95.7 mi^2 of drainage above this gauging station (water years 1942 through 1987) is 59,000 AF. Approximately 98 percent of the total average annual runoff occurs between November and June; 49 percent between November and February, and 49 percent between March and June (refer to figure 3-9). Table 3-5 lists monthly runoff volumes at this station.

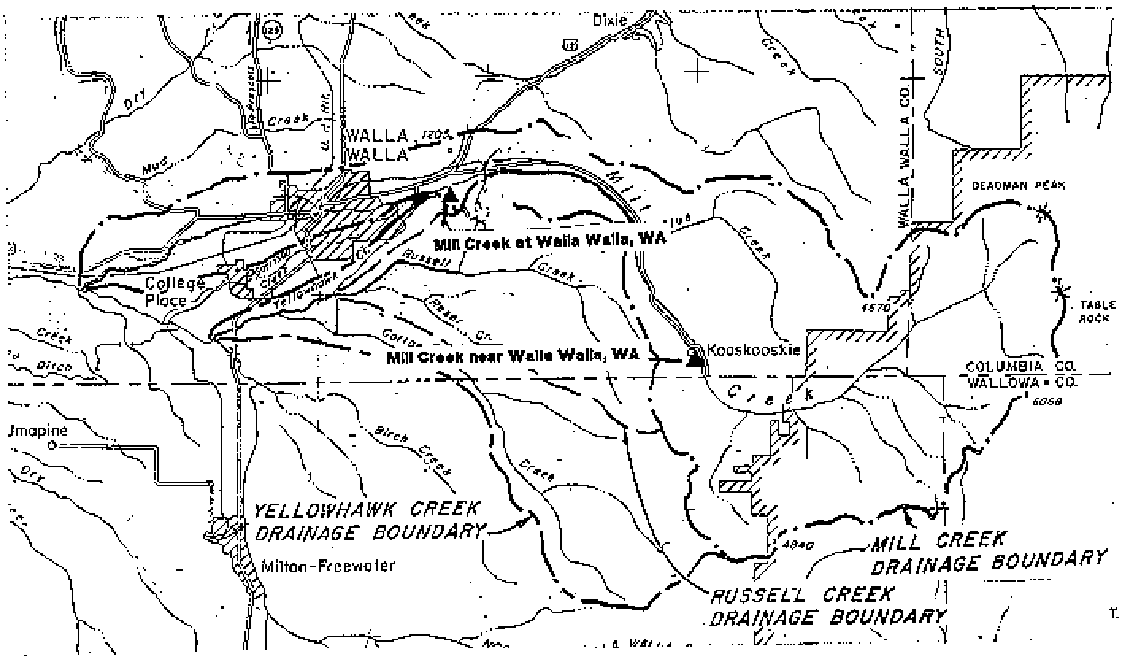


Figure 3-8. Gaging Stations in the Mill Creek Drainage

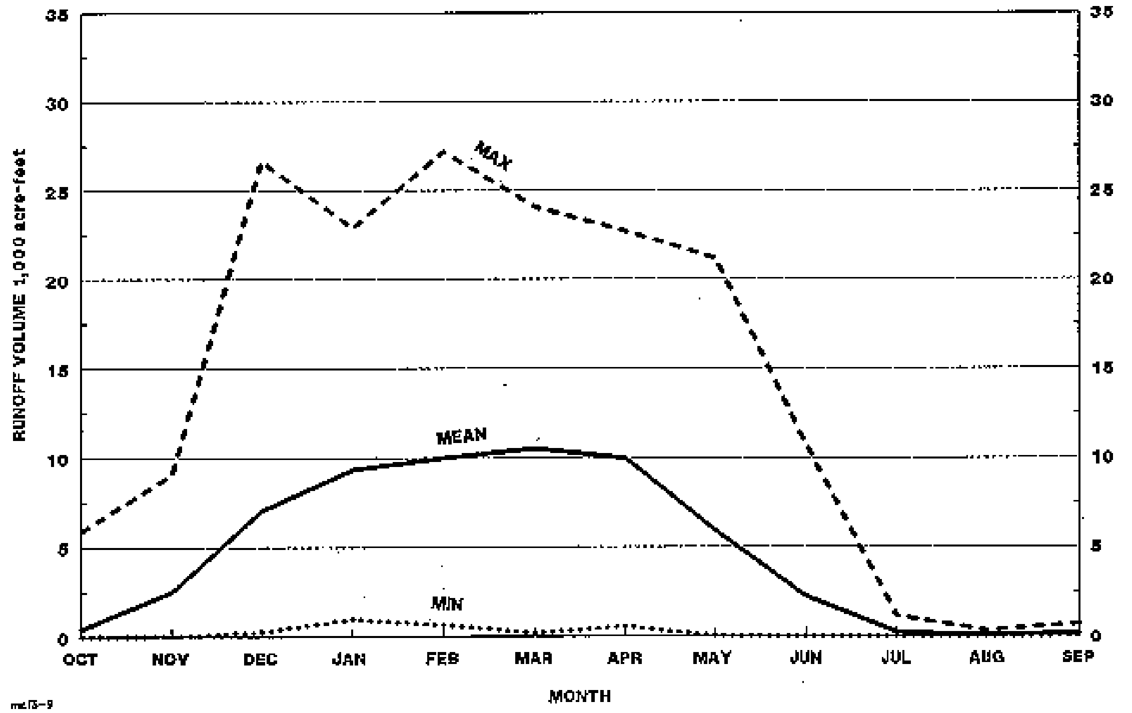


Figure 3-9. The MCP Runoff Volume, Mill Creek at Walla Walla, Washington (RM 10.5)

Table 3-5
Mill Creek at Walla Walla, Washington (USGS Gage Number 14015000)
Total Monthly Runoff Volume in 1,000 Acre-Feet

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Nov-Feb	Pct	Mar-Jun	Pct
1942	0.375	2.588	5.586	5.008	6.567	6.020	3.273	4.384	3.858	0.528	0.317	0.438	38.942	19.749	51%	17.535	45%
1943	0.643	3.667	11.709	7.135	11.615	6.843	14.236	7.936	2.017	0.184	0.290	0.196	66.471	34.126	51%	31.032	47%
1944	1.099	1.410	2.146	0.974	3.582	8.585	9.346	2.436	0.403	0.105	0.139	0.123	30.348	8.112	27%	20.770	68%
1945	0.367	0.319	0.280	3.917	10.449	9.069	11.254	6.942	2.200	0.171	0.103	0.228	45.299	14.965	33%	29.465	65%
1946	0.230	2.668	9.660	16.798	10.163	15.017	6.458	5.096	1.595	0.349	0.300	0.325	68.659	39.289	57%	28.166	41%
1947	0.407	5.270	8.039	7.972	0.887	0.179	0.547	0.904	0.371	0.137	0.252	0.472	25.436	22.168	87%	2.001	8%
1948	1.029	8.727	6.901	8.882	6.865	7.101	14.722	21.180	5.223	0.339	0.333	0.214	81.516	31.375	38%	48.226	59%
1949	0.214	1.160	2.856	3.243	11.447	19.625	14.769	9.437	1.214	0.260	0.278	0.274	64.777	18.706	29%	45.045	70%
1950	0.403	0.655	2.009	5.346	18.298	20.714	11.324	6.615	7.006	0.226	0.077	0.103	72.775	26.308	36%	45.659	63%
1951	0.825	8.132	9.525	12.990	18.460	10.280	7.976	4.393	5.227	0.278	0.284	0.173	78.543	49.107	63%	27.876	35%
1952	5.895	2.771	6.863	3.602	10.760	7.065	16.421	5.962	0.692	0.591	0.054	0.093	60.770	23.996	39%	30.140	50%
1953	0.165	0.194	0.276	16.045	12.609	12.794	9.479	7.539	4.013	0.438	0.317	0.345	64.214	29.124	45%	33.825	53%
1954	0.339	0.662	8.712	7.472	8.474	3.713	8.493	2.009	6.748	0.252	0.230	0.200	47.304	25.320	54%	20.963	44%
1955	0.113	0.391	0.768	1.563	1.662	2.793	10.628	9.856	1.537	0.363	0.121	0.177	29.971	4.384	15%	24.814	83%
1956	0.192	3.035	15.204	11.088	4.804	14.418	11.480	6.605	1.377	0.381	0.040	0.010	68.633	34.131	50%	33.880	49%
1957	0.294	0.478	6.778	2.073	9.396	14.969	11.554	7.674	0.504	0.133	0.119	0.115	54.086	18.725	35%	34.701	64%
1958	0.052	0.428	7.295	10.398	16.378	4.614	17.451	7.440	1.507	0.246	0.123	0.127	66.058	34.499	52%	31.012	47%
1959	0.024	3.777	12.623	17.009	8.416	11.072	9.945	5.976	1.022	0.061	0.065	0.474	70.464	41.825	59%	28.015	40%
1960	1.335	3.336	2.596	2.743	8.571	9.455	8.795	5.893	0.754	0.141	0.208	0.129	43.956	17.246	39%	24.897	57%
1961	0.087	3.009	2.501	3.142	6.451	18.885	7.755	5.994	0.807	0.190	0.232	0.214	59.269	25.103	42%	33.441	56%
1962	0.135	1.031	6.212	5.516	2.705	10.584	10.677	4.395	0.474	0.093	0.083	0.071	41.979	15.464	37%	26.130	62%
1963	1.722	3.193	5.927	2.440	8.819	5.104	7.601	1.591	0.000	0.016	0.004	0.002	36.417	20.379	56%	14.296	39%
1964	0.000	0.561	2.017	6.589	4.655	6.980	12.056	7.313	2.023	0.093	0.054	0.038	42.379	13.822	33%	28.372	67%
1965	0.032	3.717	26.611	19.462	12.756	5.849	8.803	2.418	1.216	0.115	0.087	0.034	81.099	62.546	77%	18.286	23%
1966	0.002	0.058	0.583	5.994	4.830	15.354	9.299	1.531	0.097	0.071	0.091	0.048	37.958	11.465	30%	26.281	69%
1967	0.008	0.879	5.201	12.855	5.058	6.237	5.992	7.960	0.242	0.073	0.133	0.107	44.635	23.993	54%	20.321	46%
1968	0.044	0.010	3.842	4.520	12.425	2.596	2.906	0.0030	0.052	0.058	0.061	0.028	26.571	20.797	78%	5.584	21%
1969	0.532	4.812	7.619	18.595	6.500	11.235	17.814	8.400	0.504	0.004	0.000	0.000	76.014	37.526	49%	37.953	50%
1970	0.008	0.002	1.339	22.691	12.304	11.461	8.386	6.187	1.571	0.044	0.030	0.089	64.111	36.336	57%	27.605	43%
1971	0.371	5.802	5.907	16.997	8.146	10.152	8.523	5.835	4.556	0.401	0.077	0.672	67.439	36.852	55%	29.066	43%
1972	0.274	3.013	10.471	10.146	15.110	24.070	10.344	7.732	1.051	0.115	0.050	0.006	82.381	38.740	47%	43.197	52%
2973	0.000	0.155	5.980	8.521	4.334	6.002	1.966	0.079	0.000	0.000	0.000	0.026	27.063	18.990	70%	8.047	30%
1974	0.012	9.055	23.086	22.892	13.813	15.368	22.687	13.448	10.645	0.813	0.000	0.000	131.819	68.846	52%	62.148	47%
1975	0.000	0.476	4.560	20.202	8.206	12.437	8.116	11.231	2.898	0.494	0.012	0.000	68.631	33.444	49%	34.682	51%
1976	0.135	2.051	21.102	21.273	11.350	12.472	19.303	8.212	2.162	0.020	0.111	0.034	98.225	55.776	57%	42.149	43%
1977	0.248	0.559	0.809	1.906	0.661	4.413	3.711	0.494	0.000	0.010	0.105	0.020	12.936	3.935	30%	8.618	67%
1978	0.034	2.551	14.160	10.536	9.013	6.825	7.553	4.336	0.000	0.048	0.054	0.014	55.123	36.260	66%	18.714	34%
1979	0.000	0.272	4.727	2.680	12.851	12.121	13.289	8.511	0.317	0.077	0.032	0.016	54.903	20.540	37%	34.238	62%
1980	0.119	0.296	3.376	10.015	7.791	9.509	7.579	2.386	1.660	0.000	0.000	0.000	42.731	21.478	50%	21.134	49%
1981	0.042	1.446	10.673	3.410	16.477	7.523	14.329	4.205	8.795	1.127	0.000	0.000	68.026	32.006	47%	34.852	51%
1982	0.214	2.079	10.150	14.184	27.170	15.739	12.425	7.333	1.882	0.268	0.002	0.133	91.578	53.583	59%	37.379	41%
1983	0.625	2.751	7.067	12.113	12.224	13.676	7.599	5.421	0.339	0.026	0.000	0.056	61.897	34.155	55%	27.035	44%
1984	0.030	2.807	6.460	13.484	10.062	20.402	6.657	5.958	9.622	0.829	0.186	0.157	76.654	32.813	43%	42.639	56%
1985	0.260	5.933	7.398	3.808	5.988	9.346	15.646	6.803	1.974	0.012	0.006	0.000	57.174	23.127	40%	33.769	59%
1986	0.748	2.460	3.068	8.593	20.053	14.882	4.721	4.221	0.956	0.335	0.127	0.353	60.517	34.174	56%	24.780	41%
1987	0.369	6.436	2.456	3.660	9.933	9.969	4.497	1.444	0.032	0.006	0.099	0.000	38.900	22.485	58%	15.942	41%
1988	0.006	0.008	0.567	5.425	7.220	7.476	9.051	2.719	0.641	0.008	0.000	0.000	33.120	13.220	40%	19.887	60%
1989	0.000	3.366	4.286	13.607	6.742	20.226	14.487	6.417	2.043	0.446	0.472	0.317	72.410	28.001	39%	43.173	60%
1990	0.061	0.060	1.494	6.272	6.655	7.884	5.320	6.682	3.955	0.002	0.002	0.000	38.387	14.481	38%	23.841	62%
1991	0.091	2.001	3.120	8.362	5.766	6.329	7.273	10.076	3.529	0.147	0.000	0.000	46.696	19.249	41%	27.207	58%

Monthly

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Nov-Feb	Pct	Mar-Jun	Pct
*Mean	0.434	2.331	7.214	9.638	9.840	10.447	10.082	6.030	2.283	0.236	0.118	0.139	58.792	29.023	49%	28.842	50%
*Max	5.895	9.055	26.611	22.892	27.170	24.070	22.687	21.180	10.645	1.127	0.472	0.672	131.819	68.846	87%	62.148	83%
*Min	0.000	0.002	0.276	0.974	0.661	0.179	0.547	0.030	0.000	0.000	0.000	0.000	12.936	3.935	15%	2.001	8%

*For 1942 to 1984

NOTE: Water Year 1990 = October 1979 through September 1990.

2. Mill Creek Near Walla Walla Gauging Station (Kooskooskie).

Figure 3-10 shows summary hydrographs from the Mill Creek gauging station (No. 14013000) near Walla Walla, located at Kooskooskie, Washington (RM 21.2), for water years 1914 through 1917, 1940 through 1976, and 1980 through 1987. The mean annual runoff for the 59.6 mi^2 of drainage above this gauging station (period of record through water year 1987) is 70,200 AF. Approximately 87 percent of the total average annual runoff occurs between November and June; 39 percent between November and February, and 48 percent between March and June.

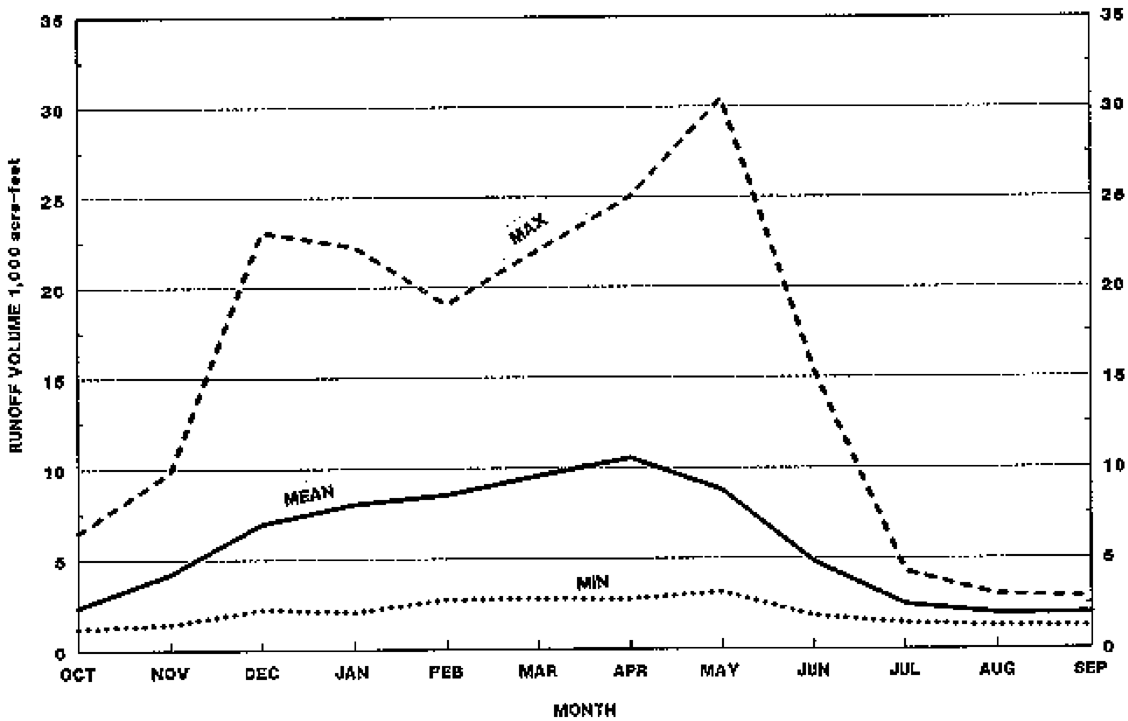


Figure 3-10. The MCP, Mill Creek Near Walla Walla, Washington (Kooskooskie) (RM 21.2)

3. Water Withdrawal.

Water is diverted from Mill Creek at the following locations: 1) at Waterworks Dam (RM 25.2), where the municipal water supply intake for the city of Walla Walla is located; 2) other small upstream diversions for irrigation purposes; 3) at the Diversion Dam (RM 11.4), into Virgil B. Bennington Lake (offstream storage reservoir) for flood control; and 4) 200 feet upstream from the Walla Walla gauging station [at the Division Structure (RM 10.5)] into Yellowhawk and Garrison Creeks for irrigation and stock water rights.

(2) Analysis of Hydrology.

Because runoff is low in the summer and the demand for water is extremely high, Mill Creek's low runoff years can critically affect lake levels in the summer. A lower lake level affects recreation, water quality, and fisheries. Lower lake level elevations reduce the area and volume of the lake. This reduces the area available for boating and increases the water temperature, adversely affecting both water quality and fisheries. (See paragraph 3.03.c., *Project Water Control Operations and Lake Levels*, for a further discussion of this subject.)

e. Limnology.

(1) Mill Creek.

(a) Above Division Works.

Water quality in the upper reaches of Mill Creek is excellent. It is maintained by the restriction of land use activities in the upper watershed, since it must provide the water supply for the city of Walla Walla. Rainbow trout, bull trout, and some steelhead use these upper reaches (USFWS, 1984). While some degradation of water quality does occur as the stream passes through small residential areas, recreational sites, and agricultural activities, it is still of high quality (A rating) as it reaches the project area. [Refer to section 2, paragraph e.(1)(a) for an explanation of the State of Washington Water Quality Rating System.]

(b) Below Division Works.

The most significant degradation of water quality occurs below the Division Works for Yellowhawk and Garrison Creeks. Zero flow exists here during the dry season (see photo 3-3) and, in the city of Walla Walla, point source loading of municipal sewage treatment plant effluent, cannery waste, and storm water runoff reconstitutes the flow as it contributes to the water quality degradation. At the Division Works, water is diverted into Yellowhawk and Garrison Creeks for irrigation. Although water does not flow in this section of the Mill Creek Channel during the dry season, it has a Class A rating as it arrives at the 13th Street Bridge. From the 13th Street Bridge to the mouth of Mill Creek, the creek has a Class B rating. This low water quality rating is primarily caused by industrial wastewater treatment plant effluent, and agricultural inputs and temperature increases caused by withdrawals and the removal of riparian vegetation that once provided shading.

Photo 3-3. Low flows below thte division works is a major contributor to poor water quality.

(c) Indicators.

Hallsted (1972) reported that, as the distance downstream increases, there is a corresponding increase in temperature, pH, turbidity, phosphate, and nitrate. The greatest increase was measured between sites immediately above and below the city of Walla Walla. Because of the turbulence induced by the energy dissipation structures, dissolved oxygen (DO) concentrations seldom deviate substantially below the 100-percent saturation level, except in the numerous stagnant pools that appear during the dry season. Below the Walla Walla wastewater treatment plant, outfall DO levels decrease measurably.

(d) Biologic Characteristics.

Mill Creek is a low alkaline, soft water stream. The land above MCP that is drained by the creek generally consists of soils composed of loess and weathered basalt, or loess and silty clay loam, both underlain by gravels. Algal composition in Mill Creek is limited to free-floating diatoms and attached benthic algae. Below the project area, filamentous green algae (especially *Cladophor*), are abundant. The aquatic invertebrate population is composed of mayflies, stoneflies, and caddisflies. All of these aquatic invertebrates require well-oxygenated, coarse-substrate streams.

(e) Diversion of Flow.

As pointed out in paragraph d.(1)(b)3., *Water Withdrawal*, water is diverted at four locations along Mill Creek. During the summer low-flow period, most (or all) of the water in the creek is diverted to Yellowhawk and Garrison Creeks at the Division Works. For a few miles below this diversion, Mill Creek is dry. Flows increase through Walla Walla as the creek is recharged by groundwater, storm-drainage return, point-source discharges, and irrigation return flow. An exception is where Titus Creek enters back into Mill Creek at Walla Walla Community College, but these waters enter in the gravels underlying Mill Creek and are gone before surface water reaches the Wilbur Street Bridge.

(2) Virgil B. Bennington Lake.

(a) General.

The water quality of lakes and reservoirs is primarily determined by the quality of inflowing tributaries, as well as other point source loadings. Although Mill Creek is a stream of fairly high quality, Virgil B. Bennington Lake is typically eutrophic, and of poorer quality (see table 3-6). This is largely due to the hydrologic characteristics of the lake. It only receives tributary input during the spring runoff, when the creek's sediment and nutrient load is highest. While water quality in the creek improves as flows subside, the water quality in the lake does not undergo a similar improvement. As a result, very turbid, high nutrient concentration conditions often exist in the lake throughout the season.

Table 3-6
Virgil B. Bennington Lake
Water Quality Data

				Data Ranges at Depths		
Parameter	No. of Sam	Sample Dates	Sample Gaps	Surface	Middle	Bottom
SECCHI (m)	17	70, 73-75, 77, 79, 86-88, 89	71, 72, 76, 78, 80-85, 89-91	0.04-4.2	.	.
TEMP (C)	173	70, 73-75, 77,79, 86-88, 89	71, 72, 76, 78, 80-85, 89-91	5.6-25	5.2-23	5.2-22.58
DO (mg/L)	112	70, 73-75, 77, 79, 86-88, 89	71, 72, 76, 78, 80-85, 89-91	6.4-11.2	4.3-10.3	0.1-10.4
COND. (umhos/cm)	47	73-76, 77, 79, 88, 92	70-72, 76, 78, 80-87, 89-91	26-95	42-96	10-103
pH	49	73-74, 77, 79, 88, 92	70-72, 75, 76, 78, 80-87, 89-91	72-8.84	6.02-8.68	5.83-8.67
TURB. (NTU)	44	73-74, 77, 79, 88, 92	70-72, 75, 76, 78, 80-87, 89-91	3.7-300	3.7-64	3.9-65
ALK. (mg/L)	23	73-74, 77, 79	70-72, 75, 76, 78, 80-92	3.8-74	38-74	40-68
HARDTOT. (mg/L)	26	73-74, 77, 79, 86	70-72, 75, 76, 78, 80-85, 87-92	11-60	14.2-37	16.10-71
HARDCALC. (mg/L)	21	73-74, 77, 79	70-72, 75, 76, 78, 80-92	4-40	5.2-25	5.1-31
CO2 (mg/L)	13	73-74, 77	70-72, 75, 76, 78-92	1.6-66	5-26	2.2-11
PO4 (mg/L)	18	73-74, 77, 86	70-72, 75, 76, 78-85, 87-92	0.02-6.5	0.04-.1	0.07-0.1
NITRATE (mg/L)	30	73-74, 77, 79, 87, 92	70-72, 75, 76, 78, 80-86, 88-91	<0.1-2.4	<0.1-0.11	<0.1-.5
ORTHOP (mg/L)	12	87, 92	70-86, 88-91	0.02-<0.025	0.01-<0.025	0.02-<0.025
TOTALP (mg/L)	12	87, 92	70-86, 88-91	<0.025-0.04	<0.025-0.04	<0.025-0.1
FECAL COL/100 ml	30	73, 74, 83-89, 91	70-72, 75-82, 90, 92	0-930		

The values that have a less than (<) sign mean that the samples were below the limit of detection. Table compiled by Robin Kenney.

Virgil B. Bennington Lake water quality is, therefore, indicative of the quality of Mill Creek during filling. Diversions of water to the lake during peak flow conditions (*e.g.*, flood-control purposes) result in high loading of suspended particulates and nutrients, causing high turbidities in the lake. Filling the lake after peak flows subside results in less loading of suspended solids and nutrients and better water clarity during the following summer. Because daily variation of water quality in the creek during the spring runoff period is substantial, yearly lake water quality conditions are similarly variable. This could be minimized by monitoring the stream water quality, and timing the diversion accordingly.

(b) Turbidity.

Historically, high turbidity has been the most significant water quality problem in Virgil B. Bennington Lake. Excessively high turbidities [300 Nephelometric Turbidity Units (NTU's)], occurred during the 1970's. This prompted an investigation into the possibility of using alum sulfate to flocculate the suspended particles (Morency and Funk, 1975). In the past 10 years, turbidity levels have generally been much lower (1 to 50 NTU's), due to the improved operation for filling the reservoir. There is still substantial yearly variation, however. Secchi disk transparency values (the distance through the water at which an 8-inch-diameter black and white disk is barely visible) have ranged from 0.2 meters (corresponding to years of extremely high turbidities) to 3.0 meters in 1987. Although most of the turbidity results from the concentration of high suspended solids in the inflowing water, resuspension of bottom sediments or shoreline material following high velocity wind events (and subsequent wave agitation) and high phytoplankton densities also contribute to increased turbidity levels.

(c) The DO.

In the surface waters, DO is generally at, or near, saturation levels, and pH ranges from 7.0 to 8.5. Conductivity [60 to 80 micromhos per centimeter (umhos/cm)] and total alkalinity (30 to 50 mg/L as calcium carbonate) show little change from conditions in Mill Creek. Nutrient concentrations in the lake are sufficient to sustain substantial algal growth (0.03 to 0.2 mg/L phosphate; 0.3 to 3.0 mg/L nitrate). The minimal depth of light penetration, caused by extremely turbid conditions, appears to limit the productivity of algal blooms.

(d) Micro and Benthic Organisms.

In the summer, phytoplankton growth is dominated by *Aphanizomenon*. This is a blue-green algae indicative of eutrophic waters, and it is typically a dominant component of algal blooms (see photo 3-4). Also present is *Microcystis*, the green alga *Euglena*, and the diatom *Navicula*. *Aphanizomenon* and *Microcystis* blooms are commonly toxic to mammals that drink scums concentrated along the shoreline by wind action. Earlier in the summer, diatoms probably dominate the algal population, as they are the primary phytoplankton of the creek. Fecal coliform bacterial concentrations occasionally exceed state and Federal criteria for primary contact water (>100 organisms/100 ml water), and typically average between 50 and 100 organisms/100 ml. Reported cases of swimmers itch (*schistosome cercarial dermatitis*), caused by a free-floating (planktonic) parasite of the genus *Trichobilharzia*, were confirmed by doctors during the summer of 1992. The benthic organism population primarily consists of oligochaetes and tubificids. These organisms are tolerant of the frequent periods of anoxia (DO concentrations of less than 0.5 mg/L) that occur in sediments and bottom waters.

Photo 3-4. Algal blooms in Mill Creek Channel result from high nutrient levels and stagnation.

(e) Temperature.

Despite the extremely shallow water in the lake (ranging from 3 to 7 meters), thermal stratification does occasionally develop. This thermal stratification creates temperature gradients (thermoclines) of up to 8 degrees centigrade per meter of depth. The thermocline, usually from 2 to 4 meters below the surface, prevents mixing of surface and bottom waters. No consistent seasonal pattern of thermal stratification appears, however. Depending on the atmospheric conditions, the water column may exhibit any of the following characteristics: 1) isothermal (completely mixed from surface to bottom) the entire year; 2) strong, stable stratification throughout the summer period; or 3) stratify intermittently for brief periods during the summer. Thermal stratification results from low wind energy reaching the surface, the lack of hydraulic flow-through, and the amount of solar radiation. Surface-to-bottom temperature differences of as much as 10 degrees centigrade have been observed.

(f) Stratification.

When the lake is stratified, significant chemical changes take place in the water mass below the thermocline. The high content of organic material in the sediments accelerates oxygen depletion, and anoxia rapidly appears. Concurrent with the decrease in DO, other chemical changes occur. Concentrations of ortho-phosphorus, ammonia, and conductivity increase significantly; and pH decreases. Eventually, the production of hydrogen sulfide begins. This is indicated by the presence of a rotten egg smell. During anoxic conditions, the bottom water mass is no longer habitable for the lake's fish, and benthic invertebrates are limited to those tolerant of short periods of anoxia.

(3) Analysis of Water Quality.

Due to the occasional occurrences of low water quality conditions that result from anoxia, hydrogen sulfide production, excessive turbidity, and microorganisms, there is some impact to the existing uses of Virgil B. Bennington Lake. Although conditions are not ideal for trout, they are restocked annually. The lake is unique, in terms of water quality, because of its tendency to stratify thermally and because of the way it is filled. Therefore, the lake's responses to various management practices, or to natural alterations, may not approximate those of more typical lakes and reservoirs.

f. Climate (Mill Creek Basin).

(1) General.

The Mill Creek Basin is characterized by great seasonal variations in temperature, and wide precipitation variations over geographic areas. Mill Creek Basin is in a belt of prevailing westerly winds, and the climate is greatly influenced by air from the Pacific Ocean. Occasionally, polar outbreaks of cold air spill over the Rocky Mountain barrier, and these outbreaks result in short periods of extremely low temperatures (USACE, 1991).

Climatological records for stations in, and adjacent to, the Mill Creek Basin are published by the National Oceanic and Atmospheric Administration at the climatic Data Center in Asheville, North Carolina. Table 3-7 lists climate stations in the Mill Creek Basin. Figure 3-11 shows the location of these stations.

Table 3-7. Climate Stations

Station	Type	Latitude	Longitude	Elevation	Location
Walla Walla 13 ESE	TP	N 46°0'	W 118°0'	2400 feet	City's Waterworks Dam
Mill Creek Dam	P	N 46°5'	W 118°16'	1175 feet	MCP
Walla Walla FAA AP	TP	N 46°6'	W 118°17'	1170 feet	Walla Walla Regional Airport
Walla Walla WSO	TP	N 46°2'	W 118°20'	949 feet	Post Office, Walla Walla
Walla Walla 3W	TPE	N 46°3'	W 118°27'	632 feet	Whitman Mission NHS

P = Precipitation records only
TP = Temperature and precipitation records
TPE = Temperature, precipitation, and evaporation records
FAA AP = Federal Aviation Administration at the Walla Walla Regional Airport
Walla Walla WSO (Weather Station Office) = Station was closed in December 1988. The closest office is now located in Pendleton, Oregon.
13 ESE 13 miles east south east

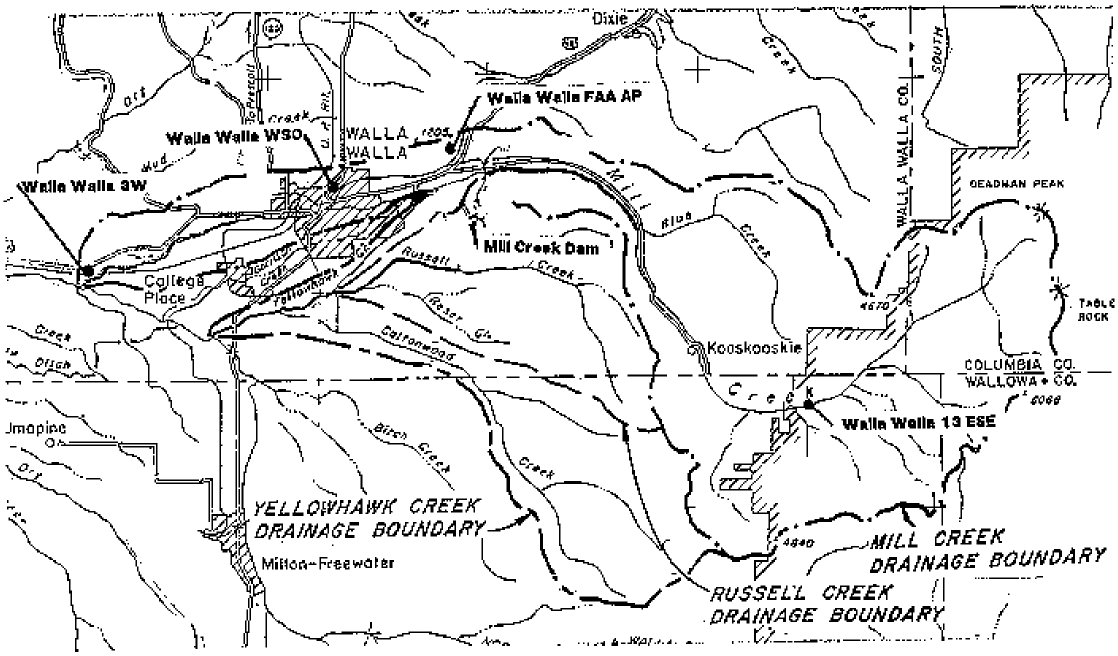


Figure 3-11. Climate Station Location in the Mill Creek Basin

(2) Temperature.

The following subparagraphs summarize the temperature data from selected climate stations in the Mill Creek Basin.

(a) Walla Walla Weather Service Office (WSO), Washington (Elevation 949).

The Walla Walla WSO was located in the lower portion of the basin (see figure 3-7), in the Walla Walla Post Office building, and was closed in December 1988. Average monthly maximum temperatures at WSO range from 40°F in January to 89°F in July. Average monthly minimum temperatures range from 28°F in January to 62°F in July. Average monthly temperatures range from 34°F in January to 76°F in July (see table 3-8). Extreme temperatures have ranged from -16°F to 113°F. The average frost-free period extends from late March through early November, and the average growing season is about 220 days. (See table 3-9 for monthly temperature by year.)

Table 3-8
Walla Walla Basin Average Monthly Temperature (in °F)

Month	January		July	
Elevation	949		2400	
Station	WSO	13 ESE	WSO	13 ESE
Maximum	40°	35°	89°	84°
Mean	34°	29°	76°	65°
Minimum	28°	24°	62°	46°

Table 3-9
Mill Creek Basin - Temperatures
Maximum, Minimum, and Computed Mean
Walla Walla, Washington FAA (Elevation 1170)

		Month										Annual Summary				
Water Year		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean	Max	Min
1950	Min	.	.	.	9	27	35	39	45	54	60	60	53	.	.	.
.	Max	.	.	.	24	42	51	61	70	76	89	89	80	.	.	.
1951	Min	45	36	35	28	31	32	40	47	53	60	59	52	43.2	60	28
.	Max	62	49	45	41	46	51	67	72	79	90	86	79	63.9	90	41
1952	Min	43	34	24	23	32	36	42	48	52	60	60	54	42.3	60	23
.	Max	61	48	36	37	47	53	68	72	77	90	87	82	63.2	90	36
1953	Min	46	28	30	39	33	36	40	45	50	58	59	53	43.1	59	28
.	Max	71	42	43	53	49	55	61	68	72	89	85	82	64.2	89	42
1954	Min	44	37	34	26	33	30	39	46	49	57	56	50	41.8	57	26
.	Max	67	53	48	40	45	52	61	73	74	87	81	75	63.0	87	40
1955	Min	40	40	28	28	28	29	37	44	53	58	58	51	41.2	58	28
.	Max	62	55	42	39	44	49	56	66	81	84	88	78	62.0	88	39
1956	Min	44	26	26	27	20	35	42	50	51	62	58	52	41.1	62	20
.	Max	63	41	40	41	35	53	67	73	76	91	86	79	62.1	91	35
1957	Min	42	31	30	13	29	35	42	51	55	59	57	54	41.5	59	13
.	Max	61	43	43	26	44	52	64	72	80	85	83	81	61.2	85	26
1958	Min	41	32	34	33	39	34	41	52	57	63	63	52	45.1	63	32
.	Max	57	51	48	45	54	54	60	78	83	93	92	76	65.9	93	45
1959	Min	43	35	32	28	31	36	41	44	54	60	58	51	42.8	60	28
.	Max	68	50	44	44	44	55	64	68	79	91	84	72	63.6	91	44
1960	Min	43	28	29	19	31	35	42	45	52	63	57	52	41.3	63	19
.	Max	64	28	40	33	47	54	63	68	81	95	83	79	62.9	95	33
1961	Min	44	36	26	31	38	39	40	47	57	63	64	49	44.5	64	26
.	Max	66	50	35	44	53	56	61	70	87	92	93	73	65.0	93	35
1962	Min	40	27	30	25	31	34	42	45	52	59	58	52	41.3	59	25
.	Max	62	45	42	40	46	52	67	64	80	88	83	79	62.3	88	40
1963	Min	44	38	33	20	34	37	40	48	54	57	61	57	43.6	61	20
.	Max	62	52	46	35	48	57	59	72	79	84	88	83	63.8	88	35
1964	Min	47	38	29	34	33	36	39	45	53	59	56	48	43.1	59	29
.	Max	68	51	36	47	51	54	61	70	78	88	83	75	63.5	88	36
1965	Min	38	35	26	31	35	34	44	46	54	62	62	50	42.9	62	26
.	Max	63	47	41	42	51	56	67	71	81	91	87	75	64.3	91	41
1966	Min	47	39	31	32	33	36	41	47	52	58	59	56	44.3	59	31
.	Max	71	53	45	44	47	56	64	75	77	86	87	80	65.4	87	44
1967	Min	42	38	35	37	35	35	38	46	56	62	64	57	45.4	64	35
.	Max	65	52	47	49	52	53	56	70	85	92	96	85	66.8	96	47
1968	Min	45	34	30	31	36	39	39	47	54	63	60	55	44.4	63	30
.	Max	67	50	44	45	49	59	59	70	79	92	81	76	64.3	92	44
1969	Min	44	38	27	17	30	37	42	50	58	60	59	55	43.1	60	17
.	Max	62	50	39	29	41	55	62	74	84	87	86	78	62.3	87	29
1970	Min	41	36	32	29	36	37	38	49	58	63	61	49	44.1	63	29
.	Max	60	52	40	39	47	54	57	71	84	92	91	71	63.2	92	39
1971	Min	42	35	31	34	33	34	39	47	51	59	63	47	42.9	63	31
.	Max	60	49	43	46	47	51	60	71	72	91	93	71	62.8	93	43
1972	Min	40	37	31	26	30	40	38	49	55	60	62	50	43.2	62	26
.	Max	61	50	42	39	42	57	59	73	80	88	90	75	63.0	90	39
1973	Min	42	36	22	25	33	39	41	50	56	62	61	54	43.4	62	22
.	Max	63	50	35	39	45	56	65	76	81	93	87	76	63.8	90	35
1974	Min	45	36	36	24	37	37	42	46	57	59	64	55	44.8	64	24
.	Max	63	48	46	35	49	54	60	66	86	88	90	84	64.1	90	35
1975	Min	44	39	35	30	31	36	39	49	55	66	58	52	44.5	66	30
.	Max	68	51	48	42	44	52	59	72	78	92	83	83	64.3	92	42
1976	Min	46	36	33	33	32	33	39	45	50	60	58	55	43.3	60	32
.	Max	64	52	44	45	47	52	60	72	76	90	82	83	63.9	90	44
1977	Min	43	38	30	22	36	37	43	46	59	60	67	53	44.5	67	22
.	Max	67	49	42	29	50	54	71	68	86	87	92	73	64.0	92	29

1978	Min	44	35	32	29	34	38	40	44	53	60	61	54	43.7	61	29
.	Max	64	50	41	37	45	56	58	66	82	90	84	74	62.3	90	37
1979	Min	42	28	26	15	34	38	42	50	56	62	62	54	42.4	62	15
.	Max	68	43	38	25	47	59	64	75	82	91	86	82	63.3	91	25
1980	Min	47	33	34	23	32	37	45	50	53	61	58	54	43.9	61	23
.	Max	68	44	47	33	43	51	67	69	73	87	82	77	61.8	87	33
1981	Min	44	39	35	35	33	38	43	49	54	60	65	56	45.9	65	33
.	Max	63	50	46	46	47	57	63	68	75	88	95	82	64.6	95	41
1982	Min	45	38	33	29	35	38	39	47	59	61	63	53	45.0	63	29
.	Max	64	53	43	42	48	55	60	71	83	89	88	76	64.4	89	42
1983	Min	44	34	34	36	39	42	42	50	54	59	64	50	45.7	64	34
.	Max	63	45	42	50	52	58	64	74	77	84	90	73	64.3	90	42
1984	Min	44	42	19	30	36	41	43	48	55	63	62	50	44.4	63	19
.	Max	64	54	30	40	48	57	60	68	77	94	90	74	63.0	94	30
1985	Min	42	38	25	25	27	35	45	50	55	66	59	49	43.0	66	25
.	Max	61	50	35	29	43	55	69	75	83	98	85	71	62.8	98	29
1986	Min	43	22	17	29	33	41	41	48	57	57	64	50	41.8	64	17
.	Max	63	32	24	42	45	58	61	70	85	83	94	71	60.7	94	24
1987	Min	44	38	38	25	34	40	45	50	55	58	58	54	44.1	58	25
.	Max	67	49	35	37	46	57	68	75	86	85	89	83	64.8	89	35
1988	Min	42	35	28	27	33	36	43	47	54	61	59	52	43.1	61	27
.	Max	69	50	40	38	51	56	64	72	79	90	88	79	64.7	90	38
1989	Min	47	39	28	31	17	34	43	47	54	58	59	52	42.4	59	17
.	Max	72	51	38	43	31	49	65	69	82	88	83	81	62.7	88	31
1990	Min	43	38	30	35	31	37	45		55	63	63	57			
.	Max	64	52	38	45	45	57	68	47	79	93	87	86	45.3	63	30
1991	Min	43	40	19	26	37	35	40	68	50	59	62	52	65.2	93	38
.	Max	62	54	34	37	54	53	62		73	89	92	83			
1992	Min	42	36	33	35	36	40	45	49	58	61	61	51			
.	Max	65	48	41	46	50	61	66	79	87	87	89	75			
1993	Min	45	36	27	18											
.	Max	66	46	38	32											
Statistics 1950 to 1992 (42 Years)																
N	42	42	42	42	42	42	41	42	42	42	42					
Mean	55	33	31	36	44	54	61	68	78	76	67					
Max	72	55	48	53	54	59	71	78	87	98	96	86				
Mn Max	64	49	41	39	46	54	63	71	80	89	87	78				
Minum	38	22	17	9	17	29	37	44	49	57	56	47				
Mn Min	43	35	29	27	32	36	41	47	54	60	61	53				

Notes:
1. Water Year includes Oct, Nov, Dec of 1 year plus Jan through Sep of the following year (*i.e.*, Water Year 1980 = October 1979 through September 1980).
2. Source: Climatological Data, Washington.

(b) Walla Walla 13 East Southeast (13 ESE), Oregon (Elevation 2400).

The Walla Walla 13 ESE is located at the city of Walla Walla Waterworks Dam (elevation 2400) (see figure 3-7). The average maximum monthly temperatures there range from 35°F in January to 84°F in July. Average minimum temperatures range from 24°F in January to 46°F in July. Average monthly temperatures range from 29°F in January to 65°F in July (see table 3-8).

(3) Precipitation.

Mean annual precipitation for climate stations in the Mill Creek Basin ranges from 13 inches at Walla Walla 3W (lower portion of the basin), to 16 inches at Walla Walla WSO, to 43 inches at Walla Walla 13 ESE (refer to tables 3-11 through 3-14). At elevations above 5,000 feet, the mean annual precipitation more than likely exceeds 50 inches. In the city of Walla Walla, approximately 10 percent of the normal annual precipitation falls as snow. At higher elevations, this percentage increases considerably, and becomes approximately 40 percent at the 5000-foot level. The mean snowfall ranges from a trace to 7 inches in Walla Walla in January (see table 3-15). Above MCP, the normal annual precipitation ranges from 35 to 40 inches (USACE, 1991).

Table 3-11
Mill Creek Basin - Monthly Precipitation
Walla Walla, Washington WSO (Elevation 949)
(Station Closed December 1987)

	Month							Annual Summary							
Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean	Max	Min
1949	0.66	1.91	2.72	0.34	2.21	1.03	0.50	1.49	0.24	0.00	0.06	0.96	12.12	2.72	0.00
1950	0.84	2.05	1.47	2.73	1.83	2.38	0.86	0.49	2.66	0.18	0.47	0.10	16.06	2.73	0.10
1951	4.20	2.05	2.96	1.79	1.65	1.50	0.88	0.56	2.48	0.13	0.07	0.74	19.01	4.20	0.07
1952	2.77	0.89	1.26	1.22	1.75	1.25	1.10	0.70	2.33	0.00	0.02	0.49	13.78	2.77	0.00
1953	0.09	0.41	1.96	4.52	1.52	1.41	1.77	1.91	0.75	0.00	0.57	0.17	15.08	4.52	0.00
1954	1.32	1.97	1.94	2.21	0.60	1.30	1.13	0.81	1.34	0.13	0.96	0.61	14.32	2.21	0.13
1955	0.88	1.38	1.65	1.43	0.43	0.59	2.08	1.20	0.30	0.97	0.00	1.32	12.23	2.08	0.00
1956	3.03	3.16	2.49	3.29	1.63	0.97	0.11	2.03	0.74	0.08	1.52	0.19	19.24	3.29	0.08
1957	2.08	0.53	1.82	1.76	1.10	2.94	0.56	4.19	1.05	0.00	0.15	0.97	17.15	4.19	0.00
1958	1.97	1.80	1.87	2.06	1.60	1.49	3.17	2.36	0.80	0.08	0.01	0.49	17.70	3.17	0.01
1959*	0.44	1.39	3.35	4.00	2.25	1.50	0.86	1.53	1.19	0.05	0.99	2.41	19.96	4.00	0.05
1960	0.93	0.73	0.88	1.15	1.28	1.69	1.31	2.27	0.93	0.00	0.92	0.79	12.88	2.27	0.00
1961	1.51	2.29	0.88	0.98	3.01	2.00	1.36	1.56	0.87	0.01	0.39	0.14	15.00	3.01	0.01
1962	1.32	1.79	2.42	0.63	0.92	2.36	1.20	3.78	0.45	0.00	0.41	1.44	16.72	3.78	0.00
1963	2.99	1.76	2.40	0.93	1.60	0.78	1.86	0.67	0.20	0.49	0.66	0.92	15.26	2.99	0.20
1964	0.60	2.89	2.00	0.97	0.17	0.60	0.90	0.23	1.22	1.47	0.30	0.94	12.29	2.89	0.17
1965	0.66	3.51	4.31	3.29	0.55	0.34	1.68	0.74	0.87	0.59	2.52	0.42	19.48	4.31	0.34
1966	0.73	1.94	0.29	2.22	0.83	1.85	0.19	0.45	1.09	1.78	0.29	0.15	11.81	2.22	0.15
1967	0.87	2.72	2.60	2.11	0.36	1.99	1.66	1.46	0.31	0.00	0.00	0.70	14.78	2.72	0.00
1968	0.88	1.25	1.24	0.79	2.42	0.88	0.43	0.69	0.91	0.48	0.98	1.45	12.40	2.42	0.43
1969	1.62	2.64	3.77	4.17	1.21	0.73	2.88	1.10	0.76	0.01	0.00	0.45	19.34	4.17	0.00
1970	1.43	0.61	2.12	5.86	2.56	1.54	1.84	0.48	1.27	0.15	0.01	1.92	19.79	5.86	0.01
1971	1.56	2.74	0.67	1.59	0.85	1.23	1.35	3.39	2.81	0.65	0.36	1.80	19.00	3.39	0.36
1972	1.25	2.70	3.24	1.20	1.61	2.63	1.14	1.89	1.12	0.57	0.34	0.66	18.35	3.24	0.34
1973	0.60	0.83	2.66	0.99	1.71	0.90	0.40	1.11	0.38	0.12	0.15	1.60	11.45	2.66	0.12
1974	1.86	4.13	4.24	1.68	1.62	1.64	2.25	0.40	0.32	0.91	0.00	0.01	19.06	4.24	0.00
1975	0.39	1.85	2.01	3.82	1.55	0.88	1.24	0.58	0.46	0.04	1.18	0.00	14.00	3.82	0.00
1976	1.68	1.57	2.65	1.35	1.70	1.57	1.39	1.17	0.61	0.30	1.52	0.11	15.62	2.65	0.11
1977**	1.61	0.31	0.75	0.55	0.64	0.98	0.20	1.31	0.35	0.34	2.94	1.18	11.16	2.94	0.20
1978	0.49	2.03	3.83	2.42	1.42	1.07	3.26	0.68	0.61	0.81	2.29	0.99	19.90	3.83	0.49
1979	0.03	2.38	2.29	1.48	1.86	1.63	1.77	0.89	0.37	0.08	1.20	0.31	14.29	2.38	0.03
1980	2.67	2.16	1.33	3.11	1.62	1.92	0.61	1.95	0.89	0.31	0.42	1.39	18.38	3.11	0.31
1981	3.67	1.74	2.89	0.90	3.19	2.89	1.37	2.07	2.47	0.69	0.03	0.84	22.74	3.67	0.03
1982	2.42	2.47	3.16	2.35	2.87	2.69	1.70	0.58	0.32	0.82	0.59	2.10	22.07	3.16	0.32
1983	3.06	1.59	2.90	2.17	2.62	4.17	1.20	1.52	1.74	1.73	0.70	0.93	24.33	4.17	0.70
1984	1.73	3.42	3.50	0.83	2.62	3.68	1.48	1.37	3.01	0.00	0.23	1.26	23.13	3.68	0.00
1985	1.71	3.75	2.21	0.56	1.53	1.74	0.47	0.95	0.90	0.67	1.06	1.40	16.95	3.75	0.47
1986	1.40	2.50	0.84	2.46	3.65	2.57	1.25	2.25	0.35	0.55	0.14	1.86	19.82	3.65	0.14
1987	0.90	4.24	0.62	2.65	1.05	1.06	1.53	1.23	0.57	0.94	0.17	0.04	15.00	4.24	0.04
1988	0.00	0.93	1.40	***	***	***	***	***	***	***	***	***	***	***	***
Statistics 1949 to 1987 (40 Years															
N	40	40	40	39	39	39	39	39	39	39	39	39	39		
Mean	1.47	2.03	2.19	2.01	1.63	1.65	1.31	1.39	1.03	0.41	0.63	0.88	16.71		
Maximum	4.20	4.24	4.31	5.86	3.65	4.17	3.26	4.19	3.01	1.78	2.94	2.41	24.33		
Minimum	0.00	0.31	0.29	0.34	0.17	0.34	0.11	0.23	0.20	0.00	0.00	0.00	11.16		

* Highest Year
** Lowest Year
*** Walla Walla Weather Service Office (WSO) Closed in December 1987.

NOTES:

1. Water Year includes Oct, Nov, Dec of one year plus Jan through Sep of the following year (*i.e.*, Water Year 1980 = October 1979 through September 1980).
2. Source: Climatological Data, Oregon

Table 3-12
Mill Creek Basin - Monthly Precipitation
Walla Walla, Washington FAA (Elevation 1170)

Water Year	Month												Annual Summary		
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean	Max	Min
1950				2.39	2.15	2.76	0.88	0.56	2.86	0.13	0.45	0.18			
1951	4.42	2.71	2.73	1.90	1.74	1.63	0.74	0.57	2.33	0.44	0.06	0.80	20.08	4.42	0.06
1952	3.50	1.21	1.29	1.25	2.03	0.93	1.21	1.17	2.67	0.00	0.00	0.45	15.71	3.50	0.00
1953	0.03	0.50	1.94	5.25	1.92	1.42	1.77	2.02	0.98	0.00	0.97	0.48	17.28	5.25	0.00
1954	1.14	2.70	2.32	2.63	0.77	1.23	1.30	1.00	2.14	0.11	1.30	0.51	17.15	2.70	0.11
1955	1.12	1.80	2.14	1.39	0.41	0.93	2.58	1.75	0.27	0.84	0.00	1.58	14.81	2.58	0.00
1956	3.50	3.47	2.83	3.75	1.74	1.29	0.15	2.44	0.91	0.75	1.80	0.32	22.95	3.75	0.15
1957	2.46	1.18	2.19	1.49	1.23	3.28	0.68	2.96	0.74	0.01	0.25	0.95	17.42	3.28	0.01
1958	2.25	2.38	2.59	2.83	1.97	1.70	3.57	2.18	0.99	0.00	0.00	0.61	21.07	3.57	0.00
1959	0.50	2.15	3.12	4.06	2.17	2.02	1.46	1.89	1.35	0.10	0.21	2.85	21.88	4.06	0.10
1960	1.37	0.83	1.11	1.21	1.57	2.32	1.44	2.86	0.80	0.00	1.36	0.86	15.73	2.86	0.00
1961	1.62	3.06	0.87	1.13	3.92	2.37	1.54	2.62	0.99	0.00	0.45	0.25	18.82	3.92	0.00
1962	1.73	2.28	2.07	0.81	1.19	2.88	1.52	4.13	0.27	0.00	0.43	2.04	19.35	4.13	0.00
1963	3.36	2.31	2.73	1.04	1.65	1.04	2.22	0.74	0.45	0.67	0.36	0.71	17.28	3.36	0.36
1964	0.77	3.57	1.87	1.94	0.52	1.24	1.09	0.40	1.37	2.12	0.52	1.03	16.44	3.57	0.40
1965	0.88	4.14	4.69	3.92	0.62	0.42	1.86	0.80	1.16	0.76	2.70	0.39	22.34	4.69	0.39
1966	0.76	2.10	0.49	2.32	0.94	1.94	0.26	0.68	1.42	1.90	0.35	0.17	13.33	2.32	0.17
1967	0.83	3.35	3.25	2.77	0.49	2.34	1.58	1.87	0.49	0.00	0.00	0.95	17.92	3.35	0.00
1968	1.35	1.50	1.22	0.96	2.66	1.17	0.87	0.71	0.89	0.49	1.01	1.70	14.53	2.66	0.49
1969	2.01	3.15	4.76	4.35	0.91	0.70	3.45	1.36	0.89	0.00	0.00	0.48	22.06	4.76	0.00
1970	1.59	0.66	2.21	5.91	2.67	1.71	1.95	0.40	1.50	0.33	0.25	2.15	21.33	5.91	0.25
1971	1.85	2.79	0.71	2.04	0.95	1.29	1.35	3.17	2.86	0.67	0.29	2.24	20.21	3.17	0.29
1972	1.42	3.05	3.50	1.47	1.79	3.33	1.45	2.09	0.76	0.54	0.44	0.88	20.72	3.50	0.44
1973**	0.69	0.94	2.49	1.17	1.62	1.17	0.57	1.22	0.53	0.08	0.19	1.83	12.50	2.49	0.08
1974	1.98	5.11	5.37	2.20	1.97	2.15	2.86	0.56	0.48	0.86	0.00	0.01	23.55	5.37	0.00
1975	0.37	2.29	3.05	4.85	1.60	1.39	1.38	0.63	0.54	0.38	1.54	0.00	18.02	4.85	0.00
1976	2.06	2.33	3.55	1.77	2.32	1.86	1.77	1.18	1.12	0.32	1.81	0.05	20.14	3.55	0.05
1977	2.03	0.50	0.85	0.64	0.78	1.24	0.17	1.48	0.36	0.25	3.11	1.31	12.72	3.11	0.17
1978	0.57	2.13	3.61	2.46	1.55	1.17	4.01	0.92	0.37	0.70	2.14	0.98	20.61	4.01	0.37
1979	0.03	2.22	2.42	1.66	2.05	1.70	2.13	0.62	0.37	0.03	1.33	0.28	14.84	2.42	0.03
1980	2.65	2.36	1.73	3.36	2.09	1.93	0.73	2.48	1.25	0.29	0.66	1.67	21.20	3.36	0.29
1981	1.81	2.68	3.37	1.31	3.65	2.79	2.09	2.47	2.80	0.87	0.03	0.72	24.59	3.65	0.03
1982*	2.97	2.96	4.02	3.11	3.22	3.07	1.53	0.40	0.56	1.04	1.04	1.94	25.86	4.02	0.40
1983	3.33	1.75	2.54	2.51	2.84	4.33	1.17	1.61	2.09	1.68	0.58	0.92	25.35	4.33	0.58
1984	1.87	3.76	2.92	1.04	2.79	4.25	1.84	1.59	3.09	0.00	0.27	1.12	24.54	4.25	0.00
1985	1.73	4.71	3.01	0.44	1.65	2.08	0.64	1.00	1.10	0.39	1.85	1.87	20.47	4.71	0.39
1986	2.12	2.85	1.28	2.46	4.12	2.78	1.42	2.45	0.53	0.55	0.37	1.94	22.87	4.12	0.37
1987	0.90	4.63	0.68	2.74	1.19	1.34	1.96	1.43	0.67	1.15	0.24	0.09	17.02	4.63	0.09
1988	0.01	1.13	1.85	3.46	0.97	2.86	2.83	2.04	0.83	0.11	0.00	0.38	16.47	3.46	0.00
1989	0.10	4.15	1.40	3.16	1.34	3.71	1.76	3.05	0.25	0.02	1.49	0.39	20.82	4.15	0.02
1990	1.24	1.78	1.69	1.68	1.13	1.96	2.51	3.35	0.67	0.38	0.91	0.00	17.30	3.35	0.00
1991	3.51	2.00	1.83	0.91	0.93	2.59	1.50	6.63	2.71	1.09	0.15	0.00	23.85	6.63	0.00
1992	1.77	4.91	0.64	1.46	1.38	0.49	2.03	0.26	1.37	4.73	2.29	1.23			
1993	1.21	2.48	1.55	2.05											
Statistics 1950 to 1992 (42 Years)															
N	42	42	42	42	42	42	42	42	42	42	42	42			
Mean	1.67	2.47	2.40	2.33	1.76	2.01	1.61	1.75	1.18	0.48	0.74	0.91	19.30		
Maximum	4.42	5.11	5.37	5.91	4.12	4.33	4.01	6.63	3.09	2.12	3.11	2.85	25.86		
Minimum	0.01	0.50	0.49	0.44	0.41	0.42	0.15	0.40	0.25	0.00	0.00	0.00	12.50		

* Highest Year
** Lowest Year
NOTES:
1. Water Year includes Oct, Nov, Dec, of one year plus Jan through Sep of the following year (*i.e.*, Water Year 1980 = October 1979 through September 1980).
2. Source: Climatological Data, Washington.

Table 3-13
Mill Creek Basin - Monthly Precipitation
Mill Creek Dam near Walla Walla, Washington (Elevation 1175)

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean	Max	Min
	Month												Annual Summary		
1948	.	.	.	.	.	.	.	.	.	1.59	0.16	0.69	.	.	.
1949	0.95	2.29	2.51	0.38	1.89	1.15	0.46	1.67	0.21	0.00	0.18	1.17	12.86	2.51	0.00
1950	1.24	2.27	1.30	2.09	1.93	2.29	0.92	0.66	2.73	0.12	0.49	0.21	16.25	2.73	0.12
1951	4.61	2.77	2.60	1.60	1.65	1.07	0.89	1.48	2.86	0.30	0.10	0.83	20.76	4.61	0.10
1952	3.76	0.87	1.26	1.00	0.94	0.97	1.17	1.30	2.41	0.04	0.01	0.48	14.21	3.76	0.01
1953	0.08	0.54	1.57	4.84	2.20	1.71	1.78	1.87	1.14	0.00	0.57	0.05	16.35	4.84	0.00
1954	1.17	2.54	2.34	2.65	0.71	1.25	1.31	1.21	2.07	0.37	1.43	0.57	17.62	2.65	0.37
1955	1.08	1.68	1.78	1.32	0.57	0.85	2.03	1.66	0.16	0.67	0.00	1.76	13.56	2.03	0.00
1956	3.23	3.31	2.33	3.59	1.45	1.12	0.21	2.37	1.01	0.67	1.68	0.03	21.00	3.59	0.03
1957	3.05	0.96	1.85	1.55	1.26	2.45	1.59	3.38	0.69	0.04	0.24	0.72	17.78	3.38	0.04
1958	2.56	2.35	2.70	2.44	1.77	1.63	3.57	2.22	1.25	0.02	0.00	0.74	21.25	3.57	0.00
1959	0.49	2.39	3.30	3.73	2.37	1.59	1.38	1.86	1.52	0.07	1.17	3.31	23.18	3.73	0.07
1960	1.22	0.81	1.07	1.28	1.37	2.42	1.49	2.24	0.92	0.00	1.25	0.90	14.97	2.42	0.00
1961	1.65	2.19	0.84	1.23	3.30	2.39	1.29	2.61	0.97	0.00	0.21	0.61	17.29	3.30	0.00
1962	1.77	2.07	1.87	0.72	0.79	2.64	1.43	3.57	0.42	0.01	0.52	1.93	17.74	3.57	0.01
1963	3.32	2.02	2.55	0.19	.	.	.	0.86	0.24	0.78	0.20	0.73	.	.	.
1964	0.66	3.20	1.97	1.01	0.26	0.84	1.21	0.49	1.41	1.98	0.48	0.86	14.37	3.20	0.26
1965	0.82	3.05	4.61	2.87	0.82	0.41	1.86	0.82	1.29	0.69	2.31	0.38	19.93	4.61	0.38
1966	0.71	1.93	0.35	1.91	0.78	1.97	0.24	0.62	1.05	2.15	0.35	0.21	12.27	2.15	0.21
1967	0.88	2.83	2.80	2.30	0.35	2.11	1.57	1.88	0.41	0.00	0.00	0.74	15.87	2.83	0.00
1968	1.33	1.37	0.69	0.88	2.52	1.07	0.78	0.77	0.88	0.47	1.29	1.75	13.80	2.52	0.47
1969	1.82	2.85	3.11	4.53	1.14	0.87	3.14	0.91	1.03	0.02	0.00	0.53	19.95	4.53	0.00
1970	1.64	0.62	2.41	5.37	2.20	2.14	2.00	0.39	1.36	0.24	0.21	2.26	20.84	5.37	0.21
1971	1.91	3.10	0.83	2.08	0.93	1.38	1.42	2.79	3.05	0.75	0.33	2.28	20.85	3.10	0.33
1972	1.07	3.57	3.29	1.16	1.39	3.00	1.39	2.02	0.76	0.50	0.57	0.90	19.62	3.57	0.50
1973**	0.59	0.87	1.79	0.93	1.18	1.68	0.50	1.19	0.51	0.04	0.18	1.75	11.31	1.79	0.04
1974	1.03	5.62	5.06	2.15	1.75	2.75	3.14	0.80	0.65	0.97	0.00	0.01	23.93	5.62	0.00
1975	0.36	2.33	2.89	4.70	1.50	1.48	1.51	0.84	0.69	0.29	1.45	0.00	18.04	4.70	0.00
1976	2.12	2.11	3.43	1.50	2.32	1.38	2.21	1.20	0.99	0.51	1.80	0.13	19.70	3.43	0.13
1977	1.01	1.52	0.95	0.89	0.41	1.45	0.38	1.57	0.49	0.36	3.23	1.53	13.79	3.23	0.36
1978	0.66	2.10	4.07	2.47	1.73	1.16	3.88	1.09	0.69	0.84	2.14	1.21	22.04	4.07	0.66
1979	0.11	1.80	3.00	1.65	2.11	2.16	2.00	.	0.39	0.10	1.39	0.31	.	.	.
1980	2.58	2.21	1.57	3.43	1.94	1.96	0.64	2.29	1.22	0.32	0.49	1.59	20.24	3.43	0.32
1981	2.71	2.21	3.40	1.08	3.22	2.80	1.64	2.43	2.50	0.51	0.06	0.78	23.34	3.40	0.06
1982*	2.59	2.17	4.84	3.50	2.97	2.62	1.27	0.60	0.65	0.74	1.72	1.87	25.54	4.84	0.60
1983	3.20	1.96	2.52	2.16	2.94	4.25	1.19	1.46	1.53	1.43	0.98	0.91	24.53	4.25	0.91
1984	1.52	3.66	3.92	1.06	2.48	3.22	1.38	1.58	2.88	0.00	0.29	0.95	22.94	3.92	0.00
1985	2.10	3.96	2.73	0.70	1.75	1.48	0.62	0.95	1.09	0.18	1.05	1.64	18.25	3.96	0.18
1986	1.64	2.71	1.22	2.32	3.59	2.63	1.26	2.03	0.47	0.43	0.09	1.86	20.25	3.59	0.09
1987	0.84	4.04	0.75	2.46	1.37	2.13	1.16	1.94	0.56	1.42	0.27	0.00	16.94	4.04	0.00
1988	0.00	0.92	1.77	4.03	1.06	2.53	2.76	1.95	1.10	0.10	0.00	0.50	16.72	4.03	0.00
1989	0.14	.	1.39	3.50	1.68	3.68	1.49	2.75	0.32	0.07	1.15	0.27	.	.	.
1990	1.02	1.78	1.49	1.66	1.21	2.14	2.11	2.35	0.59	1.00	2.14	0.00	17.49	2.35	0.00
1991	2.16	0.32	1.12	1.08	0.80	2.53	1.22	5.67	2.80	0.30	1.35	0.01	19.36	5.67	0.01
1992	1.27	4.79	1.92	1.17	1.35	0.55	1.69	0.39	0.80	3.16	1.72	1.31			
1993	0.99	3.14	1.55	2.41											
Statistics 1948 to 1992 (42 Years)															
N	44	43	44	43	42	42	42	42	43	43	44	44	44	40	
Mean	1.56	2.29	2.27	2.14	1.63	1.63	1.94	1.51	1.68	1.16	0.48	0.76	0.91	18.42	
Maximum	4.61	5.62	5.06	5.37	3.59	3.59	4.25	3.88	5.67	3.05	2.15	3.23	3.31	25.54	
Minimum	0.00	0.32	0.35	0.19	0.26	0.26	0.41	0.21	0.00	0.16	0.00	0.00	0.00	11.31	

* Highest Year
** Lowest Year
NOTES:
1. Water Year includes Oct, Nov, Dec of one year plus Jan through Sep of the following year (*i.e.*, Water Year 1980 = October 1979 through September 1980).
2. Source: Climatological Data, Washington.

Table 3-14
Mill Creek Basin - Monthly Precipitation
Walla Walla 13 ESE, Oregon (Elevation 2400)

	Month												Annual Summary		
Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Mean	Max	Min
1951	7.55	6.39	6.11	6.26	4.70	.	0.85	1.31	4.46	0.61	0.00	1.73	.	7.55	0.00
1952	9.25	5.69	7.00	2.96	2.93	4.06	2.89	2.74	4.90	0.39	0.00	0.97	43.78	9.25	0.00
1953	0.37	1.03	4.48	13.32	5.18	4.73	3.44	3.39	2.05	0.00	1.49	0.41	39.89	13.32	0.00
1954	1.40	5.70	7.89	7.26	2.16	2.20	4.18	2.86	4.19	0.42	3.17	0.67	42.10	7.89	0.42
1955	1.51	2.85	4.58	2.97	2.52	5.54	4.05	1.92	0.61	2.46	0.00	2.69	31.70	5.54	0.00
1956	5.90	5.86	7.93	6.45	4.86	4.98	0.46	4.63	2.35	0.74	2.49	0.77	47.42	7.93	0.46
1957	4.58	3.06	6.66	3.01	6.40	5.53	4.42	4.36	1.30	0.03	0.36	0.80	40.51	6.66	0.03
1958	4.21	4.29	8.44	6.33	5.85	2.39	8.01	2.10	2.41	0.24	0.18	1.37	45.82	8.44	0.18
1959	3.03	8.75	8.36	8.25	3.05	5.53	3.42	3.52	1.98	0.69	1.64	6.73	54.95	8.75	0.69
1960	4.56	4.22	2.71	2.78	5.69	5.50	4.01	4.84	1.70	0.07	1.93	1.37	39.38	5.69	0.07
1961	3.26	7.98	2.83	2.95	9.85	7.21	3.73	2.79	1.64	0.09	0.78	2.12	45.23	9.85	0.09
1962	4.53	4.12	5.38	3.01	2.11	5.93	3.72	3.05	0.47	0.00	0.75	3.45	36.52	5.93	0.00
1963	4.91	4.49	2.89	2.04	4.13	4.50	4.62	1.12	1.50	0.62	0.47	1.87	33.16	4.91	0.47
1964	1.28	7.19	3.49	9.40	2.07	5.58	3.86	1.22	2.27	0.95	1.15	2.41	40.87	9.40	0.95
1965	2.26	8.15	12.93	10.19	3.43	0.72	3.49	2.57	2.76	1.33	2.93	1.71	52.47	12.93	0.72
1966	1.53	3.59	1.48	8.04	5.05	6.45	1.36	1.57	2.04	1.79	0.88	0.68	34.46	8.04	0.68
1967	3.91	5.57	4.54	8.28	1.95	4.32	3.18	2.82	1.13	0.05	0.00	0.98	36.73	8.28	0.00
1968	4.75	2.96	4.80	2.47	6.57	2.28	2.93	3.01	2.58	1.13	3.97	4.27	41.72	6.57	1.13
1969	4.73	5.91	6.58	9.79	2.20	3.03	5.51	1.92	2.86	0.00	0.00	1.50	44.03	9.79	0.00
1970	2.98	1.56	5.30	12.64	4.00	5.10	4.83	1.89	3.27	0.81	0.33	3.84	46.55	12.64	0.33
1971	4.60	7.91	3.59	7.93	3.48	5.40	2.70	4.57	4.09	1.06	0.80	4.31	50.44	7.93	0.80
1972	5.27	5.49	7.65	4.34	6.07	5.92	4.78	2.63	1.49	0.04	0.57	2.19	46.44	7.65	0.04
1973	1.70	2.65	8.82	4.55	2.08	2.58	1.26	2.14	1.18	0.00	0.36	4.08	31.40	8.82	0.00
1974**	3.24	12.83	9.51	10.29	4.72	6.07	7.16	2.41	3.98	1.12	0.00	0.00	61.33	12.83	0.00
1975	0.00	4.93	6.22	9.74	4.23	4.63	4.04	1.96	2.06	0.62	1.72	0.00	40.15	9.74	0.00
1976	4.96	7.08	3.78	.	.	.	.	.	.	.	2.92	0.05	.	7.08	0.05
1977	.	2.82	2.34	1.48	2.05	4.32	0.86	3.39	0.85	0.20	4.42	2.89	.	4.42	0.20
1978	0.91	3.58	7.75	3.43	3.74	2.11	5.85	2.97	.	.	.	.	.	7.75	0.00
1979	.	4.65	.	.	.	.	.	2.51	1.19	0.22	1.04	0.23	.	4.65	0.22
1980	4.19	3.12	4.65	5.95	3.04	4.52	3.44	3.31	2.89	0.70	1.35	1.92	39.08	5.905	0.70
1981	2.12	5.47	5.23	1.08	4.85	4.11	3.33	2.62	2.33	0.54	0.01	1.63	33.32	5.47	0.01
1982	4.68	5.97	8.16	7.81	9.16	5.53	3.57	1.93	1.54	1.70	0.99	3.05	54.09	9.16	0.99
1983	.	.	.	6.09<B	5.22	7.35	2.16	3.56	1.98	2.43	0.80	1.94	.	7.35	0.80
1984	1.81	.	.	R.	4.94	7.38	2.86	4.10	4.03	0.48	1.63	1.48	.	7.38	0.48
1985*	1.87	2.58	2.00	0.52	3.32	2.87	2.54	1.83	1.97	0.44	1.06	1.88	23.88	3.52	0.44
1986	3.34	3.73	1.23	5.87	8.38	4.72	.	.	.	.	.	.	.	8.38	1.23
1987	1.26	8.66	1.35	4.64	3.61	3.86	2.62	2.42	1.19	0.72	0.60	0.39	31.32	8.66	0.39
1988	0.00	2.66	5.55	6.09	1.88	6.33	3.30	2.33	1.68	0.29	0.00	1.10	31.21	6.33	0.00
1989	0.47	11.21	3.90	7.95	1.53	6.01	1.83	3.94	1.43	0.28	2.61	0.62	41.78	11.21	0.28
1990	2.43	4.46	2.95		3.54	2.68	5.21	4.19	2.15	0.89	0.52	0.00		5.21	0.00
1991	7.00	6.46	.											7.00	0.02
1992	0.54	4.40	0.95	1.14	0.35	1.22	1.60	3.50	1.66		0.35	0.02		4.40	0.54
Statistics 1951 to 1980 (40 Years															
N	39	40	38	37	39	38	38	39	39	38	40	40	31		
Mean	3.25	5.25	5.26	5.87	4.13	4.56	3.48	2.82	2.16	0.64	1.11	1.73	41.35		
Maximum	9.25	12.83	12.93	13.32	9.85	7.38	8.01	4.84	4.90	2.46	4.42	6.73	61.33		
Minimum	0.00	1.03	0.95	0.52	0.35	0.72	0.46	1.12	0.00	0.00	0.00	0.00	23.88		

* Highest Year
** Lowest Year
NOTES:
1. Water Year includes Oct, Nov, Dec of one year plus Jan through Sep of the following year (*i.e.*, Water Year 1980 = Ocotber 1979 through September 1980).
2. Source: Climatological Data, Oregon.

Table 3-15 Mean Snowfall 1931 to 1965 at Walla Walla WSO								
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Mean		T	1.5	3.7	7.1	3.8	1.3	0.2
Median		0	T	2.3	5.5	2.6	0.3	0
Greatest		1.5	12.0	13.6	30.0	17.4	6.2	7.0
Least		0	0	0	0	0	0	0

(4) Humidity.

The relative humidity at Walla Walla WSO is moderate most of the time, and averages between 50 and 70 percent, annually. The highest relative humidity, near 100 percent, occurs during periods of fog in late fall and winter. In the period from December through January, the average monthly relative humidity is about 80 percent at 4 a.m., and 78 percent at 4 p.m. The lowest relative humidity, near 10 percent, usually happens during hot summer afternoons. During the summer months, there is considerable diurnal variation in relative humidity values (*e.g.*, the average monthly relative humidity values over Virgil B. Bennington Lake and its adjacent lands are higher because of water evaporation. Table 3-16 is a summary of evaporation data from 1963 to 1990 (27 years). This data was collected and measured at Whitman Mission, Washington (elevation 623).

Table 3-16 Virgil B. Bennington Lake--Monthly Evaporation (Measured in Inches) Statistics 1963 to 1990							
	Apr	May	Jun	Jul	Aug	Sep	Apr to Sep
Mean	4.76	6.67	8.50	10.69	9.24	5.58	45.52
Maximum	6.59	8.07	10.47	12.63	10.97	6.80	51.31
Minimum	3.67	5.30	6.40	8.98	7.38	4.12	39.21
Location: Whitman Mission National HIstorical Site Source: Climatological Data, Washington For monthly evaporation by year, see USACE 1991, table 4-5.1.							

(5) Wind.

During daylight hours, the prevailing winds in the Walla Walla area come from the south. They are generally quite light, but occasional damaging windstorms and duststorms have occurred at times. Average wind speeds vary from 4 to 6 miles per hour. Mornings are usually calm, and afternoon winds pick up out of the south and southwest. At night, prevailing winds (drainage winds) drift off the Blue Mountains, and come out of the southeast. The strongest wind ever recorded at Walla Walla FAA was 69 miles per hour. This happened in January 1990, and was the result of a weather system passing through the area.

(6) Analysis of Climate.

The MCP was envisioned and constructed because of the damaging effects of climate. Climate also has an effect on water control operations and recreational activities at Virgil B. Bennington Lake. High temperatures and/or low precipitation during the summer recreation season attracts visitors to the project (see figure 3-12). Low precipitation during November through February results in below normal spring snowmelt runoff. This, in turn, affects the length of time the lake level can be maintained at elevation 1205 during the summer (see section 3.03.,e., *Water Resources Facilities and Operations*).

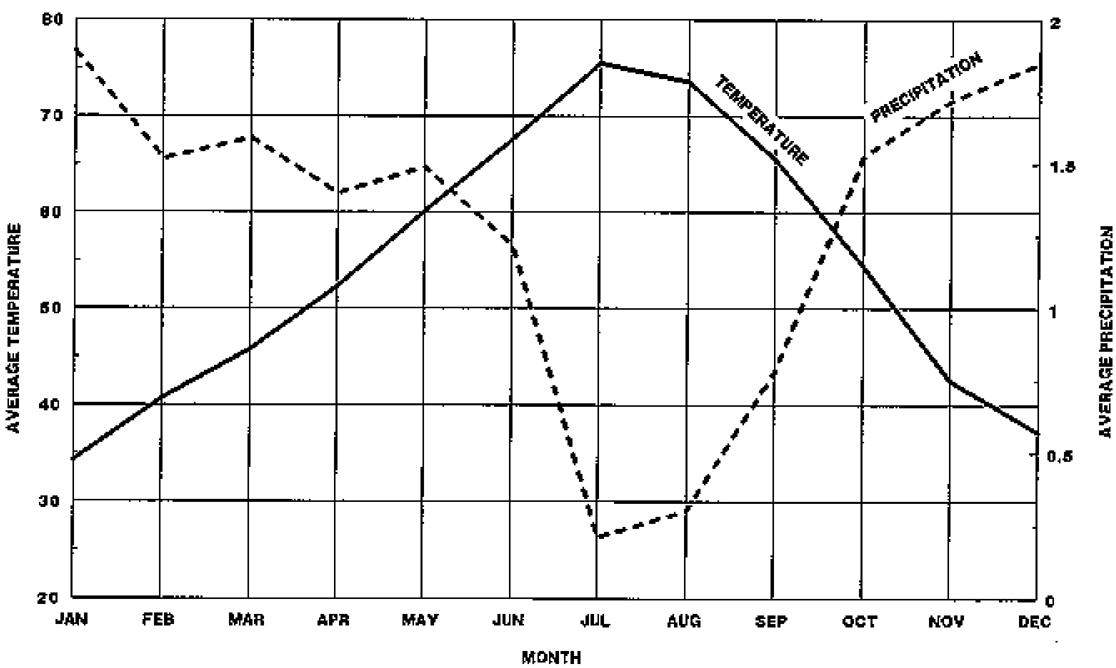


Figure 3-12. Mean Temperature and Precipitation, MCP, Walla Walla, Washington

g. Air Quality.

(1) General.

The air quality in southeastern Washington is very good, except in localized areas where agricultural practices encourage dust storm formation during high wind periods.

(2) Analysis of Air Quality.

The air quality in the Walla Walla area is generally good because of the adequate ventilation of the valley and the lack of intensive urbanization. Air quality problems with suspended particulates usually occur during the summer season and may be attributed to agricultural activities (*i.e.*, tillage, harvesting, and field burning), thermal atmospheric inversions, and winds. Smoke from inefficient woodstoves poses a problem in the cold winter months. Carbon monoxide levels are minimal, and are concentrated in the central business district, Eastgate, and Plaza Way during peak traffic hours. Table 3-17 shows recent suspended particulate levels for Walla Walla (Susan Davison, 1988).

Table 3-17
Suspended Particulate Levels
City of Walla Walla
Annual Geometric Means (umhos g/m3)

1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	State Standard
71	59	70	62	60	55	64	68	51	62	70	50

h. Land Cover and Vegetation.

(1) General.

Land covers are classifications of vegetation, water, and natural surfaces on the land. Vegetation is further broken into categories of life forms that fall under the headings of upland vegetation, riparian vegetation, wetlands, and agricultural land (see figure 3-13). This section describes these various types of land cover at, and surrounding, MCP. Urban, or built-up, cover types are also described here. Urban (built-up) and agricultural lands would normally be in paragraph 3.02, *Cultural factors*, since they are influenced by man. However, for convenience, they are all described in the following paragraphs. Additional detailed information on project structures, parks, and wildlife developments is described in paragraph 3.03., *Transportation*. For a checklist of vegetation by species, refer to Supporting Data, Item 7, at the back of this volume.

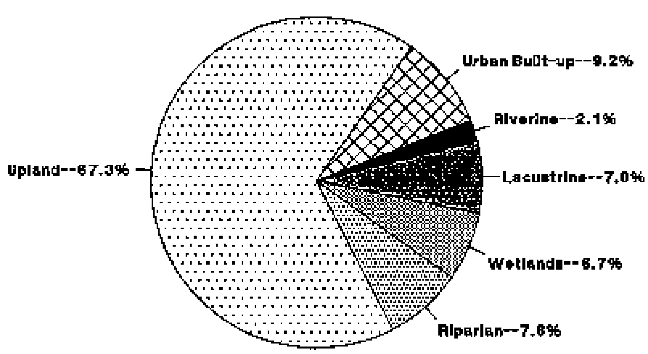


Figure 3-13. Land Cover and Vegetation

(2) Description.

The MCP is located in an arid transitional grassland area. It is bounded by dry desert shrub areas to the north and west, and arid transitional timbered areas to the south (Weber and Larreson, 1977). This whole area is now largely grain fields, with some grazing lands located on poorer soil sites. Irrigated croplands are located in the Walla Walla Valley, west of the project. The dominant physical components influencing vegetation at MCP are elevation, slope, aspect, soil depth, climate, seed availability, and manmade influences. Trees and shrubs have been planted in former croplands in an effort to improve wildlife habitat by providing cover and the interspersion of plant communities. Much of the project area adjacent to the lake has been planted in dryland grasses. These grasses lie in parallel strips, alternating between high- and low-growing varieties.

The original planting of grasses, trees, and shrubs was conducted by the Washington Department of Game [now Washington Department of Wildlife (WDW)] in the 1950's (see section 3.02.h., *Wildlife Habitat Improvement*). It has proved to be of considerable benefit to wildlife habitat in the area, as well as being aesthetically pleasing. The WDW planted approximately 5,000 trees and shrubs. The trees planted at this time included Russian olive, Chinese elm, black locust, prune, peach, mugho pine, and juniper. The shrubs planted included carigana, honeysuckle, and serviceberry. Tall wheatgrass and Sherman big bluegrass have also been planted. Dodder, thistles, morning glory, and a variety of herbaceous plants grow naturally in the lake area. The forebay (upstream of the dam), and other areas of the project, have been allowed to develop naturally. A steep natural geologic embankment, running adjacent and south of the main Mill Creek channel, is vegetated with various native trees, shrubs, vines, and perennials dependent on that specific slope and orientation. The steeper areas contain grass and shrubs, while the flat areas are densely covered with larger deciduous trees and vines. This area provides an excellent habitat for many varieties of songbirds.

The forebay area (upstream of the diversion structure) has become a unique wetland area, with excellent stands of deciduous riparian trees and shrubs on areas of slightly higher elevation. The diversion structure serves to partially impound Mill Creek during high flows, thereby raising the elevation enough to create a seasonally flooded wetland. This provides even greater overall plant and wildlife development opportunities.

The diversion canal, the area surrounding the lake along the Russell Creek Outlet Canal, and the lake roads are planted wildlife areas, as previously mentioned. The larger, dense, deciduous riparian vegetation, located adjacent to the inlet channel and lake, became established in the past, when the location of the channel encouraged their growth. In order to maintain themselves over time, the root systems followed the water. Much of this vegetation now appears to be stressed. This is probably due to the movement of the channel away from the vegetation.

Over the years, the pool elevation has been fluctuated, for operation and testing purposes. This change in water regime has strongly affected the vegetation composition. Areas originally planted in dryland grasses and, to a lesser extent, trees and shrubs, have been replaced with flood-tolerant species. This hydrologically-impacted area (zone of inundation) adds diversity and wildlife value to the overall project.

The Rooks Park area, located west of the forebay, is characterized by native black cottonwood and irrigated grass, as well as tree and shrub plantings.

(3) Land Cover Classifications.

Land cover classifications are described in the following paragraphs, as well as in table 3-18. Plate 3-6 is a view of these various land cover classifications and vegetation cover characteristics.

Table 3-18
The MCP Land Cover Vegetation

		MCP Acreage	Number of Acres	Percent of MP
Upland Vegetation		411.65	75	67.3
(U-F)	Upland Field	324.89	18	53.1
(U-S)	Upland Shrubs	45.02	36	7.4
(U-SP)	Upland Deciduous Saplings	6.83	1	1.1
(U-CT)	Upland Coniferous Trees	0.04	1	0.0
(U-DT)	Upland Deciduous Trees	16.21	15	2.6
(U-D)	Upland Disturbed	18.66	4	2.8
Riparian Vegetation		46.44	16	7.6
(R-F)	Riparian Field	13.13	2	2.1
(R-S)	Riparian Shrubs	12.68	4	2.1
(R-DT)	Riparian Deciduous Trees	19.98	10	3.4
Wetlands		40.87	10	6.7
(W-OW)	Palustrine Open Water	3.17	2	0.5
(W-PE)	Palustrine Emergent	16.53	4	2.7
(W-PS)	Palustrine Scrub Shrub	11.26	3	1.8
(W-PF)	Palustrine Forest	9.91	1	1.6
Lacustrine		43.09	2	7.0
(L-OW)	Open Water	19.79	1	3.2
(L-UB)	Unconsolidated Bottom	23.30	1	3.8
Riverine		13.07	2	2.1
(R-OW)	Open Water	13.07	2	2.1
(R-UB)	Unconsolidated Bottom	--	1	--
Urban or Built-Up Land		56.49	13	9.2
(UB-L)	Irrigated Lawn	6.79	6	1.1
(UB-P)	Project Structures	44.68	6	7.3
(UB-T)	Transportation/Roads	5.02	1	0.8

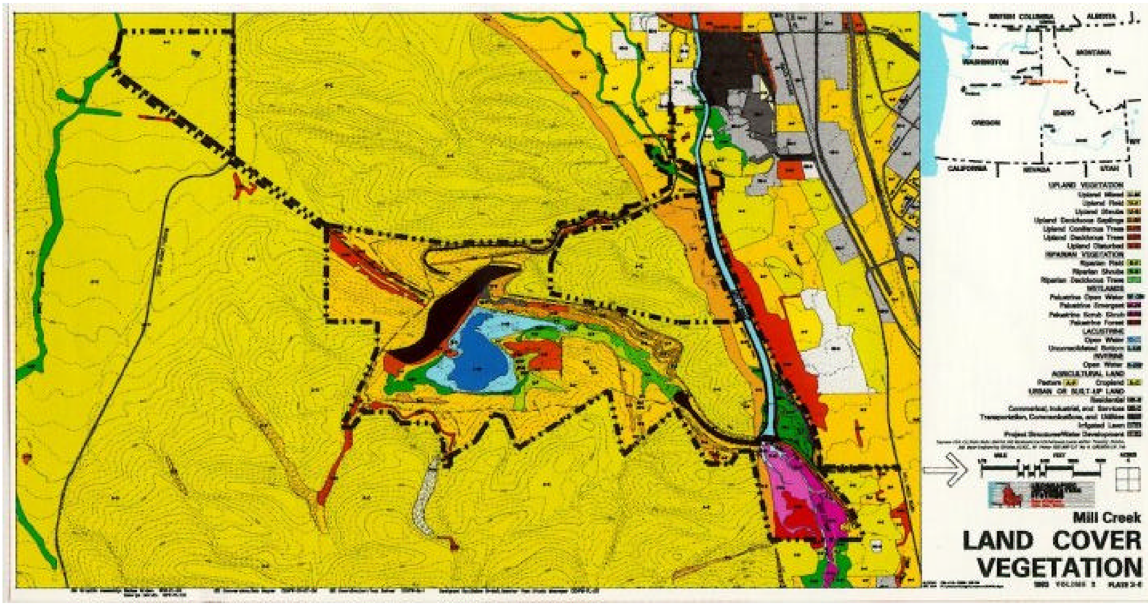


Plate 3-6. Land Cover and Vegetation

(a) Upland Vegetation.

There are seven classifications of upland vegetation, but only six of them exist at MCP (see photo 3-5). Upland Field is the single largest classification type, and it covers 53 percent of MCP.

Photo 3-5. A variety of upland vegetation has developed on MCP in contrast to surrounding agricultural fields.

1. Upland Mixed (U-M).

The U-M vegetation contains a mixture of any, or all, of the upland life forms. None of this type of vegetation occurs on MCP lands. No individual life form (*i.e.*, saplings, shrubs, *etc.*) represents greater than 50-percent aerial cover. The majority of vegetation in this category consists of remnant mature deciduous trees. The remaining cover is composed of saplings, shrubs, and pockets of annuals. A mixture of upland life forms is an indication that an area has been disturbed sporadically over a long period of time. The U-M areas are located just west of the project, in and around Walla Walla Community College.

2. Upland Field (U-F).

This is the largest land cover classification, and it covers 53 percent of MCP. The U-F areas have a dominant cover of herbaceous plants. Woody plants may be present, but do not represent more than 50 percent of the horizontal cover. The MCP contains approximately 325 acres of U-F. These areas are located below the dam, as well as to the north and east of Virgil B. Bennington Lake. Other U-F areas are located both north and west of the project. The 63-acre land parcel, recently purchased for the LSRFWCP, has just been seeded to herbaceous plants. [This is still shown as Cropland (A-C) on plate 3-6.]

3. Upland Shrubs (U-S).

Any woody plant commonly considered a shrub (as opposed to trees or saplings), with a cover greater than 50 percent, falls into the U-S classification. Generally, shrubs range in height from 3 to 8 feet, but some grow taller than 15 feet [*e.g.*, staghorn sumac *(Rhus typina)*]. These areas represent a late stage of old field succession, and commonly dominate the areas they inhabit. The MCP contains approximately 45 acres of U-S. Naturally occurring U-S inhabits the bluff just south of Mill Creek. The areas north of the lake (along Upper Service Road) and across from Rooks Park are planted by WDW.

4. Upland Deciduous Saplings (U-SP).

This land cover classification consists of areas dominated by deciduous saplings, 20 feet or less in height. Cover provided by these trees is greater than 50 percent. Seven acres northwest of the lake contain U-SP.

5. Upland Deciduous Trees (U-DT).

Areas dominated by mature deciduous trees over 20 feet in height make up this land cover classification. Cover provided by these trees is greater than 50 percent, and understory and ground cover species are usually dependent upon overstory density, shading, and competition. There are 16 acres of U-DT at MCP. The largest area lies along the Russell Creek Outlet Canal, just below the dam. A large area just north of the project boundary (along Mill Creek) consists primarily of U-DT.

6. Upland Coniferous Trees (U-CT).

This land cover classification is comprised of areas dominated by mature coniferous trees over 20 feet in height. Cover provided by these trees is greater than 50 percent, and the understory may consist of the same species as the overstory. Ground cover is usually sparse, and is often nonexistent. Less than 1/10 of an acre (along Lake Access Road) contains U-CT. A small Christmas tree farm, along the south entrance road to Walla Walla Community college contains the only other U-CT area anywhere around MCP.

7. Upland Disturbed (U-D).

The U-D areas may be completely void of any vegetation, or they may have a herbaceous cover of less than 50 percent. This subclass is representative of areas that have been recently disturbed, or areas that have been severely disturbed in the past (*e.g.*, topsoil removal). Vegetation, when it is present at all, tends to be of a xeric composition. The three U-D areas (19 acres) at MCP were used as Bp's for construction activities. The Bp's are located to the south of the lake (along Mill Creek Dam), to the west of the lake, and to the north of the lake.

(b) Riparian Vegetation.

1. Riparian Field (R-F).

The R-F areas are indicated by a dominant cover of herbaceous plants. Woody plants may also be present, but do not exceed 50 percent of the horizontal cover. The dominant influencing physical attribute is water. Irregular flooding, or inundation, determines the species composition components of the area, by eliminating dry area grass and herbs, and introducing broadleaf "weedy" vegetation associated with riparian areas. Two areas (13 acres total) on the project have R-F coverage: one is located between the inlet canal and the lake, and the other is located just northeast of the lake.

2. Riparian Shrubs (R-S).

Woody plants commonly considered shrubs (as opposed to trees or saplings), with a cover greater than 50 percent, make up the R-S subclassification. Generally, shrubs range in height from 3 to 8 feet, but many grow taller than 15 feet. These areas represent a late stage of old field succession, and commonly dominate areas influenced by the presence of water. This vegetation grows near streams, rivers, lakes, or other bodies of water. This behavior suggests water dependence. Of the 13 acres of this type of vegetation located at MCP, a small portion is located just below the intake diversion, while the remainder can be found along the intake canal.

3. Riparian Deciduous Trees (R-DT).

This type of vegetation is characterized by areas dominated by mature deciduous trees (over 20 feet tall), found in locations influenced by the presence of water. This behavior suggests water dependence. The MCP contains 20 acres of R-DT. These areas are located at Rooks Park [Mill Creek Channel (see photo 3-6)], around Virgil B. Bennington Lake, and along Yellowhawk Creek.

Photo 3-6. Riparian vegetation along Mill Creek Channel

(c) Wetlands.

1. Palustrine Open Water (W-OW).

This class applies to small, shallow, permanent, or intermittent water bodies (often called ponds). The diversion dam forms a 3-acre area of W-OW on the project. There is also a small area (2/10th of an acre) in Rooks Park (just south of the gravel parking lot) that is W-OW. This area was the original Mill Creek channel, before Mill Creek was channelized in 1941.

2. Palustrine Emergent (W-PE).

This type of land cover is dominated by meadow emergents, with marsh-type emergents appearing in wetter areas. Sixteen and one-half acres of W-PE are located in the forebay area, behind the diversion structure (see photo 3-7).

Photo 3-7. Extensive wetlands have developed behind Diversion Dam

3. Palustrine Scrub Shrub (W-PS).

Water-dependent shrubs (primarily willow and red osier dogwood) are dominant in this type of land cover. Ground cover is typically a mixture of emergents similar to those dominating W-PE. Hydric soil is present, but is seasonally flooded. Eleven acres of W-PS are located in the forebay, on the north side of Mill Creek.

4. Palustrine Forest (W-PF).

This subclass applies to wetlands dominated by trees (primarily black cottonwood) over 20 feet tall. Ground cover, as described in the W-PE and W-PS subclasses, often appears with a subcanopy of water-dependent shrubs. The east end of the forebay contains 10 acres of W-PF.

(d) Lacustrine.

1. Open Water (L-OW).

This land cover classification applies to natural or manmade basins or channels that contain permanent water. Typically, they include extensive areas of deep water. Virgil B. Bennington Lake, at elevation 1187 (20 surface acres), is considered to be L-OW.

2. Unconsolidated Bottom (L-UB).

This type of land cover, which has a particle cover of at least 25 percent that is smaller than stones and a vegetative cover of less than 30 percent, creates a generally unstable surface for plant attachment. Virgil B. Bennington Lake, between elevations 1187 and approximately 1200, contains 23 acres of L-UB.

(e) Riverine.

1. Open Water (R-OW).

This land cover classification consists of permanent areas of moving water, such as creeks or rivers. Mill Creek (to the first Division Works) is R-OW, and covers 13 acres of MCP. Mill Creek is dry below the first Division Works during the summer, due to the diversion of water to Yellowhawk and Garrison Creeks for irrigation.

2. Unconsolidated Bottom (R-UB).

This type of land cover includes creek channels that are dry part of the year. Mill Creek (below the second division works) is R-UB, due to the diversion, in the spring and summer, of all (or most) of Mill Creek into Yellowhawk and Garrison Creeks for irrigation. This portion of the channel runs for 300 feet, and ends at the MCP boundary. It covers ½ acre of project lands.

(f) Agricultural Land.

There are no fee-owned project lands under these classifications, but the flowage easement lands are classified as cropland.

1. The A-C Lands.

Cultivated lands used primarily for crop production make up this type of land cover. These lands are used almost exclusively for wheat and pea crops. The A-C lands surround the project south of Mill Creek on Prospect Ridge. This is the largest land classification type in the MCP environs. Approximately 80 percent of the MCP boundary is adjacent to A-C.

2. Pasture (A-P).

The A-P classification consists of cultivated or natural lands used for cattle grazing, rather than crop production. Most of the A-P areas are located west of the project, along Reservoir Road and between Yellowhawk and Mill Creeks.

(g) Urban or Built-Up Land.

1. Residential (UB-R).

Lands divided into single- and multi-family housing units make up the UB-R land cover classification. The majority of these lands are located west of the project.

2. Commercial, Industrial, and Services (UB-C).

This land cover classification is comprised of lands that are used for commercial and industrial purposes. The majority of these lands are located north and west of the project, along Isaacs Avenue and the Walla Walla Regional Airport. The building area of Walla Walla Community college is classified as UB-C, but it also contains some irrigated lawns (UB-L).

3. Transportation (UB-T).

The UB-T classification includes lands covered by highways, roads, and streets. Only paved roads, and paved and gravel parking lots, are found at MCP. Less than 1 percent of the project (5 acres) falls under this classification. These areas include Rooks Park Road, the Rooks Park parking lots, and the reservoir road that leads to the lake and the parking lots.

4. The UB-L Lands.

This land cover classification is made up of lands that are planted and maintained as lawn grass. These lands include the Walla Walla Community College campus and the Airport entrance area, as well as portions of the project. Two areas totaling approximately 7 acres, fall under this classification at the project. The largest area is Rooks Park, which contains over 6 acres of UB-L. Lawn areas that are covered with trees are classified as R-DT. The Project Office area has four small areas (1 acre total) of UB-L.

5. Project Structures/Water Development (UB-P).

Lands occupied by development for flood control and irrigation purposes comprise the UB-P land cover classification. This includes instream structures, Mill Creek Dam, the Intake Canal, levees, and outlet canals.

(4) Preconstruction Condition (1939).

The MCP was constructed in the area where Garrison and Yellowhawk Creeks naturally split off from Mill Creek and flow southwest across the Walla Walla valley. The area south of Mill Creek (above the bluff) was primarily used for agricultural crop production. The area along Mill Creek was forest and pastureland (SCS, 1939). Mill Creek Road was the only major road in the project area. There was no commercial development.

(5) Analysis of Land Cover Vegetation.

Vegetation cover has gone from predominantly agriculture (see photo 3-8) to a variety of vegetation types (see photo 3-9). Differences in vegetation were used to identify and classify the vegetation commonly found on terrestrial, riparian, and wetland areas of MCP. To a large extent, these differences determine wildlife niches and habitats, and their associated values. Nearly 70 percent of the project is classified as upland vegetation, with U-F making up 53 percent of the project. The remaining portions of the project consist of riparian (7.6 percent), wetlands (6.7 percent), lacustrine (7 percent), riverine (2.1 percent), and urban (9.2 percent). There are six major classifications, and nineteen subclasses. There are 118 separate areas on the project. The MCP has a variety of vegetation types in a relatively small area. This contributes to good wildlife habitat, recreation, and visual quality. Some of the vegetation types are made up of mon-culture species (one type of plant). In the future, the creation of greater species diversity would further improve wildlife habitat. The 63-acre land parcel purchased in 1991 has been seeded in native grasses, and is in the planning stages of wildlife planting.

Photo 3-8. 1949 aerial photo of MCP, prior to WDG wildlife plantings and the lake (September 14, 1949)

Photo 3-9. 1987 aerial photo of MCP. The vegetation types on MCP are in sharp contrast to the surrounding area.

i. Wildlife.

(1) General.

The MCP provides a wildlife habitat for approximately 170 species very close to the city of Walla Walla. This close proximity allows the community to view wildlife for educational, recreational (both passive and consumptive), and aesthetic experiences.

The MCP supports diverse vegetation. This, in turn, provides a habitat for a wide variety of wildlife. Limited development along the banks of Mill Creek allows it to serve as an important corridor for wildlife from the Blue Mountains to the project. The trees, shrubs, and grasses along the stream above the project provide cover and food for foraging animals. Raccoon, beaver, mink, muskrat, and the belted kingfisher are only a few of the animals attracted by the riparian habitat and woodlots in, and around, Rooks Park. The park area, together with small spots of undeveloped private land adjacent to the park, offers a variety of cover in the form of honeysuckle, elderberry, wild clematis, snowberry, and wild rosebushes. Cottonwood, willow, black locust, sumac, and birch grow along the streambanks. Open spaces between these heavily vegetated clusters provide grassy areas, and create an edge effect. Heavy willow growth is predominant in the sediment basin (forebay) above Diversion Dam, although it is partially removed periodically to prevent the restriction of floodflows. In these settings, occasional mule and white-tailed deer may be found, along with striped skunk, rabbits, coyote, and bobcat. Numerous birds can also be found here, including the red-shafted flicker, mourning dove, pheasant, quail, and various swallows, sparrows, and thrushes. Hunting is limited to shotgun or archery, because of the project's small size, limited remote areas, and other recreational usage.

The rolling land around the lake supports modified Palouse prairie vegetation. This area was leased in the past to WDW, who managed it in an effort to facilitate favorable conditions for the hunting of game birds. The WDW planted over 5,000 trees and shrubs, as well as native grasses. In the 1980's, the Corps added wildlife plantings, trees and shrubs, pasture, and food plots. Coyote, badger, cottontail rabbit, ring-necked pheasant, California quail, and several species of hawks are only some of the wildlife species found in these rolling hills.

(2) Reptiles and Amphibians.

The following reptiles and amphibians have been found, or are believed to inhabit the project: western skink, western fence lizard, western garter snake, great basin gopher snake, western yellow-bellied racer, western painted turtle, pacific treefrog, leopard frog, and bullfrog (see photo 3-10).

Photo 3-10. Wetlands on the project support a variety of amphibians, including a bullfrog in the pond at Rooks Park.

(3) Birds.

Numerous species of birds (see photo 3-11) are attracted to MCP because of its diversity of habitat. Birdwatching is a popular year-round activity at the project, and over 146 species have been observed (see table 3-19). Supporting Data, Item 8, lists the 76 songbirds observed.

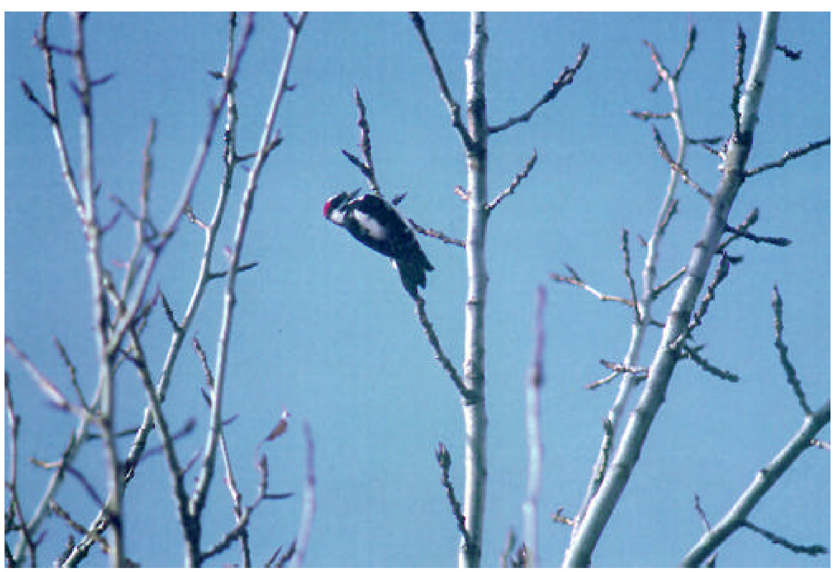


Photo 3-11. Downy woodpecker in riparian vegetation (black cottonwood).

Table 3-19
Wildlife Inventory

Common Name	Scientific Name	Season* Sp	Su	F	W
Amphibians (3 species)					
Pacific Treefrog	Hyla regilla	U	U	U	U
Leopard Frog	Rana pipiens	C	C	C	C
Bullfrog	Rana catesbeiana	C	C	C	C
Reptiles (4 species)					
Western Skink	Eumeces skiltonianus siltonianus	U	U	U	U
Western Fence Lizard	Sceloporus occidentalis	U	U	U	U
Western Garter Snake	Thamnophis sirtalis parietalis	C	C	C	C
Great Basin Gopher Snake	Pituophis melanoleucus deserticola	C	C	C	C
Western Yellow-Bellied Racer	Coluber constrictor mormon	C	C	C	C
Western Painted Turtle	Chrysemys picta belli	U	U	U	U
Birds (146 species)					
Western Grebe	Aechmorphorus occidentalis	R	R	R	R
Double-Crested Cormorant	Phalacrocorax auritus	X	X	X	X
Great Blue Heron	Ardea herodias	U	U	U	U
Black-Crowned Night Heron	Nycticorax nycticorax	R	R	R	R
Whistling Swan	Cynus columbianus	R	R	R	R
Canada Goose	Branta canadensis	U	U	U	U
Mallard	Anas platyrhynchos	C	C	U	U
Northern Pintail	Anas acuta	C	C	A	C
Green-Winged Teal	Anas crecca	.	.	.	.
Blue-Winged Teal	Anas discors	R	.	R	R
Cinnamon Teal	Anas cyanoptera	U	U	U	.
American Widgeon	Anas americana	U	U	O	U
Northern Shoveler	Anas clypeata	O	.	R	O
Wood Duck	Aix sponsa	R	R	R	R
Ring-Necked Duck	Aythya collaris	U	O	C	U
Canvasback	Aythya valisineria	O	.	R	O
Lesser Scaup	Aythya affinis	O	.	R	O
Bufflehead	Bucephala albeola	O	.	.	O
Ruddy Duck	Oxyura jamaicensis	R	.	R	R
Common Merganser	Mergus merganser	O	.	R	O
Northern Goshawk	Accipter gentilis	X	X	X	X
Sharp-Shinned Hawk	Accipter striatus	O	O	O	O
Cooper's Hawk	Accipter cooperii	O	O	O	O
Red-Tailed Hawk	Buteo jamaicensis	U	U	U	U
Swainson's Hawk	Buteo swainsoni	O	O	R	.
Ferruginous Hawk	Buteo regalis	X	X	X	X
Northern Harrier	Circus cyaneus	U	U	U	U
Osprey	Pandion haliaetus	R	O	R	R
Prairie Falcon	Falco mexicanus	R	R	R	R
American Kestrel	Falco sparverius	U	U	U	U
California Quail	Lophortyx californicus	C	C	C	C
Ring-Necked Pheasant	Phasianus colchicus	A	A	A	A
Chukar	Alectoris chukar	X	X	X	X
Gray Partridge	Perdix perdix	O	O	O	O
American Coot	Fulica americana	O	O	O	O
American Avocet	Recurvirostra americana	X	X	X	.
Killdeer	Charadrius vociferus	U	U	U	U
Common Snipe	Capella gallinago	O	O	O	O
Greater Yellowlegs	Tringa melanoleuca	O	O	O	.
Lesser Yellowlegs	Tringa flavipes	O	O	O	.
Solitary Sandpiper	Tringa solitaria	R	R	R	.
Spotted Sandpiper	Actitis macularia	O	O	O	.
Wilson's Phalarope	Phalaropus tricolor	R	R	R	.
Long-Billed Dowitcher	Limnodromus scolopaceus	O	O	O	.

Semipalmated Sandpiper	Calidris pusilla	X	X	X	.
Western Sandpiper	Calidris mauri	O	O	O	.
Pectoral Sandpiper	Calidris melanotos	R	R	R	.
California Gull	Larus californicus	R	R	R	R
Ring-Billed Gull	Larus delawarensis	U	U	U	U
Bonaparte's Gull	Larus philadelphia	R	R	R	R
Rock Dove	Columba livia	U	U	U	U
Mourning Dove	Zenaida macroura	C	C	C	R
Common Barn Owl	Tyto alba	O	O	O	O
Western Screech Owl	Otus kennicotti	U	U	U	U
Great Horned Owl	Bubo virginianus	U	U	U	U
Snowy Owl	Nyctea scandiaca	.	.	.	X
Northern Pygmy Owl	Glaucidium gnoma	O	O	O	O
Long-Eared Owl	Asio otus	O	O	O	O
Short-Eared Owl	Asio flammeus	O	O	O	O
Northern Saw-Whet Owl	Aegolium acadicus	R	R	R	R
Common Nighthawk	Chordeiles minor	U	C	U	.
Vaux's Swift	Chaetura vauxi	U	U	O	.
Black-Chinned Hummingbird	Archilochus alexandri	O	U	O	.
Rufous Hummingbird	Selasphorus rufus	O	U	O	.
Calliope Hummingbird	Stellula calliope	R	R	R	.
Belted Kingfisher	Megaceryle alcyon	U	U	U	U
Northern Flicker	Colaptes auratus	C	C	C	C
Lewis Woodpecker	Melanerpes lewis	R	R	R	R
Hairy Woodpecker	Picoides villosus	U	U	U	U
Downy Woodpecker	Picoides pubescens	U	U	U	U
Eastern Kingbird	Tyrannus tyrannus	U	U	U	.
Western Kingbird	Tyrannus verticalis	U	C	U	.
Say's Phoebe	Sayornis saya	U	U	U	.
Western Flycatcher	Empidonax difficilis	U	U	.	.
Hammond's Flycatcher	Empidonax hammondii	U	U	.	.
Western Wood Pewee	Contupus sordidulus	U	U	.	.
Violet-Green Swallow	Tachycineta thalssina	U	U	.	.
Tree Swallow	Tachycineta bicolor	O	O	.	.
Bank Swallow	Riparia riparia	U	U	.	.
Northern Rough-Winged	Stelgidopteryx serripennis	U	U	.	.
Swallow	Hirundo rustica	C	C	.	.
Barn Swallow	Hirundo pyrrhonota	A	A	.	.
Cliff Swallow	Cyanocitta stelleri	.	.	.	O
Steller's Jay	Pica pica	C	C	C	C
Black-Billed Magpie	Corvus corax	R	R	R	O
Common Raven	Corvus brachyrhynchos	O	O	O	O
Common Crow	Parus atricapillus	U	.	U	C
Black-Capped Chickadee	Parus gambeli	R	.	R	O
Mountain Chickadee	Parus rufescens	X	.	X	X
Chestnut-Backed Chickadee	Sitta carolinensis	R	.	.	R
White-Breasted Nuthatch	Sitta canadensis	O	.	.	O
Red-Breasted Nuthatch	Certhia americana	O	.	.	O
Brown Creeper	Troglodytes aedon	U	U	.	.
House Wren	Troglodytes troglodytes	O	O	O	O
Winter Wren	Thryomanes bewickii	U	U	U	U
Bewick's Wren	Turdus migratorius	C	U	U	C
American Robin	Ixoreus naevius	O	R	R	O
Varied Thrush	Catharus guttatus	R	R	R	R
Hermit Thrush	Sialia mexicana	U	U	U	O
Western Bluebird	Sialia currucoides	O	O	R	.
Mountain Bluebird	Myadestes townsendi	O	.	O	O
Townsend's Solitaire	Regulus satrapa	U	.	U	C
Golden-Crowned Kinglet	Regulus clendula	U	U	U	U
Bohemian Waxwing	Bombycilla garrulus	C	U	U	C
Cedar Waxwing	Bombycilla cedrorum	C	U	U	C
Northern Shrike	Lanius excubitor	U	O	O	U

Loggerhead Shrike	Lanius ludovicianus	O	R	R	O
European Starling	Sturnus vulgaris	C	C	C	C
Red-Eyed Vireo	Vireo olivaceus	O	O	R	.
Warbling Vireo	Vireo gilvus	O	O	R	.
Orange-Crowned Warbler	Vermivora celata	U	U	O	.
Nashville Warbler	Vermiovora ruficapilla	O	O	O	.
Yellow Warbler	Dendroica petechia	C	C	U	.
Gray Catbird	Dumetella carolinensis	U	U	R	.
Yellow-Rumped Warbler	Dendroica coronata	U	U	O	O
Townsend's Warbler	Dendroica townsendi	O	O	O	.
MacGillivray's Warbler	Oporornis tolmiei	O	O	O	.
Common Yellowthroat	Geothlypos trichas	R	R	R	.
Yellow-Breasted Chat	Icteria virens	R	<R	R	.
Wilson's Warbler	Wilsonia pusilla	O	O	O	.
House Sparrow	Passer domesticus	C	C	C	C
Western Meadowlark	Sturnella neglecta	U	C	U	U
Yellow-Headed Blackbird	Age.aius xanthomus	R	R	.	.
Red-Winged Blackbird	Agelaius phoeniceus	U	U	U	O
Brewer's Blackbird	Euphagus cyanocephalus	U	U	U	U
Brown-Headed Cowbird	Molothrus ater	U	U	U	.
Northern Oriole	Icterus galbula	U	U	.	.
Black-Headed Grosbeak	Pheucticus melanocephalus	U	U	.	.
Evening Grosbeak	Coccothraustes vespertinus	U	O	O	U
Lazuli Bunting	Passerina amoena	U	U	.	.
Purple Finch	Carpodacus purpureus	.	.	.	R
Cassin's Finch	Carpodacus cassini	.	.	.	R
House Finch	Carpodacus mexicanus	U	U	U	O
Rosy Finch	Leucosticte arctoa	.	.	.	R
Pine Sisken	Carduelis pinus	O	.	.	O
American Goldfinch	Carduelis tristis	C	U	U	C
Rufous-Sided Towhee	Pipilo erythrophthalmus	O	O	O	O
Savannah Sparrow	Passerculus sandwichensis	O	O	.	.
Vesper Sparrow	Pooecetes gramineus	R	R	.	.
Lark Sparrow	Chondestes grammacus	R	R	.	.
Chipping Sparrow	Spizella passerina	O	O	O	.
White-Crowned Sparrow	Zonotrichia leucophrys	U	O	O	U
Golden-Crowned Sparrow	Zonotrichia atricapilla	R	R	R	R
Fox Sparrow	Passerella iliaca	R	R	R	.
Song Sparrow	Melospiza melodia	U	U	U	U
Dark-Eyed Junco	Junco hyemalis	C	.	U	C

Mammals (18 Species)					
Vagrant Shrew	Sorex vagrans	C	C	C	C
Coast Mole	Scapanus orarius	U	U	U	U
Little Brown Myotis	Myotis lucifugus	U	U	U	R
Silver-Haired Bat	Lasioncycteris noctivagans	U	U	U	R
Hoary Bat	Lasiurus cinerus	U	U	U	R
Nuttall's Cottontail	Sylvilagus nuttallii	A	A	A	A
Columbia Ground Squirrel	Spermophilus columbianus	C	C	C	C
Northern Pocket Gopher	Thomomys talpoides	C	C	C	C
Beaver	Castor canadenesis	C	C	C	C
Deer Mouse	Peromyscus maniculatus	A	A	A	A
Montane Vole	Microtus montanus	A	A	A	A
Coyote	Canis latrans	U	U	U	U
Raccoon	Procyon lotor	U	U	U	U
Longtail Weasel	Mustela frenata	C	C	C	C
Mink	Mustela vison	C	C	C	C
Badger	Taxidea taxus	U	U	U	U
Striped Skunk	Mephitis mephitis	U	U	U	U
White-Tailed Deer	Odocoileus virginianus	U	U	U	C

* Seasonal appearance and abundance area coded as follows:
Sp - Spring (March - May) Su - Summer (June - August) F - Fall (September - November) W - Winter (December - February) A - Abundant (occurs in large numbers) C - Common (occurs regularly in small numbers) U - Uncommon (occurs regularly in small numbers) O - Occasional (a few noted each year) R - Rate (a few noted, but not every year) X - Accidental (out of normal range)

(4) Raptors.

A number of species potentially inhabit or migrate through MCP. Species that potentially inhabit MCP are sharp-shinned hawk, cooper's hawk, red-tailed hawk, Swainson's hawk, ferruginous hawk, northern harries, American kestrel, western screech owl, great horned owl, long-eared owl, short-eared owl, and northern saw-whet owl. Those species that migrate through the project include northern goshawk, osprey, prairie falcon, snowy owl, and northern pigmy-owl.

(5) Waterfowl.

Nesting waterfowl are not abundant around the lake because of the lack of marshy shoreline, rooted aquatics, and the lack of the stable water level that these birds prefer. Although a few mallards and wood ducks produce broods at the project (see photo 3-12), most waterfowl use the lake only as a resting area during migration (see photo 3-13).

Photo 3-12. Ducks in the Mill Creek Channel

Photo 3-13. Great Blue Heron in Mill creek Channel below Diversion Dam

(6) Upland Game Birds.

Because of their proximity to the city of Walla Walla, the project lands are heavily hunted for upland birds. The WDW has supplemented the natural population by stocking the area with 600 to 1,500 male ring-necked pheasants, and 500 to 800 chukar in past hunting seasons. Budget restrictions, and a change in the philosophy of habitat management and preservation, have forced the State to reduce their stocking efforts in recent years. Pheasant hunting has remained good, due to the excellent habitats found at the project and its proximity to agricultural areas.

(7) Other Mammals.

A wide variety of mammals inhabit MCP. These include insectivorous shrews and bats; herbivorous rabbits, squirrels, gophers, beaver, mice, and moles; omnivorous coyote, raccoon, badger, and skunk; and carnivorous weasel and mink.

(8) Deer.

Mule and white-tailed deer (see photo 3-14) are often observed on project lands. The forebay area provides excellent cover and late winter browse, and serves as a corridor for movement to and from off-project habitats adjacent to Virgil B. Bennington Lake.

Photo 3-14. White-tailed deer along Mill Creek

(9) Wildlife Habitat Analysis.

Wildlife habitat development is limited by ecological, cultural, and economic constraints. The dry summers make the establishment of trees and shrubs difficult, but the fertile soils and gently sloping topography provide considerable opportunity for development. The MCP provides excellent habitat for 3 species of amphibians, 4 species of reptiles, 146 species of birds, and 18 species of mammals.

Many habitat improvements were made by WDW in the 1950's. The vegetation planted then has provided food and cover for a wide variety of birds and mammals. These initial habitat improvements, however, are limited in plant species composition and age class. In addition, raising and lowering the elevation of the lake has resulted in a manipulating force that has changed the structure and composition of vegetation adjacent to the lake and diversion channel. The process of filling the lake (raising the water elevation) can be used as a management tool to modify areas away from water sources. These areas are presently limited to the introduced species adaptable to dry-land sites. Vegetation management on these elevated sites has been limited to manipulation through prescribed burns, or mechanical alteration. Selective control has been achieved through the chemical eradication of undesirable species, partially to comply with the local county weed board.

Dam-site rehabilitation has provided many opportunities for wildlife habitat improvements in recent years. During the early 1980's, a large-scale habitat improvement effort was undertaken. This effort involved the planting of approximately 45,000 trees and shrubs, including approximately 4,000 willow and cottonwoods, randomly located in clumps along a proposed shoreline (elevation 1212). Subsequent decisions resulted in a lower shoreline (elevation 1205).

Section 3.03.h., *Wildlife Habitat Improvements*, discusses the location and configuration of the new plantings. A review of the existing vegetation cover characteristics (see plate 3-6) and the new wildlife planting clearly illustrates the high wildlife habitat value that will develop in the next 5 to 10 years. This improvement is timely in regards to overall project wildlife value. Earlier plants have matured to a point where their actual vertical and horizontal cover may not meet the needs of many wildlife species (*i.e.*, as trees mature, ground cover may become sparse). The new wildlife planting will bridge the gap in species age composition, and greatly increase the interspersion and juxtaposition of habitats.

The forebay area contains important wetland and riparian habitat. A considerable opportunity exists to improve this habitat through water elevation manipulation. This area could become an important waterfowl and furbearer habitat, and provide opportunity for both passive and consumptive use.

j. Fish (Mill Creek/Virgil B. Bennington Lake).

(1) Mill Creek Fishery Habitat.

The Mill Creek watershed can be divided into three reaches: upper, middle, and lower. Upper Mill Creek is located in the Umatilla National Forest, starting at the headwaters downstream to RM 25.2, and is the watershed for the city of Walla Walla. The middle reach extends from the city's intake structure (RM 25.2) through the Division Works (RM 10.5). The MCP is located in the middle reach, between RM 10.5 and 12. The lower reach starts at RM 10.5 and extends downstream to where Mill Creek (RM 0) enters the Walla Walla River (RM 33.5). This lower reach includes the portion of the Mill Creek Flood Control Project that is owned and maintained by the Mill Creek Flood Control Zone District of Walla Walla County.

(a) Upper Reach.

The upper reach is in the part of the basin known as the "Mill Creek Watershed," and provides drinking water to the city of Walla Walla. This reach extends from the headwaters to the city of Walla Walla water intake (RM 25.2) (see photo 3-15). Mill Creek drainage presently provides excellent habitat for rainbow and bull trout, as well as good, though underutilized, spawning and rearing habitat for steelhead. The Mill Creek Watershed (23,000 acres) contains some of the highest quality fish habitat in southeastern Washington. Water quality in the watershed is excellent primarily because the area is roadless, unlogged, and ungrazed by domestic animals. It is closed to the public, except during a limited elk-hunting season (USACE, 1984).

Photo 3-15. Upper reach of Mill Creek

The U.S. Forest Service has estimated that the Mill Creek watershed contains 28 miles of streams that have the potential to support anadromous fish. Anadromous fish, such as salmon and steelhead, are those fish that spend most of their lives in salt water, but spawn and rear in fresh water. Steelhead production is potentially 10 redds per mile. Until an agreement was reached with the local sportsman's group, the State of Oregon, and the city of Walla Walla, upstream passage was effectively blocked at the city's intake dam, so this potential was not realized (USFWS, 1984). Adult fish passage facilities have recently been improved.

(b) Middle Reach.

The middle reach of Mill Creek extends between the city of Walla Walla intake (RM 25.2) and the Division Works at MCP (RM 10.5). Riparian habitat and instream cover are fairly good in this reach, and fishery values appear to be good. The middle reach passes through Mill Creek Canyon and rolling farmland (see photo 3-16). A significant amount of the steelhead spawning and rearing in Mill Creek occurs in this middle reach. Both naturally produced and stocked rainbow trout inhabit this reach, as well. This area is subject to moderate fishing pressure.

Photo 3-16. Middle reach of Mill Creek. Agricultural activities begin 3 miles north of the Washington/Oregon border.

(c) Lower Reach.

The lower reach of Mill Creek begins at the Division Works (RM 10.5) (see photo 3-17), where up to 70 cfs of water is diverted into Garrison and Yellowhawk Creeks for irrigation. Mill Creek flows through a controlled channel, and then into a concrete channel that goes through downtown Walla Walla. This reach is usually dry after the first of June. The Corps' current policy is to keep between 60 and 80 cfs of water in the main channel through March, as this is the peak period for returning adult steelhead.

Photo 3-17. Lower reach of Mill Creek begins at Division Works

(2) Virgil B. Bennington Lake.

Virgil B. Bennington Lake is an off-channel, flood storage reservoir. Water is diverted to the lake during high flows (usually from December to March) in Mill Creek. After the winter and spring flood season (usually March to April), water is diverted to the lake in an attempt to provide and maintain a lake elevation of 1205 feet (52 surface acres) (see photo 3-18). This process continues for as long as there is more water than necessary for the required irrigation withdrawals into Yellowhawk and Garrison Creeks. The lake elevation has usually dropped below 1185 feet (end of gauge) by December. This is caused by evaporation and leakage, and shrinks the lake surface to less than 20 acres.

Photo 3-18. Virgil B. Bennington Lake at elevation 1205. Fishing is popular all year long.

(3) Fish Passage.

(a) Adult.

In the past, adult fish passage problems have occurred at the following locations: the controlled channel (at the Gose Street crossing), the Roosevelt Street weir (in Walla Walla), the Division Works at MCP (RM 10.5), Division Dam at MCP (RM 11.4), and Waterworks Dam (RM 25.2). Fish passage improvements have been made recently at each of these sites. The Roosevelt Street control weir facility was reconstructed, and two downstream weirs were added. This created two jump pools that allow fish to jump the weirs more easily, and move past the structure. A fish ladder was constructed in one of the two existing sluiceways at Diversion Dam (RM 11.4), but lacks proper fish attraction flows. Another ladder was constructed at the Division Works (RM 10.5) along the right bank of Mill Creek. This ladder provides fish passage through a small, two-step, vertical-slot weir. A fish ladder was built at the city's Waterworks Dam (RM 25.2), when the city replaced the transmission water line in the early 1980's. (Refer to paragraph 3.03.e., *Water Resources Facilities and Operations*, and plate 3-14 in this section for fish ladder locations at MCP.) Despite these improvements, however, fish passage through Mill Creek is still not optimal because of low migration flows.

(b) Juvenile.

Juvenile anadromous fish (smolts) passage is also not optimal because of dependence on the natural and controlled variability in the flows; especially in dry, low-flow years. The smolt outmigration occurs between April and May when flows are usually higher than average, or during greater water years. Low-flow water years are the greatest concern. Weir construction in the channel operated and built by the Corps has dissipated the more extreme conditions of the original channel, probably causing less functional use of flow by the smolts to outmigrate passively. Concrete weirs also may physically contribute to lowering the fish condition by abrasion, leading to descaling. To the Corps' knowledge, no habitat or flow improvement projects to enhance juvenile passage have been completed in the project area prior to this Master Plan and its proposed recommendations.

(4) Fish Species.

(a) Species of Special Concern.

The bull trout (*Salvelinus confluentus*), which inhabits portions of Mill Creek, was petitioned for listing under the Endangered Species Act in October 1992. The margined sculpin (*Cottus marginatus*) and the mottled sculpin (*Cottus bairdi*) are also found within the project area. Both sculpin are considered native to the State of Washington, and may be rare enough to warrant a special status. The margined sculpin is found only at the Walla Walla River and Umatilla River drainages (Lee *et al.*, 1980). (See figure 3-14.)

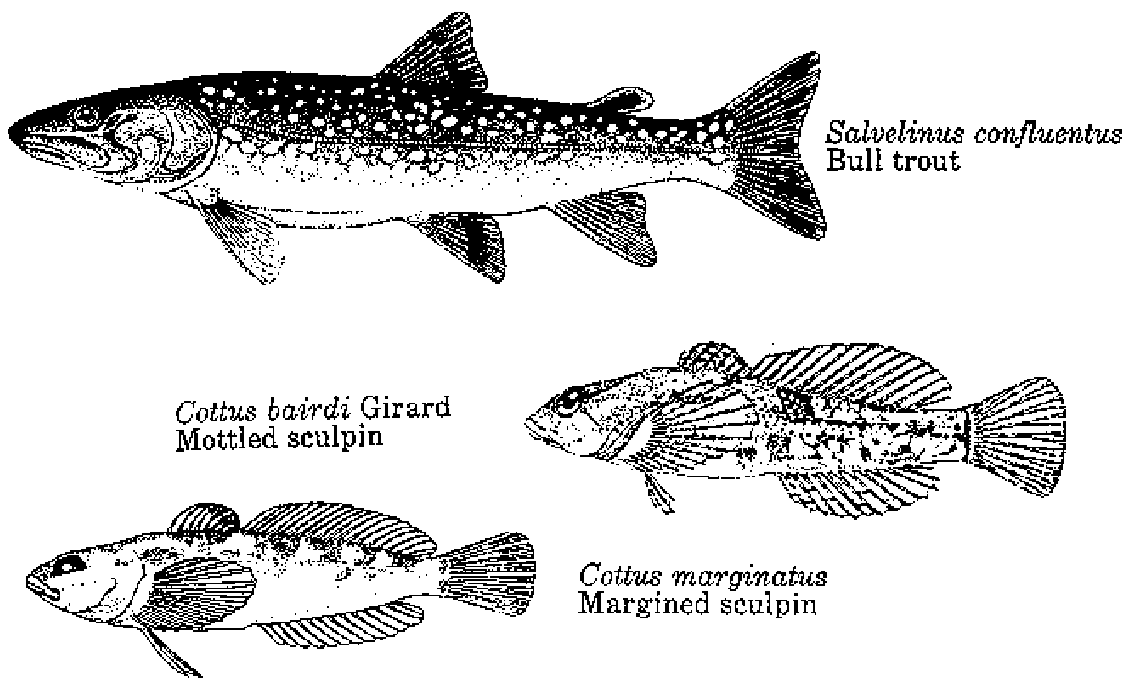


Figure 3-14. Fish of Special Concern (adopted from Lee *et al.*, 1980)

(b) Summer Steelhead.

Mill Creek currently supports a summer steelhead (*Oncorhynchus mykiss*) run of about 200 adult fish. Those adult fish that successfully negotiate the dams of the Columbia River generally return to the Mill Creek area from December through April. During low flows, some returning fish may avoid the main channel of Mill Creek by going through Yellowhawk Creek. They then attempt to reenter Mill Creek (with some difficulty) at the Division Works. The major steelhead spawning area starts just below Kooskooskie (RM 21.5) and continues upstream to the city's water intake structure (RM 25.2). A few spawning areas lie above the intake. Rearing occurs over a distance of 15 miles; between Diversion Dam and the city's intake structure. After spending 2 years in the rearing areas, juvenile steelhead outmigrate in April and May. Juvenile steelhead probably do not have difficulty outmigrating from Mill Creek and the Walla Walla River, because these streams normally have high flows during April and May (USFWS, 1984). In 1992, the Corps began maintaining 60 cfs of water in the main channel of Mill Creek (past the Project Office) for as long as possible in an effort to further aid the outmigrating juvenile steelhead (USACE, 1993).

The WDW currently plants young steelhead in Mill Creek. The program was started in 1936, stopped in 1939, and begun again in 1968. The current stocking program (30,500 smolts) is expected to increase the annual run by 150 to 200 adult fish. Steelhead fishing is not allowed upstream of the Mullin Creek Bridge (RM 6.5) to help protect spawning activities and passage through the concrete channel in Walla Walla (USFWS, 1984).

(c) Rainbow Trout.

Rainbow trout are found throughout the Mill Creek drainage and its main tributary, Blue Creek. Since 1980, approximately 7,000 trout have been planted in Mill Creek each year, as part of the LSRFWCP. These fish are planted from the mouth of Mill Creek to within 3 miles of the Washington/Oregon border (USFWS, 1984).

(d) Other Fish Species.

Although the bull trout has been petitioned for Endangered Species Act listing throughout its range [see paragraph 3.02.j.(4)(a), *Species of Special Concern*], they are still found in good numbers in the upper reach of Mill Creek. They are not, however, common in other parts of the drainage. Other fish that inhabit the area include mountain whitefish, redside shiner, dace, sucker, and squawfish.

(e) Historical Stocks.

1. Spring Chinook Salmon.

Spring chinook salmon (*Oncorhynchus tshawytcha*) were apparently found in Mill Creek until the mid-1920's. These fish were probably eliminated by low flows and high temperatures at critical seasons (USFWS, 1984). The last notable chinook run was reported in 1925 (Van Cleve and Ting, 1960). There has been some discussion regarding the possibility of reintroducing spring chinook salmon into the Mill Creek drainage.

2. Fall Chinook Salmon, Coho Salmon, and Chum Salmon.

Historically, fall chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), and chum salmon (*Oncorhynchus keta*) have also been found in the Walla Walla Basin, and possibly Mill Creek. These species are now extinct in this part of their range. Coho and chum salmon were reported to have been harvested by tribal fishermen in the late 1800's.

(5) Virgil B. Bennington Lake.

Approximately 22 species of fish live in the Mill Creek system, and many of these are found in Virgil B. Bennington Lake. As part of the LSRFWCP, rainbow trout are planted in both the lake and in Mill Creek by the WDW. Between 5,000 and 40,000 rainbow trout are planted in the lake each year, and estimated harvests range between 1,790 and 14,500 for individual years. The amount of turbidity in the lake, caused by diversion, has negatively affected fishing success in recent years. In 1972, WDW implemented a lake rehabilitation plan to rid the lake of an excessive number of "trash fish." This was done by applying the poisonous rotenone to the water. After a complete fish kill was accomplished, the lake was restocked with trout. In 1976, warm water fish were planted in a joint effort between WDW and the Corps. The food supply found in Virgil B. Bennington Lake appears to be particularly well-suited to these types of fish. The lake was not filled in 1989 and 1990. By the end of the summer of 1990, all the fish were removed by WDW before the lake was dry.

As a result of heavy siltation and turbidity, caused by the diversion of muddy spring runoff waters into the lake, there is little vegetation on the lake bottom. The present program, which allows only clear water to be channeled into the lake during normal runoff years, has greatly improved the water quality of the lake. The development of submerged, emergent, and algal plant growth on the lake bottom has enhanced the efforts to provide a sustained fishery.

(6) Fish Habitat Analysis.

(a) Mill Creek.

The fish habitat in Mill Creek is presently limited by a number of factors, including barriers to upstream migration; habitat degradation caused by stream bank erosion and flash flows; a lack of instream cover and riparian vegetation below Diversion Dam; high temperatures; and low, or zero, flows in the concrete channel (USFWS, 1984).

Both high and low flows can degrade habitat quality. Mill Creek has been greatly impacted by the effects of irrigation withdrawals. These withdrawals result in a zero flow below the Division Works (RM 10.5) after the beginning of June. The concrete channel through the city could provide pass juveniles to downstream rearing habitat if sufficient flows become available.

The water quality in Mill Creek degrades steadily as it flows downstream from Kooskooskie (RM 21.5). Summer water temperatures may increase from 65°F to 79°F by the time the creek reaches Diversion Dam (RM 11.5). Temperatures greater than 65°F are considered stressful to salmonids. The DO remains at saturation levels until the creek passes the city sewage treatment plant (RM 5.5). Other water quality parameters are generally uniform in the upper and middle reaches, and are indicative of a clean stream (refer to paragraph e., *Limnology*).

(b) Mill Creek After Completion of the Mill Creek Flood Control Project.

The sections of Mill Creek that flow through project lands include the channel area and forebay area (above Diversion Dam). The channel is designed to carry high flows during flood events, and lacks a low-flow channel. Boulders were added in 1986 to mitigate the impacts of flood channel maintenance and enhance fish habitat, but the uniform depth of the channel limits its aquatic value (USACE, 1986). During low-flow periods, the water becomes very shallow and is too warm to support fish life. Channel weirs also limit fish movement during low-flow periods.

The forebay area is slightly impounded during high flows. This reduces flows, and allows silt and gravel to settle. Excavation necessary to maintain flood-control capability periodically alters the stream channel. High winter and spring flows, following maintenance excavation, scour out new pools and channels and increase the carrying capacity of the stream. This constant siltation and frequent dredging limits functional habitat development in the stream channel.

(c) Virgil B. Bennington Lake.

Virgil B. Bennington Lake's value as a fishery resource is limited by poor water quality and supply, as well as substrate value. Organically rich bottom sediments presently reduce water quality, especially during periods of lake stratification, by eliminating or reducing oxygen supply at lower depths (see paragraph 3.02.e.(3), *Analysis of Water Quality*). The existing silt-organic substrate limits benthic organisms to burrowing varieties, and does not provide cover for small fish and crayfish. The fluctuating water level (due to dam seepage problems and the lack of summer inflows) reduces the lake level during the growing season, thus eliminating the establishment of littoral rooted vegetation. A more consistent lake elevation would benefit fisheries.

(d) The Endangered Species Act Listing of Bull Trout.

If bull trout are listed under the Endangered Species Act, any actions proposed for the project would need to be carefully considered to determine what, if any, effect the action might have on the bull trout. These actions could include the operation and maintenance of the project water and recreation. On May 17, 1993, USFWS published its determination that the petitions have merit in the Federal Register, and began a 1-year status of the species. In that 1-year period, USFWS must make a final decision on whether or not the listing is warranted.

3.03. Project Cultural Factors

This section presents the cultural factors affecting the MCP. Cultural factors are manmade influences, and include local archaeological/historical information, the project's construction history, land status, water resource facilities and operations, recreational facilities, wildlife developments, project visitation, and recreational carrying capacity.

a. Archaeological and Historical Resources.

(1) Archaeological.

(a) Prehistory.

There is no direct archaeological data providing information on the prehistory of the project. In the absence of any data to the contrary, five temporal and technological sequences, based on artifact assemblages and stratigraphic information from the Lower Snake River, have been applied to the Mill Creek drainage. These phases, from oldest to most recent, are the Windust, Cascade, Tucannon, Harder, and Numipu Phases. These phases date from approximately 10,000 years ago to the present time (Western Heritage, Incorporated, undated).

(b) Ethnohistory.

The following ethnohistory was extracted from a report entitled Mill Creek Cultural Resource Management Unit, prepared for the Corps. The Mill Creek area was originally the homeland of the Walla Walla Indians. It was occupied by the Cayuse Indians when the first white trappers and explorers appeared (around 1810). The Cayuse Indians received their name (which means "horse" in their native language) from early French-Canadian trappers who entered the area to trade, and were favorably impressed by the horses and horsemanship of the Indians. The Cayuse called themselves Waiilatpus, which means "place of the people of the rye grass" (Western Heritage, Incorporated, undated).

The Cayuse Indians settled in semi-permanent winter villages, and moved periodically to seasonal and special-use sites. Their mobility was greatly enhanced by the use of horses. Depending on the time of year, housing varied in style. In the summer months, the Cayuse lived in mat lodges. In the spring and fall, they inhabited lean-to shelters and, in the winter, they lived in semi-subterranean pit-house villages. They gained subsistence through hunting, fishing, and plant food-gathering activities. In an official census taken around 1800, the Cayuse Indians numbered between 400 and 500, and the Walla Walla Indians numbered about the same.

(c) Surveys.

No systematic cultural resource survey of the MCP has ever been done. To date, only periodic, cursory inspections of specific locations have been made, and these surveys have not found any evidence of cultural sites or artifacts. Although the project area was almost certainly utilized in prehistoric times by native inhabitants, the scouring effects of repeated flooding have most likely left no evidence of prehistoric occupation.

(2) Historical.

(a) General.

French-Canadian trappers came through the area around 1810. Little is know about this period. In 1836, Dr. Marcus Whitman (see photo 3-19) established the Waiilatpu Mission on the Walla Walla River among the Cayuse Indians. The mission became an important station on the Oregon Trail. In 1844, Dr. Whitman set up a sawmill on Mill Creek, and logged timber to facilitate the construction of housing for the early settlers. These settlers were beginning to settle on, and farm, the rich bottomlands of the Walla Walla Valley. The Cayuse War began in 1845 and continued to 1850. A measles epidemic brought in 1847 by emigrants killed half of the Cayuse tribe. Dr. Whitman's medicine helped white children, but did not help the Cayuse because they had no resistance to the disease. The continued number of immigrants, and the stories of settlers taking Indian land, convinced the Cayuse that their way of life was in danger. On November 29, 1847, Dr. Whitman, his wife, Narcissa (see photo 3-20), and eleven other mission residents were killed in a violent attack during the war [U.S. National Park Service (USNPS), 1982]. By the 1870's, commerce was expanding, and consisted of logging and related industries. By the 1880's, settlement of the area was well underway with the establishment of residences, outbuildings, and cultivated fields.

Photo 3-19. Marcus Whitman
(sketch from Paul Kane)

Photo 3-20. Narcissa Whitman
(sketch from Paul Kane)

In 1976, an historical survey of the project area was conducted by Washington State University's Washington Archaeological Research Center. The survey report noted that the reservoir vicinity included no significant historical sites (Stratton and Lindeman, 1976).

(b) Nez Perce Trails.

The Nez Perce Trails ran throughout the region, and were centered around the area where the Idaho, Oregon, and Washington borders now intersect (Shaley, 1977). The trails connected the region to the coastal areas, and to the great plains. They were used for travel routes, trade, marriage, ceremonies, hunting, and the seasonal gathering of food and materials (Broncheau-McFarland, 1992). One of the trail routes headed west, through Walla Walla and the Pendleton area. This trail led from Nez Perce territory to Walla Walla, Cayuse, and Umatilla territory; and was primarily used for trading, fishing, and hunting. The trail extended to Celilo and the Mid-Columbia Region (Shaley, 1977).

The city of Walla Walla was founded where the trail crossed Mill Creek. Main Street was located on the trail (Bennett, 1988). As shown on the original survey of 1861 (see figure 3-15), the Nez Perce Trail entered the Walla Walla Valley just north of the present project boundary and near Rooks Park (see plate 3-8). The trail crossed the present Mill Creek Road approximately 400 feet west of its intersection with Rooks Park Road. It continued southwest for 600 feet, followed Mill Creek to the west, and crossed Mill Creek at the present site of Walla Walla, as mentioned above [U.S. Survey (USS), 1861].

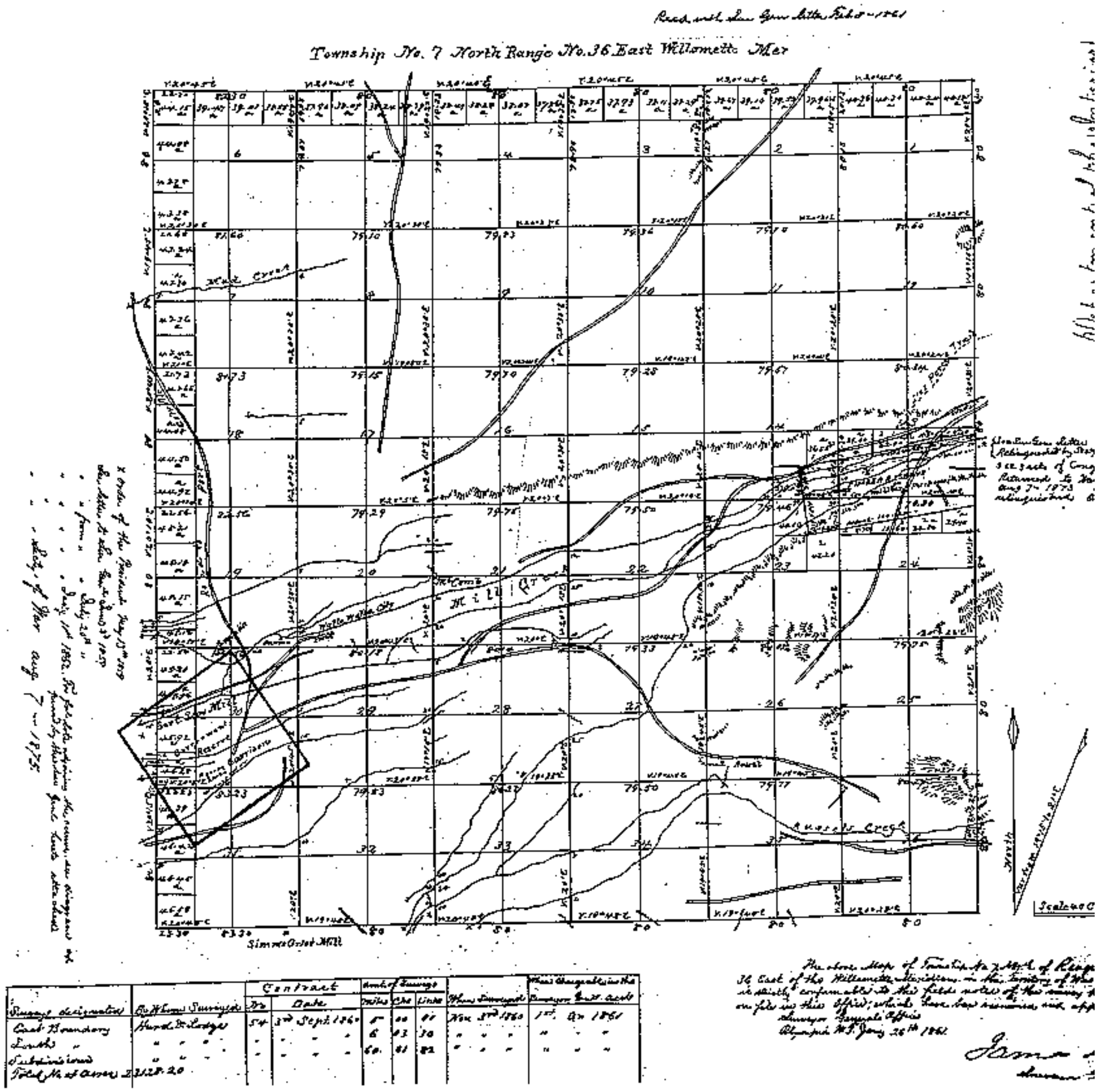


Figure 3-15. Original Land Survey

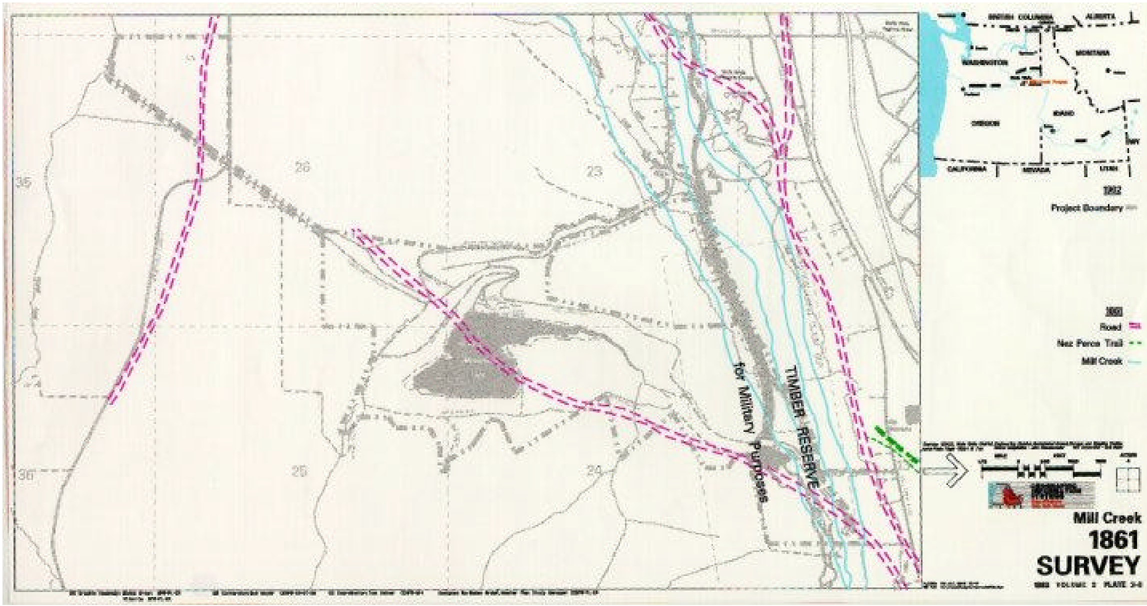


Plate 3-8. 1861 Survey

(c) Fort Walla Walla.

The MCP occupies 166 acres of the original 640-acre "Timber Reservation for Military Purposes," so labeled by the original land survey, dated January 26, 1861. This parcel was later called both "Fort Walla Walla Timber Reserve" and the "Military Timber Reservation." Figure 3-16 is a copy of a portion of the original land survey (around the Timber Reservation).

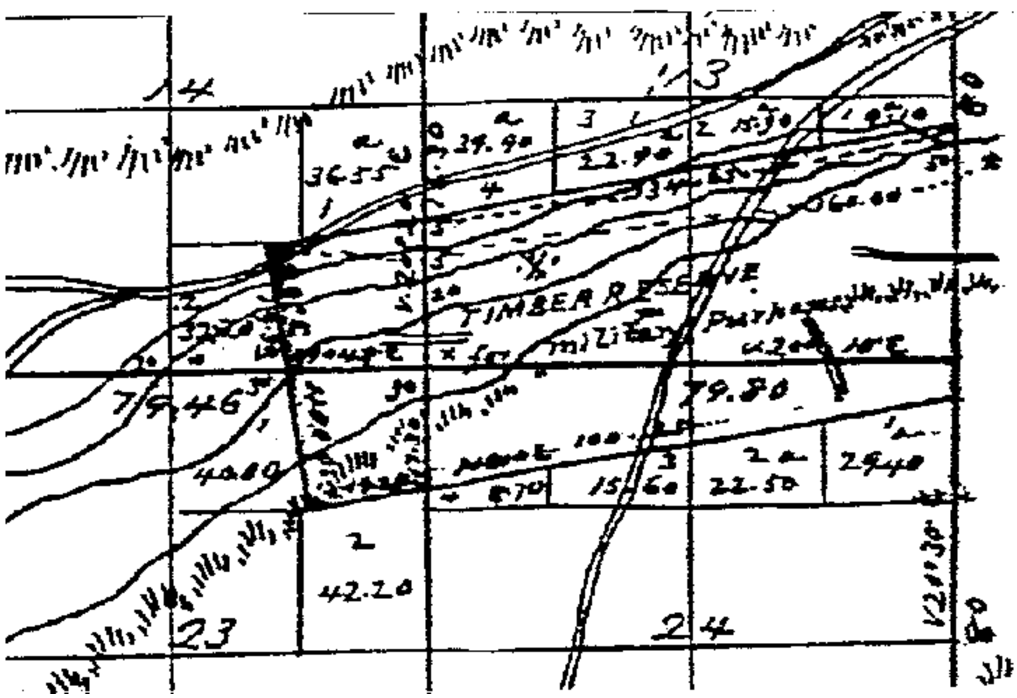


Figure 3-16. Portion of the Original Land Survey (Timber Reservation)

The following paragraphs are extracts from a hand-written account, entitled History of Fort Walla Walla, Washington, authored by Captain F. H. Pope in 1908. This was transcribed, in September 1983, by the Veterans Administration (VA) Medical Center in Walla Walla, Washington. The VA Medical Center is located on a portion of the original Fort Walla Walla.

> "In May 1856, Governor Stevens issued a call for volunteers, and, of the regiments formed, the 2nd Regiment W. T. Mounted Volunteers moved into Walla Walla country and in July defeated the Indians in several fights.
>
> In August 1856, a regular force consisting of four companies of the 1st Dragoons and a detachment of the 3rd Artillery, under the command of Lt. Col. E.J. Steptoe, 9th Infantry, was sent to Walla Walla, and Gov. Stevens proceeded there to arrange a council with the Indians and to send home the volunteers.
>
> The council, which lasted several days, ended on September 16, 1856, in a fight in which the Indians were defeated...
>
> In November, Colonel George Wright, 9th Infantry, commanding the Columbia River district, accompanied Col. Steptoe back to Walla Walla, where a treaty was concluded with the Indians, among the provisions of which was the "concession" that "no whites were to settle in the country without the permission of the Indians."
>
> In May 1857 Co. E, 9th Infantry, arrived and camped at the point where the present barracks are located.
>
> This company brought a saw mill and erected barracks from lumber cut from logs hauled from the Blue Mountains some ten miles distant.
>
> The barracks were completed and occupied in the following year.
>
> On February 10, 1858, a survey of the land on which the fort was built was forwarded to the War Department by Col. Steptoe, and the reservation was declared by Executive Order dated May 7, 1859 (out of public lands of the United States). The reservation declared contained 640 acres, in addition to hay and timber reservations, each containing 640 acres. (Note: The Hay reserve was located 5 miles north of the Fort on Dry Creek.)
>
> In 1875, the timber and a portion of the hay reservation was relinquished (Note: to the Department of Interior) and in 1880 the remainder of the Hay reservation. [Note: By an act of congress in 1876, the "Military Timber Reservation" was granted to the widow and heirs of James Sinclair. This donation was in accordance with the "Act to create the office of surveyor general of the public lands in Oregon, and to provide for the survey, and donations to settlers of the public land" (USC, 1877, chapter 33, page 417)].

In the fall of 1858, the Walla Walla County was thrown open to settlement, and soon the prosperous town of Walla Walla grew up around the garrison. The post was continuously occupied by troops until 1865, when all troops, except a small detachment were withdrawn, and the post was practically abandoned."

(d) Preconstruction Condition.

The MCP was constructed in the area where Garrison and Yellowhawk Creeks naturally split off from Mill Creek and flowed southwest across the Walla Walla Valley. The area south of Mill Creek (above the bluff) was used for agricultural crop production. The area along Mill Creek was forest and pastureland (SCS, 1939). U.S. Highway 12 and Isaacs Avenue were not built until World War II. Walla Walla Air Base was constructed at that time, and the highway (U.S. 410, previously) was relocated here. The current four-lane highway was constructed in the early 1970's. The current original route left Walla Walla via Wellington Avenue, ran through the current Walla Walla Regional Airport, and headed on to Dixie, Washington.

(3) Analysis of Archaeological/Historical Resources.

(a) General.

To date, no known prehistoric or historic sites or events have been located on project lands, except for the Fort Walla Walla Timber Reservation. Data on the project's past is derived from information available in the region that is applicable to the project.

(b) Future Findings.

If cultural resources are found at MCP in the future, they will be assessed for significance. Depending upon the significance of the resource, as well as its location, proposed project developments may have to be temporarily stopped and/or modified to address cultural resource concerns.

b. History of the Mill Creek Flood Control Project.

The following paragraphs explain the beginnings of the Mill Creek Flood Control Project. The involvement of the Corps, from the project's inception to its completion in 1949, is also documented here.

(1) Project Names.

The Federal project contained two basic components: 1) the Mill Creek ("Improved") Channel through Walla Walla, now owned and operated by the Mill Creek Flood Control Zone District (MCFCZD); and 2) Mill Creek, itself. The Mill Creek portion of the project consists of the lands and works owned by the United States Government. These lands are operated and maintained by the Corps [refer to paragraph c.(b), Ownership]. The term "Mill Creek Flood Control Project" has been sed since the Works Progress Administration (WPA) work project began in the 1930's. The legislation authorizing the project called it "Mill Creek, Washington." Until 1963, the project was called either the "Mill Creek Flood Control Project" or "Mill Creek, Washington." From 1963 to 1970, the term "Mill Creek Reservoir" was used. From 1971 to 1992, the term "Mill Creek Lake" was adopted (USACE, 1953, 1962, 1963, 1970, 1971). The last two titles can be confusing, since the terms "lake" and "reservoir" tend to exclude the main channel through Walla Walla. On October 30, 1992 (Public Law 105-580), this reservoir, authorized in the original legislation, was formally named "Virgil B. Bennington Lake."

In this report, the term "Mill Creek Project (MCP)" refers only to that portion of the project owned by the U. S. Government, and maintained by the Corps. The title "Mill Creek Channel" refers to the Mill Creek Channel. It is owned by MCFCZD. The term "Mill Creek Flood Control Project" includes both the "Mill Creek Channel" and "Mill Creek Project."

(2) Past Flooding.

The city of Walla Walla experienced flooding fifteen times between 1878 and 1931. The 1906 and 1931 floods were, by far, the most damaging (USACE, 1937).

The first recorded flood prevention measures were constructed in Walla Walla in 1900 (USACE, 1954). Over the years, flood walls and other improvements in the Mill Creek Channel were constructed to help protect property. Most of this work was done within the city limits, but the actual work was done in a cooperative effort between city and county governments, as well as individual property owners (USACE, 1982).

During 1928, three floods occurred. This prompted the employment of a consultant to study the flood problem. Dr. O. L. Walter, head of the Engineering Department at Washington State College (currently, Washington State University), proposed a plan he felt would eliminate the problem. This plan included cleaning the channel, building more bulk heads, eliminating pipes and other obstructions under the street bridges, and creating a diversion system above the town to channel flood waters into a reservoir or other streams (Bennett, 1988). However, the proposed plan was never executed.

(3) 1931 Flood.

The worst recorded flood in Mill Creek was on March 31 and April 1, 1931 (see photo 3-7). Approximately $1,150,000 in damages were inflicted on the city of Walla Walla and its environs (USACE, 1937). A total of 6.65 inches of rain fell at Kooskooskie (15 miles upstream) from 28 March to 1 April, with the largest amount (3.81 inches) falling on 31 March. Extensive damage was caused to state and county highways and bridges, railroad crossings, city buildings, and city streets (USACE, 1954). An observer reported that, between Walla Walla and Milton-Freewater, Oregon, the whole area resembled a big lake (Bennett, 1988). The flood covered 7,500 acres, including many city blocks, residential and business properties, and farmlands (USACE, 1937). Tons of gravel and silt were deposited in the flooded areas (Bennett, 1988). The cleanup and street repairs took 6 months and $310,000 to complete. A report, dated September 1931 and entitled Walla Walla, Washington, Report on Flood Control, was compiled by the engineering firm of Pearse, Greeley, and Hansen Engineers of Chicago. This report states that the flood peaked at 6,000 cfs, and the average over a 24-hour period was 5,000 cfs (USACE, 1937). The average flow for Mill Creek is approximately 90 cfs (USACE, 1991). As described above, the community was totally unprepared for the flood. The April 1931 headline in the Walla Walla Union Bulletin (WWUB) stated this fact quite clearly (see photo 3-8). The headline read "CITY SHOCKED BY WORST FLOOD IN HISTORY" (WWUB, 1931) [see figure 3-17 (in progress)]. The community realized that flood protection measures were totally inadequate and new measures were desperately needed.

(4) Channel Work, 1931 to 1935.

Following the 1931 flood, studies were made of the Mill Creek drainage system by the Washington Department of Conservation and Development (WDCD), Division of Hydraulics; W.J.Roberts, Tacoma consulting engineers; and Pearse, Greeley, and Hansen of Chicago, consulting engineers. The WDCD study was the starting point for the later "improved channel" of Mill Creek. On April 21, 1933, a plan was released that proposed bypassing flood waters around the city. Between 1931 and 1935, the city of Walla Walla, with assistance from the State of Washington, the Civil Works Administration, and the Federal Emergency Relief Administration, did cleanup work, repaired existing structures, and began new construction in the channel (USACE, 1937, 1982). The retaining walls were completed in 1933 (USACE, 1954).

(5) Channel Work, 1935 to 1939.

On January 9, 1935, the Mill Creek Flood Control District, today known as MCFCZD, was organized. This is a local municipal corporation that has the legal ability to assume obligations in connection with local cooperators. The area covered by the MCFCZD is within Walla Walla city limits, and includes the unincorporated areas of the county. The MCFCZD applied for funds needed to construct a flood control channel through the city of Walla Walla. In the fall of 1935, the project was approved by the State of Washington WPA, using funds from the Emergency Relief Act of 1935 (74th Congress, 1st session) (USC, 1938, page 20; DM No. 7, page 2-1; and USACE, 1982).

Between 1935 and 1939, the Mill Creek control channel was built (see photos 3-21, 3-22, and 3-23). This channel extended from Three Mile Bridge (Tausick Way) downstream from city limits; and from Goose Street Bridge upstream to the city limits. This work was accomplished with WPA funds (WPA Official Project No. 64-93-926, 18 October 1938), workers from relief roles, and equipment from the city and county. The work was supervised by the Second Portland District Corps (later the Bonneville District). Work was started on 31 October 1935 (WWUB, 1940). City and state monies funded about one-fourth of the total cost of the project ($33,000). The remainder of the monies ($87,000) came from Federal relief funds (USACE, 1937, 1954).

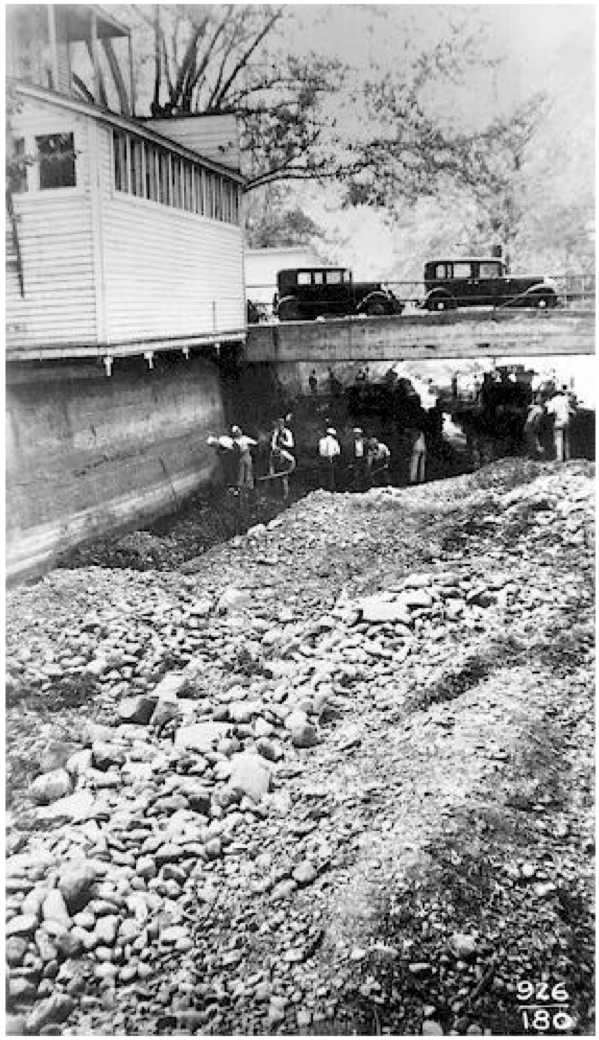


Photo 3-21. Hand excavation of channel under 4th Avenue Bridge (11/2/36).

Photo 3-22. Completed blanket revetment west of 6th Street Bridge (2/26/37)

Photo 3-23. Completing south blanket revetment west of 6th Street Bridge (2/26/37)

After this portion of the channel was completed (1941), it was turned over to the Mill Creek Flood Control District for operation and maintenance.

(6) Corps Studies.

(a) Authority.

The Corps was authorized, by the "Flood Control Act of 1934," to study the Columbia River and its tributaries. The Corps was further authorized, by the "Flood Control Act of 1936," to study the Walla Walla River and its tributaries. The Corps started to collect data before the end of 1934 and, as early as late December 1934, the Corps favored an earth dam in the Russell Creek drainage for storage of Mill Creek flood waters (WWUB, 1940).

In January 1937, a movement was started to have Congress include flood control in general flood control proposal appropriations (WWUB, 1940). The Corps, Bonneville District, completed a report, dated December 17, 1943, entitled Walla Walla River Flood Control. The Corps conducted a preliminary examination of the Walla Walla River Basin. The report of this preliminary examination included hydrological studies to aid in the determination of possible floods, a topographic survey of streams through the area, and a survey of channels suitable for future work. The report also included cost estimates of the best measures of flood relief, and collection of data on flood damages (both past and potential). Enough information was obtained to determine the economic feasibility of all proposed flood relief measures [House Document (HD) 578, 1938].

(b) Plan For The Protection of Walla Walla.

The aforementioned study recommended a comprehensive flood-control plan for the protection of the city of Walla Walla. This plan was titled Mill Creek Flood Control Works. It included a 7-mile channel through Walla Walla, as well as an offstream reservoir. The report further stated that the Mill Creek improved channel was currently under construction, and was funded with local, state, and Federal WPA funds. It was an acknowledged fact that the improved channel was not sufficient to control flooding, and more protection was needed. The report stated:

> "Channel improvement work through the city (Walla Walla) is virtually completed and it is believed that construction of additional works to complete the comprehensive project is fully justified." (USC, 1938, page 26.)

The report additionally recommended that money be authorized for construction of the off-channel flood storage facility necessary for completion of the comprehensive plan.

(7) Congressional Authority.

(a) Authorization of the Flood Control Project.

This same report, and its accompanying recommendations, was sent to the 75th Congress, 3d session, on April 9, 1938 by the Secretary of War. This became House of Representatives Document, No. 578, entitled "MILL CREEK, WASH." (HD 578, 1938).

The proposed plan for the protection of Walla Walla, and authorized expenditures for construction of the off-channel reservoir referenced in HD No. 578, was authorized by the 75th Congress, 3d session, and signed by President Roosevelt on 28 June 1938 in "The Flood Control Act of 1938" (Public Law 75-761). The section of that law specifically pertaining to MCP reads:

MILL CREEK, WASHINGTON

> "The plan for the protection of the city of Walla Walla, Washington, and adjacent lands by means of a reservoir and related works, as set forth in House Document Number 578, Seventy-Fifth Congress, Third Session, is approved and for the execution of this plan there is hereby authorized $1,608,000." (USC, vol. 52, page 1222.)

(b) Appropriations.

On June 20, 1938 the Corps applied to WPA for $1,606,000 for further Mill Creek work. An appropriation of $1,000,000 for the project was made available to the Corps through the WPA, under the "Emergency Relief Act of 1939" (76th Congress, 1st session) on June 29, 1939 (WWUB, 1940).

(c) Amendment To Original Authorization.

It became necessary to ask for additional funding for work on the project because of changes in local responsibilities, safety, and costs. These additions were included with the Corps' flood control recommendations for the Walla Walla River, submitted to Congress as HD 719, dated April 24, 1940. The endorsement of the Chief of Engineers, in HD 719, stated:

> "In addition to the proposed improvements on the Walla Walla River, the district Engineers find that it is desirable to make certain modifications in the plans for the existing project on Mill Creek at and in the vicinity of Walla Walla, Wash., authorized by the 1938 Flood Control Act..." (HD 719, 1940, page 3).

The report further explained that:

> "The District Engineer finds that the amount of funds authorized for construction of the Mill Creek, Wash., flood-control project, should be increased for bridges across Mill Creek in the city of Walla Walla at Otis and Merriam Streets, (2) additional costs of right-of-way, and (3) additional construction measures required to insure safety of the proposed earth dam..." (HD 719, 1940, page 5).

The Flood Control Act of 1941, 77th Congress, 1st session, approved the modifications recommended in HD 719.

COLUMBIA RIVER BASIN

> "...the project for the protection of the city of Walla Walla, Washington, authorized by the Act approved June 28, 1938 is hereby modified in accordance with the recommendations of the Chief of Engineers in House Document Numbered 719, Seventy-sixth Congress, third Session, at an estimated cost of $754,000."

(8) Construction.

(a) Virgil B. Bennington Lake.

The Mill Creek portion of the project (dam, reservoir, and auxiliary works) was designed by the Corps, Bonneville District (see figure 3-19). The Corps supervised construction of the general contractors on the project. This was a joint venture between the Parker-Schram Company of Portland, Oregon, and Eaton and Smith (general contractors) of San Francisco (WWUB, 1940). Construction on the dam and the auxiliary works began on June 25, 1940 (see photos 3-24, 3-25, 3-26, 3-27, and 3-28). It was completed in late 1941, and final acceptance took place on January 6, 1942. The Corps, Bonneville District, continued to operate and maintain the reservoir and its surrounding lands. Mill Creek was also channelized between the Diversion Works and Three Mile Bridge (Tausick Way) at this time. (See figure 3-20 for the location of the original Mill Creek Channel.)

Figure 3-19. The MCP Headlines

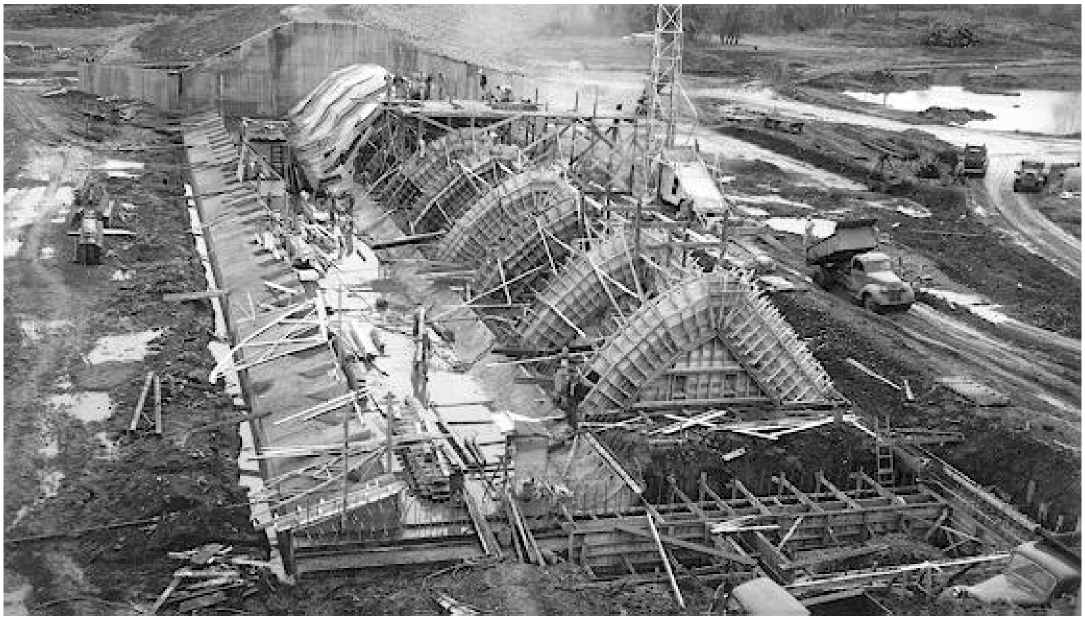


Photo 3-24. Mill Creek Diversion Dam under construction

Photo 3-25. Mill Creek Channel and diversion site under construction (10/16/40)

Photo 3-26. Field office and soils laboratory (10/01/40). The field office occupies the project office today.

Photo 3-27. Intake canal under construction (05/27/40)

Photo 3-28. Mill Creek Dam under construction

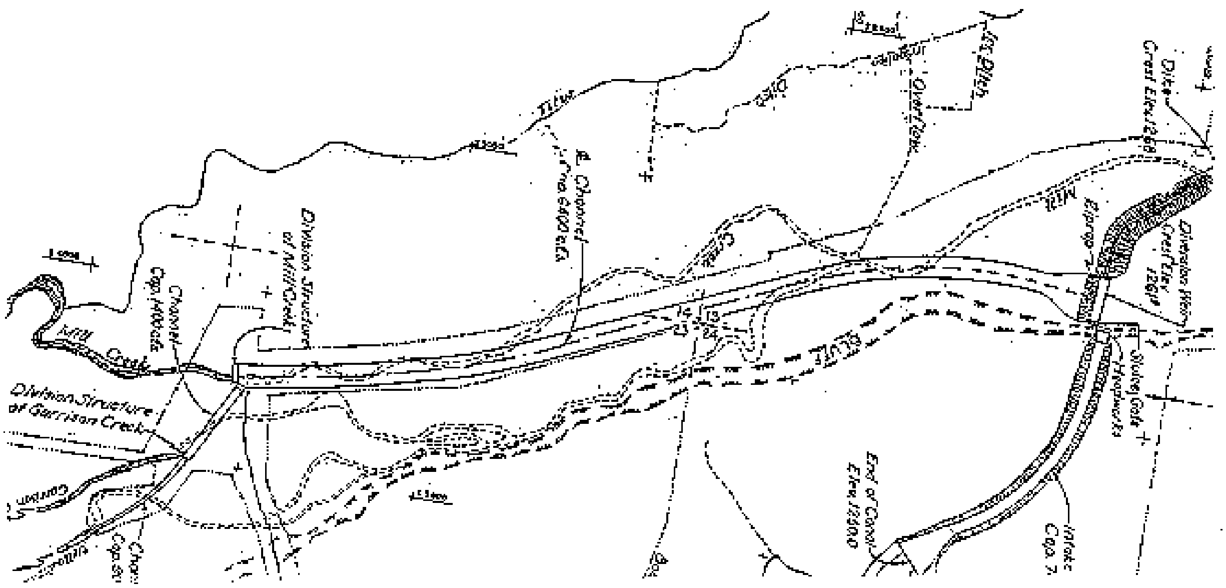


Figure 3-20. Mill Creek Channel--Pre-Construction

(b) Completion of the Mill Creek Channel.

Mill Creek flooded in 1945 and 1946, and this flooding damaged the channel portion of the project. The Corps, Bonneville District, performed emergency repairs to the channel in 1946 and 1947 (see photo 3-29). In 1947, another report by the Corps was submitted to a higher authority. This report requested approval to complete the intermittent WPA work by paving the bottom of the channel. The authority for this work came under the Flood Control Act of 1938, which approved the Mill Creek Flood Control Protection Plan (USACE, 1948). In August 1948, the contract was awarded for the work, and this project was completed in January 1949. At this point, the "Mill Creek Flood Control Project" was officially completed.

**Photo 3-29. Mill Creek Channel under construction.
Placement of concrete paving on bottom of channel.**

(9) Operation and Maintenance.

(a) The MCP (Off-Channel Reservoir and Lands).

The project came under the control of the Corps, Walla Walla District, on November 1, 1948. The Walla Walla District is still responsible for the operation and maintenance of the reservoir project and its associated lands. Many repairs and improvements have been done to the project since this time, and recreation has been considered a project purpose since 1944.

(b) Mill Creek Channel.

The "Improved Mill Creek Channel," through Walla Walla (except for the walls), and the channel from the diversion works, was built with WPA funds. The remainder of the channel was built by the Corps. The "Improved Mill Creek Channel" is now owned, operated, and maintained by the MCFCZD. Per a local agreement and Corps Regulations, the Corps is authorized to provide rehabilitation for the channel. This was last done in 1986 (USACE, 1985).

(10) Virgil B. Bennington.

The "Water Resources Act of 1992," signed in October 1992 by President Bush, named the MCP's reservoir "Virgil B. Bennington Lake." In the past, the lake was referred to as Mill Creek Reservoir, or Mill Creek Lake.

Virgil B. Bennington was a local businessman and farmer. In 1937, during his term as president of the local chamber of commerce, he was chosen by the County Commissioners to lobby in Washington, D.C. for a flood control district in Walla Walla County.

Bennington was an enthusiastic supporter of outdoor sport, and was an avid hunter and fisherman. He served on the Washington State Game Commission for 23 years, and he served as chairman for 12 of those years. He was also instrumental in obtaining the William T. Wooten Game Refuge.

In addition to Bennington's support of outdoor sport, he was a vital member of the community in many other ways. He served as president of the Whitman College Alumni Association, and was a member of the Whitman College Board of Overseers.

After Bennington's death in 1983 at age 93, Vance Orchard, an outdoor writer for the WWUB, began leading an effort to name the lake after Bennington (WWUB, 1992). His efforts culminated in the official naming of Virgil B. Bennington Lake in the "Water Resources Act of 1992."

c. Status of Lands.

(1) The MCP.

(a) Boundary/Monumentation.

The MCP boundary outlines both U. S. Government fee and easement lands. The MCP fee lands are owned by the U.S. Government, and managed by the Corps. The Corps does not own the easement lands, but has the rights to use them for specified purposes [see paragraph (d), Corps Flowage Easements and Reservations, below]. There are 12.5 miles of boundary at MCP.

The MCP boundary runs between Mill and Russell Creeks, and it is centered around Virgil B. Bennington Lake. Small narrow areas of the boundary run parallel to Mill Creek, Lake Access Road, and Russell Creek Outlet Canal. There is a block between Russell Creek Road and Russell Creek. The furthest distance from any point of the boundary to another is approximately 3 miles.

Table 3-20 lists the amount of project boundary that is monumented (with surveyed markers). Only 50 percent of the total MCP boundary has been monumented, but two-thirds of the fee lands are monumented. None of the easement land boundaries have been monumented. Plate 3-9 shows the location of current monumentation, plus other survey monumentation. Lands owned in fee title, but not currently monumented, include the west boundary along Mill Creek Return Canal, and the boundary along the 63 acres recently purchased for the LSRFWCP.

Table 3-20
The MCP Boundary
(In Linear Feet)

	Total	**Monumented**		**Non-Monumented**	
Fee Lands	48,155.40	37,265.80	77%	10,889.60	23%
Easement Lands	17,960.90	0	0%	17,960.90	100%
	66,116.30	37,265.80	54%	28,850.50	43.6%
Canal Easement	10,378.99 *	18,021.17 - 2,955.45 =			. 15,065.72
Flowage Easement	7,764.95* -122.77 7,642.18				2,895.18 17,960.90
Road Easement	2,925.90** 21,039.12	-30.72			
Common Boundaries					
* Canal and Flowage	2,955.45				
** Road easement with fee lands	30.72				
Canal easement with fee lands	122.77 3,108.94				

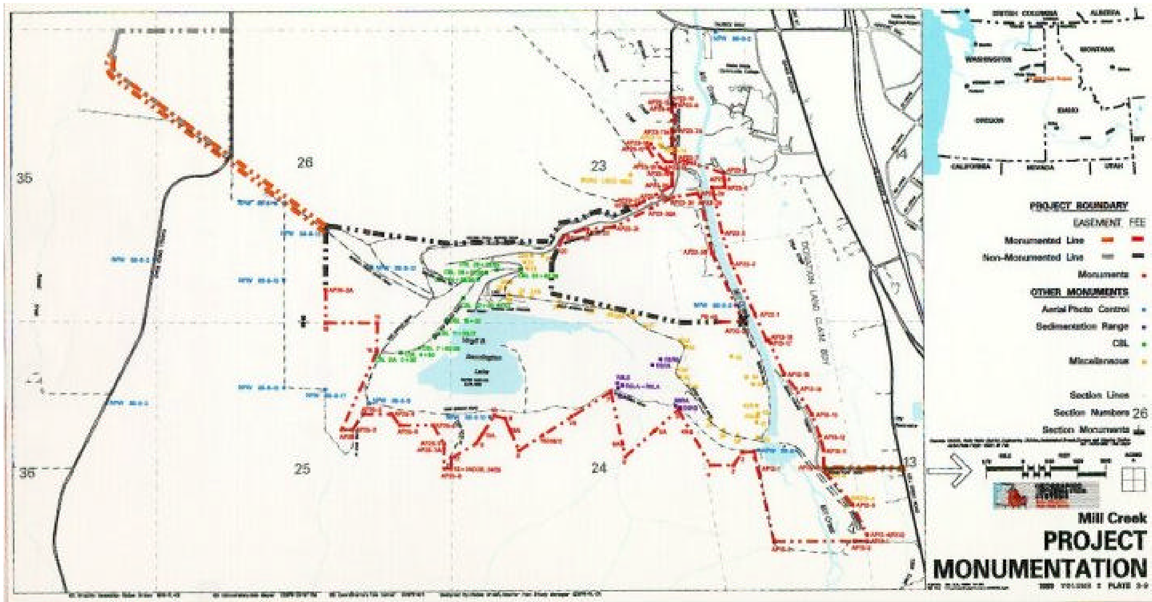


Plate 3-9. Project Monumentation

(b) Ownership.

The U.S. Government currently owns 611.46 acres (computer measured) in fee title within the MCP boundary, and has easements and reservation rights on 87.27 acres [see paragraph (d), Corps Flowage Easements and Reservations, below].

The Government originally purchased 743 acres in 1942 [see paragraph (e), Disposals, below for disposed lands]. Under the LSRFWCP, the 63.07 acres were purchased and transferred to MCP. The majority of MCP lands are centered around Virgil B. Bennington Lake, with the small narrow lands paralleling Mill Creek, and Reservoir Road/Bennington Lake Road. These narrow areas run from 60 to 350 ft wide. The furthest distance from any point fee lands to another is approximately 2.1 miles. Table 3-21 gives the ownership of lands within the MCP, and ownership is further illustrated on plate 3-10.

Table 3-21
Ownership of Lands Within MCP
August 1993

Lands			526.19
Lands Under Water			85.27
	Virgil B. Bennington Lake (Elevation 1205)	51.95	
	Mill Creek Channel	13.06	
	Mill Creek Forebay W-OW	2.98	
	Mill Creek Forebay W-PE	16.53	
	Rooks Park Pond W-OW	0.20	
	Rooks Park Pond W-PE	0.55	
Total Fee Lands			611.46
Easement son private and county land			87.27
	Flowage	73.26	
	Outlet Canal Right-of-way	11.53	
	Road Rooks Park	2.48	
Total Project Lands			698.73

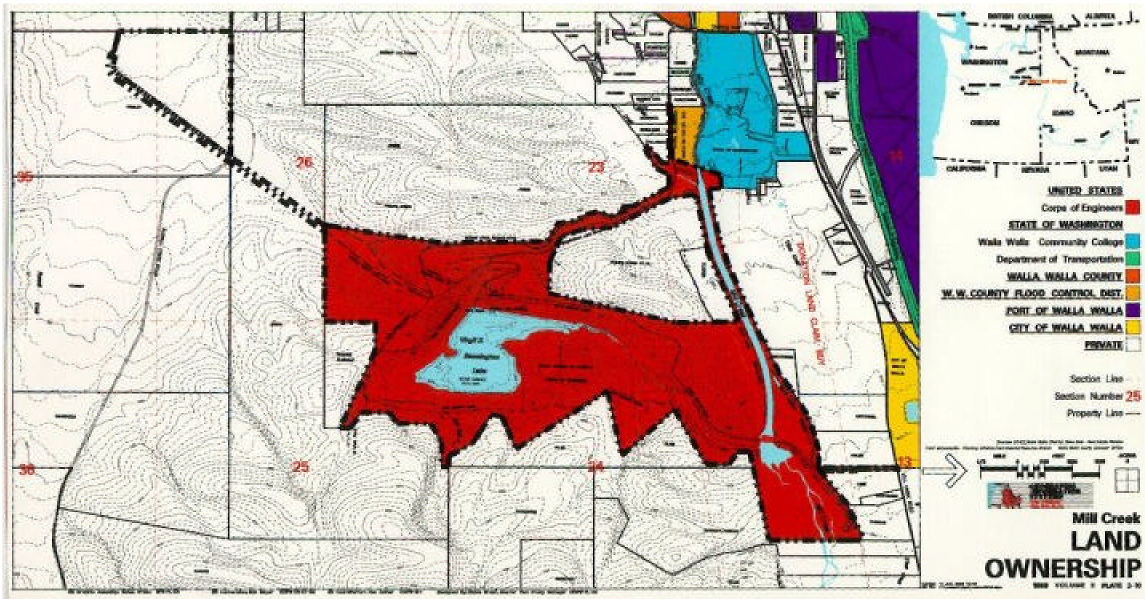


Plate 3-10. Land Ownership

(c) Withdrawn Lands.

No MCP lands have been withdrawn from the public domain.

(d) Corps Easements and Reservation.

The Corps acquired approximately 83 acres of easement rights for MCP. An easement of over 11.53 acres (Tract A-1E and A-3E) was acquired in order to construct and maintain the Russell Creek Outlet Canal (below the dam). This channel runs southwest, from the corner of feelands to Russell Creek. After the 1945 test filling of the reservoir, saturation and inundation occurred due to seepage from the reservoir. Another flowage easement, of over 73.26 acres (Tract A-4E), was acquired. This easement is adjacent to the outlet canal easement, and is located west of the lower end of the Russell Creek Outlet Canal (see table 3-22).

Table 3-22
Corps Easements

Corps Easements	Acreage
Outlet Canal	11.53
Russell	73.26
Flowage	2.49
Road Rooks Park	87.28

The Corps conveyed 2.49 acres to Walla Walla County, but retained access rights for operation and maintenance of the project. This land is located along Rooks Park Road (North Access Road), between Mill Creek Road and Rooks Park. See plate 3-11 for the locations of the easements and reservation.

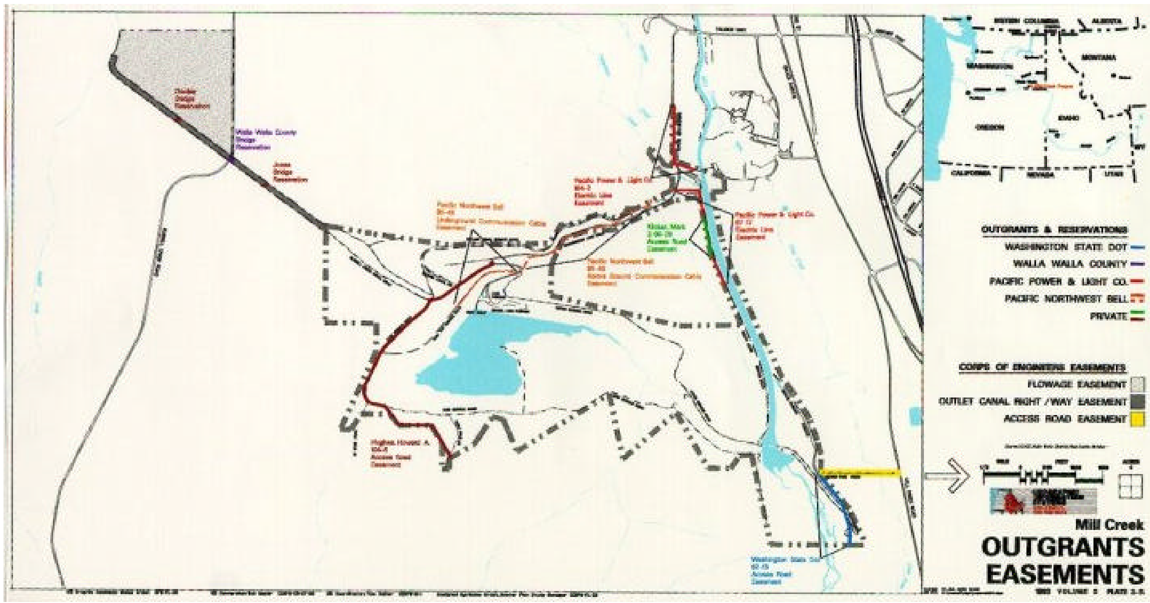


Plate 3-11. Outgrants and Easements

(e) Disposals.

The Corps has disposed of 195.47 acres of land purchased for MCP. The majority of these (186.85 acres) were disposed of in 1956. Approximately 2.49 acres were conveyed to Walla Walla County in 1968, but the Corps reserved access privileges for the operation and maintenance of MCP. A land exchange of approximately equal acres occurred in 1977 for the Mill Creek Channel. On May 27, 1993, 0.64 acre was excessed. This parcel is located on a piece of land between Yellowhawk and Garrison Creeks, just south of the Project Office. In 1991, 63.01 acres that had been disposed of in 1956 were reacquired [see paragraph (f), Land Allocation andplate 3-12].

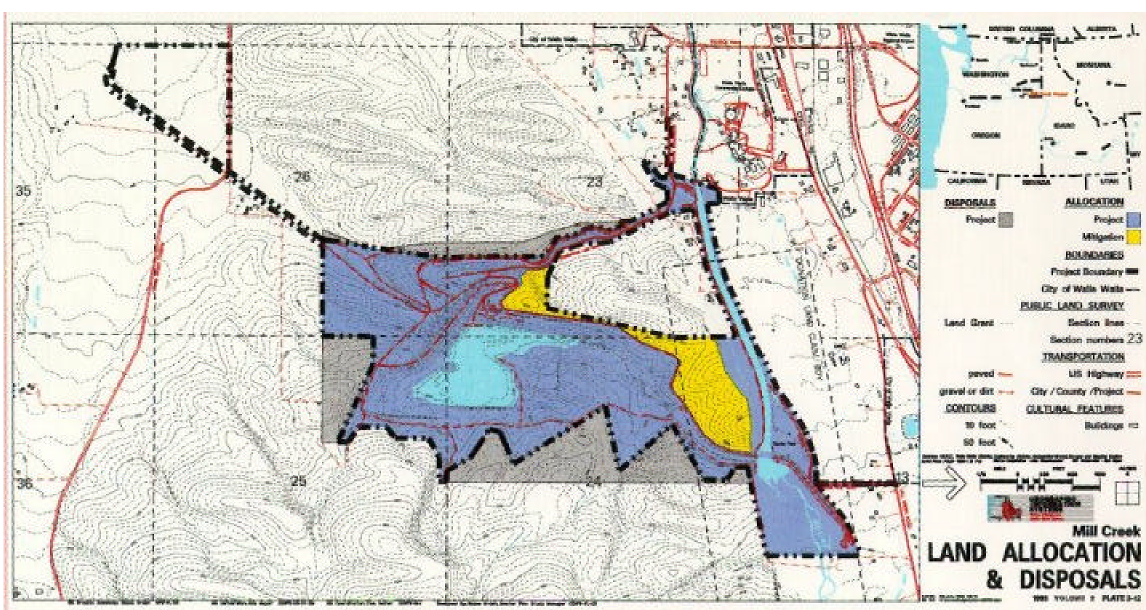


Plate 3-12. Land Allocation and Disposals

(f) Land Allocation.

Until 1992, all MCP lands were under the allocation of operations. The phrase "land allocation" refers to the purposes for which the project lands were acquired. Engineer Regulation (ER) 1130-2-435 requires that project lands be identified to one of four primary land allocation categories applicable to all Corps projects. All land acquisitions must be in accordance with these authorizing documents. The four primary allocations are:

- Operations: Lands acquired in accordance with the authorizing documents for operation of the project (*i.e.*, flood control, hydropower, navigation, water supply, *etc.*).
- Recreation: Separable lands acquired in accordance with authorizing documents for public recreation.
- Fish and Wildlife: Separable land acquired in accordance with authorizing documents for fish and wildlife management.
- Mitigation: Land acquired or designated in accordance with authorizing documents to offset losses associated with the development of the project.

In 1991, 63 acres were repurchased for mitigation under the LSRFWCP. This acreage (Tract 1900) was reassigned to MCP on 7 July 1992. These 63 acres were part of the original acquisition for MCP, and were disposed of as "parcel B" on 9 July 1956 (see plate 3-12 and table 3-23).

Table 3-23
Mill Creek Project Land Allocation

Acreage			
Fee	Easement	Allocation	Reason Lands Were Acquired
548.39	84.79	Operations	flood control, hydropower
0	0	Recreation	public recreation
0	0	Fish and Wildlife	fish and wildlife management
63.07	0	Mitigation	to offset losses associated with the development of the project
611.46	84.79		

The initially authorized project purpose, as set forth in Public Law 761, 75th Congress, was flood control. Although subsequent legislation related to such civil works projects has authorized other project purposes, including recreation and fish and wildlife management, all of the lands originally purchased and retained are allocated to project "operations," in accordance with the initial acquisition purposes.

The land classifications are determined through the master plan process. This master plan, including land classifications, is approved by the Corps, North Pacific Division. Only uses allowed within each classification are permitted. Any other usage would require a land classification change, and approval from the Corps, North Pacific Division. The process is further explained in volume 1, section 1, of this master plan. The definitions, and the map of land classifications for MCP, are contained in volume 1, section 4, *Land Classification*. In the past, land classification maps for MCP have been approved in 1961, 1974, and 1982.

As described in ER 1130-2-435, the following is a list of possible classifications:

1. Project Operation.

This classification includes lands required for the structure, operations center, project office, maintenance compound, and other areas that are used solely for project operations.

2. Recreation.

Lands developed for intensive recreational activities by the visiting public are included in this classification. Areas that may be developed in the future are classified as multiple resource management until the initiation of development.

3. Mitigation.

This classification encompasses all lands acquired, or designated, specifically for mitigation.

4. Environmentally Sensitive Areas.

This classification includes lands where scientific, ecological, cultural, or aesthetic features have been identified. Activities within this category must be managed to insure that the "sensitive area" is not adversely impacted. Normally, limited or no development of public use is contemplated on this land classification.

5. Multiple Resource Management.

a. Recreation - Low Density.

Low density recreational activities such as hiking, primitive camping, wildlife observation, hunting, or similar activities are allowed on this classification of land.

b. Wildlife Management General.

Lands reserved for fish and wildlife management comprise this land classification.

c. Vegetative Management.

This classification includes lands reserved for the protection and development of forest and vegetative cover.

d. Inactive and/or Future Recreational Areas.

Lands that are currently inactive and/or reserved for possible recreational usage in the future comprise this classification.

6. Easement Lands.

This classification includes all lands for which the Corps holds an easement interest but no fee title. Planned use and management of the easement lands will be in strict accordance with the terms and conditions of the easement lands acquired.

(h) Outgrants and Reservations.

There are seven real estate outgrants at MCP. The purpose of an outgrant is to allow other agencies or individuals use of project lands. These outgrants are issued by easement, permit, license, or lease. They are issued if the land is available, and if the proposed use is consistent with operational needs and resource management objectives. Other outgrants may be issued, and existing ones terminated or amended, when circumstances warrant.

There are three reservations on MCP lands. All three are for a bridge crossing the Outlet Canal Easement held by the Corps [see paragraph (d), Easements, above]. Reservations are distinct from outgrants, because reserved rights and interests are retained by the landowner at the time the land is purchased by the Government. Unlike outgrants, these vested interests cannot be terminated by the Government.

The Real Estate Division of the Corps, Walla Walla District maintains all current information on outgrants and reservations. All of the outgrants are in the form of easements. Four are held by utility companies, one is held by the State of Washington, and the remaining two are held by private interests. One reservation is held by Walla Walla County (for Russell Creek Road), and the other two are held by private landowners. Outgrants and reservations are listed on table 3-24, and plate 3-11.

Table 3-24
Mill Creek Project Outgrants and Reservations

Grantee	Type of Instrument	Contract Number	Purpose	From	To	Acreage
Dooley, Clarence	Reservation	Tract A-3E	Bridge over RC outlet canal	01-16-47	Perpetual	0.18
Hughes, Howard A.	Easement	Control 104-4	Access Road	09-12-57	Perpetual	1.8
Jones, Verna Dwelley	Reservation	Tract A-1E	Bridge over RC outlet canal	01-16-47	Perpetual	0.18
Klicker, Mark R.	Easement	DACW68-2-90-29	Road	01/16/47	08-06-2015	0.16
Pacific Northwest Bell	Easement	DACW68-2-85-48	Communications Cable	01/16/47	07-30-2025	N/A
Pacific Power & Light	Easement	Control 104-	Electric power underground cable	01/16/47	10-01-2003	0.65
Pacific Power & Light	Easement	DACW68-2-67-17	Electric power line	01/16/47	11-16-2016	0.51
Walla Walla County	Reservation	Tract A-2L	Use of bridge over RC outlet canal	01/16/47	Perpetual	0.23
Washington State	Easement	CIVENG=62-13	Haul road	01/16/47	Perpetual	1.0

(2) Adjacent Lands.

(a) General.

The following paragraphs describe the status of lands adjacent to MCP.

(b) Adjacent Ownership.

Approximately 95 percent of the project boundary is adjacent to, or enclosed by, privately-owned lands. Some publicly-owned lands lie both north and west of the Project Office. These lands are owned by the State of Washington (Walla Walla Community College) (see photo 3-30) and Walla Walla County MCFCZD.

Photo 3-30. Walla Walla Community College is adjacent to the project.

There are two inholdings of private land, totaling 119 acres, that are surrounded by MCP fee title lands. One inholding consists of a relatively large block of agricultural land (104 acres) at the eastern end of the MCP office, with a farming operation and equipment area. The other inholding is a small parcel of 15 acres that includes a residence. Lands to the north of the Project Office area include those of Walla Walla Community College. This area is sparsely populated, and has only a few large rural lots. Much of the area protected by the north levee, including Rooks Park, lies in the natural floodplain of Mill Creek and below the crest elevation of the project-designed flood. Ownership of adjacent lands is shown on plate 3-10.

The MCP is located on the eastern edge of the city of Walla Walla. Lands south of the MCP are used for agricultural purposes. There is some residential use west of the project, along Reservoir Road. Within 1/3 mile of the project, along Isaacs Avenue and the main access road to Walla Walla, the land is used for commercial purposes. Refer to paragraph 3.02, h. and plate 3-6 for adjacent land uses and cover types.

(c) City/County Planning.

Both the city and county have planning departments that develop and recommend planning documents designed to guide growth in the respective areas. Recently, the State of Washington has adopted the "Growth Management Act" (GMA) of 1990 and 1991. The GMA requires certain counties and cities to develop comprehensive growth management plans. Walla Walla County was not required to develop a plan under the act but, in October 1990, the county (with support of the city) opted to follow the planning process outlined in the GMA. The County Commissioners have opted to bring the county plan in line with Growth Management Standards.

1. City/County Comprehensive Plan.

The comprehensive plan formulated by the city and county is used to focus future zoning towards plan standards. All publicly-owned lands are classified as "Public." These include all of the MCP lands owned by the U.S. Government, as well as land owned by Walla Walla County, and the State of Washington (see plate 3-13).

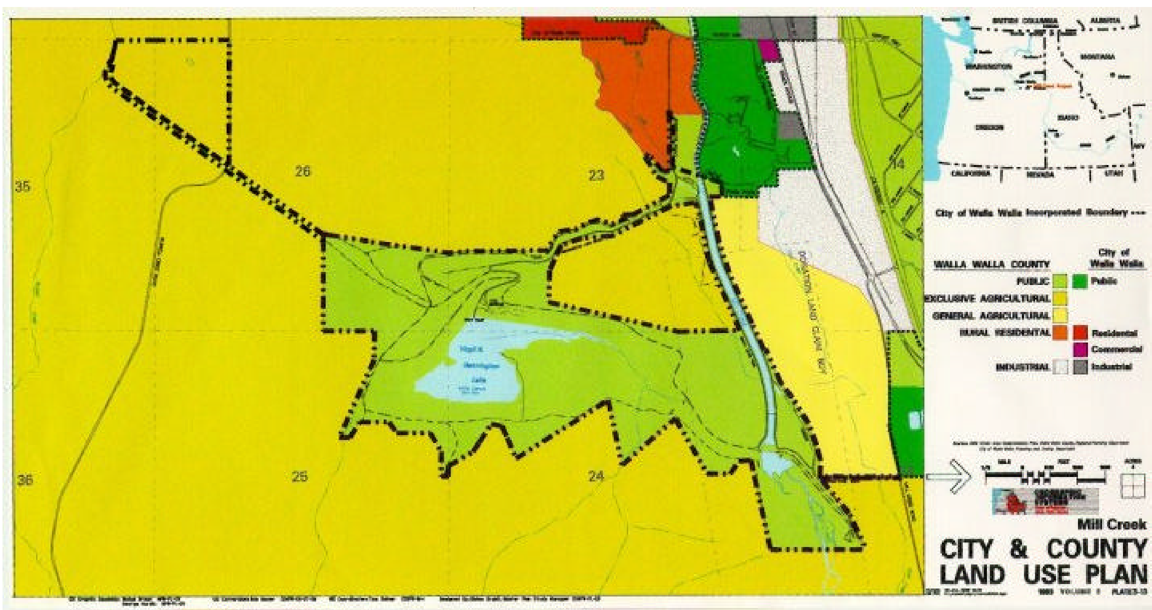


Plate 3-13. City and County Land Use Plan

Rural residential lands represent a transitional area between higher density urban lands and the lands set aside for agricultural production.

The MCP is at the intersection of four county planning areas: Russell Creek, Mill Creek, Isaacs, and Tausick.

Lands south of Mill and Yellowhawk Creeks are exclusively agricultural. Lands west of the Project Office, along Reservoir Road and north of Yellowhawk Creek, are rural (see plate 3-13).

2. Zoning.

Most of the current zoning was established by the County before the formulation of the comprehensive plan. Any zoning changes are now required to fit into the plan. Walla Walla County and the city of Walla Walla have enacted zoning ordinances based on this comprehensive plan (see plate 3-13). The land adjacent to MCP has been zoned for agricultural purposes. This zoning restricts the density of allowable residential development, and fosters the continued stability of agricultural production. Specifically, the area just north of the Mill Creek channel and levee has a zoning designation of "General Agricultural." This designation restricts individual lot and parcel size to 10 acres or more. The land south of Mill and Yellowhawk Creeks was rezoned in May 1992, and was designated as "Exclusive Agriculture" (AE). The AE zoning restricts individual lot size to 20 acres or more.

(3) Analysis of Lands Status.

(a) The MCP.

1. Boundary/Monumentation.

The monumentation on the MCP boundary serves both the project and the public by identifying MCP lands. There are 11,000 feet of fee title lands that still need to be monumented.

2. Ownership.

The lands purchased by the Corps in the early 1940's were acquired for flood control purposes only. Over 194 acres were disposed of in 1955, based again on requirements for flood control use only. The lands outside the lake (elevation 1265) were disposed of because they were no longed needed for flood control. Since that time, the Corps has managed the MCP for recreation and fish and wildlife habitat, as well as for flood control. The original acquisition would have better served these purposes, because they would provide additional wildlife habitat and recreational opportunities for the public. The Corps has management rights and responsibilities on these U.S. Government fee-owned lands.

3. Disposals.

No land disposal is currently pending.

(b) Adjacent Lands.

The lands that surround the project are highly productive, agricultural lands. They are large tracts, except for the area around Reservoir Road. The county comprehensive plan reflects this, and promotes continued agricultural use. However, the 20-acre lot size could allow some residential areas to develop near the project. There have been such developments within ½ mile of MCP. In 1992, Walla Walla County, at the urging of private land owners, changed the minimum lot size to 10 acres. This will restrict development near the project. The county is currently updating its zoning to reflect the plan.

d. Transportation.

(1) General.

The following paragraphs are an inventory of transportation facilities at MCP, including MCP access routes. Plate 3-14 displays the responsible agency for different roads (project, city, county, and state) by surface classification (paved, gravel, dirt). Plate 3-17 displays the trails at MCP, as well as trails adjacent to the project, by surface type. Tables 3-26 and 3-27 list the roads and trails, by name, type, and length.

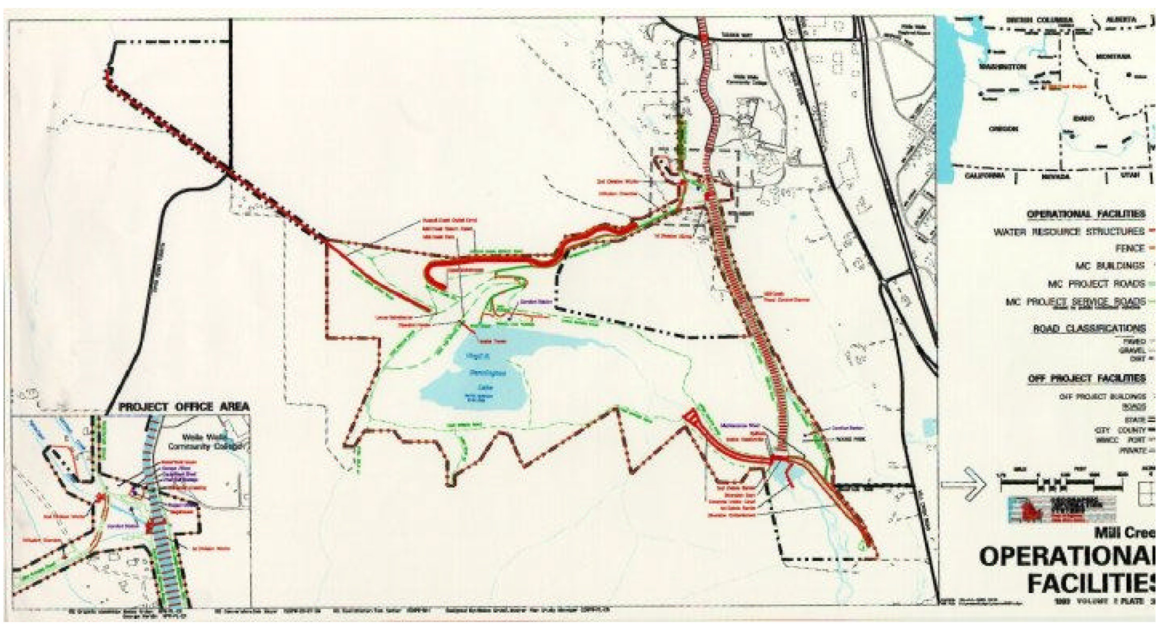


Plate 3-14. Operational Facilities

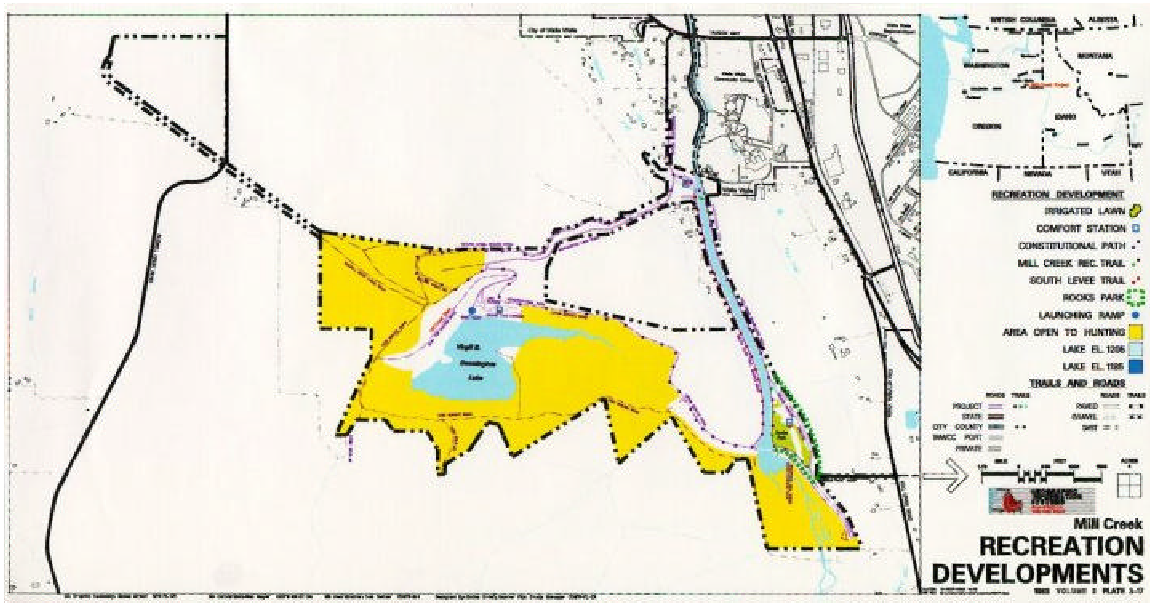


Plate 3-17. Recreation Developments

Table 3-26 Transportation Facilities--Roads					
Road Name	Length (Miles) By Surface				Type
	Paved	Gravel	Dirt	Total	
Dam Top Service		0.60		0.60	service
East Service		0.51		2.50	service
Farm Spur #1	.	.		0.05	service
Farm Spur #2	.	.		0.21	service
Bennington Lake	.	.		0.00	public
Lake Access Parking	.	0.16	.	0.00	public
Lake Access Boat Ramp	1.05	.	1.99	.	public
Reservoir Road	0.10	.	0.05	.	public
Return Canal	0.04	1.96	0.21	1.96	service
North Access Road	0.24	.		0.00	public
Rooks Park Parking	.	0.17		0.17	public
Russell Creek Return Canal	0.11	0.43		0.43	service
South Levee	0.14	0.96		0.96	service
Upper Service		1.29		1.29	service
Total	1.7	7.9	2.4	12.0	
None: All service roads are open to foot and bicycle trails.					

Table 3-27 Transportation Facilities--Trails				
Trail Name	Length (Miles) By Surface			
	Paved	Gravel	Dirt	Total
Constitutional	1.5	2.4		3.9
Mill Creek Recreation	1.1	.		1.1
South Levee		0.9		0.9
Subtotal	2.6	3.3	0.0	5.9
minus overlap	.9	0.1		
TOTAL	1.7	3.2		4.9
Note: Constitutional Path overlays .94 mile of the Mill Creek Recreation Trail on the project and .124 mile of the South Levee Trail.				

(2) Access to MCP.

(a) Roads.

Access to MCP is provided by Reservoir Road and Mill Creek County Road (see photo 3-31), both of which are paved. Reservoir Road runs east from Tausick Way to the MCP boundary (3/10 mile), and then on to Project Office Road. It connects with Bennington Lake Road, which leads to the MCP and the lake recreation area. The project's boundary intersects with Mill Creek Road, and then follows along another county road. Rooks Park Road connects with Rooks Park.

Photo 3-31. Mill Creek Project is easily accesible from Mill Creek Road and from U.S. Highway 12

(b) Trails.

1. Mill Creek Recreation Trail.

Currently, access to MCP is provided by the Mill Creek Recreation Trail. The trail begins at Cambridge Drive and is connected to existing bike routes that run through the city of Walla Walla. From Cambridge Drive, the Mill Creek Recreation Trail (which will be the South Trail of the proposed Walla Walla Trail) runs along the north side of Mill Creek for almost 1 mile. It crosses Tausick Way, and continues along the Walla Walla Community College campus for ½ mile, until it reaches the MCP boundary across from the Project Office. From there, it continues through the project for another 1.1 mile, until it reaches Rooks Park Road.

2. Proposed Walla Walla Trail.

The MCP is at the eastern end of the proposed Walla Walla Trail loop. This loop will, when completed, form a loop system between Rooks Park and the Whitman Mission National Historic Site, 10 miles west of College Place, Washington (see figure 3-21). It will utilize existing trails, city streets, and county roads, as well as new trails. The trail will connect to the existing Mill Creek Recreation Trail where it will run north, and then continue west along Mill Creek Road.

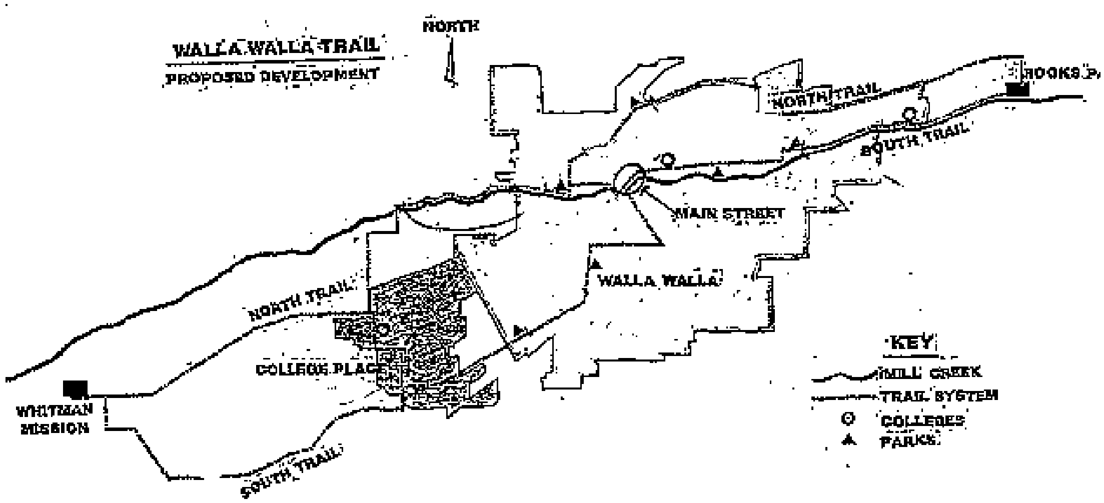


Figure 3-21. Walla Walla Trail Proposed Development

(3) The MCP Transportation Facilities.

(a) Roads.

Two paved roads provide vehicular public access to MCP. The longest of these roads is Reservoir Road/Bennington Lake Road. It begins 1000 ft west of Project Office Road, runs south along Return Canal to the MCP, and then heads to the lake parking area. The other road is North Access Road, which goes only a short distance from Rooks Park Road and leads to the Rooks Park parking area.

(b) Service Roads.

The MCP is well served by project access roads. No part of the project is further than 1/4 mile from an access road. These roads are paved gravel and dirt, and serve as formal and informal trails.

(c) Trails.

There are three formal trails at MCP. These trails are described in the following subparagraphs.

1. Mill Creek Recreation Trail.

The MCP is located at the eastern end of the Mill Creek Recreation Trail. This trail enters the project north of Mill Creek Channel, across from the Project Office. It winds through MCP lands for another 1.1 mile, until it reaches North Access Road/Rooks Park Road.

2. South Levee Trail.

The South Levee Trail is one of the two project trails. The South Levee Trail (gravel) runs on the south levee of Mill Creek, and is parallel to the Mill Creek Recreation Trail. The trails run west from the Diversion Dam to the Project Office area (0.9 mi). The trail also functions as a service road.

3. Constitutional Path.

Constitutional Path is the other formal trail at the project. It is 3.9 miles in length, and utilizes the Mill Creek Recreation Trail, the South Levee Trail, and various service roads. The trail starts and ends at Rooks Park. As it leaves the park, the trail goes across the foot bridge over Mill Creek, follows Upper Service Road southwest to the boat launching area along Bennington Lake Road, and goes around the right embankment of Mill Creek Dam to Return Canal Service Road. The path then turns north along Return Canal Service Road, and heads across Mill Creek towards the Project Office. The trail utilizes the Division Works (see photo 3-32) to cross Mill Creek, heads east (using the Mill Creek Recreation Trail) and then goes on to Rooks Park.

Photo 3-32. Pedestrians and bicyclists take advantage of both the foot bridge and this bridge provided on the project.

4. Other Informal Trails.

The public may use all of the service roads on the project as trails (see photo 3-33). This allows visitors access to the entire project. These service roads total 7.4 miles. They allow the public to go to other parts of the project, as well as around the lake. There are some other informal trails in different areas of the project.

Photo 3-33. Service roads on the project also serve as informal trails for recreationists

(4) Lake Access.

There is only one vehicular access point to the lake. The MCP has one boat launching ramp, and it extends to elevation 1200. Bennington Lake Road runs to within 150 feet of the lake. The rest of the lake is accessible only by boat or by foot. The other side of the lake is accessible by 1.6 miles of trail. This trail uses the upper portion of Dam Service Road, as well as East Service Road.

(5) Analysis of Project Transportation.

The MCP has a good system of roads and trails that serve both the project operations and the public. A road is never farther than frac14; mile from any part of the project lands. The existing service roads provide excellent service, and emergency access to the project lands. A small portion of the shorelines are accessible by road. The short length of the boat ramp limits boating when the lake elevation falls below 1200 ft (usually around 1 July). A trail system closer to the lake would provide improved access for recreational activities (*e.g.*, shore fishing). Currently, access to the lake is dangerous for the elderly and difficult for other visitors. No access for persons with disabilities is available to the lake.

e. Water Resources Facilities and Operations.

(1) Facilities.

The flood control facilities at MCP consist of: 1) diversion facilities to divert flood waters; 2) storage facilities (Virgil B. Bennington Lake) for flood waters; 3) return facilities that allow water to return to Mill Creek or Russell Creek; and 4) division works that divert water to Yellowhawk and Garrison Creeks for irrigation. The following subparagraphs contain an overview of these facilities. For an in-depth review of the facilities, refer to the Water Control Manual for Mill Creek Flood Control Project, Mill Creek, Washington, published by the Corps, Hydrology Branch. Plate 3-14 displays the facilities and their locations.

(a) Diversion Facilities.

The diversion works allow the flood waters from Mill Creek to be diverted into the intake canal, and on to the storage reservoir (Virgil B. Bennington Lake). The diversion facilities consist of the following:

1. Diversion Levee.

Flood waters from Mill Creek are directed to the Diversion Dam by the diversion levee (see photo 3-34), a rolled earth levee 1,800 feet long and 23 feet high (at maximum section).

Photo 3-34. The Diversion Levee prevents flooding along the flat Mill Creek floodplain

2. Diversion Dam.

Located at RM 11.5, the Diversion Dam (see photo 3-35) enables the Corps to divert water from Mill Creek into the intake canal that leads to Virgil B. Bennington Lake. The Diversion Dam is composed of concrete, and contains a spillway and outlet. It is 250 feet long and 14 feet high. The spillway is Ambursen ogee-crest type, and is designed to handle 17,000 cfs. The outlet is a radial sluicegate, 6 feet by 8 feet, that is manually operated by portable engine drive.

Photo 3-35. Diversion Dam. View from South Mill Creek Trail.

3. Debris Facilities.

Two debris barriers (see photo 3-36) ensure the performance of the project. The first barrier is located near Diversion Dam. It is a 550-foot-long steel crib and cable designed to stop debris during flooding. The second debris facility is a steel panel shear wall located at the intake canal headworks. This shear wall is 90 feet long, and keeps debris from plugging the trash racks of the intake headworks.

Photo 3-36. Debris Facilities. Two types of barriers collect debris.

4. Intake Canal Facilities.

The canal facilities are composed of the headworks and the canal. The headworks (see photo 3-37) controls the water with a gate 8 feet long and 18 feet wide. This gate is both electrically and manually controlled. The concrete canal (see photo 3-38) is 60 ft wide and 1,800 ft long. It has a capacity of 7,000 cfs.

Photo 3-37. Headworks allows floodwaters to move from Mill Creek to the Intake Canal

Photo 3-38. Intake Canal Facilities

(b) Storage Facilities.

1. Offstream Storage Reservoir.

Virgil B. Bennington Lake serves as an offstream reservoir for the diverted floodwaters of Mill Creek (see photo 3-39). The reservoir has a maximum capacity of 8,300 AF at pool elevation 1265, with a 5-ft free board (elevation 1270). Table 3-28 (in progress) and figure 3-22 display the capacity curve or the amount of storage at different lake elevations. Figure 3-22 also displays the surface area in relation to elevation and storage capacity.

Photo 3-39. The concrete canal transports water from Mill Creek to Virgil B. Bennington Lake.

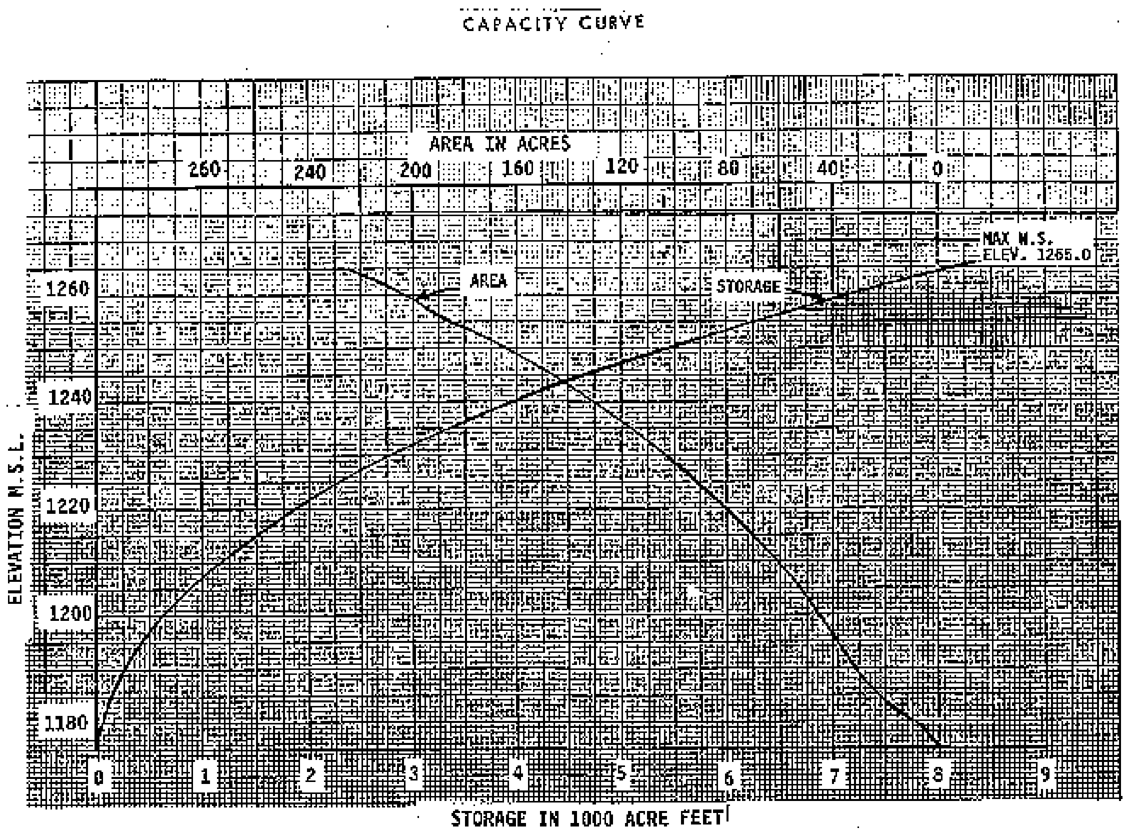


Figure 3-22. Capacity Curve

2. Mill Creek Dam.

The storage dam (see photo 3-40), Mill Creek Dam (MCD), is an earthfill structure with a heavy gravel face. The dam is 800 feet wide at the base, 125 feet high, and 20 feet wide at the top. The top, or crest, of the dam is at elevation 1270. The MCD covers an area of 33 acres. The downstream slope is 1V on 3H, while the upstream slope is 1V on 4H. The dam is an homogenous section of loess, or silt, on a silt and conglomerate foundation. A concrete cutoff wall, 2,260 feet long, extends 2 feet into bedrock. This wall was constructed in 1982 on the upstream toe of the dam. Silt treatment provides a surface seal to the compaction silt hill.

Photo 3-40. Mill Creek Dam. This 1958 photo clearly shows the earthen dam.

(c) Return Facilities.

1. Outlet Works.

The outlet works consist of the intake tower and connecting facilities to the outlet canals. The intake tower allows water to be drawn to elevation 1187. Water can be returned to Mill Creek down to elevation 1210, and to Russell Creek down to elevation 1187. From the intake tower, a 42-inch-diameter steel pipe runs under Mill Creek Dam, for 900 feet, to a valve in the valvehouse. From there, the water can be directed through a 36-inch-diameter pipe (for 125 feet) to Russell Creek Canal, or through a 42-inch-diameter pipe (for 460 feet) to the Mill Creek Return Canal. the Russell Creek route is only used during emergencies because of potential damages downstream on Russell Creek. The restricted channel capacity of Russell Creek allows about 140 cfs to be released from the reservoir.

2. Outlet Canals.

a. Mill Creek Return Channel.

The Mill Creek Return Channel (see photo 3-41) allows water to lake elevation 1210 to be returned to Mill Creek Channel. The channel is trapezoidal in shape, and is a 5,889-foot-long shotcrete-lined channel with a design capacity of 190 cfs. It begins below the right embankment of Mill Creek Dam, follows the Lake Access Road, crosses under the road, and enters Mill Creek just above the Division Works. The channel was constructed in the 1980's.

Photo 3-41. Mill Creek Return Canal returns floodwater stored in the lake to return to Mill Creek.

b. Russell Creek Canal.

Russell Creek Canal (see photo 3-42) returns water to Russell Creek. Water can be drawn from the lake to elevation 1187. The canal is trapezoidal in shape (3.5-foot-bottom with 1V on 1.5H side slopes), and is 7,300 feet in length, made of concrete, and has a design capacity of 250 cfs. It runs southwest of the dam, along the fee title lands and easement lands, and under Russell Creek Road to Russell Creek. As mentioned in paragraph (f), above, Russell Creek Canal is used only during emergencies because of the restricted capacity of Russell Creek.

Photo 3-42. Russell Creek Return Canal is used only in emergencies.

(d) Division Works.

The Division Works (see photo 3-43) allows water to be divided between Mill Creek and Yellowhawk and Garrison Creeks. Water is diverted to Yellowhawk Creek (60 cfs maximum) and Garrison Creek (10 cfs maximum) for irrigation. The First Division Works consists of a concrete structure across Mill Creek at RM 10.5, and a channel to the Second Division Works. The flow is apportioned between Mill Creek and the channel leading to the Second Division Works (about 500 ft from Mill Creek). At the Second Division Works, the flows are further divided between Yellowhawk and Garrison Creeks.

Photo 3-43. Division Dam on Mill Creek allows water to be transferred to Yellowhawk and Garrison Creeks

(e) Mill Creek Flood Control Channel.

The Mill Creek Channel, from the Diversion Dam spillway through the city of Walla Walla, has been modified for flood control. The channel is party rock and wire, cribbed with transverse bottom stabilizers, and lined with party concrete. The concrete portion is 2.2 miles long, and passes through both residential and commercial areas (including the central business district). The rock and wire-cribbed sections of the channel run for 2.8 miles from Diversion Dam to Roosevelt Street (where the concrete channel begins), and for 1.9 miles below the concrete channel to Gose Street. Six miles of the channel below MCP is owned and maintained by the MCFCZD established by Walla Walla County. The improved flood channel has a capacity of 5,400 cfs. However, hydraulic model studies have indicated that the leveed reaches of the channel are not suitable for discharges above 3,500 cfs. The natural channel, which runs from Gose Street to the mouth of Mill Creek, has a capacity of 1,400 cfs. Flows between 1,400 and 1,700 cfs caused minor overbank flooding and some channel erosion in the natural channel. Flows of over 1,700 cfs flood homes and seriously erode channel banks, roadways, and bridge abutments.

(f) Analysis of Water Resource Facilities.

The water resources facilities on the project are designed to protect the city of Walla Walla up to a 140-year flood event. The only major problem is the slow seepage of the lake which, at this time, adds to a drop in the elevation of the lake during the summer. Since the facilities were constructed over 50 years ago, they have been improved and modified over time. If the seepage problem is corrected in the future, a higher conservation lake elevation could remain in place.

(2) Flood Control Operations.

(a) General.

Mill Creek water resource facilities are operated under the guidelines of the 1991 Water Control Manual for Mill Creek Flood Control Project, Mill Creek, Washington, prepared by the Corps, Planning Division, Hydrology Branch (USACE, 1991).

(b) Channel Capacities.

Virgil B. Bennington Lake provides offstream flood control protection for the city of Walla Walla as well as the area below the city. Below Diversion Dam, Mill Creek Channel consists of two separate and distinct channel reaches. The first is an improved channel with a capacity of approximately 3,500 cfs (from the diversion structure to the Gose Street bridge), and the second is a natural channel with a capacity of approximately 1,400 cfs (from Gose Street bridge to the mouth of Mill Creek). The regulation procedures and practices currently used to control Mill Creek flows during a flood event and minimize annual flood damages are outlined in the following paragraphs.

(c) Flood Diversions.

The process of diverting water to Virgil B. Bennington Lake for flood control begins when Mill Creek flows exceed 1,400 cfs at the Project Office gauge (USGS gauge No. 14015000, Mill Creek at Walla Walla, Washington). Flows above 1,400 cfs are then diverted to Virgil B. Bennington Lake until the flood event is over, or until lake elevation limits of 1265 are reached on the flood control rule curve (see figure 3-23). An initial regulation objective of 1,400 cfs passing the Project Office gauge is used to limit flows in the lower channel reach (below Gose Street) to approximately channel capacity, and provide flood control protection for the more frequently expected floods. At flows of 1,400 cfs, minor overbank flooding and some channel erosion occurs in the natural channel reach. Flows in excess of 1,700 cfs flood homes and seriously erode channel banks, roadways, and bridge abutments. Even in extreme cases, the discharge passing the Project Office will not exceed 3,500 cfs as long as space remains in the lake. The lake can be filled to elevation 1265.

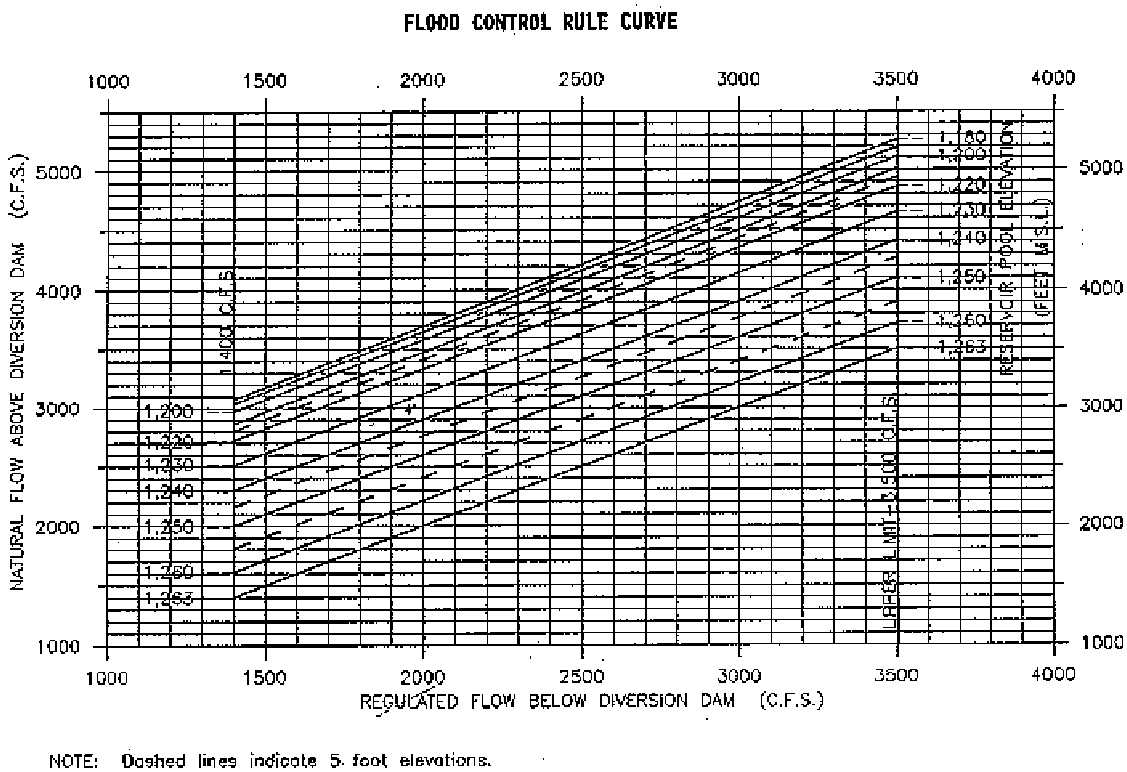


Figure 3-23. Flood Control Rule Curve

(d) Flood Control Objective.

During major (or less frequent) flood events, the regulation objective is increased beyond 1,400 cfs to a maximum of 3,500 cfs as the pool fills, according to the flood control rule curve (see figure 3-23). This sliding regulation objective is a function of both the natural Mill Creek flow and the Virgil B. Bennington Lake elevation. Increasing the regulation objective above 1,400 cfs for major flood events is necessary to prevent losing control of the flood as it moves through Walla Walla. This allows for the premature filling of Virgil B. Bennington Lake, in an effort to protect the natural channel reach below Walla Walla, and to effectively utilize Mill Creek flood control space for various magnitude flood events.

(e) Flood Frequencies.

Using the flood control rule curve with a regulation objective of 3,500 cfs (design capacity for riprapped channel sections) provides control of natural flows up to a 140-year flood event (0.71 percent probability for any given year) in the city of Walla Walla. Regulated flood frequencies for a 3,500 cfs flood control regulation objective are shown on figure 3-23.

If Virgil B. Bennington Lake becomes unusable for flood control in the future (because of increased seepage and/or dam safety problems), areas within the improved channel riprapped reaches (design capacity of 3,500 cfs) would experience flood damage approximately every 16 years (6.25 percent probability for any given year). Areas in the natural channel reach below Gose Street would experience some flood damage approximately every 3-1/2 years (28.6 percent probability for any given year).

(3) Lake Elevations.

(a) General.

As a result of the Water Control Plan, Virgil B. Bennington Lake has seasonal fluctuations in water level. In a normal year, the lake elevation ranges from below 1185 feet to 1204 feet (see plate 3-15). Refer to table 3-29 for lake elevations on the first of each month, for the period from 1976 through 1992. During the beginning of the "Winter Flood Control Season" (December through February), the lake elevation is below 1184.7 feet. When flood waters are diverted into the lake, the elevation could rise as high as 1265 feet. The highest elevation in project history for flood prevention was 1242.3 feet in January 1965. The highest total elevation was 1235.07 feet on 19 May 1984. Between March and May, water is diverted to maintain a "conservation elevation" of 1205 feet. This is done until the "Irrigation Season" starts (normally after 1 May), when flows in Mill Creek are diverted to Yellowhawk and Garrison Creeks. By the end of the summer, the lake elevation has dropped from 1205 feet to 1191 feet, due to lack of inflows, evaporation, and seepage into the ground.

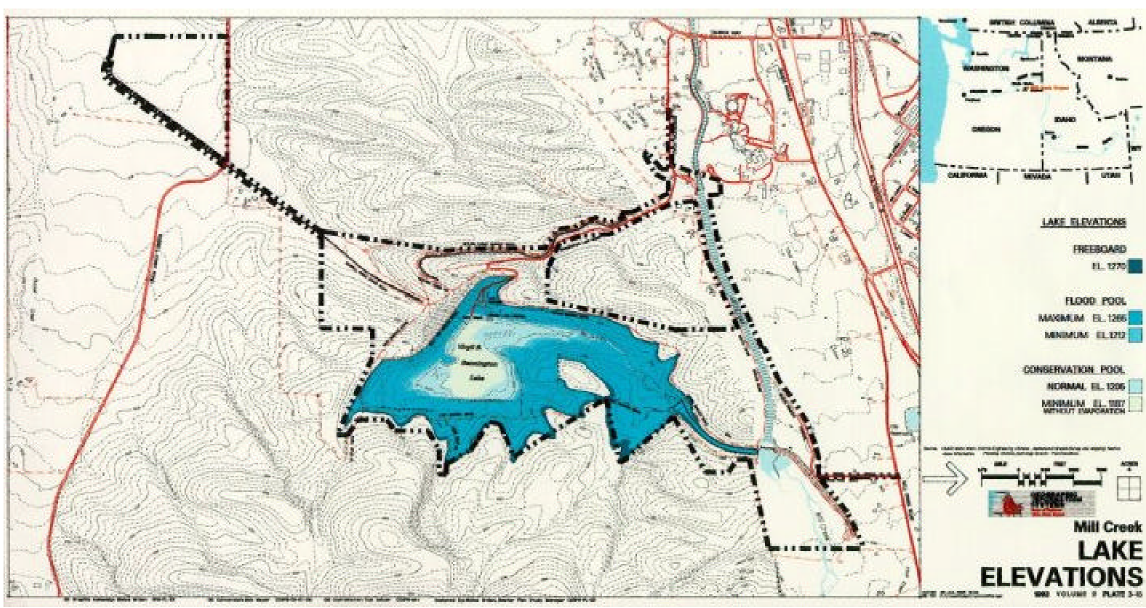


Plate 3-15. Lake Elevations

The area and capacity curves (figure 3-22) show the changes in surface area in relation to the lake level. Table 3-29 shows the historical lake elevations. Figure 3-24 shows the mean monthly water levels between 1976 and 1992.

Table 3-29
Lake Elevations 1976 to 1993*, **

	Avg	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976
Jan	<1184.7	--	--	--	--	--	1191.4	--	1189.4	--	1188	1182	1182	1887.4	1188.3	1193.6	1189.9	1194.4
Feb	<1189.5	1194.7	--	--	--	1185	1190	1192.0+	1190.9	--	1185.1	1182	1182	1193.6	1189.5	1192.3	1189.3	1194.6
Mar	1195.75	1199.7	1188.8	--	--	1186	1195.0	1213.3	1192.90	--	1197.9	1186.9	1182	1193.1	1188.4	1191.5	1200.4	1193.3
Apr	1204.25	1197.7	1206	--	--	1205	1202.6	1209.3	1204.95	--	1201.0	1189.9	1182	1196.3+	1225.0	1190.5	1204.7+	1192.8
May	1240.6	1203.1	1204.3	--	--	1205.8	1205.1	1204.5	1205	1224.93+	1201.3	1186.6	1182	1201.6+	1203.8	1194.9	1204.4	1195.0+
Jun	1203.4	1198.0	1204.8	--	--	1204.9	1202.8	1204.6	1205.15+	1234.693	1198.0	1178	1182	1201.6	1202.5	1202.7	1202.0	1205.0
Jul	1200.2	1193.5	1201.8	--	--	1202.3	1198	1200.4	1205.15	1210.23	1194.2	1178	1182	1196.5	1196.9	1197.6	1199.6	1203.0
Aug	1195.2	1190.1	1196.9	--	--	1197.4	1194.2	1193.3	1199.5	1203.8	1190.7	1178	1182	1192.7	1192.7	1193.6	1194.3	1201.0
Sep	1191.6	1187.4	1192.5	--	--	1193.5	1189.4	1191.5	1195.5	1199.0	--	1178	1182	1190.4	1190.4	1191.3	1194.0	1198.1
Oct	1189.5	1184.9	1189.4	--	--	1189.6	1187.7	1189.4	1196.16	1195.4	--	1178	1182	1182	1189.1	1190.3	1192.2	1193.9
Nov	1189.0	--	1186.7	--	--	1188.7	1187	1194.2	1192.8	1192.25	--	1178	1182	1182	1188.1	1188.9	1190.4	1191.4
Dec	<1174.6	--	--	--	--	--	--	--	--	--	--	1178	1182	1182	1187.7	1188.5	1189.2	1190.4

Notes:
*Elevation at first of the month. If it became higher or lower at any point during the month, it is noted with a plus sign (+), and further identified below.
#Test Set
**Historic High Elevation - Jan 1965 (1242.3)
--Elevation below 1184.7
+Unusual deviation in elevation:
24 Feb 1986 - 1217.4
19 Jun 1985 - 1207.1
19 May 1984 - 1235.07
9 Apr 1980 - 1205.6
6 May 1980 - 1205.2
18 Apr 1977 - 1205.1
3 May 1976 - 1196
30 May 1976 - 1205.3

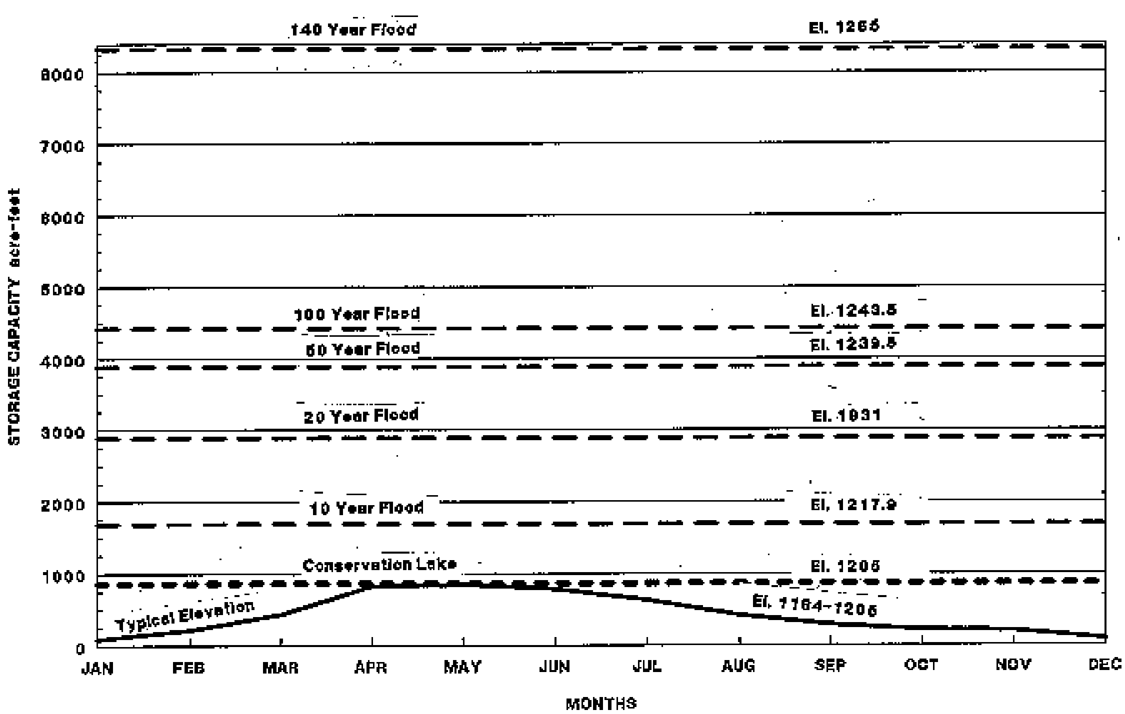


Figure 3-24. Virgil B. Bennington Lake Drawdown and Refill

(b) Flood Control.

When flood water is stored in Virgil B. Bennington Lake, and the lake rises above elevation 1212, the water above this elevation will be evacuated as soon as possible via the return canal to Mill Creek in order to minimize seepage damage and make space available for future flood events. This plan of operation will provide flood control space for future flood-events.

(c) Lake Elevation Frequency.

Under the current flood control plan, there is only a 20-percent probability that more frequent floods would fill the lake to elevation 1199.5 or higher in any given year. There is a 1-percent probability that a less frequent or extreme flood event would fill the lake to elevation 1243.5 or higher in given year. Specific frequency lake elevations are tabulated on table 3-30 for flood control operations only, as well as for multiple purpose operations (flood control and recreation).

Table 3-30
Specific Frequency Lake Elevations

Flood Control Recurrence Interval (Years)	Probability* (percent)	Operation Lake Elevation** (feet mean sea level)
5	20	1199.5
10	10	1217.9
20	5	1231.0
50	2	1239.5
100	1	1243.5

*Probability of filling lake to the indicated elevation or higher in any given year.
**Used a starting pool elevation of 1190.

(d) Conservation Pool.

Since 1953, with the exception of 1989 and 1990, the Corps has attempted to bring the lake elevation to 1205 in order to provide a lake for fishing and recreation. During drought years, however, there is not enough water to bring the elevation to 1205.

The maintenance of a conservation pool during spring and early summer provides the only body of water within 28 miles of Walla Walla that can be used for recreation activities. Virgil B. Bennington Lake is generally filled up to elevation 1205 (with surplus Mill Creek water) near the end of the winter flood season (March or April). The conservation pool elevation of 1205 is maintained by small diversions of flows that are excess to irrigation requirements, until Mill Creek irrigation demands increase (normally 1 May). By the end of the summer, evaporation and seepage normally reduce the lake elevation to approximately 1185 to 1190 feet.

(4) Irrigation.

Since 1942, the Corps has diverted water from Mill Creek to the delta streams of Yellowhawk and Garrison. Originally the water was diverted for flood control and irrigation. Over the years, because of encroachments, the streams have lost their capacity for flood control. As a service, the Corps transfers enough irrigation water to meet downstream water rights. Irrigation water requirements for the Gardena Farms Irrigation District are provided by requests from the Water Master to the Mill Creek Project Manager. Water is normally diverted for irrigation after 1 May each year.

(5) Analysis of Flood Control Operations.

Low runoff seasons will affect the following: 1) sport fishing, both at Virgil B. Bennington Lake and in Mill Creek; 2) irrigation; and 3) the Walla Walla Municipal water supply. During a drought year, downstream water rights have priority over the diversion of water from Mill Creek into Virgil B. Bennington Lake. As a result, the length of time that the conservation pool remains near elevation 1205 would be significantly shorter throughout the spring and early summer than during above average runoff seasons. In addition, on an average annual basis, evaporation alone would result in approximately 4 feet of reservoir drawdown (refer to paragraph 3.02.f., *Climate*, and table 3-16, *Monthly Evaporation*).

f. Buildings and Other Facilities.

(1) General.

Buildings at MCP provide the facilities needed for project operations, administration, and recreation.

(2) Project Office.

The project office is located on Reservoir Road, just off of Tausick Way. The building was constructed in 1939, at the same time the project began. This wood-frame building serves as an office and a storage facility, and has approximately 900 square feet of floor space.

(3) Maintenance and Storage Facilities.

There are three buildings for storage and maintenance at MCP. Two of these buildings are located near the Project Office, and were also built in 1939. The chemical storage building is 150 square feet and the maintenance shop is 1,272 square feet. The third building is a 278-square-foot metal storage building built in 1984. This metal building is located at Rooks Park next to Mill Creek Recreation Trail, and was constructed in 1978. It is a 720-square-foot metal storage/ maintenance building (see photo 3-44).

Photo 3-44. Storage building at Rooks Park

(4) Gage Stations.

There are four gage stations at MCP. One of these gages is a stream gage, and the other three are MCP gages. They are used to monitor water flows, and are critical for monitoring and controlling flood and water levels.

(a) Stream Gage.

The stream gage (USGS No. 14015000) is located on Mill Creek, below the division works. It is maintained by the USGS. This gage is telemetered, which means it can be monitored from any commercial telephone.

(b) Project Gages.

There are three project gages. They are located at the Diversion Dam forebay, Intake Canal, and along the boat ramp and entrance road to the Lake Recreation Area. All of these are day-time, manually-read, staff-type gages.

(5) Restrooms.

There are three restrooms at MCP. They are open from 15 May through 15 October. The newest, and the largest (488 square feet), is located at Rooks Park (see photo 3-45). Built in 1990, it is made of concrete block, has separate men's and women's rooms, and is of the flush-type, with potable water. A pay telephone is also located at the building. The other two restrooms are prefabricated wood frame, and were purchased in 1984. They are the unisex-type, and are located near the Project Office and the Lake Recreation Area. They are 108 square feet and 230 square feet in size, respectively.

Photo 3-45. Restroom at Rooks Park

(6) Other Buildings.

Three other small buildings are located on the project. One is a 160-square-foot metal well house located near the Project Office. A 92-square-foot concrete Pump House is located at Rooks Park, and a 196-square-foot concrete block Operator's House is located on top of Mill Creek Dam.

(7) Analysis of Project Buildings.

Some of the project buildings were constructed in 1939. The buildings were constructed for purposes different than their current usage. From an aesthetic viewpoint, the buildings are very diverse. An evaluation of the structures for energy, usage, and aesthetics needs to be done.

g. Fencing.

The MCP contains 9.46 miles of fencing. The project boundary incorporates 7.7 miles of this fencing, and the other 1.8 miles of fencing are located inside the project. Refer to plate 3-14 for the location of fencing on the project; and volume 1, section 5, for a more detailed location of fencing at each management unit. Table 3-31 lists the total amount of each type of fencing used at MCP.

Table 3-31
MCP Fences

	Barb Wire	Chain Link	Steel Pipe	Wood Rail/Wood Slat	Hog Wire	Total
Boundary	36,724.60	.	.	2,408.97	1,436.13	40,078.52
Interior	4,690.54	524.16	857.80	3,354.47		9,426.97
41,415.14	524.16	857.80	5,763.44	1,436.13	49,605.49	
Barb Wire = 3, 4, 5, 6, 7 Barb Wire						

(1) Boundary Fences.

Almost 85 percent (40,078.52 feet) of the project boundary is fenced. The fencing allows for better management, is helpful in locating the project boundary in the field, and prevents agricultural encroachments. All but 3,210 feet of the outside boundary is fenced. Half of this area is in the Mill Creek Flood Plain, so only 1,900 to 2,300 feet must still be fenced. The inside project boundary is about half complete, with 4,400 feet still to be fenced. This boundary area also needs to be surveyed (see paragraph 3.03.c.(1)(a), *Boundary/Monumentation*). Approximately 90 percent of the fence along the boundary is barb-wire fence.

(2) Fences Within Project Boundaries.

Inside the project boundary, there are 9,426.97 feet of fence. About half is made of barb-wire, 35 percent is made of wood rail or slat, and the remainder is made of chain link and steel pipe. The fences are used to provide barriers and guides at the lake area, and near the Project Office area. The chain-link fence is used for security around the Project Office, and steel pipe is used over the division works for safety. Rooks Park has approximately 1,000 feet of fencing. The Project Office area has approximately 1,100 feet of fencing, including the security fence around the Project Office and maintenance buildings. The lake area, near the boat launch and parking ramp, contains 2,500 feet of fencing.

(3) Analysis of Fencing.

The fences on the project boundary provide identification of project property. In the past, agricultural crop production has encroached onto MCP lands. At times, the fence has been damaged. The unfenced project boundary may have a problem with agricultural encroachment. The area along Mill Creek should be fenced to identify Government property for operation and recreational activities in the forebay area. The fencing located within MCP provides security, guidance, and barriers. The security around the Project Office is unsightly, and other alternatives should be explored.

(4) Guardrail.

There are 2,858.9 feet of guardrail at MCP. All of this guard rail is located along Bennington Lake Road.

h. Wildlife Habitat Improvements.

(1) History.

When the project lands were purchased in the 1940's, all of the lands south of the bluff were used for wheat production. The wildlife management activities at the MCP were initially conducted by utilizing a cooperative agreement with Washington Department of Game (now WDW). The initiation of intensive wildlife management activities began in the mid-1950's, when the original meadows and tree-shrub plantations were established by WDW. As is the case today, the harvesting of wildlife was restricted to the use of shotguns and bows and arrows.

The Corps, Walla Walla District, began active wildlife habitat management by establishing 21 tree and shrub habitat areas at MCP between December 1982 and February 1985 (see photo 3-46). These plantings were conducted as compensation for plants destroyed by the 1980 to 1982 Mill Creek Rehabilitation Project. The wildlife habitat developments are shown on plate 3-16.

Photo 3-46. Wildlife habitat plantings

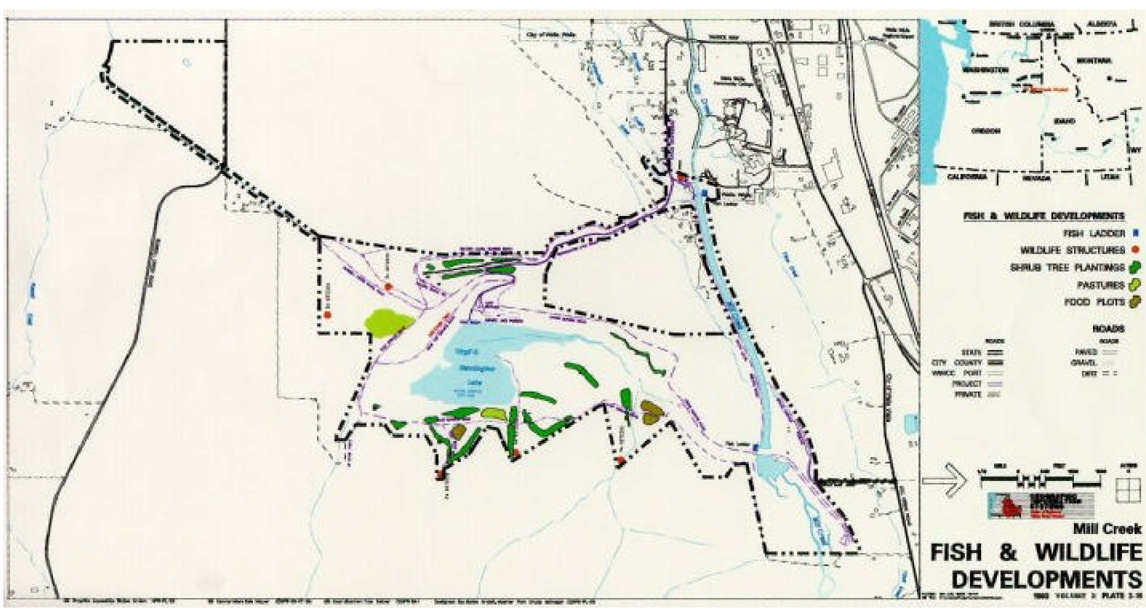


Plate 3-16. Fish and Wildlife Developments

The purchase of 61.8 acres adjacent to the project, as Element X credit for the LSRFWCP, was completed in Fiscal Year 1991. This land was agricultural cropland when purchased. Initial development of this tract has included controlling noxious weeds and seeding the area to grass.

(2) Analysis of Wildlife Habitat Improvements.

The existing wildlife habitat developments have greatly improved the MCP for wildlife, but the tree and shrub plantings need to be further enhanced to improve their quality for more species of wildlife.

i. Fish Habitat Improvements.

(1) Fish Stocking.

(a) Background.

Fish have been stocked in Virgil B. Bennington Lake since 1953. The use of the lake for fishing evolved from the lake seepage problem. In the early 1950's, there were experiments to use muddy water diverted from Mill Creek during the spring. This resulted in a continuously held lake surface elevation that attracted the attention of the local game supervisors. After considerable study, an agreement was reached between the Corps and WDW to plant legal-length rainbow trout in the lake and open the area to sport fishing. The result was judged to be the most intensive of any in the entire region. The fishing pressure became so heavy that WDW replanted the lake in the middle of the summer. The lake was maintained between elevations 1190 and 1205. All evidence indicated a successful fishery. Based on that experience, the conservation pool was maintained at elevation 1205 during the summer, and at elevation 1190 during the winter, if water was available (USACE, 1951).

(b) Current Program.

Approximately 20,000 to 30,000 rainbow trout are planted in Virgil B. Bennington Lake by WDW each year. Few trout are thought to survive beyond summer. This is based on the poor water quality of the lake during late summer as a result of reduced system runoff flows and diversion for irrigation, as well as the few trout caught by people at this time of year (USACE, 1984).

(2) Mill Creek Channel.

(a) Fish Ladders.

There are two fish ladders at MCP. The first is located in the right abutment at the First Division Works (see photo 3-47) in the division structure (RM 10.5). The other is located upstream in the sluiceway of Diversion Dam (RM 11.5).

Photo 3-47. Fish ladder entrance at the First Division Dam

(b) Habitat Improvement in Mill Creek.

In 1986, when the Mill Creek Channel was rehabilitated, large boulders (in groups of three) were placed sparingly in the channel, as shown in photo 3-48, to provide resting places and create pools for migratory fish.

Photo 3-48. Boulders placed in Mill Creek Channel

(3) Virgil B. Bennington Lake.

In 1982, a fishing peninsula was constructed in the lake that extended from the dam into the lake. This was accomplished during construction of a 2-foot Mill Creek Dam concrete cutoff wall.

j. Recreation Facilities and Operations.

(1) Overview.

The recreational facilities at MCP can be divided into five areas: 1) Rooks Park; 2) Mill Creek Channel; 3) Project Office; 4) Virgil B. Bennington Lake Area; and 5) the Wildlife Habitat Area (see plate 3-17). The facilities provide a wide range of recreational pursuits, and all of them are operated and maintained by the Corps.

The lands around the lake are divided into two areas, by use. These areas are the central lake area (Virgil B. Bennington Lake Area) and the Wildlife Habitat Area. The Central Lake Area contains intensive recreational use and development, while the wildlife habitat area contains very limited development and is used far less. This area was opened to fishing and hunting in 1953 (USACE, 1961).

(2) Rooks Park.

(a) General.

The development of Rooks Park began in 1963, and the park was opened to the public in 1964 (USACE, 1963). The park is located along the floodplain of Mill Creek (RM 11.5). It contains approximately 16 acres of old-growth cottonwood trees and irrigated lawn grass. In 1939, this was the location of Mill Creek, but the Corps moved the creek channel south to its present location. The pond and wetland area are remnants of the original channel. Today there are islands of native vegetation (cottonwood, alder, willow) as well as introduced species and lawn. The lawn area is interspersed with both ornamental and fruit trees (see photo 3-49).

Photo 3-49. Rooks Park

(b) Access.

Rooks Park is accessed by automobile from Mill Creek Road and Rooks Park Road. Rooks Park Road (originally called North Access Road) was constructed by the Corps to provide access from Mill Creek Road. Signs along U.S. Highway 12 and Mill Creek Road provide visitors directions to the project. The park is also on the Mill Creek Recreation Trail and the proposed Walla Walla Trail, which will extend to the Whitman Mission National Historical Site (see figure 3-21). See plate 3-17 for trail locations. The park also serves as a trailhead for the Constitutional Path, which is a loop trail on the project.

(c) Facilities.

Rooks Park contains a paved entrance road, a paved parking lot for 53 vehicles, and a gravel parking lot for 30 to 40 vehicles. It also has a large playfield, volleyball court, playground, wheelchair access to restroom facilities, and drinking water. The park has approximately 35 picnic tables, 15 waist-height grills, and 8 on-the-ground grills. These are the only picnic tables on the MCP, except for one along Mill Creek Recreation Trail across from the Project Office. There is also a display about Captain Rooks, for whom the park is named.

(d) Recreational Activities.

Rooks Park is used as a day-use picnic area. It also has a playfield, volleyball court, playground, wheelchair access to restroom facilities, and drinking water. The park is an excellent location for observing birds, because the surrounding area is undeveloped.

(e) Operation.

The park facilities are open during daylight hours from April 1 to October 15.

(3) Project Office.

(a) General.

The Project Office (see photo 3-50) is located at the end of Reservoir Road, along Mill Creek at RM 10.5, and is next to the Division Works.

Photo 3-50. Project Office area

(b) Access.

Tausick Way and Reservoir Road provide vehicular access to the Project Office. The South Levee Trail and the Mill Creek Recreational Trail are accessible from here by using the Division Works to cross Mill Creek.

(c) Facilities.

Visitor information is available on a kiosk. There is a restroom, and parking for 13 vehicles.

(d) Recreational Activities.

A trailhead for hiking and an area for unloading horses are located east of the Project Office, along the South Levee.

(e) Operations.

The area is open all year, but the restroom facilities are closed during the winter months.

(4) Mill Creek Channel.

(a) General.

The Mill Creek Channel is located on Mill Creek between the Division Works (RM 10.5) and Diversion Dam (RM 11.5). The channel trail system runs on both sides of the channel. The channel averages about 113 feet at the bottom, and the trails run parallel to each other and are about 170 ft apart. The channelized portion of Mill Creek is composed of concrete weirs, and has grasses in the channel. Trees and shrubs are not permitted to grow in the channel for flood control reasons. The reasons for this are that the root system could jeopardize the integrity of the parallel levels, and large trees during a flood could wash away and block stream flows near bridges (see photo 3-51).

Photo 3-51. Mill Creek Channel runs from Diversion Dam to the project boundary below Division Dam (this photo is only a section of the channel).

(b) Access.

There is no vehicular access to the channel except for authorized personnel. This includes one outgrant, for access to a private home [see paragraph c.(g), *Outgrants*]. The Mill Creek Recreation Trail (part of the proposed Walla Walla Trail) and Constitutional Path pass through the channel area (see plate 3-17). There are two trailheads on the project, and parking and access to both sides of the channel is available from either of them. One trailhead is located at the Project Office and has parking for 10 vehicles and 6 horse trailers as well as access to a stream crossing (over the Division Works). The other trailhead is at Rooks Park, and the crossing is located at the foot bridge (see paragraph (2), *Rooks Park*, above).

(c) Facilities.

The Mill Creek Recreation Trail, which runs on the north side of the channel, was paved in 1986. There is gravel along the trail for equestrian traffic. The South Mill Creek Trail runs along the south side of the channel and has a gravel surface. There is one picnic table on the north side, across from the Project Office area. There is a foot bridge, constructed in 1975 at RM 11.3, to provide a crossing from Rooks Park to the South Mill Creek Trail and the lake area.

(d) Recreational Activities.

Hiking, bicycling, horseback riding, and jogging are activities enjoyed along the trails. Because both the South Mill Creek Trail and the Mill Creek Recreation Trail cross here, a 1.7-mile loop is possible.

(e) Operations.

The area is open all year long.

(5) Lake Recreation Area.

(a) General.

The 65-acre area around Virgil B. Bennington Lake includes the boat launching ramp, the lake, a fishing peninsula, and the lake shore (see photo 3-52).

Photo 3-52. Lake Recreation Area

(b) Access.

The boat launching area and parking lot are 1.6 miles from Tausick Way via Reservoir Road and Bennington Lake Road. The Lake Recreation Area is also accessible by foot or bicycle from Constitutional Path (see paragraph d., *Transportation*, for a description of project roads and trails). Access to the lake is by foot only, except for the boat ramp. The boat ramp is the only paved access to the lake shore and, due to the steep and rocky banks, access is difficult for elderly and/or disabled individuals.

(c) Facilities.

The Lake Recreation Area has a single-lane boat ramp (which extends to elevation 1200), parking for 55 vehicles, a combination vault, and a flush toilet with portable water.

(d) Recreation Activities.

The Lake Recreation Area is used primarily for fishing, small craft boating (no internal-combustion motors), swimming, picnicking, and sightseeing. Fishing is open year round at the lake and is extremely popular in the spring, when the lake is stocked with trout by WDW. A free fishing derby is sponsored each June to children under 14 years of age by WDW, Washington Department of Fisheries, Tri-State Steelheaders, and the Corps. In 1992, 180 children attended (WWUB, 1992).

(e) Operations.

<u>1</u>. Recreation Facilities.

The lake area is open year round during daylight hours. The lake is stocked with fish each year, and the fishing season continues year round. Restroom facilities are also available year round.

<u>2</u>. Lake Elevations.

Refer to paragraph e., *Water Resource Facilities and Operations*, for a description of lake elevation operations. The lake elevation usually fluctuates during the year, from a winter low of 1184 feet up to 1205 feet in the early spring. Since 1953, with the exception of 1989 and 1990, water has been diverted from Mill Creek in the early spring in order to provide a recreation lake (USACE, 1961 and 1991). In March, the lake elevation is brought to 1205 feet, and is maintained at that elevation until the flows from Mill Creek are not sufficient to meet the 60 to 80 cfs required for fish during March and April, or the necessary irrigation diversions to Yellowhawk and Garrison Creeks that usually begin after 1 May. During the summer recreation season, the lake surface elevation ranges from 1205 to 1185. This creates many variations in the lake's characteristics. The surface area will range from 52 to 20 acres, and the perimeter of the shoreline ranges from 2 to 1 mile in length and has a maximum depth of 25 to 5 feet (see table 3-32).

Table 3-32
Virgil B. Bennington Lake at Various Elevations

Elevation (msl)	Surface Area (acres)	Shoreline (miles)	Maximum Depth (feet)	Comments
1185	19.8	0.99	7.8	
1205	51.9	2.00	27.8	December
1212	63.2	2.30	34.8	Conservation
1214	67.6	2.40	36.8	1205 is for flood control
1217	74.4	2.40	39.8	
1265	225.8	4.80	87.8*	

*Max elevation depth is based on elevation 1177.2 (USACE, 1984). Deposits in the lake of 1.7 feet of sedimentation have appeared since 1951, when the maximum depth was 1175.5 (USACE, 1951).

(6) Wildlife Habitat Area.

(a) General.

The wildlife habitat area contains approximately 288 acres that lie within 3000 ft of the lake, and another 57 acres east of the intake and forebay area. It includes the east shoreline of the lake (at elevation 1205). The area has been open to hunting since 1953 (see photo 3-53).

Photo 3-53. Wildlife area

(b) Access.

Access to the wildlife habitat area is either by boat or dirt trails (service roads). During most of the year, it is possible to make a complete loop around the lake. This is not possible, however, during the spring or during flood events.

(c) Facilities.

The only recreation facilities located at the wildlife habitat area are service trails used as informal trails. Refer to paragraph h., *Wildlife Habitat Improvements,* for habitat improvements in this area.

(d) Recreation Activities.

The gentle terrain and solitude around this area makes it popular for less intensive recreational pursuits (*i.e.*, hiking, cross country skiing, horseback riding, and wildlife observation). The area includes land no further than 0.6 miles from the lake. This area is also used for hunting during the Washington Hunting Season (refer to plate 3-17 for the location of the current hunting area). It is hunted primarily for upland game birds.

(e) Operation.

The area is open year round. Motorized vehicles are prohibited on all of the trails and service roads.

(7) Analysis of Recreation Sites.

The MCP provides recreational opportunities for over 250,000 people per year. The facilities have increased and improved over the last 40 years. However, there are improvements that can be made to better serve the public, while still meeting the resource capacity.

The project is relatively undeveloped for recreation. Only 24 acres (4 percent) of the total land available is specifically used for recreational facilities. There is overcrowding at Rooks Park, and the facilities at the lake are underdeveloped. There is also a demand for improved day-use facilities and access to the lake area. Access to the lake shore is difficult for the elderly and/or persons with disabilities, and could be considered a safety problem. There are no facilities for picnicking at the lake. The boat ramp only extends to elevation 1200, and the lake is usually below 1200 feet by 1 July.

k. Visitation.

(1) General.

Section 4 of the Flood Control Act of 1944 authorized recreational development at MCP. From 1942 (when MCP was completed) to 1953 there were no recreational facilities at MCP. In 1954, when the lake was elevated, held, and stocked with trout by the State of Washington, MCP's first major recreation visitation occurred. However, no formal recreational facilities were made available to the public until 1965. The approval of the report Master Plan for Mill Creek Reservoir (Design Memorandum No. 1), dated 24 May 1961, gave authorization to build and operate the recreational facilities at Rooks Park, which opened to the public in 1965. The next closest non-urban recreation facility from Walla Walla is Lewis and Clark Trail State Park, 28 miles away.

Ever since Virgil B. Bennington Lake was first stocked with trout in 1953, it has been a major recreation attraction in the Walla Walla Valley (USACE, 1961). Visitation was estimated until 1965, when it was recorded for both Rooks Park and the Lake Recreation Area. Beginning in 1979, the Mill Creek Recreation Trail (North Levee Trail) and the South Mill Creek Trail (South Levee Trail) were added to the visitation count.

As recreation facilities were added (refer to paragraph j., *Recreation Facilities*), attendance has increased. Attendance continues to increase as facilities and the area's population also increase. There have been 4.4 million visitors at MCP since 1965. The two most significant factors contributing to attendance are the availability of facilities and the lake elevation when it drops below elevation 1205 around May 1 each year.

Visitation is recorded by the Corps, Operations Division, at MCP. It is maintained by the Corps, Natural Resources Branch, at Walla Walla District Headquarters. The information found in this section is based on data maintained by the Natural Resources Branch.

(2) Accounting Methods.

(a) Changes in Accounting Methods.

1. Attendance Counting Method, 1965 - 1985.

Attendance methods varied throughout this period.

2. Counting Method Implemented in 1986.

In 1986, new counting methods were used for calculating the number of vehicles and the number of people per vehicle, based on a 1984 to 1985 survey. The counting methods established the percent of people engaging in each different type of activity. This percentage has been amended by observation at the project. The percents are discussed in more detail in paragraph (b), Current Accounting Methods, below. The new survey data included a higher non-recreation vehicle count, as well as a lower number of people per vehicle. These percentages were used in computing the visitation count for the recreation area. The use of these new figures caused a decline in the overall figures.

3. New Counting Method Implemented in 1988.

Beginning in September of 1988, a new Waterways Experiment Station (WES) visitation formula was used for visitation data. This new method indicated that the visitation was much higher than what had occurred in the past.

4. Visitation Estimation Reporting System (VERS).

In 1993, a new survey will be conducted at MCP. This survey, which will utilize VERS, will provide updated information on visitation. The survey will run for a period of 1 year.

(b) Current Accounting Method.

The current accounting method is based on the 1984-85 survey, project observations, and the WES formula. Visitation is measured at four areas of MCP: 1) Rooks Park; 2) the lake area; 3) South Levee (South Mill Creek Trail); and 4) North Levee Trail (Mill Creek Recreation Trail). There are three magnetic-loop counters and two electric-eye counters on the project. The North and South Levee areas have been combined into one area ("Levee Trail") for the purpose of this report. The Corps, Natural Resources Branch, calculates the following data from the traffic counts: visits, visitor hours/days, and visitation activities distribution. All of the figures reflect day use. Each of the sites has a different set of criteria for each season. The various seasons are defined as spring (March, April, and May), summer (June, July, and August), fall (September, October, and November), and winter (December, January, and February).

1. Visits.

A visit is defined as the entry of one person into a recreation area or site to engage in one or more recreation activities. This is the easiest form of measurement, and is used by other Federal agencies. At MCP, the meter counts are converted by using the following formula, as well the figures in tables 3-33 and 3-34:

$$\text{VISIT} = \text{meter count} \times \text{percent that is recreation} \times \text{persons per vehicle}$$

Table 3-33
Percent of Vehicles

	Spring	Summer	Fall	Winter
Rooks Park	87	93	82	100
Lake Area	85	75	73	73
Levee Trails*	100	100	100	100

*Mill Creek Recreation Trail and South Mill Creek Trail.

Table 3-34
Number of People Per Vehicle

	Spring	Summer	Fall	Winter
Rooks Park	2.0	2.1	1.9	1.0
Lake Area	2.0	2.4	2.1	2.0
Levee Trails	1.0	1.0	1.0	1.0

2. Visitor Hours/Days.

A visitor hour is "the presence of one or more persons on an area of land or water for the purpose of engaging in one or more recreation activities during continuous, intermittent, or simultaneous periods of time aggregating 60 minutes." One visitor day is equal to twelve visitor hours. Visitor hours/days is a more accurate accounting of the amount of use at a project or site. Areas that have overnight activities (*e.g.*, campgrounds) would have more use as opposed to an area that is strictly meant for day use. The visitor hours at MCP are calculated by using the following formula, and are shown in table 3-35:

Visitor Hours = visit x hours per visit

Table 3-35
Hours Per Person

	Spring	Summer	Fall	Winter
Rooks Park	1.82	1.19	1.49	1.49
Lake Area	2.23	1.55	1.65	1.65
Levee Trails	1.74	1.00	1.10	1.10

As can be seen in table 3-35, the hours are different for each area and season. They vary from 2.23 hours for the lake area in the spring to 1.0 hour at the Levee Trails during the summer.

3. Distribution of Visits into Activities.

The following paragraphs contain a description of the activities, by area, at MCP. These activities are based on a 1984 to 1985 survey, with some adjustments from the project. The lake area, Rooks Park, and the Levee Trails each have different percentages of activities for each season. Visits are distributed over seven recreation activities at MCP. The visits are multiplied by the percents shown in table 3-36. If added together, they would be greater than 100 percent, based on the fact that many visitors engage in more than one activity. In addition, the percentages vary by season. These percentages are multiplied by visitation to arrive at total visitation activities.

Table 3-36
Percent Used to Distribute Visitors by Activity

	Season											
	Spring			Summer			Fall			Winter		
Activity	Rooks Park	Lake Area	North Levee	Rooks Park	Lake Area	North Levee	Rooks Park	Lake Area	North Levee	Rooks Park	Lake Area	North Levee
Picnicking	21.65	4.73 (26.38)	101.72	20.00	0.89 (20.89)	84.28	13.59	9.21 (22.80)	101.72	5.00	9.21 (14.21)	119.39
Boating		26.35	84.28		7.48	37.83		2.00	37.83		2.00	37.83
Fishing		55.42	121.11	3.00	20.70 (25.70	2.00 (101.72)	7.68	19.14 (26.82)	2.03 (119.39)		9.42 (11.45)	2.03 (101.72)
Hunting		0.26	24.26		0		2.0	18.00 (20.0)	84.28		6.00	84.28
Swimming	5.36	1.42 (6.78)	37.83	3.84	27.74 (31.58)	121.11	1.81	0 (1.81)	24.26		0	
Other	106.14	34.05 (265.63)	125.44 (846.40)	81.47	43.68 (248.68)	123.53 (846.40)	62.12	32.90 (215.19)	120.17 (846.40)	84.00	40.47 (244.64)	120.17 (846.40)
Sightseeing	5.49	14.25 (48.57)	28.83 (119.39)	13.69	16.40 (30.09)	119.39	11.53	32.90 (44.43)	121.11	11.53	32.90 (44.43)	121.11

a. The MCP.

The activity with the highest percent is "other" (see photo 3-54). This category is highest throughout the year, and includes activities that do not fall into the other activity categories. This is followed by swimming (second in the summer and fall), fishing (second in the spring), sightseeing, picnicking, boating, and hunting. Table 3-37 lists the order, by rank, based on the percent for each season.

Photo 3-54. Bicycling falls under the category of "other"

Table 3-37 Percent Rank Order				
	Season			
Rank	Spring	Summer	Fall	Winter
1	Other	Other	Other	Other
2	Fishing	Swimming	Swimming	Sightseeing
3	Sightseeing	Sightseeing	Fishing	Picnicking
4	Picnicking	Fishing	Picnicking	Fishing
5	Boating	Picnicking	Hunting	Hunting
6	Swimming	Boating	Sightseeing	Boating
7	Hunting		Boating	

b. Rooks Park.

The "other" category is the dominant activity at Rooks Park throughout the year as well. This category includes field games, walking, running, and bicycling. Picnicking (see photo 3-55) and sightseeing, in that order, are the next two major activities in the spring, summer, and fall. Sightseeing is second in the winter, and is followed by picnicking even then. Figure 3-25 displays the visitor activities, by season, compared to each other. Rooks park is the only picnic area on the project, except for one table along the Mill Creek Recreation Trail. Rooks Park is also the trailhead for both the Mill Creek Recreational Trail and Constitutional Trail. There is swimming and fishing in, or along, the Mill Creek Channel. Figure 3-26 displays the percent in each activity, for each different season.

Photo 3-55. Picnicking is most popular in the spring at Rooks Park

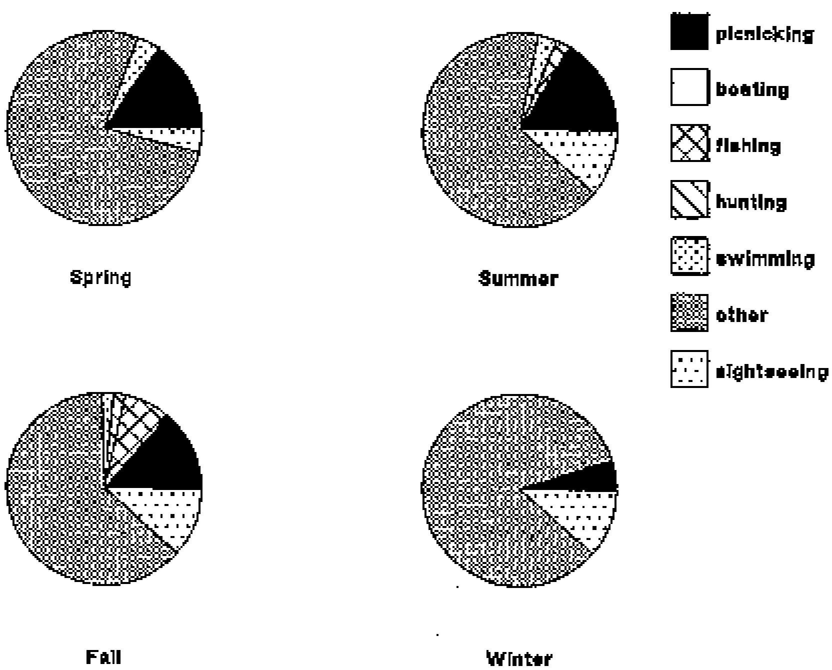


Figure 3-25. Visitor Activities by Season for Calculation, Rooks Park

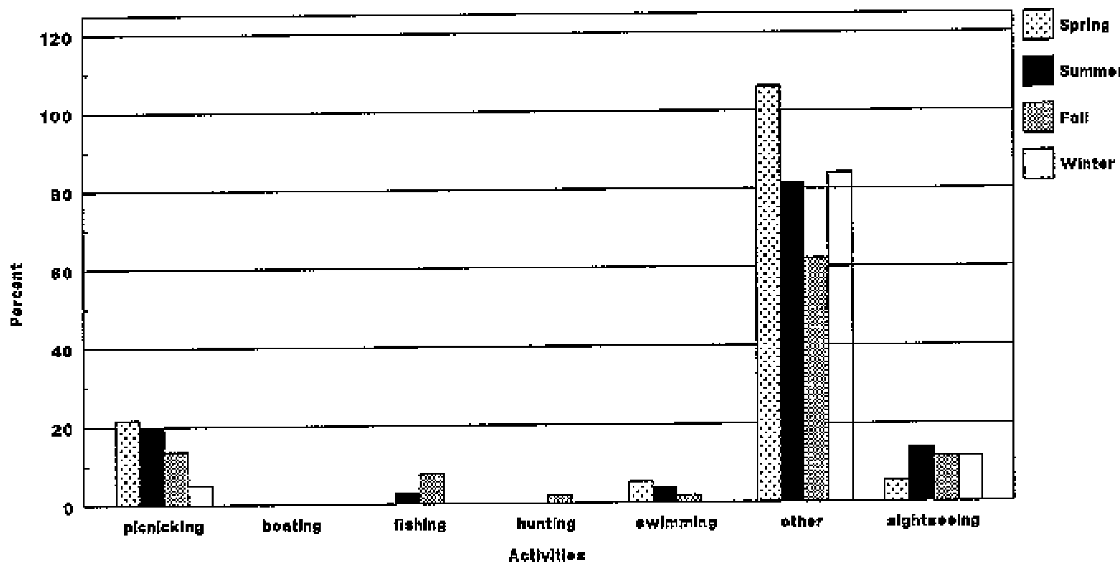


Figure 3-26. Acutual Visitor Activities Percent by Season for Calculation, Rooks Park

c. Lake Recreation Area.

In the spring, fishing is the most popular activity at the lake area, and is followed by boating and "other." "Other" is the most popular activity in the summer, fall, and winter. Swimming is the second most popular activity in the summer. During the fall, "other" is the most popular activity; and is followed by sightseeing, hunting, and fishing. In the winter, sightseeing is second; followed by fishing, picnicking, and hunting. Fishing (see photo 3-56) is the most popular activity in the spring and early summer when the conservation elevation of the lake is maintained and the lake is stocked with fish by WDW (refer to figures 3-27 and 3-28).

Photo 3-56. Fishing is popular in both Mill Creek and Virgil B. Bennington Lake

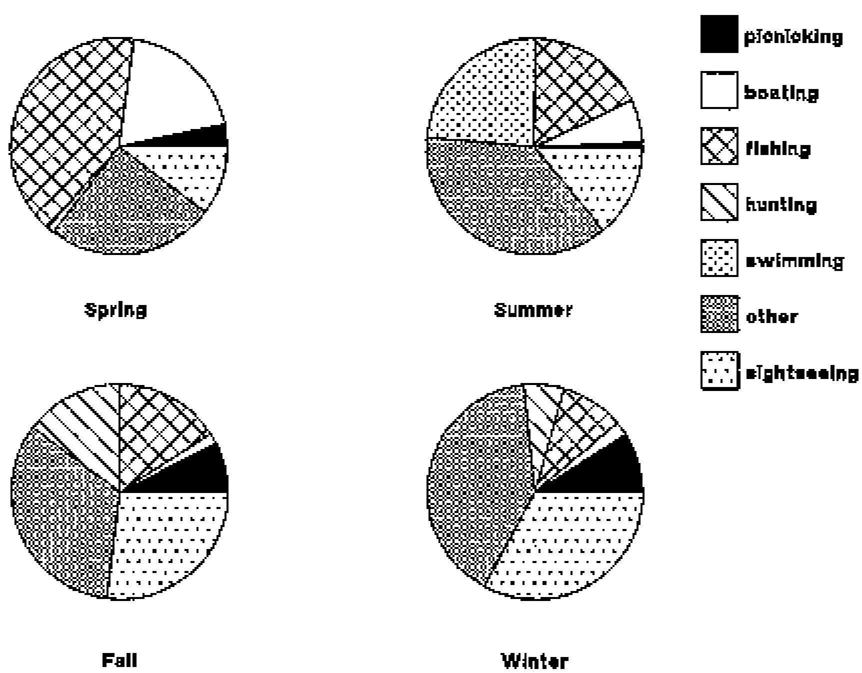


Figure 3-27. Visitor Activity by Season for Calculation, Lake Area

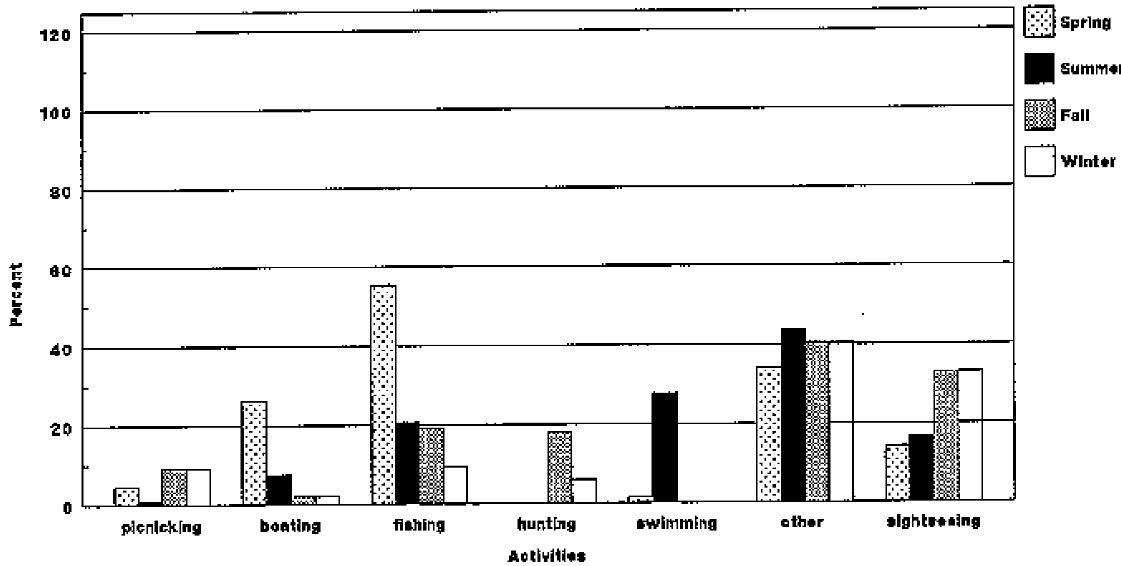


Figure 3-28. Actual Visitor Activity Percent by Season for Calculation, Lake Area

d. Levee Trails.

Since the completion of the Mill Creek Recreation Trail in 1979, it has attracted a significant number of hikers, bicyclists, horseback riders, and cross-country skiers. As shown in figures 3-29 and 3-30, the "other" category is by far the most popular activity in this area. It is followed by sightseeing; and swimming (see photo 3-57) in the summer, and fishing in the summer and fall. There is also some picnicking and sightseeing in the area.

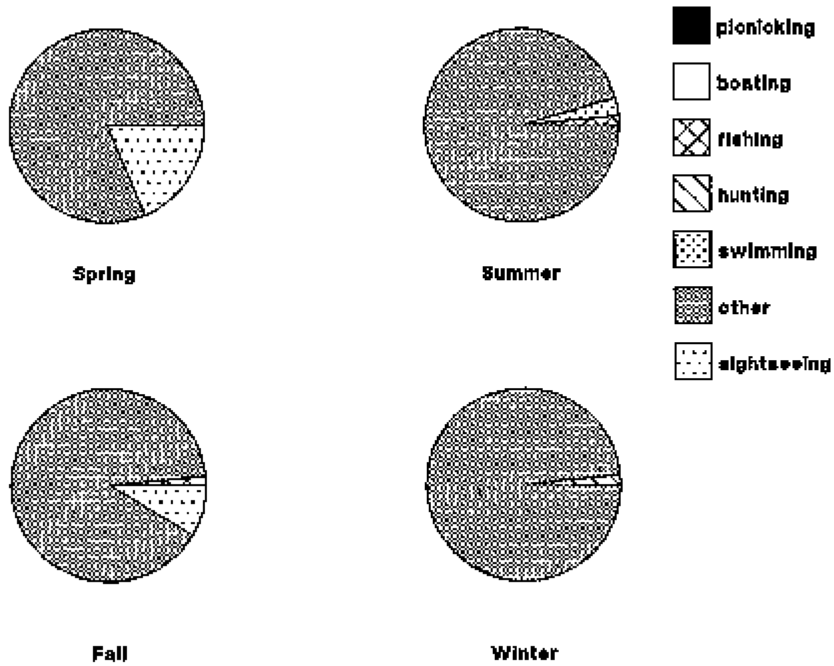


Figure 3-29. Visitor Activity by Season for Calculation, Levee Trail

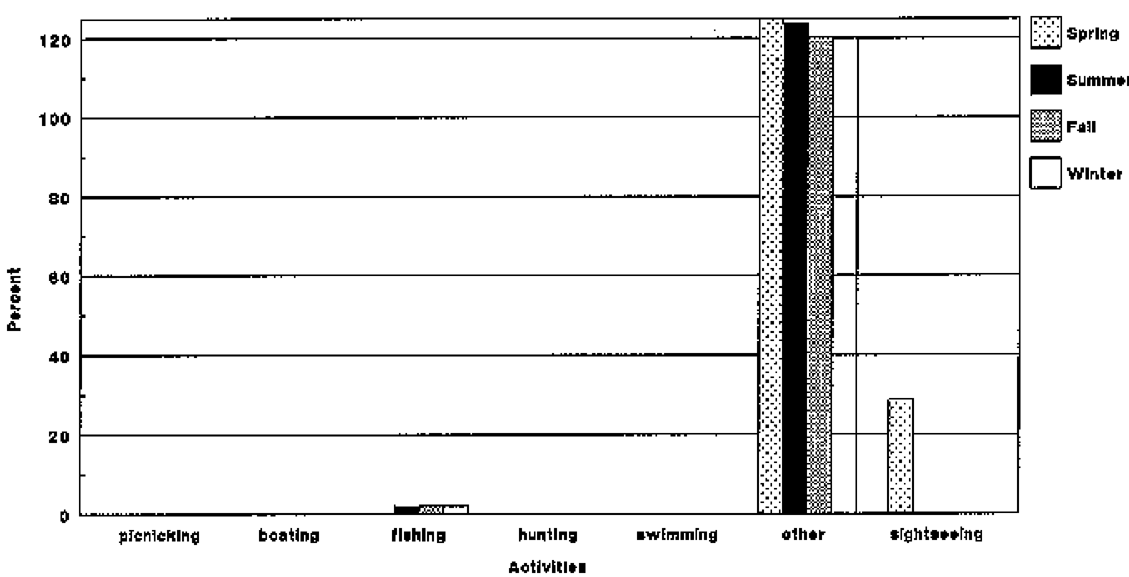


Figure 3-30. Actual Visitor Activity by Season for Calculation, Levee Trail

Photo 3-57. Wading and swimming are popular summer activities, both in Mill Creek and at Virgil B. Bennington Lake

(3) Visits at MCP.

(a) Annual Visitation, 1965 to 1992.

1. General.

The MCP visitor attendance figures from 1965 to 1992 are shown on table 3-38 and figure 3-31. Visitation has increased over the 27-year period, as is indicated on figure 3-31. In 1965, there were 54,050 visitors to the project. This has increased by 500 percent, to 250,000 visits per year. The yearly totals vary from year to year, because different factors (*i.e.*, seasonal precipitation, and construction at the project) influence the number of visits both seasonally as well as annually. The largest yearly decrease came from 1980 to 1981, when a 36-percent decrease in visitation occurred. This is further discussed in paragraph (6), *Factors Influencing Visitation*.

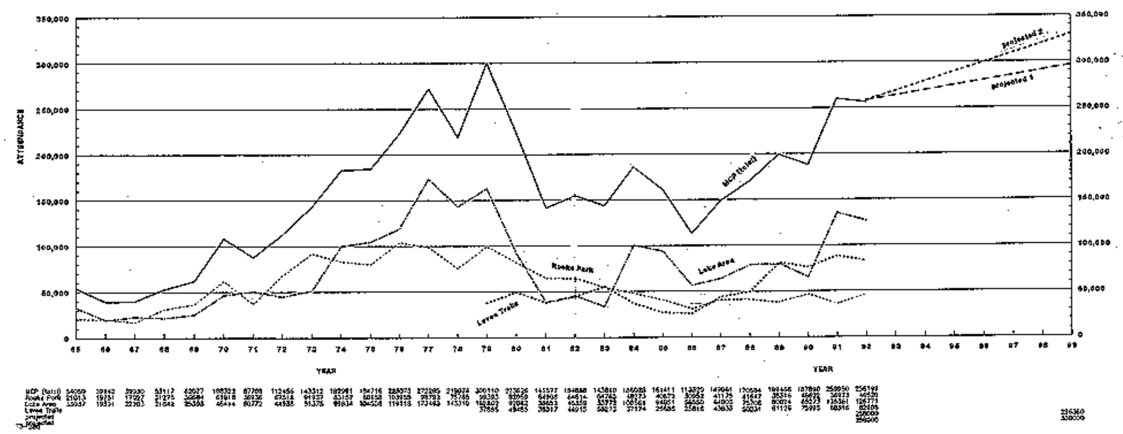


Figure 3-31. Mill Creek Project Annual Attendance (Visits)

Table 3-38
The MCP Annual Attendance

Year	Visits		Max S/S			Comments
	RP	Lake	Levee	Total	Lake Elev	
1953	--	.	.	.	1205	first year s/s lake
1958	--	55,000	.	55,000	.	estimate
1964	.	.	.	54,050	.	Rooks Park open
1965	21,013	33,037	.	39,142	.	Jan lake elev. 1242.3
1966	19,751	19,391	.	39,930	.	.
1967	17,027	22,903	.	53,117	.	.
1968	31,275	21,842	.	62,077	.	.
1969	36,684	25,393	.	108,332	.	.
1970	61,918	46,414	.	87,708	.	.
1971	36,936	50,772	.	112,456	.	.
1972	67,518	44,938	.	143,312	.	lowest year of precipitation (12.5")
1973	91,937	51,375	.	182,991	.	.
1974	83,157	99,834	.	184,716	.	.
1975	80,158	104,558	.	223,073	1205.0	.
1976	103,955	119,118	.	272,285	1205.3	.
1977	98,792	173,493	.	219,074	1202.7	.
1978	75,764	143,310	37,855	300,110	1203.8	levee trail developed
1979	99,393	162,862	49,485	223,626	1201.6	.
1980	82,059	92,082	38,017	141,577	1182.0	Dam rehabilitation - 36 percent visits
1981	64,908	38,652	44,915	154,888	1189.6	Dam rehabilitation, highest year of precipitation
1982	64,614	45,359	55,273	143,810	1201.3	Dam rehabilitation
1983	54,765	33,772	37,174	186,028	1235.7	Dam test, high June precip., visitor survey
1984	48,273	100,581	26,688	161,411	1207.1	Visitor survey
1985	40,672	94,051	25,818	113,320	1204.6	Channel rehab, survey data used, trail paved
1986	30,952	56,550	43,883	149,061	1205.1	.
1987	41,175	64,003	N/A	133,253	1205.8	WES visitation formula used, low
1988	54,547	78,706	81,126	199,466	dry	Lake drained, low temp Aug
1989	38,316	80,024	75,995	187,890	dry	Lake drained
1990	46,622	65,273	88,316	259,950	1203.1	.
1991	36,273	135,361	82,908	256,199	1204.6	.
1992	46,520	126,771		260,000	1205.0	estimate higher than normal precip.
1993						
1994						

s/s = Spring high lake elevation.

2. Visits By Area and Month.

a. Annual.

The distribution of visits on an annual basis varies, depending on facilities and other influencing factors. As shown in figure 3-32, the 1990 distribution varies from 1979, in that the lake area dropped from 54 percent to 35 percent because the Corps did not fill the lake in the spring. In figure 3-32, 1970 is displayed because it was a peak visitation year, and 1979 is displayed because the Levee Trails were opened that year. In 1992, the lake area received 48.5 percent of all visitors, followed by the Levee Trails (33.8 percent), and Rooks Park (17.8 percent). These percentages are displayed in figure 3-32.

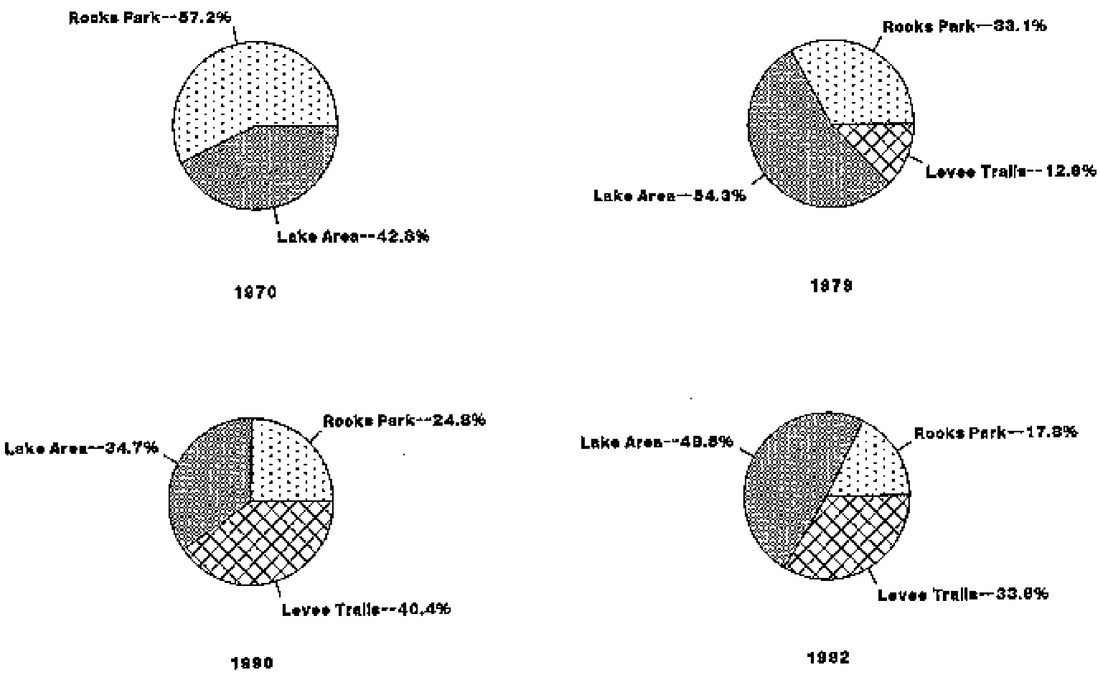
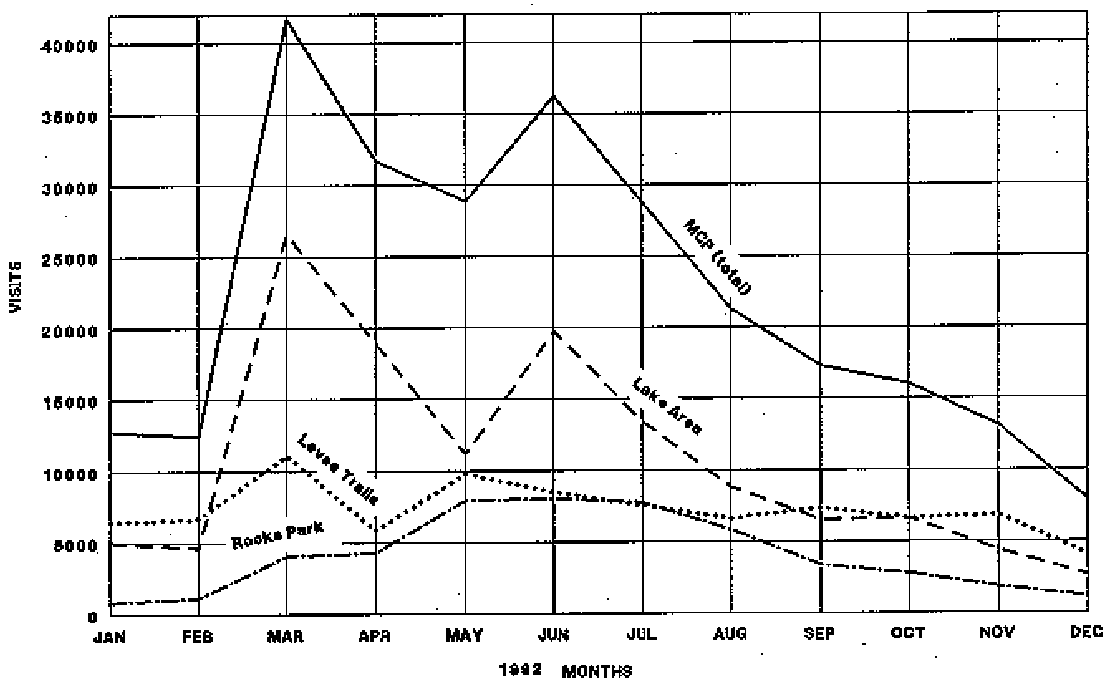


Figure 3-32. Mill Creek Project Annual Visits By Area, 1970, 1979, 1990, and 1992

b. Monthly.

Figure 3-33 displays visitation, by month, for 1992. As can be seen in figures 3-33 and 3-34, visitation peaks in March through June, and then gradually declines into December. The percent of visitors at each area varies throughout the year (see figure 3-31). The lake area receives the highest percentage of visitors in March through August but, from September through January, the Levee Trails are the highest. Only in June and July does Rooks Park visitation equal or exceed that of the Levee Trails area.



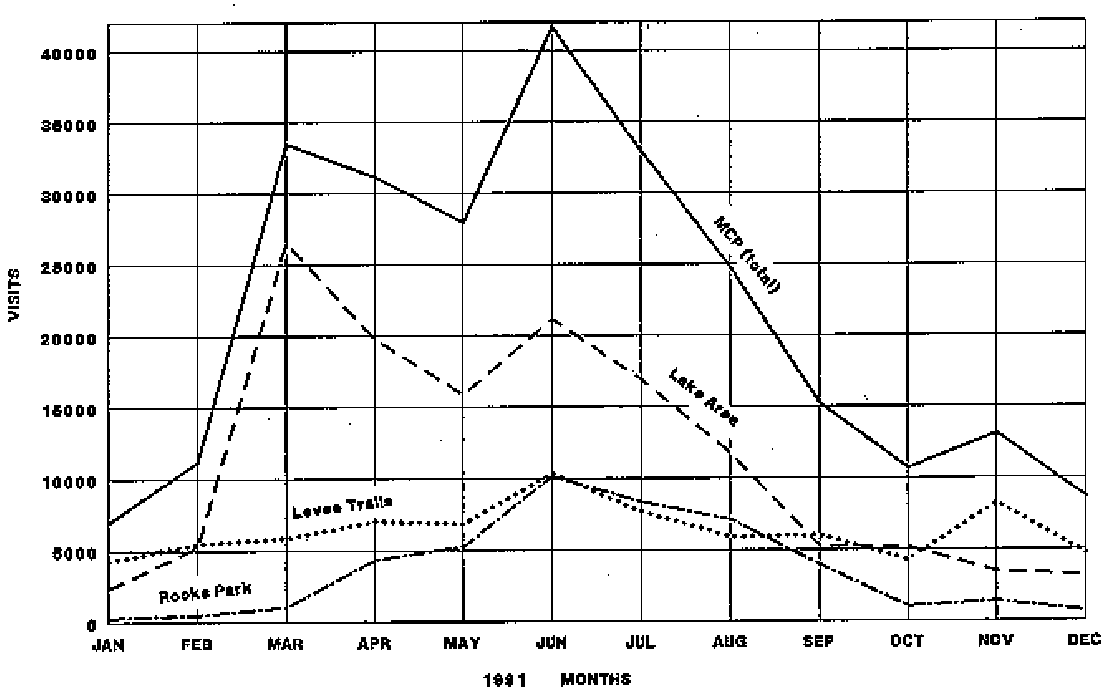


Figure 3-33. MCP Visitation by Month and Area

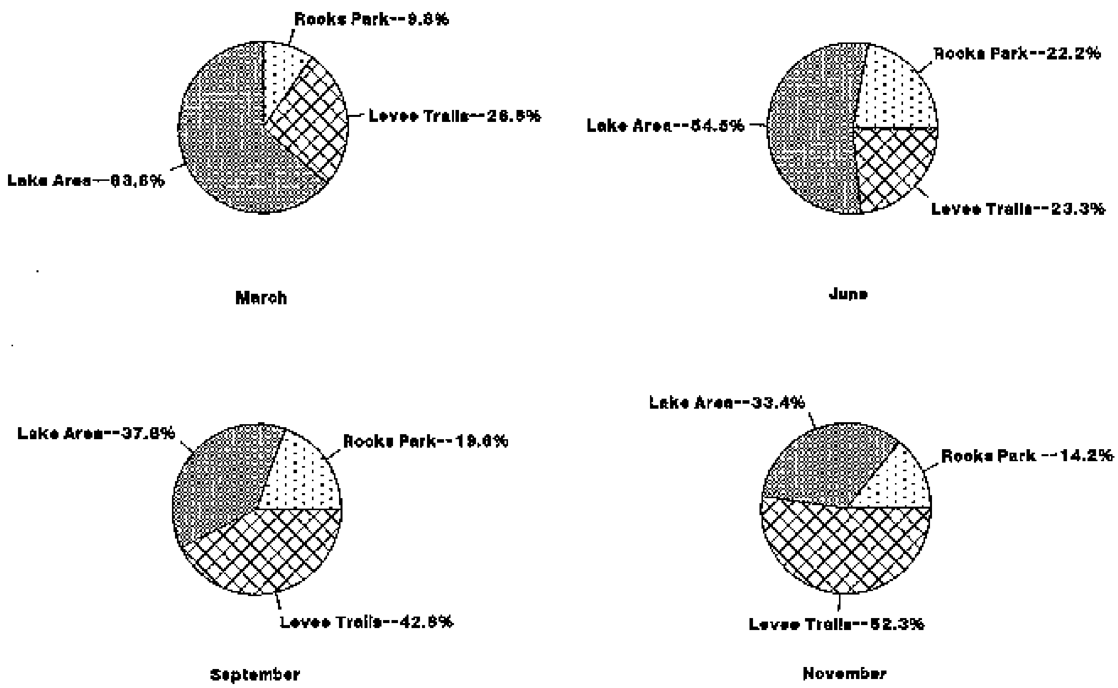


Figure 3-34. Mill Creek Project 1992 Month Visits by Area

(4) Visitation Hours.

Visitation hours are defined and calculated as described in paragraph (2)(b)2., *Visitor Hours/Days*. Visitor hours is the most accurate measure of use at the project. Based on 1991 and 1992 statistics, visitor hours are highest in March, and decline gradually towards December (see figure 3-35). Peak use for the lake area occurs in March, the peak for the Levee Trails occurs in April through July, and the peak for Rooks Park occurs in May and June. The percent of visitor hours between the different areas varies throughout the year (see figure 3-36). The lake area has the highest visitor hours percentage of the total throughout the year. Rooks Park and the Levee Trails average about the same number of visitor hours from May through September. The rest of the year, the Levee Trails have the second highest amount of visitor hours.

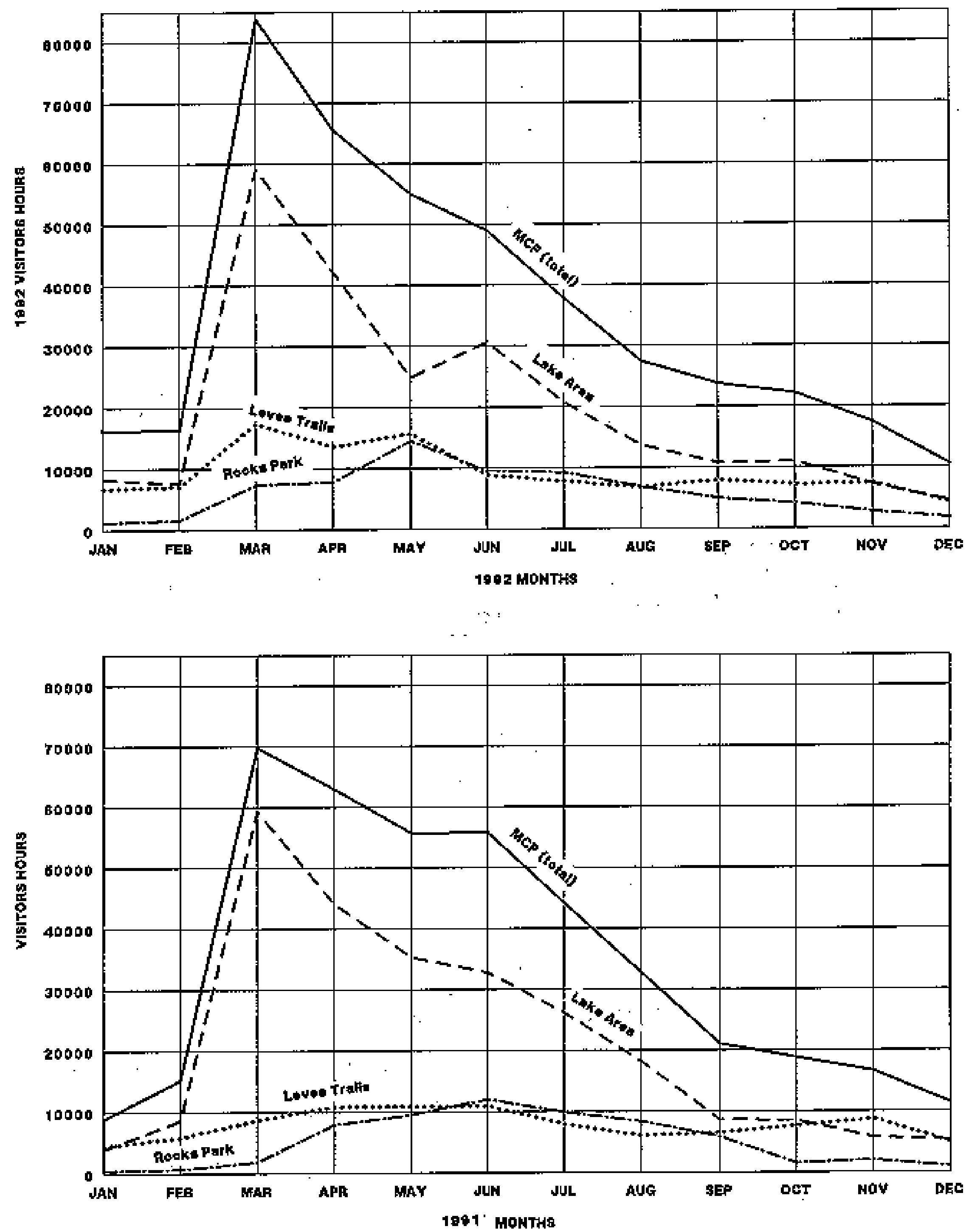


Figure 3-35. MCP Visitor Hours by Month and Area

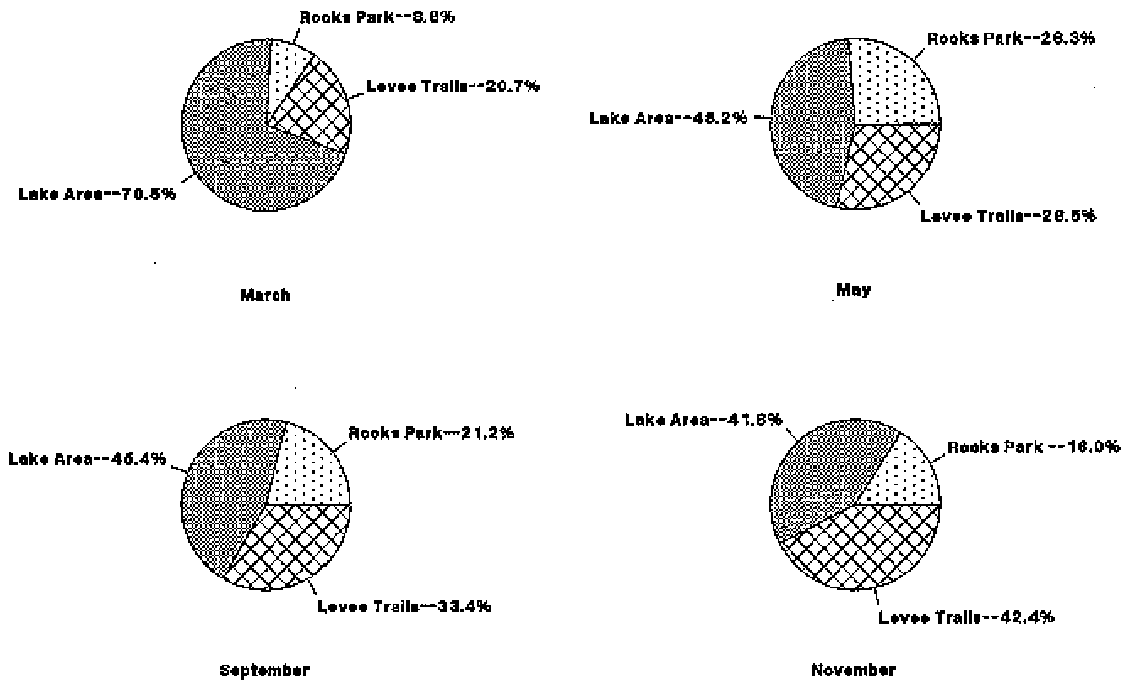


Figure 3-36. Mill Creek Project 1992 Visitor Hours by Area

(5) Visitation By Activity.

(a) The MCP.

Visitation by activity is calculated by multiplying the percent for each activity during each season (see table 3-33, and figures 3-26, 3-28, and 3-30) by the visitation counts described in paragraph (2)(b)1., Visits. Table 3-39 displays the visitation by activity for 1991 and 1992, both by rank and by season. Since the percent of each activity is different during each season and area, the ranking can change depending on visitation to each area. For example, if the lake elevation is low in the spring, there is a lack of opportunity for fishing. This results in lower visitation at the lake area, and causes fishing to receive a lower ranking.

Table 3-39
Visitation by Activity, 1991 and 1992

Rank	Spring	Summer	Fall	Winter
1	other	other	other	other
2	fishing	swimming	sightseeing	sightseeing
3	*boating	fishing	fishing	fishing
4	*sightseeing	sightseeing	hunting	picnicking
5	picnicking	picnicking	picnicking	hunting
6	swimming	boating	boating	swimming
7	hunting	hunting	swimming	

*In 1992, boating was number 4, and sightseeing was number 3.

The MCP 1992 total is shown on figure 3-39 for the entire year and season, while figures 3-37 and 3-38 show visitation by months for MCP. Table 3-40 displays the actual numbers of visitation by activity. As shown in figures 3-37, 3-38, 3-39, and table 3-40, "other" is the highest visitation by activity throughout the year. Fishing is second in the spring, and third the rest of the year. Swimming is second in the summer, and sixth/seventh the rest of the year. Sightseeing is second in the fall and winter, and third the rest of the year.

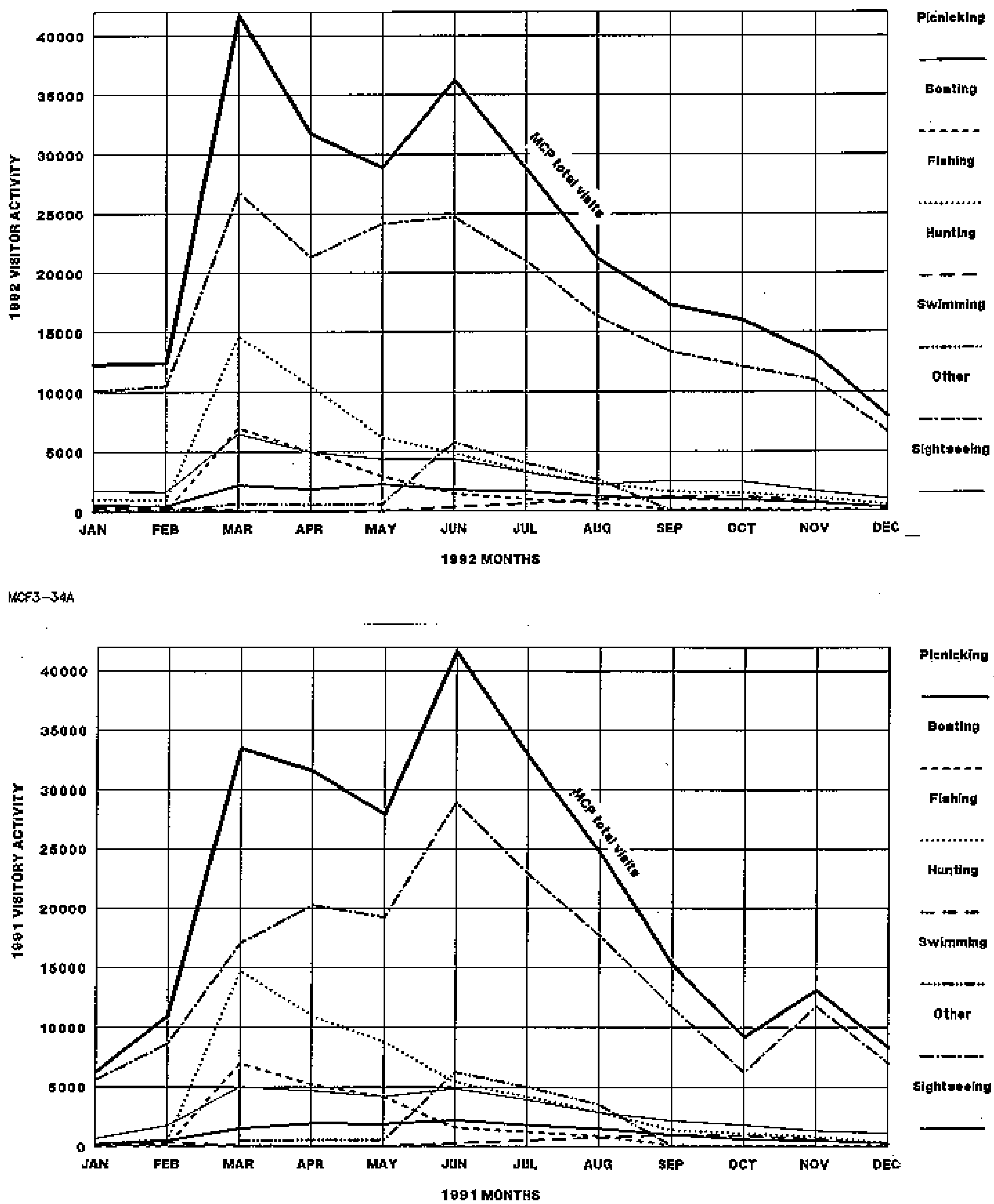


Figure 3-37. MCP Visitor Activities

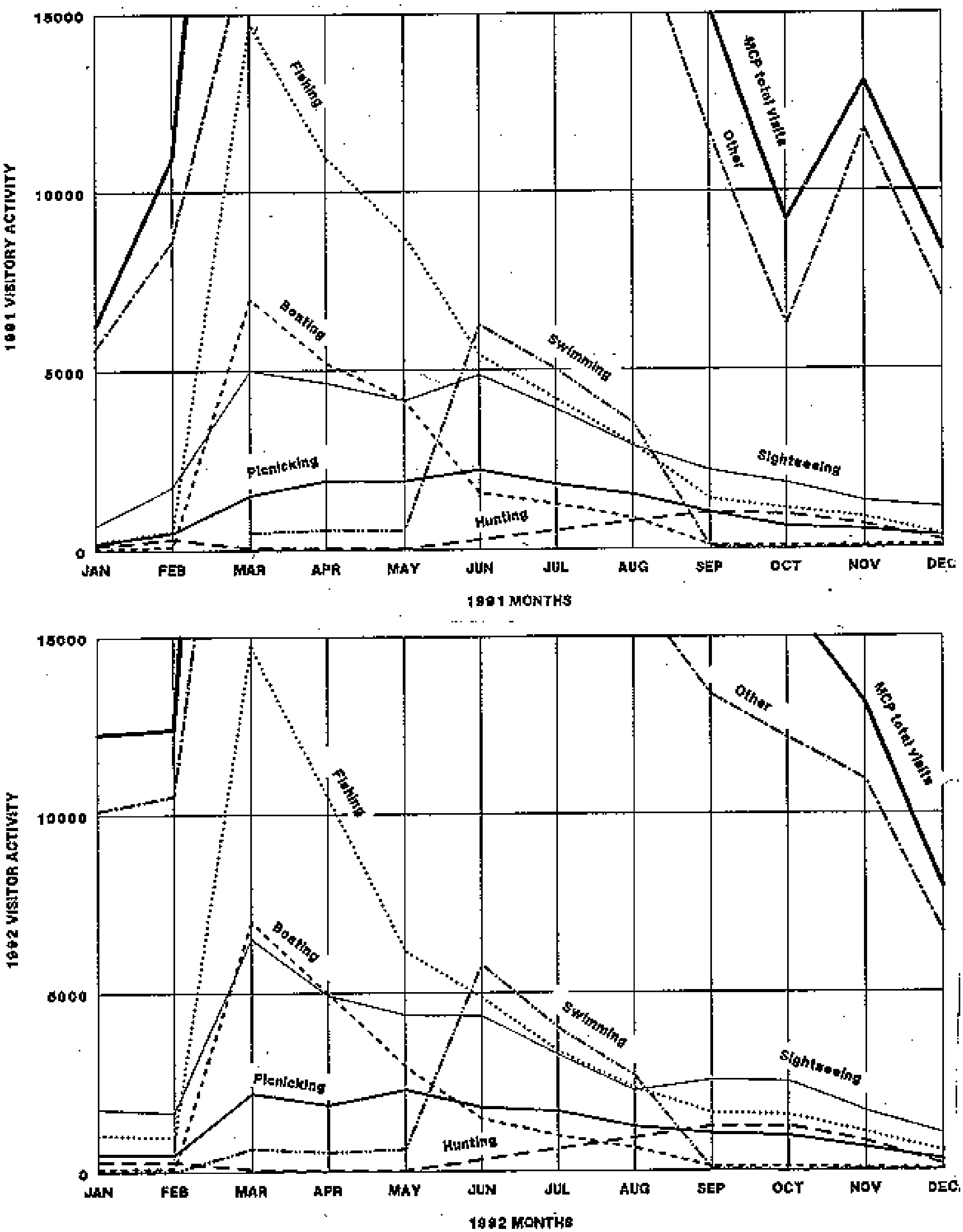


Figure 3-38. MCP Visitor Activities

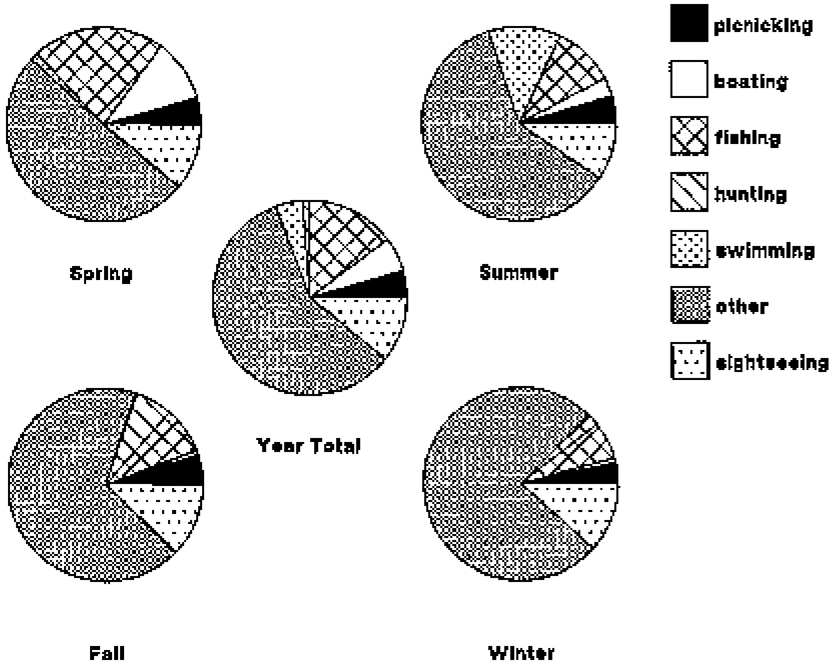


Figure 3-39. Visitor Activities by Season

Table 3-40
1992 Visitation By Activity

	Picnicking	Boating	Fishing	Hunting	Swimming	Other	Sightseeing
Spring	6,358	14,924	31,390	147	1,826	72,378	15,825
Summer	4,711	3,142	10,525	0	12,482	62,019	9,857
Fall	2,712	350	4,273	3,324	146	36,519	6,709
Winter	1.296	247	2,564	742	56	27,344	4,429
Totals	15,077	18,663	48,752	4,213	14,510	198,260	36,820
Yearly total of visitation, by activity = 336,205 Yearly total of visits = 256,199 (76 percent of visitation by activity)							

(b) Areas.

1. Rooks Park.

Rooks Park visitor activity "other" peaked in May in 1992, and in June in 1991. The second highest visitor activity is picnicking, and it peaked in May through September (see figure 3-40).

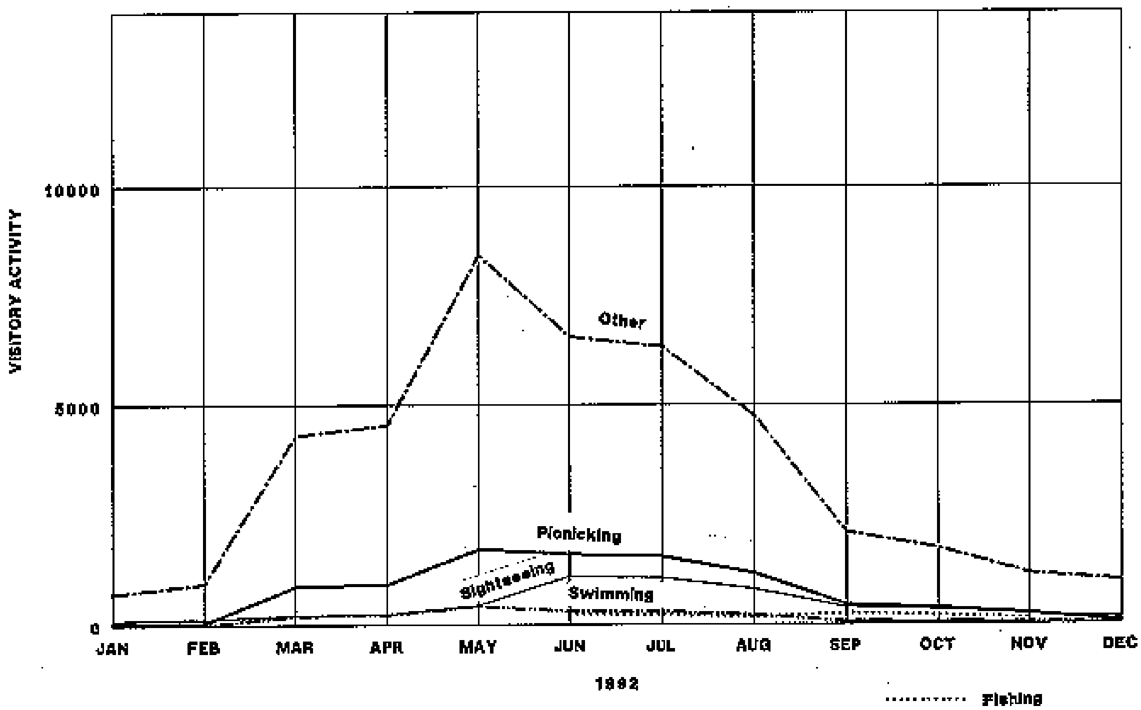


Figure 3-40. Rooks Park 1992 Visitation by Activity

2. Lake Area.

The lake area is the only area that has all seven different activities (see figure 3-41). In 1992, the highest visitor activity at the lake area is fishing, which peaks in March through May. The "other" activity peaks in March through September. During the summer, swimming is the second highest activity, peaking in June and July. Boating is high during March through June. Sightseeing and picnicking are relatively stable throughout the year.

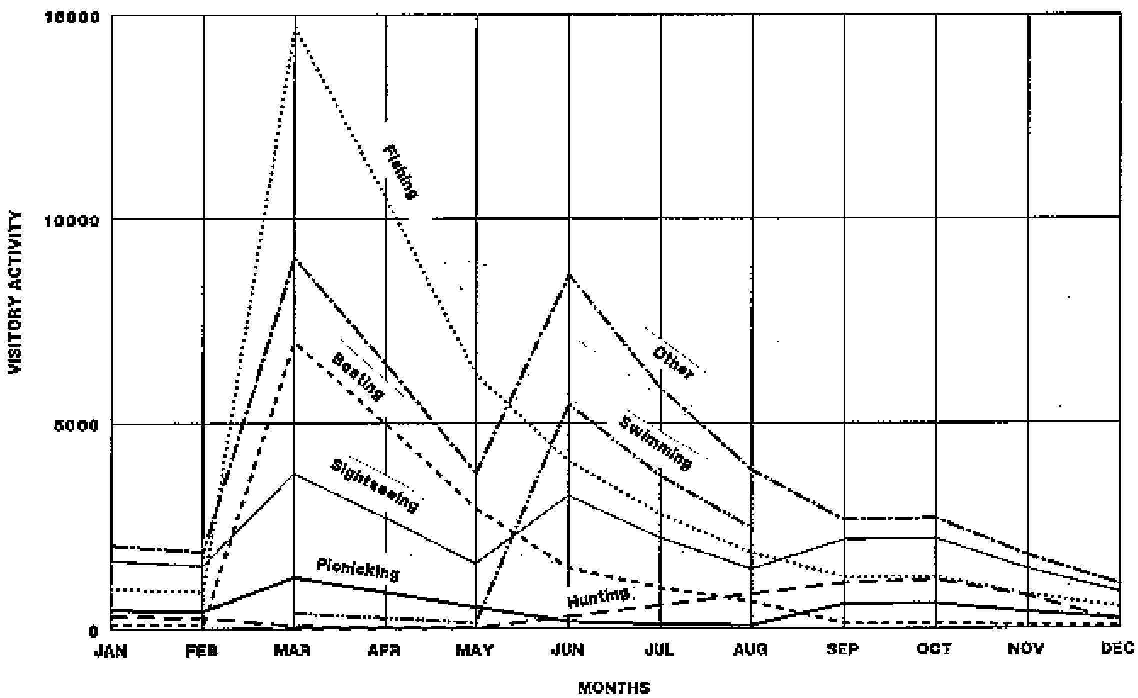


Figure 3-41. MCP 1992 Lake Area Visitation Activities

3. Levee Trails.

The Levee Trails have only four activities: other, sightseeing, fishing, and picnicking (see figure 3-42). In 1992, the "other" category peaked in March through June. Sightseeing, fishing, and picnicking were extremely low in comparison to this category.

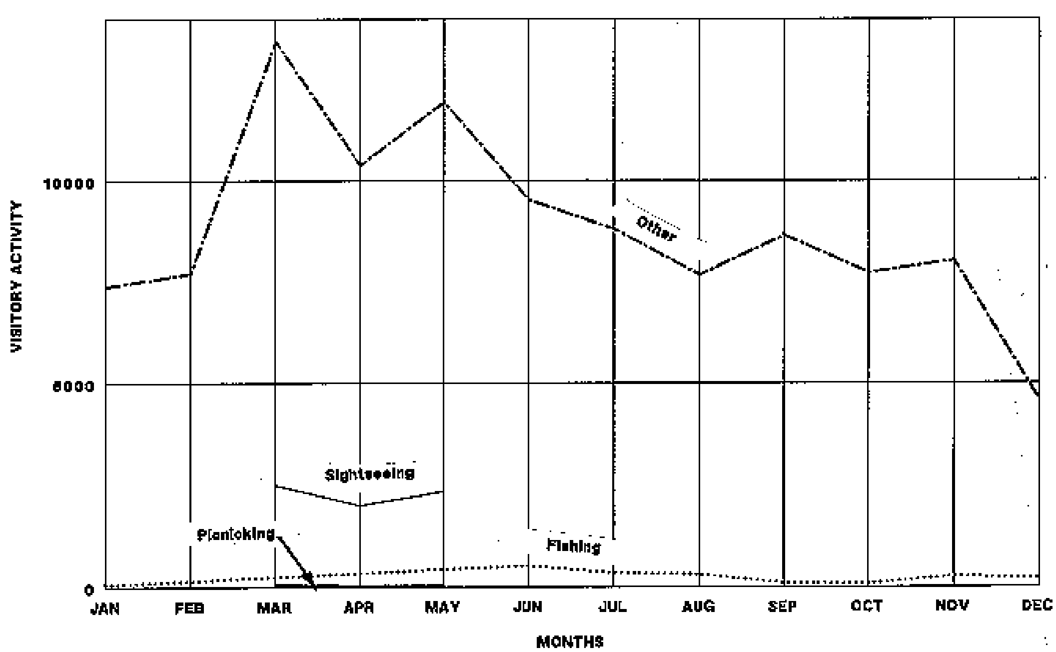


Figure 3-42. Levee Trails 1992 Lake Recreation Visitation by Activity

(6) Factors Influencing Visitation.

(a) Accounting Methods.

Accounting methods have changed over the years. There are no visitation records before 1965. Accounting methods changed in 1986 and 1988. These changes have caused abrupt changes in visitation. The survey that took place in 1992 will probably have another change in visitation.

(b) Visitor Origin.

1. Survey, 1984 to 1985.

Almost all of the visitors to MCP come from the city of Walla Walla and its environs (the cities of Walla Walla and College Place and the surrounding urban area). In 1984 and 1985, a visitor origin survey was conducted, by zip code, at MCP. The Walla Walla zip code, 99326, extends south to the Oregon State line and west of College Place (USACE, 1985). The survey found that 94 percent of the visitors came from a radius of 25 miles (30-minutes travel time) (see figure 3-43). Within the 25-mile radius, 96 percent were from the Walla Walla and College Place zip code areas. This accounts for approximately 91 percent of the total visitors to the project (approximately 50,0000 people). The demographic factors of this population will affect visitation at MCP. The following is a list of factors that are relevant to visitor origin:

- There are no other water bodies within a 28-mile radius of the Walla Walla area (Columbia River). The nearest public lake of similar size is 45 miles away (Jubilee Lake).

- The Walla Walla Valley provides a concentrated population (50,000) within a short distance (30 minutes) of MCP.

- The MCP is connected to the city of Walla Walla by the eastern part of the Mill Creek Recreation Trail.

- Other population centers outside the primary MA of MCP (refer to paragraph 2.03.a., *The MCP MA*).

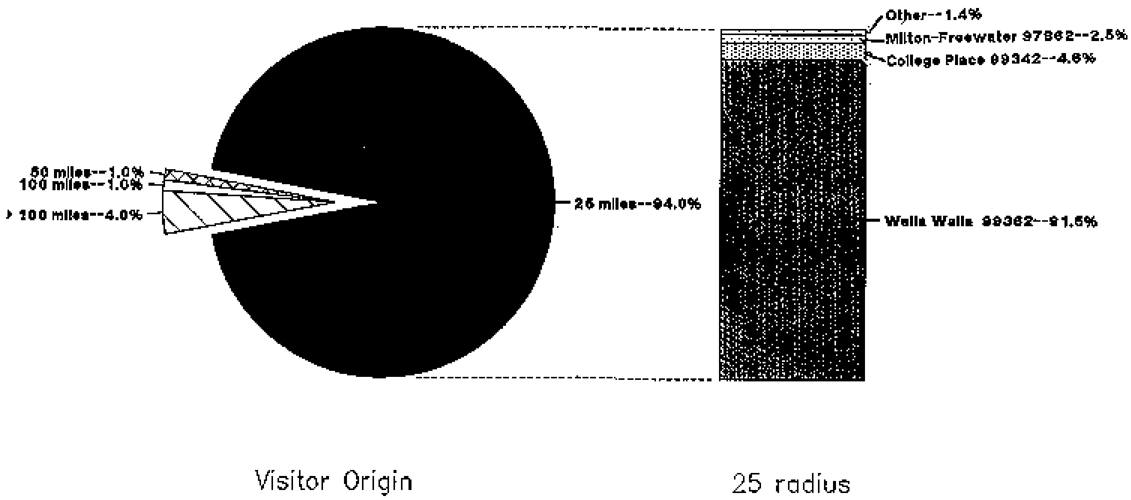


Figure 3-43. Mill Creek Project Visitor Origin

(c) Climatic Influence.

The climate of the basin results in heavy spring water flows, but extremely low summer flows. The high summer temperatures and low precipitation encourage visitation to a water-resource project. However, the low precipitation creates low stream flows in Mill Creek. Because of irrigation needs, the lake elevation can not always be kept at elevation 1205. This results in lower visitation and recreation capacity because of the smaller lake size. As seen in figure 3-44, visitation is higher in the spring when temperatures are rising, and peaks about the same time of year. Visitation numbers correlate to temperature much more closely in the fall and winter. Visitation at Rooks Park and the Levee Trails has a close correlation to temperature.

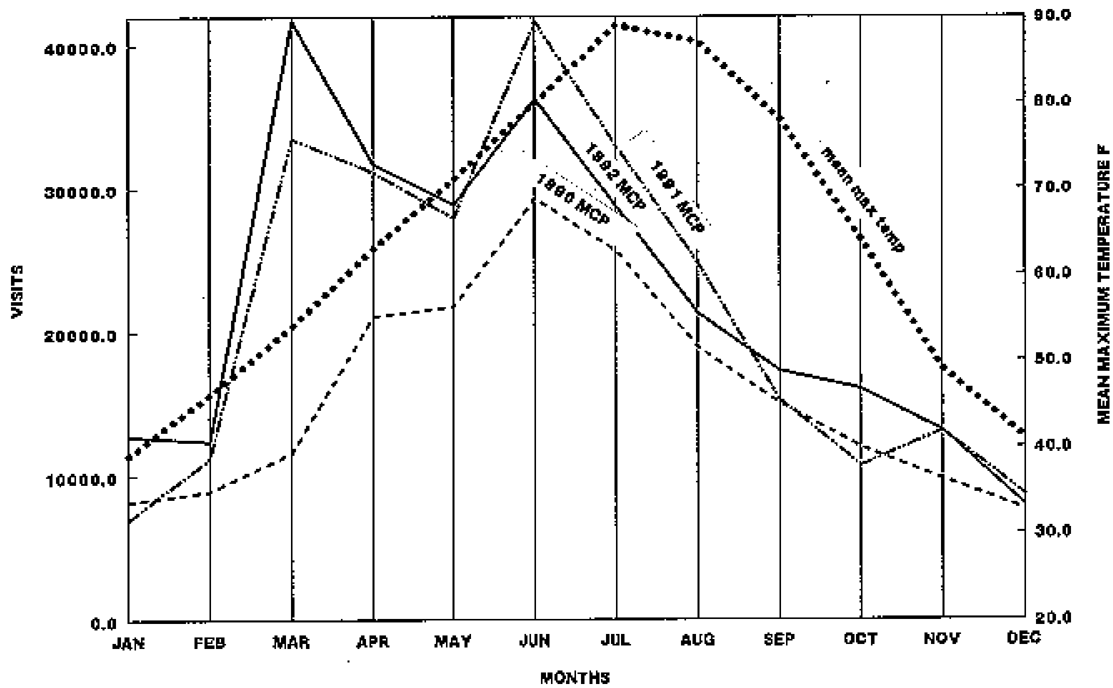


Figure 3-44. Mill Creek Project Visits And 30 Average Max Temperature

(d) Lake Elevation Influence.

The elevation of the lake is dependent on flood control responsibilities, seepage, and dam safety. When the lake is low or dry, the recreation visitation is lower. Figure 3-45 shows the visitation for 1990 (when the lake was dry), and 1992 (when the lake reached conservation elevation). As can be seen, visitation at the lake area peaked in March through June. Visitation was lower in 1990 (from March through October) than it was in 1992, when the lake was brought to conservation elevation in the spring. There is also a strong correlation between lake elevation and visitor hours. Figure 3-46 shows the difference in visitation in the various areas, from 1989 to 1992, resulting from varying lake elevations.

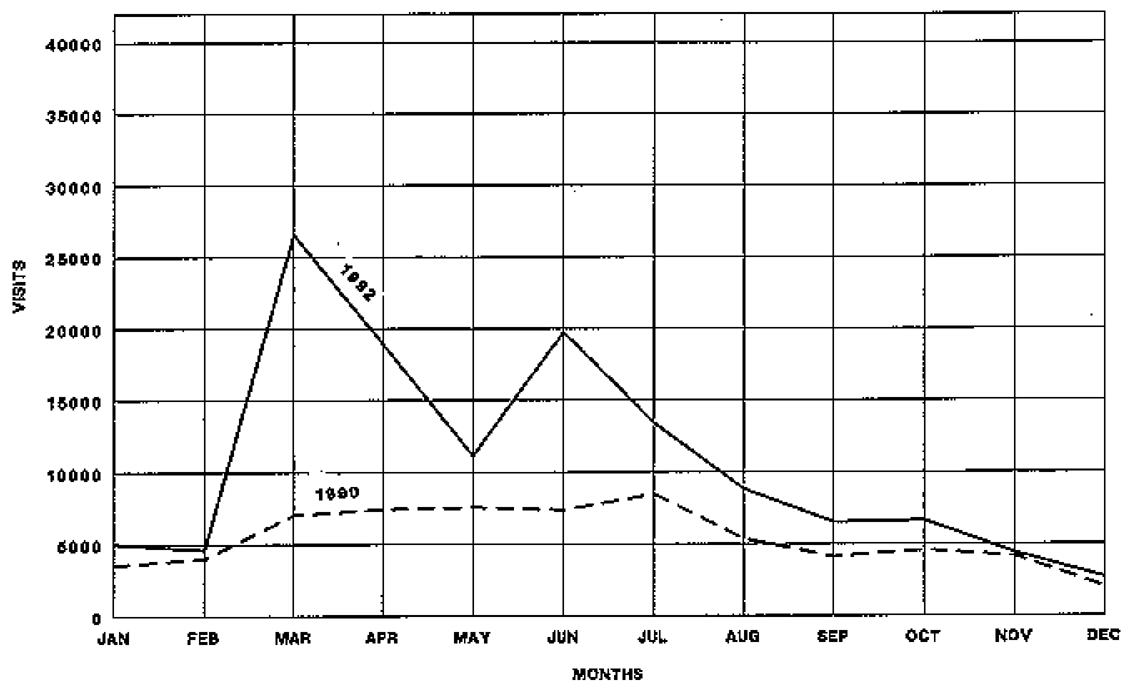


Figure 3-45. Lake Level Influence, 1990 and 1992 Visits at Lake Area

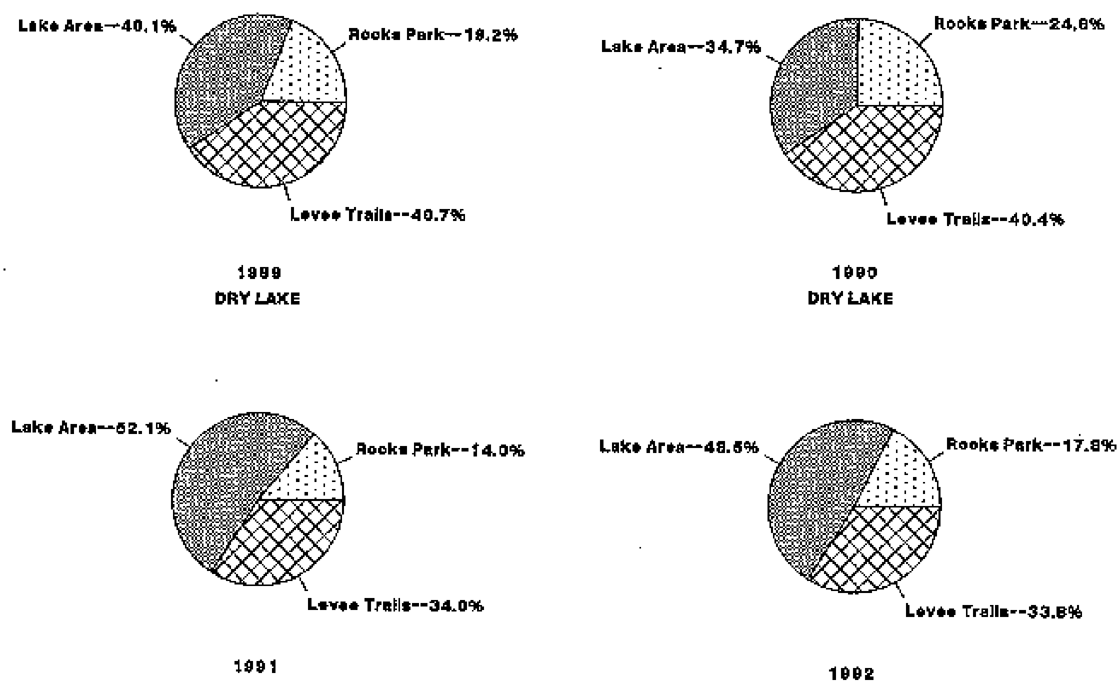


Figure 3-46. Lake Level Influence, Annual Visits by Area, 1989 to 1992

(e) Construction/Testing Influence.

Attendance was heavily influenced by construction at the reservoir area. In 6 of the last 12 years, there have been construction and testing activities at the lake (see table 3-38) that caused the lake area to be closed to recreation activities. Activities like this have caused MCP visitation figures to fluctuate during the last 12 years. There also appears to be a shadow effect on visitation following construction, as it takes a few years for attendance to reach pre-construction levels. From 1982 to 1984, recreation activities were not allowed on the lake. In 1981 through 1983, a 2-foot cut wall was constructed in Mill Creek Dam, and this forced the lake to remain at a lower elevation. In 1984, a test elevation was conducted and the lake was filled to elevation 1235.7. Visitation dropped from 90,082 in 1980 to 38,652 in 1981. After construction was completed, visitation rose to over 100,000 in 1984. In 1984 and 1985, there was construction activity in Mill Creek Channel, where the Levee Trails are located. Visitation dropped from 37,174 in 1984 to 26,688 in 2985, and on down to 25,818 in 1986. After construction, visitation rose to 43,883 in 1985.

(7) Projected Attendance.

(a) General.

Projected recreation demand for selected activities, as determined by the Washington Interagency Committee for Outdoor Recreation for Region 4, is depicted in section 2, paragraph 2.03.i., *Regional Outdoor Recreation*. These projections are based on current participation rates; population projects in growth, age, and income; estimates of changes in future participation rates; and recreation supply. As reflected in that section, the rate of growth for most recreation activities is at a rate higher than population growth.

(b) Rate of Visitation Growth.

Since 1953, when fishing was introduced on the lake, visitation has grown at a rate 10 times faster than population growth. The rate of population has increased approximately 4 percent, while visitation has increased 400 percent.

(c) Methodology.

1. Projection 1.

Forecasts of future visitation were made by assuming that visitation stabilized in 1991 and 1992, and that further recreation facilities would be added at the same rate as in the past. Increases in visitation will be a result of population increases and additional facilities. The projected visits for projection 1 are based on the 1991 and 1992 trend, when no major construction took place at the project and the lake elevation was brought up (in the spring) to conservation elevation. The conservative assumption was made that visitation will increase parallel to population growth. This is, however, contrary to State of Washington forecasts. Currently, the MA is growing at a higher rate than at any other recent time. The estimates were then calculated by multiplying the 1991 to 1992 figures by the same rate as the project MA population growth (2 percent) (see paragraph 2.03.c., *Population*).

2. Projection 2.

The forecast of future visitation for projection 2 was made by using the historical increase in visitation from 1965 to 1992, and extending the increase. This is based on the assumption that recreation facilities would be added at the same rate as in the past.

3. Projection 3.

This method used the information provided by the Washington Interagency Committee for Outdoor Recreation, as published in the report Washington Outdoor: Assessment and Policy Plan 1990-1995. Region 4 rates for each activity by area were used, and then totaled for the project. Using the total activities for the project figured out just about the same. These rates, provided for Region 4, were used to extend the 1992 visitation to 2005. The fact that the MCP MA is now projected to grow at a higher rate (29 percent) than used in this report (2 percent) is important to keep in mind. These projections would result in visitor experience changes if the same amount of facilities are not provided.

4. Projection 4.

This method attempted to compensate for the current high population increase in the MA. Region 2 rates for each activity by area were used, and then totaled for the project. Using the total activities for project figured out just about the same, much like those in projection 3. These rates, provided for Region 2, were used to extend the 1992 visitation to 2005. Region 2 was projected to grow by 19 percent, while the MCP MA is now projected to experience a 29-percent growth rate. This would place this estimate at a lower rate than if the MA population increase was used. Also, Region 2 exports their visitation to Regions 3 and 1, making this projection even more conservative (Frost, 1993). The visitor experience would change more than in projection 3.

(d) Forecast, 1992 to 2005.

1. The MCP.

Table 3-41 and figure 3-47 show the forecast for MCP, based on the above methods. The method using projection method 2 and 4 estimated the highest visitation. Method 3, using the Region 4 data (2 percent growth), was the lowest. Methods 1, 3, and 4 are very conservative. These forecasts can be monitored by plugging in the population rates as they change. Using the historical visitation trends increases visitation to a slightly higher rate, but the past population rate changed much more slowly than it is currently changing. Influencing factors will have an impact on visitation, as previously mentioned in (6), *Factors Influencing Visitation*.

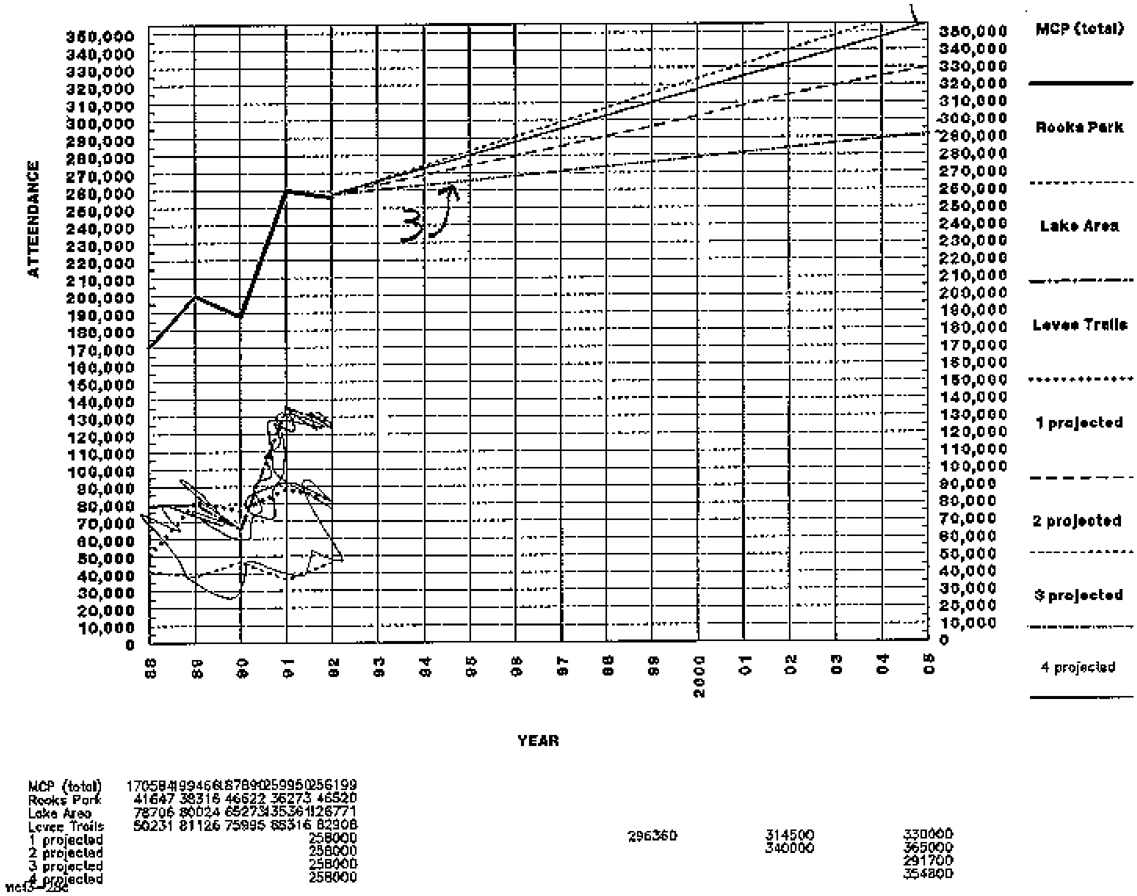


Figure 3-47. Mill Creek Project
Projected Annual Attendance (Visits), 1993 to 2005

Table 3-41
MCP Forecast Attendance

		Proj 1	Proj 2	Proj 3	Proj 4
Year	Actual	w/pop	hist rec%	Reg 4 2% pop	Reg 2 19% pop
1991	259,950	.	.	.	.
1992	256,199	258,000	.	.	.
1993		263,200	266,000	260,000	265,000
1994		268,400	.	.	.
1995		273,800	.	.	.
1999		295,000	315,000	.	.
2000		302,300	322,000	279,000	318,000
2002		314,500	340,000	284,000	354,000
2005		330,000	365,000	292,000	360,300

2. Areas.

Using projection method 4, the greatest increase will occur at Rooks Park (45-percent increase). This is, in part, due to the high numbers of picnickers and the 46-percent increase in picnicking. The lake area and the levee trails will have a 38-percent increase in visitation (see figure 3-48).

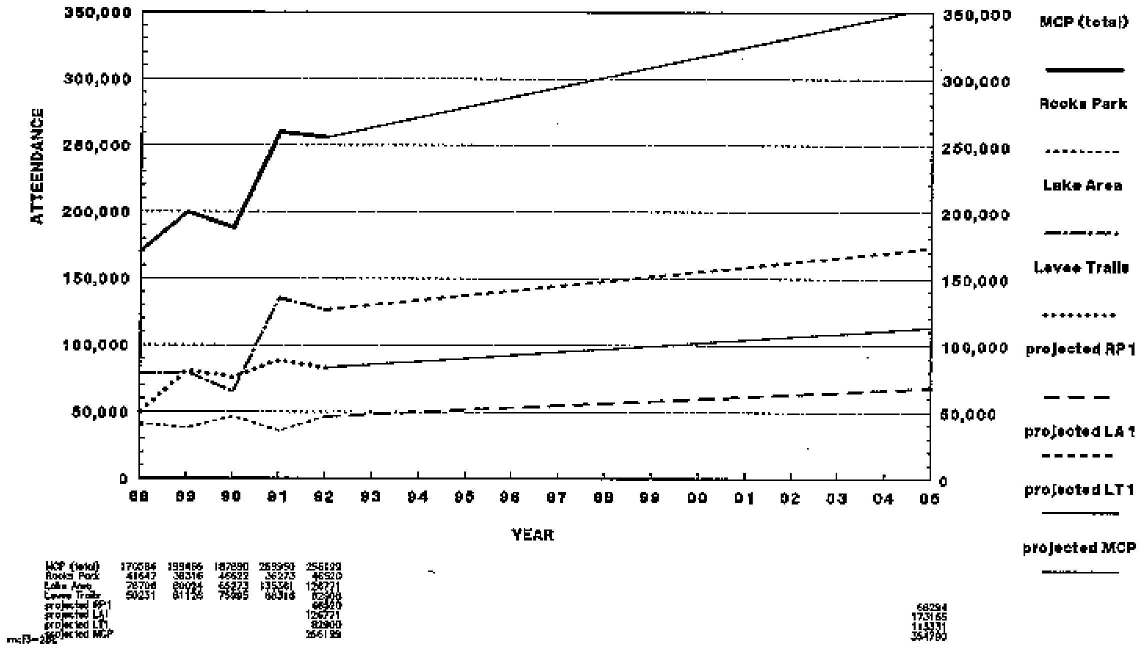


Figure 3-48. Mill Creek Project Method 4, Projected Annual Attendance (Visits), 1993 to 2005

(e) Analysis of Visitation.

1. Method.

The current method will be improved with the upcoming VERS survey. There is, however, more information needed for forecasting. The areas that need more, or updated, information are: visitor origin, breaking up the "other" category, working with correlation to influencing factors, and improving seasonal activities. Refer to volume 1, section 8, of this report for further discussion and recommendations.

2. Forecast.

Using projection 4 data, an increase in facilities must be in direct correlation with the demand, or there will be a change in visitor experience (see section 2, table 3-42, and figure 2-23). There must be a 38-percent change in the type of facilities at the lake area and the levee trails, and a 48-percent increase in the type of activities available at Rooks Park, to keep the visitor experience the same. At some point, the resource will be impacted if this demand is not managed properly, and new facilities are not provided.

Table 3-42 **MCP Attendance Projection** **By Area and Activity**					
Rooks Park					
		Projection 3		Projection 4	
	1992	Percent Growth	2005	Percent Growth	2005
Picnicking	11,428	15	13,142	46	16,685
Fishing	1,269	10	1,306	26	1,599
Hunting	161	4	167	12	180
Swimming	1,905	10	2,096	33	2,534
Other	43,338	20	52,005	51	65,440
Sightseeing	5,156	16	5,981	38	7,115
	63,257		74,787		93,553
73% Total Visits	46,520	17	54,594	46	68,294
Levee Trails					
Picnicking	148	15	149	46	216
Fishing	1,911	10	2,102	26	2,408
Swimming	148	10	149	33	197
Other	105,895	15	121,779	37	145,076
Sightseeing	6,859	16	7,956	38	9,465
	114,961		132,135		157,362
72% Total Visits	82,900	14	95,137	36	113,331
Lake Area					
Picnicking	5,810	15	6,682	46	8,483
Boating	18,665	15	21,465	36	25,384
Fishing	45,846	9	50,005	26	57,765
Hunting	3,992	4	4,152	12	4,471
Swimming	12,454	10	13,699	33	16,563
Other	49,741	15	57,202	51	75,109
Sightseeing	24,805	16	28,773	38	34,231
	161,313		181,978		222,006
78% Total Visits	126,771	11	141,943	36	173,165
		Total Visits	291,674	Visits	354,790

(8) Problems and Recommendations--Visitation.

Refer to volume 1, section 8, *Recommendations, Summary and Conclusions*, for a discussion of the problems and recommendations of visitation.

l. Social Capacity of Recreation Carrying Capacity.

(1) General.

In paragraph 3.03.k., *Visitation*, most of the future demands were determined. To make proposals for new development for desired activities and to understand current conditions of the visitor experience while still protecting the environmental resources, recreation carrying capacity must be addressed.

Recreation carrying capacity is defined as the maximum level of use that a recreation resource can sustain without exceeding either the resource capacity or the social capacity of that resource. This section deals with the social aspect of the recreation capacity, as applied to MCP.

Social capacity is defined as the level of use of a recreation resource beyond which the user's expectation of the resource is not realized. If usage goes above this level, the recreational user does not achieve a reasonable level of satisfaction.

Resource capacity is defined as the level of a recreation resource beyond which irreversible biological deterioration takes place, or degradation of the physical environment makes the resource no longer suitable or attractive for that recreation use. Section 4 addresses vulnerability, which is the negative or positive impacts on resources throughout the project.

(2) Methodology.

The method used in this section is based on Recreation Carrying Capacity Handbook, Methods and Techniques for Planning, Design, and Management, developed for the Corps by Urban Research and Development Corporation. To understand the methodology used in establishing carrying capacity, the reader should refer to section Supporting Data, item 10, in this back of this report or to the study itself.

The MCP provides a variety of water-related, and land-based, recreation opportunities. The demand for recreation activities in the future will increase as described in section 2.03.h., *Regional Outdoor Recreation*, and section 3.03.k., *Visitation*. Future recreation activities and increased usage without facility expansion will change the current user experience, and could negatively impact the resources. The advent of new forms of recreation or extensive facility development is severely restricted by the limited amount of project land and water.

The concept of carrying capacity, as applied to recreation, implies that an optimum limit exists for the amount of recreation activity that may occur before detrimental effects inhibit a quality experience for participants and deplete environmental resources. In this sense, capacity is used as the ultimate determination for the extent of recreational development. The application of this concept is a fairly new approach to recreation planning. In the past, recreation planning has typically emphasized the development and management of facilities to satisfy the anticipated demand. Planning, based on demand, could be applicable in areas of extensive size and unlimited resources. At MCP, however, resource limitations justify the establishment of reasonable capacities.

(3) Social Capacity at MCP.

Tables 3-43 through 3-52 establish baseline information regarding the social carrying capacity for every activity considered at each area of MCP. The monitoring of use patterns at the project will continue. This will enable management to refine social capacity base figures. Short-term and long-term changes in environmental, site, and user characteristics may warrant an adjustment of the resource capacity for individual areas. Analysis of social capacity figures, as applied to MCP, are discussed below.

Table 3-43
Social Capacity Calculations
Boating (Non-Motorized) at Virgil B. Bennington Lake

Social Capacity Factors	Condition	Variance
Site Characteristics		
Type of area/boat	nonmotorized	+156
Shoreline configuration	regular	+10
Number of launching areas	one	+10
Compatibility of nearby activities	incompatible	+10
Size of boating area	small	-10
Proximity to other activity area	distant	+25
Water quality	poor	+15
Location of project area	near urban	-15
Distance from highway access	less than 10 min	-5
Level of development	low	+30
Amount/location of facilities	unpleasant	+5
Maintenance of facilities	medium	-10
Number, type, and degree of manmade intrusions or disturbances	few	-10
User Characteristics		
Number of other activities	fewer than 3	+36
Experience	some	-10
Travel time	less than 30 min	-40
Age	all ages	0
Group size	>2	+5
Similarity of visitor groups	varies	+2
	Total Variance	+204

	Preference Groups		
Mill Creek Modified	A (29%)	B (37%)	C (34%)
Group Ranges (feet)	304-404	404-664	664-1704
Midpoint (feet)	354	534	1184
Density (boats/acre)	.35	.16	.03
No. Boats at EL 1185	7	3	.6
No. Boats at EL 1205	18	8	1.6

Table 3-44 Social Capacity Calculations Boat Launching at Virgil B. Bennington Lake		
Social Capacity Factors	Condition	Variance*
<u>Site Characteristics</u>		
Proximity to other activity area	distant	+
Ease of launching	fair	+
Level of development	low	+
Distance from highway access	less than 10 min	-
Distance between launching area	distant	+
Amount/location of facilities	unpleasant	+
<u>User Characteristics</u>		
Experience	some	-
Travel Time	less than 30 min	-
Origin of user (Urban-Rural)	urban	+
Similarity of visitor groups	varies	+
	Total Variance	0

	Preference Groups		
Mill Creek Modified	A (65%)	B (27%)	C (8%)
Group Ranges (minutes)	3-7	7-15	15-30
Midpoint (minutes)	5	11	22.5
Density (launches/hour)	12**	5.45	2.67

*Because of the uniformity of launch time response (*e.g.*, 65 percent of responses between 3 and 7 minutes), variance values have not been developed for boat launching.
**Peak for current use.

Table 3-45
Social Capacity Calculations
Boat Fishing at Virgil B. Bennington Lake

Social Capacity Factors	Condition	Variance
Site Characteristics		
Amount/location of facility	unpleasant	+450
Degree of control	high	-165
Catching fish	pleasant	-65
Compatibility of nearby activities	incompatible	+30
Proximity to other activity area	distant	+25
Size of fishing area	small	-50
Multiple uses in area	few uses	0
Configuration of area	regular	+25
Location of lake	semi-urban	-25
Maintenance of facilities	medium	-10
Number, type, and degree of manmade intrusions or disturbances	few	-10
Distance from highway access	less than 10 min	-5
User Characteristics		
Number of other activities	2 to 3	-10
Experience	some	+100
Travel time	less than 1 hour	+35
Age	all ages	0
Group size	>2	-85
Similarity of visitor groups	varies	+2
Equipment	non-motorized	-100
Type of fishing	non-power boat	+50
	Total Variance	+190

	Preference Groups		
Mill Creek Modified	A (49%)	B (27%)	C (24%)
Group Ranges (feet)	240-390	390-790	790-1690
Midpoint (feet)	315	590	1240
Density (boats/acre)	.44	.13	.03
No. Boats at EL 1185	8.7	2.6	0.6
No. Boats at EL 1205	22.8*	6.7	1.6

*Peak for current use.

Table 3-46 Social Capacity Calculations Shoreline Fishing at Virgil B. Bennington Lake		
Social Capacity Factors	Condition	Variance
Site Characteristics		
Degree of control	low	-5
Fishing access	medium-high	-5
Amount/location of facilities	unpleasant	+2
Size of fishing area	medium	0
Multiple use area	few other uses	+5
Proximity to other activity area	moderate	+5
Type of shoreline (privacy)	regular, flat	+10
Compatibility of nearby activities	incompatible	+15
Slope of shoreline	level to moderate	0
Distance from highway access	less than 10 min	-10
Location of area	semi-urban	-10
Quality/variety of natural amenities	moderate	0
Configuration of area (privacy)	low privacy	+10
Number, type, and degree, if manmade	few	-5
Degree of designation	low	+5
User Characteristics		
Age	all ages	0
Experience	some	-5
Travel time	less than 1 hour	0
Group size	>2	-3
Type of fishing (area required)	little area	-5
Similarity of visitor groups	varies	0
Number of other activities	less than 2	+10
	Total Variance	+14

	Preference Groups			
Mill Creek Modified	A (20%)	B (37%)	C (34%)	D (18%)
Group ranges (feet)	24-34	34-54	54-74	74-114
Midpoint (feet)	29	44	64	94
Density (fisherman/100 feet)	3.4	2.2	1.6	1.1
50 Percent of Useable Shore EL 1185	89	57.5	41.85	28.75
50 Percent of Useable Shore EL 1205	179.5*	116	84.45	58.10
*Peak for current use.				

Table 3-47 Social Capacity Calculations Camping Near Rooks Park		
Social Capacity Factors	Condition	Variance
Site Characteristics		
Accessibility to water body	unobstructed	+6
Visibility of water body	unobstructed	+6
Slope	moderate	+7
Level of development	moderate/limited	+5
Distance from highway access	1 mile	–2
Maintenance of facilities	pleasant	0
Degree of control	limited	+3
Vegetation	moderate	+1
Condition of landscape (trees, *etc.*)	pleasant	0
Amount/ location of facilities	unpleasant	+2
Proximity of other activity area	adjacent	–2
Degree of campsite delineation	medium	0
Configuration of area	low privacy	+8
Remoteness/degree of solitude	low	+5
Size of camping area	small	–5
User Characteristics		
Travel time	less than 30 min	+12
Number of other activities	1 to 3	-4
Equipment	tent	+5
Similarity of visitor groups	varies	+2
Origin of user/location of area	urban	-2
Campsite selection opportunity	low	+1
	Total Variance	+47

	Preference Groups			
Mill Creek Modified	A (20%)	B (28%)	C (31%)	D (21%)
Group ranges (feet)	67-87	87-107	107-127	127-168
Midpoint (feet)	77	97	117	147
Density (campsites/acre)	7.35	4.63	3.18	2.02
(4.3 acres) No campsites	31.6	19.9	13.7	8.7

Table 3-48 Social Capacity Calculations Boat Fishing at Virgil B. Bennington Lake		
Social Capacity Factors	Condition	Variance
Site Characteristics	.	.
Accessibility to water body	unobstructed	+6
Visibility of water body	unobstructed	+6
Slope	moderate	+7
Level of development	moderate/limited	+5
Distance from highway access	2 miles	-1
Maintenance of facilities	pleasant	0
Degree of control	limited	+4
Vegetation	moderate	+1
Condition of landscape (trees, *etc.*)	unpleasant	+5
Amount/ location of facilities	unpleasant	+2
Proximity of other activity area	adjacent	-2
Degree of campsite delineation	medium	0
Configuration of area	low privacy	+7
Remoteness/degree of solitude	low	+1
Size of camping area	small	0
User Characteristics	.	.
Travel time	less than 30 min	+12
Number of other activities	1 to 3	-4
Equipment	tent	+5
Similarity of visitor groups	varies	+2
Origin of user/location of area	urban	-2
Campsite selection opportunity	low	0
	Total Variance	+52

	Preference Groups			
Mill Creek Modified	A (20%)	B (28%)	C (31%)	D (21%)
Group ranges (feet)	72-92	92-112	112-132	132-172
Midpoint (feet)	82	102	122	152
Density (campsites/acre)	6.48	4.19	2.93	1.89

Table 3-49
Social Capacity Calculations
Swimming at Virgil B. Bennington Lake

Social Capacity Factors	Condition	Variance
Site Characteristics	.	.
Degree of control	low	0
Size of swimming area	medium	0
Amount/location of facilities	few, removed	+1
Level of development	low	+1
Proximity to other activity area	near	-1
Water quality	poor	+5
Site design	reasonable	+2
Location	semi-urban	+1
User Characteristics	.	.
Age	less than 25	+2
Number of other activities	1 or 2	0
Group size	>3	-1
Similarity of visitor groups	similar	-1
Waders/swimmers	both	0
Experience	limited	-1
Travel time	less than 30 min	-2
	Total Variance	+6

	Preference Groups			
Mill Creek Modified	A (25%)	B (41%)	C (19%)	D (15%)
Group ranges (feet)	11-21	21-31	31-41	41-56
Midpoint (feet)	16	26	36	43
Density (swimmers/acre)	170.2*	64.4	33.6	23.6
*Current use at proposed beach.				

Table 3-50
Social Capacity Calculations
Trail Activities at Virgil B. Bennington Lake and Levee Trails

Social Capacity Factors	Condition	Variance
Site Characteristics	.	.
Scenic views	fair	0
Type of trail experience	developed	-5
Configuration of trail	open	+30
Vegetation	light	+30
Length of trail	short	+10
Proximity to water	near	-10
Proximity to other activities	near	-5
Origin of user	urban	-5
Multiple use recreation	yes	0
Level of development	developed	-15
Amount/location of facilities	some	-2
User Characteristics	.	.
Similarity of visitor groups	dissimilar	+20
Travel time	less than 30 min	-10
Experience	some	0
	Total Variance	+38

	Preference Groups	
Mill Creek Modified	A (50%)	B (50%)
Group ranges (feet)	248-338	1238-5038
Midpoint (feet)	238	3138
Density (persons/mile)	22.18*	1.68
*Peak current use at Levee Trails.		

Table 3-51
Social Capacity Calculations
Picnicking at Virgil B. Bennington Lake

Social Capacity Factors	Condition	Variance
Site Characteristics	.	.
Vegetation	moderate	-3
Amount/location of facilities	unpleasant	+5
Relationship to other activity areas	adjacent	-1
Accessibility to water body	unobstructed	+2
Degree of control	limited	+1
Visibility of water body	unobstructed	+2
Maintenance of facilities	medium	-
Level of development	low	+3
Size of picnic area	small	+2
Configuration of picnic area	semi- private	+2
Visual screening between groups	moderate	0
Slope of the land	moderate	+2
User Characteristics	.	.
Number of other activities	greater than 1	-1
Group size	3 to 8	0
Age	all ages	0
Experience	all levels	0
Travel time	less than 30 min	+2
Similarity of visitor groups	varies	+2
Origin of user/location of area	urban	+1
	Total Variance	+17

	Preference Groups			
Mill Creek Modified	A (23%)	B (42%)	C (20%)	D (15%)
Group ranges (feet)	37-57	57-77	77-97	97-117
Midpoint (feet)	47	67	87	107
Density (picnic sites/acre)	19.7	9.7	5.76	3.80

Table 3-52 Social Capacity Calculations Picnicking at Rooks Park		
Social Capacity Factors	Condition	Variance
Site Characteristics	.	.
Vegetation	moderate	-5
Amount/location of facilities	pleasant	+1
Relationship to other activity areas	adjacent	-1
Accessibility to water body	unobstructed	-3
Degree of control	limited	+1
Visibility of water body	unobstructed	0
Maintenance of facilities	medium	+1
Level of development	low	-2
Size of picnic area	small	+2
Configuration of picnic area	semi- private	0
Visual screening between groups	moderate	0
Slope of the land	moderate	-2
User Characteristics	.	.
Number of other activities	greater than 1	-1
Group size	3 to 8	0
Age	all ages	0
Experience	all levels	0
Travel time	less than 30 min	+2
Similarity of visitor groups	varies	+2
Origin of user/location of area	urban	+1
	Total Variance	-4

		Preference Groups		
Mill Creek Modified	A (23%)	B (42%)	C (20%)	D (15%)
Group ranges (feet)	16-36	36-56	56-76	76-96
Midpoint (feet)	26	46	66	86
Density (picnic sites/acre)	64.4	20.6	10.0	5.89
Sites on 5 acres	322	103	50	29
Sites on 10 acres	644	206	100	58

To determine where the social capacity currently lies for each activity, the 1992 visitation figures were used. They are slightly lower than 1991. These 2 years are used, since both had a conservation pool and good weather. No major construction, or other influencing factor, occurred during these 2 years. The number of visitors used is based on the highest visitation month for 1992. The visitors are then divided by the number of days in the month, and this equals the average visitor activity per day. It is known that the number of visitors over a weekend is higher, but the percentage difference is not known at this time. This fact, however, must be kept in mind.

(a) Boating (Virgil B. Bennington Lake).

Virgil B. Bennington Lake provides approximately 52 acres of water surface at elevation 1205. Boating use varies throughout the year, and ranges from zero during the winter months to a high in the spring (when the lake is at elevation 1205 and has been stocked by WDW). The highest monthly visitation occurs between the months of March and May. Using the number of visitors boating in the peak month of March in 1992 (6,997) and dividing by the number of days in March (31), there were an average of 255 boaters each day. Estimating the boating visit at 2.23 hours in a 12-hour day [(255.12) x 2.23], there are approximately 42 boaters on the lake at one time, with an average of 2 to 2.5 people per boat. This averages out to 17 (42/2.5) or 21 (42/2) boats per hour. Using the maximum social carrying capacity of .35 boats/acre (18 boats on the lake at any one time), the number of boaters per day approaches the upper limits of the social capacity. During high-use periods, when the 18 boat figure is likely exceeded, social capacity is impacted. These impacts include visitor conflicts, increased noise levels, and degraded aesthetics. These factors keep additional boats away from boating during the high demand months.

Many variables affect the capacity of the lake. Lower pool elevations reduce the surface area and the capacity of the lake. High flows in the creek, resulting in water diversion into the lake, may have negative effects on water quality. Other uses, weather, and the availability of facilities increase or decrease the capacity.

Boating, during peak months, has reached the upper limits of capacity. However, a larger lake and/or a longer lake elevation of 1205 would increase the capacity of the lake to provide boating recreation. Boating is a direct result of lake elevation. Improvements (*i.e.*, handling docks, shoreline access trails, and boat ramp improvements) in facilities may also entice boaters to use the lake for purposes other than fishing.

(b) Boat Launching at Virgil B. Bennington Lake.

According to figure 3-44, the current use of the boat ramp is in the upper range, but still below the capacity. With the capacity of the lake between 18 and 22 boats, the number of boat launchings needed (7) is below the capacity of the ramp.

(c) Fishing (Virgil B. Bennington Lake).

1. Shoreline Fishing.

There is approximately 2 miles of shoreline around Virgil B. Bennington Lake when it is at elevation 1205. Approximately 50 percent of the shoreline is unusable, or is not used, due to poor access, slope, or vegetation. Visitation information during 1992 provides a maximum monthly number of 14,717 anglers at the lake during March 1992. Dividing user numbers by month-days provides an average daily use of 491 anglers. Estimating a fishing visit at 2.23 hours in a 12-hour day, an area use number of 91.25 anglers is produced. This number is in the mid range of the capacity of anglers per 100 feet of shoreline (see table 3-46). However, on weekends this would be 1/3 to 1/2 more fishermen at the lake. This would place the capacity of shoreline fishing in the upper range, with 121 to 136 fisherman per 100 feet of shoreline.

2. Boat Fishing.

Boating at Virgil B. Bennington Lake is at capacity during peak periods. Restrictions are determined by the limited number of water surface acres. Boat fishing allows a few more craft (5) on the lake than general boating before the upper preference limit is reached. The short boat ramp surface (down to elevation 1200) is an additional complication encountered in low-water months. This feature directly impacts the capacity of the lake for boat fishing.

Improvement to the launch ramp, the addition of handling docks, shoreline access trails, and improved parking design will improve the facility for greater visitor enjoyment.

(d) Camping at MCP.

Currently, there are no camping facilities and only a limited number of camping activities at MCP. Although camping activities have been considered in the capacity study, it has been done only as a planning tool in the event that camping development is initiated in the future. In recent years, numerous requests for a group camping/activity facility at MCP have been received from local organizations and private citizens. The location established for camping in the first Mill Creek Master Plan, across the creek from Rooks Park, will receive further consideration in order to meet demands, and as resources allow.

The site south of Rooks Park, discussed in the 1961 Mill Creek Master Plan, contains approximately 4.3 usable acres for camping. As shown in table 3-47, the density for camping ranges from 8.7 to 31.6 sites per acre. This area would probably be most suitable for group activities (*e.g.*, organization youth groups). The amount of people allowed at any one time, and the amount of use, need to be determined to prevent the area from reaching the resource capacity. The other possible camping area would be a site located in the general vicinity of the lake. Table 3-48 displays the social capacity for a camping area near the lake.

(e) Swimming (Virgil B. Bennington Lake).

A formal swimming area does not exist at Virgil B. Bennington Lake. Although swimming is not encouraged, it does occur informally, primarily because of a lack of viable alternatives. Visitation figures for 1992 reflect 4,089 swimmers during June. Baseline information on carrying capacity has been established for planning purposes.

Swimming is not currently promoted due to the lack of support facilities (*i.e.*, a swimming beach that conforms to safety design criteria, changing rooms, sun shelters, and shoreline access trails). Additionally, water quality in the lake has been unsuitable for swimming at certain times (*e.g*., fecal coliform counts do not conform to health standards). (See section 3.02.e., *Limnology*, for more information concerning water quality.) Although poor water quality is a difficult problem to overcome, swimming use can be managed during times when the water is usable.

If the existing use for June 1992 was all concentrated along a beach development below the parking area, it would be near capacity. Again, there are variables involved, but visitation data shows that such a development would be well supported.

Some work must be accomplished to prevent user conflicts at the boat ramp. Day-use enjoyment of the shoreline needs to be directed away from the boat ramp, where swimming and wading traditionally occurs because of easier access. Access along other areas of the lake is limited by steep slopes or distance from the parking areas.

(f) Trails.

The MCP provides approximately 5 miles of developed (and primitive) hiking, cycling, and equestrian trails. Levee trails are used throughout the year, with numbers varying from nearly 8,000 users per month to nearly 18,000 users per month. Dividing this total high monthly visitation number by month-days provides an average daily use of 600. Estimating a trail visit at 1.25 hours (J. Buck, 1991) in a 12-hour visitation day, a figure of 62.50 persons per hour is reached. With only 2 miles in the Levee Trails, there is an average density of 31.25 people per mile, and this is just about at capacity (see table 3-50).

There is no data for trail use at the other visitation areas, but it is assumed to be less, in terms of visitors as well as density. Applying the variance density (1.68 to 22.18) for the 3 miles of trails on MCP that are not part of the Levee Trails, a range of 5 to 66 persons at any given time is produced.

Currently, one of the elements that limits the use of trails at MCP is inadequate parking. Parking may be developed at the Project Office or at Rooks Park. Other development along the trail system will increase user enjoyment, prevent conflicts between user groups, and encourage the use of recreation areas.

(g) Picnicking.

The Lake Recreation Area has no picnic facilities. The high monthly visitation from 1992 was 1,256 picnickers in March. Dividing visitation by month-days provides an average daily use of 41.87. Estimating a picnic visit at 1.74 hours during a 12-hour visitation day produces maximum usage of 6.1 visitors. To meet existing use, 1/3 to 1 acre of land would need to be developed.

This extremely low picnic-use number suggests an opportunity to improve facilities so that they will attract picnicking visitors to the lake. Improved parking, trail access to the shoreline, shade, and other aesthetic improvements (*e.g.*, additional vegetation) will make the area more attractive to picnickers.

Rooks Park provides 34 picnic sites. Using the high monthly visitation from 1992 was 1,721 picnickers in May 1992. Dividing visitation by month-days provides an average daily use of 55.82. Estimating a picnic visit at 1.82 hours in the spring during a 12-hour visitation day produces a maximum area usage of 8.47 visitors.

Picnicking at Rooks Park is at a low density. This is somewhat expected for a park at the edge of development. In other words, the average visitor would expect less picnickers at Rooks Park than at Pioneer Park (city of Walla Walla Community Park). According to the density figures, the number of picnickers is at the low end of the density preference scale.

(h) Other Recreation Activities.

Other recreational pursuits include any new activities that could be encouraged by providing facilities that are not now available. However, any additional facilities for new activities are restricted by landform and access constraints. For example, no suitable areas are available for the establishment of large playfields for organized activities (*e.g*., softball).

(4) Analysis of Social Capacity.

Social capacity is a guide for understanding the current and projected uses of certain activities. The projected growth in all of these recreation activities will continue to place pressure on the available resources. Table 3-53 summarizes the densities for each activity, as well as the location of current use.

Table 3-53 Social Capacity Summary MCP					
Activity	High A	B	C	Low D	Area/Densities
Boating (non-motor)	*.35	.16	.03	.	boats/acre
Boat launching	*12.00	5.45	2.67	.	launches/hour
Boat fishing	*.44	.13	.03	.	boats/acre
Shoreline fishing	*3.40	2.20	1.60	1.10	fisherman/100 feet
Camping, Rooks Park	7.35	4.63	3.18	2.02	campsites/acre
Camping, lake area	6.48	4.19	2.93	1.89	campsites/acre
Swimming	170.20	64.40	33.60	23.60	swimmers/acre
Trail use	*22.18	1.68	.	.	persons/mile
Picnicking, Rooks Park	82.30	23.60	11.00	*6.32	picnic sites/acre
Picnicking, lake area	19.70	9.70	5.76	*3.80	picnic sites/acre
*Current location of use.					

Boating and boat fishing are activities that have reached social capacity. The demand is probably much higher than people's tolerance, and the current density is unacceptable. Boat launching is adequate, except that the ramp needs to be extended to allow launches at lower lake elevations. Shoreline fishing is in the upper density level, especially when considering the poor access and the lack of developed facilities for shoreline fishing. Camping facilities are possible at a few locations, but the size needs to be addressed, and the social capacity must be considered. Swimming is similar to shoreline fishing, in that there is a great demand but there are no formal facilities. Trail activities are growing, and are most dense at the Levee Trails area. The lack of information on use at the other sites is a problem. Picnicking at the lake occurs in spite of the fact that there are no formal facilities. Rooks Park provides a low density picnic experience, but this facility could triple and still provide a low density experience.

3.04. Aesthetic Resources

a. General.

The importance of managing the visual resources at MCP is based on the premise that the majority of visitors to the project expect an aesthetically-pleasing environment (see photo 3-58). This is backed up by fact, since sightseeing has the highest percentage of the visitors by activity. The criteria for managing the visual environment is based on visual quality, sensitivity levels, areas seen, and the visual absorption capacity.

Photo 3-58. Boating on Virgil B. Bennington Lake.
Visitation by recreation users and sightseers is a major influence on visual resource management.

b. Visual Quality.

The MCP is located in the Walla Walla Valley, at the edge of the Palouse Physiographic Section, and adjacent to the Blue Mountain Physiographic Section. For a detailed description of physiographic sections, see section 2.02.a., *Landform-Physiography*. The project is located on a rise called Prospect Point Ridge. This ridge is above Mill Creek to the north and Russell Creek to the south. The predominant characteristic of the MCP is the naturalistic character, grass/ forbs/shrub/tree vegetation, and the rolling topography. Textures result from the variety of vegetation types, and the seasons create many contrasting colors. The natural character is tempered by the water resource structures [MCP, intake, *etc.*, (see paragraph e., *Water Resource Facilities and Operations*)], and the presence of the planted straight rows of vegetation. During the early recreation season, when the lake is at elevation 1205 (conservation level), it appears to have a natural appearance, with the exception of the dam. However, the color and texture of the earthen dam help it to blend with the surrounding landscape (see photo 3-59). The area along Mill Creek Channel has different characteristics than the lake area.

Photo 3-59. Mill Creek Dam blends into the surrounding landscape because of its color and texture

The following list is a description of MCP landscape components:

- *Landform*: Rolling topography with a 250-foot elevation change, and long vistas of the Blue Mountains and the Walla Walla Valley.
- *Vegetation*: Native trees, shrubs, grasses, and forbs. Old-growth cottonwoods (see photo 3-60), wildlife plantings, orchards, and natural design (see photo 3-61). In total, there are 17 different types of vegetation.
- *User Activity*: Sightseeing, water recreation activities, picnicking, and hunting.
- *Water Resources*: Virgil B. Bennington Lake (with seasonal fluctuations), Mill Creek Channel, Mill Creek, and various ponds, and wetlands.
- *Manmade Objects*: Water resource structures, irrigated lawns, and project buildings (see photo 3-62).
- *Animal Life*: Deer, upland game birds, song birds, small mammals, water fowl, raptors, reptiles, and amphibians.

Photo 3-60. The large old-growth cottonwoods and open lawns of Rooks Park are the major aesthetic reasons the park receives such high visitation.

Photo 3-61. Straight rows of wildlife plantings, contrasting with the natural vegetation patterns can be seen on the project. View from the top of Mill Creek Dam.

Photo 3-62. The security fence around the Project Office does not welcome the public to the project.

c. Sensitivity Levels.

The factors that influence sensitivity levels are use volume, community importance, land use, and the attitudes and planning of other agencies. The following list is a description of each of these factors:

- *Use Volume*: High visitation because of connecting trails with Walla Walla, it is the only public water body within 28 miles of Walla Walla, and Rooks Park is in the same area and has access to Mill Creek.
- *Community Importance*: Recreational experience and sightseeing.
- *Land Use*: Water resource, recreation, wildlife, and agricultural (surrounding lands).
- *Other Agencies*: Walla Walla Community College and WDW.

d. Area Seen.

A more detailed view study needs to be completed for the visual management plan. However, almost all of the project lands can be viewed from the lake or the project roads and trails. The closer the area is seen from these areas, the more restricted the management goals must be (see photo 3-63).

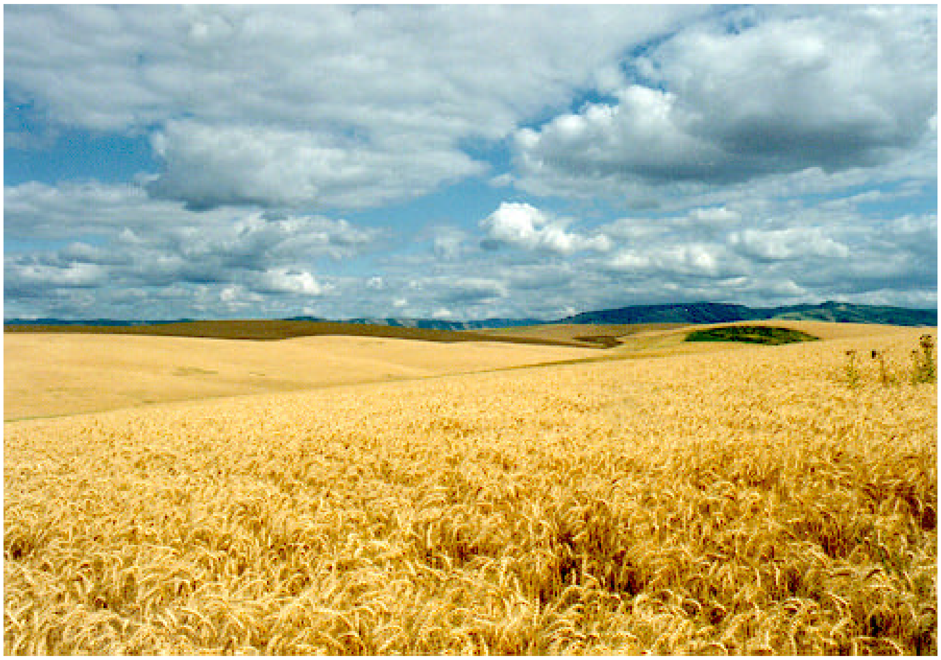


Photo 3-63. Trees and shrubs on the project, in contrast to the surrounding agriculture, wildlife, and the views of the Blue Mountains, contribute to the high scenic quality of MCP.

e. Visual Absorption Capacity (VAC).

The ability of the landscape to accept change is the VAC. Factors influencing the VAC of the MCP landscape are the rolling slopes, lake of buffer vegetation, seasonal color change, color of the soil, and changing lake levels. Surrounding agricultural lands with either low crops such as wheat or bare ground have a low VAC.

f. Analysis of Aesthetic Resources.

The landscape of MCP is moderately sensitive to negative aesthetic impacts. There are three major factors accounting for this sensitivity. One is the location of the project to two major physiographic sections (the human senses are the most acute at transition areas). The second is the low VAC of the surrounding agricultural lands. The monoculture low vegetation has no ability to absorb or screen any visual impacts. These factors create a need for a visual management plan that includes criteria and recommendations for development and management.

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Section 4 - Synthesis

4.01. General

a. Purpose.

This chapter explains the procedure used to determine land classifications and resource objectives (RO's) on MCP lands. Land classifications are informally referred to as land use or management classifications. Land classification categories permitted on administered lands, under ER 1130-2-435, are Project Operation, Recreation, Mitigation, Environmentally Sensitive Areas (ESA's), Multiple Resource Management (MRM), and Easement Lands. There are four subclasses under MRM: 1) recreation--low density; 2) wildlife management general; 3) vegetative management; and 4) inactive and/or future recreation areas. The activities allowed under each category are defined in volume 1, section 4. The analysis used for the MCP Master Plan, as explained in this section, was modeled after the method used in *Honeyhill: A System Analysis for Planning the Multiple Use of Controlled Water Areas* (Murray *et al.*, 1971).

b. Process.

(1) General.

Attractiveness, vulnerability, and compatibility models were developed for each land classification, using criteria from the regional and project inventory, as well as analysis data presented in sections 2 and 3 of this report (see figure 4-1).

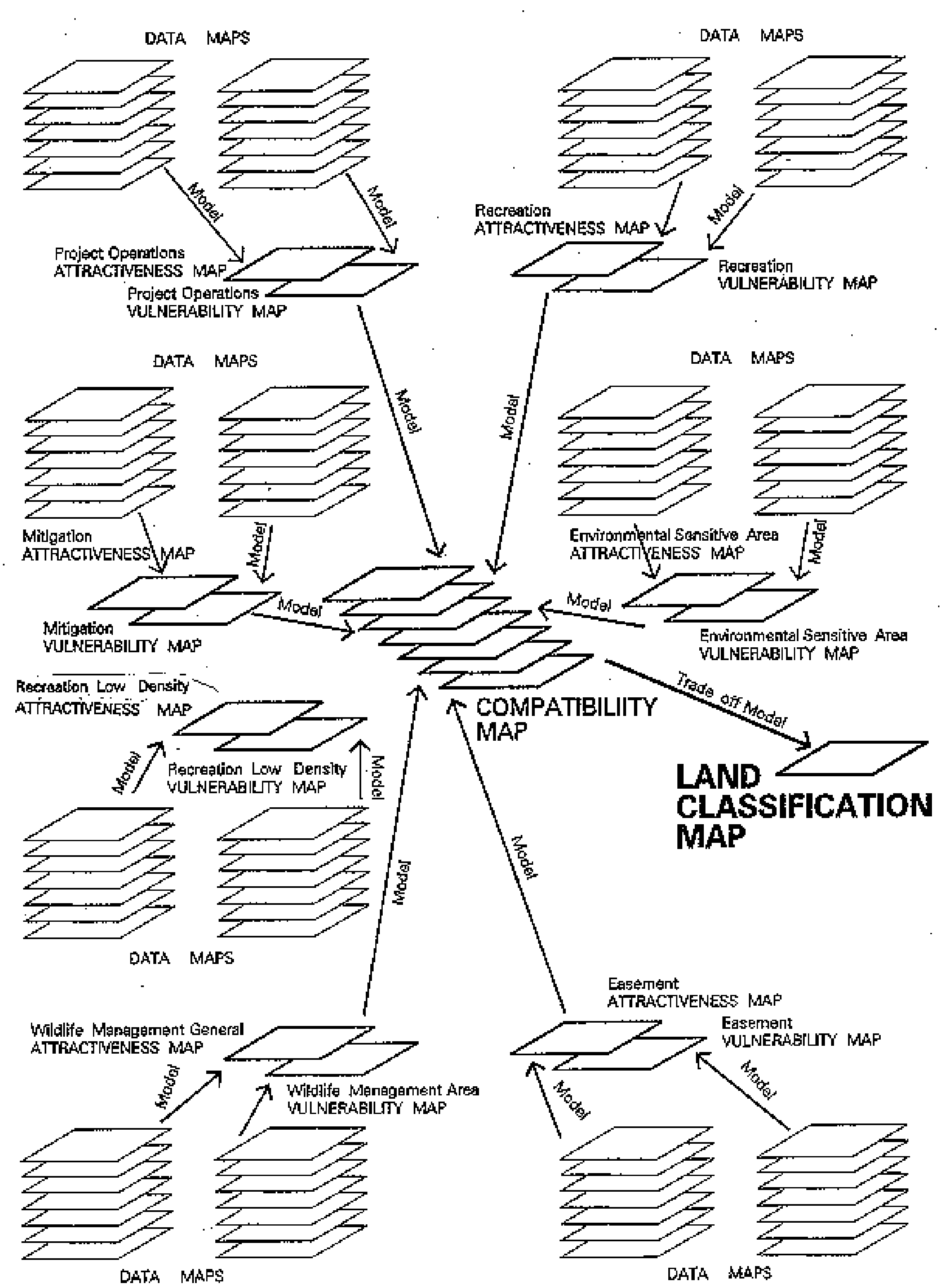


Figure 4-1. Synthesis Overlay Process

(2) Attractiveness--Process.

The first step in the process is to map those lands that are most attractive or best suited for a particular land use classification. This was done by combining resource data maps (slope, existing facilities, and vegetation). For example, the most attractive lands for recreation at MCP are those that have a slope of 0 to 25 percent, are close to water, and have good vehicular access. Environmental impacts (both positive and negative) were created under vulnerability, rather than under attractiveness.

(3) Vulnerability--Process.

The next step was to identify and map those areas vulnerable to impact (positive or negative) for a particular land use, by using the resource data maps that identified sensitive resources (*i.e.*, wildlife habitat, wetlands, or highly erodible soil). Impacts can be caused by such things as construction, use, or maintenance. For example, recreation development may impact certain wildlife species.

(4) Compatibility--Process.

The third step in the process was to create a compatibility map. This was done by combing the attractiveness and vulnerability maps. The compatibility map identifies areas that have high attractiveness and low vulnerability. The compatibility maps are subject to change as additional information is developed.

(5) Tradeoff Analysis--Process.

After all compatibility maps were completed for each different land use, they were compared. Sometimes the lands best suited for recreation and wildlife were the same. When this situation arose, a tradeoff occurred, and a decision was made as to which land use would best serve both regional and project needs. This step used the analysis of resources, the professional judgment of the interdisciplinary team, public input, and input from other agencies.

4.02. Land Classifications

a. Project Operations.

The first land classification studied was project operations. Project operations are those lands solely used for the operation of the project. They include lands containing structures (*i.e.*, Diversion Dam, levee, inlet canal, return canals, and Mill Creek Channel). Refer to section 3 for more information on project structures and facilities.

(1) Attractiveness--Project Operations.

Table 4-1 lists the attractiveness criteria used for project operations. This includes structures and the area needed for flood water storage ranges to elevation 1270. Also, areas used in the past for borrow sites, as well as major roads necessary for good access, were included.

LEGEND

Low/Medium/High Numerical Value
L = 1
M = 2
H = 3

TABLE 4-1
LAND CLASSIFICATION ATTRACTIVENESS (A) AND VULNERABILITY (V)

CRITERIA	PROJECT OPERATIONS		RECREATION		MITIGATION		ENVIRONMENTAL SENSITIVE AREAS		MULTIPLE RESOURCE MANAGEMENT				EASEMENT LANDS	
									Recreation Low Density		Wildlife Mgt. General			
	A	V	A	V	A	V	A	V	A	V	A	V	A	V
LAND FORM														
Topography														
1350-1400 feet									H					
1300-1350 feet									M					
Slope														
25+ percent							H				H			
16-25 percent											M			
8-15 percent			M		H				M		H			
0-7 percent			H		H				M		H			
Aspect														
N					H						H			
NE					H						H			
NW											H			
E					H						M			
SE											M			
S											L			
SW											–			
W											–			
SOIL														
AtE2				H			H				–			
BP	L		M								L			
WaB			H								H			
WaD			M		H						H			
WlB			H								H			
WlD			M		H						H			
YXA			M								L			
YMA			M								M			
HYDROGRAPHY														
Proximity to Perennial Streams											H			
0-1/4 mile											H			
> 200 feet											H			
50-200 feet			H				M		H		H			
0-50			H				H		H					
Proximity to Shoreline														
Lake Elevation														
El. 1187 0-200 feet			H						H					
El. 1243.5														
El. 1270	M													
1270 outside project													L	

LEGEND

Low/Medium/High Numerical Value

L = 1
M = 2
H = 3

TABLE 4-1
LAND CLASSIFICATION ATTRACTIVENESS (A) AND VULNERABILITY (V)

CRITERIA	PROJECT OPERATIONS		RECREATION		MITIGATION		ENVIRONMENTAL SENSITIVE AREAS		MULTIPLE RESOURCE MANAGEMENT: Recreation Low Density		MULTIPLE RESOURCE MANAGEMENT: Wildlife Mgt. General		EASEMENT LANDS	
	A	V	A	V	A	V	A	V	A	V	A	V	A	V
LAND COVER/VEGETATION														
L-M									M					
L-F									M		H			
L-S									M		H			
L-SP									M		H			
L-CT									M		H			
L-DT									M		H			
L-D							M		M		L			
R-F							M				H			
R-S							M				H			
R-DT			H				H				H			
W-OW		H		H			H				H			
W-PE		H		H			H				H			
W-PS		H		H			H				H			
W-PF		H		H							H			
L-OW											H			
L-UB											H			
R-OW											H			
A-P									L		M			
A-C											L			
UB-R											M			
UB-C											L			
UB-T			H								M			
UB-L			H								L			
UB-P												L		

LEGEND

Low/Medium/High Numerical Value

L = 1
M = 2
H = 3

TABLE 4-1
LAND CLASSIFICATION ATTRACTIVENESS (A) AND VULNERABILITY (V)

CRITERIA	PROJECT OPERATIONS		RECREATION		MITIGATION		ENVIRONMENTAL SENSITIVE AREAS		MULTIPLE RESOURCE MANAGEMENT: Recreation Low Density		MULTIPLE RESOURCE MANAGEMENT: Wildlife Mgt. General		EASEMENT LANDS	
	A	V	A	V	A	V	A	V	A	V	A	V	A	V
WILDLIFE														
Proximity to Columbia Ground Squirrel														
0-100 feet				H							H			
0 feet											H			
HISTORY														
Nez Perce Trail							H							
1861 Roads							H							
LANDS STATUS														
Ownership														
Corps Easements													H	
Land Allocation														
Operations														
Mitigation		H			H									
CITY/COUNTY COMPREHENSIVE PLAN														
Public			H						H					
Exclusive Agriculture			H						H					
General Agriculture			H						H					
Rural Residential														
Commercial				H										
Industrial				H										
TRANSPORTATION														
Proximity to Project Paved Roads														
<1000 feet			L								H			
200-1000 feet			H											
0-200 feet			H											
Proximity to Gravel Roads														
<1000 feet														
200-1000 feet									M					
0-200 feet									H					
Proximity to Paved Trails			H											
Proximity to Gravel Trails									H					
Proximity to Parking Lots														
300-500 feet			M											
200-300 feet			H											
<200 feet			H											

LEGEND

Low/Medium/High Numerical Value
L = 1
M = 2
H = 3

TABLE 4-1
LAND CLASSIFICATION ATTRACTIVENESS (A) AND VULNERABILITY (V)

CRITERIA	PROJECT OPERATIONS		RECREATION		MITIGATION		ENVIRONMENTAL SENSITIVE AREAS		MULTIPLE RESOURCE MANAGEMENT: Reserve for Low Density		MULTIPLE RESOURCE MANAGEMENT: Wildlife Mgt. General		EASEMENT LANDS	
	A	V	A	V	A	V	A	V	A	V	A	V	A	V
TRANSPORTATION (Continued)														
Proximity to County/City Roads														
1000 feet														
0-1000 feet			H								H			
Proximity to Traffic														
County Road 0-1/8 mile											L			
State Highway 0-1/4 mile											L			
County 1/8-1/4 mile											M			
State 1/4-1/2 mile											M			
County < 1/4 mile											H			
State < 1/2 mile											H			
County 0-500 feet				H						H				
State 1000 feet				H						H				
Roads														
Paved	H													
WATER RESOURCES FACILITIES														
Structures (Dam etc.)														
0-200 feet	H							H						
Dredge Forebay								H						
BUILDINGS														
>150 feet from Office & Restrooms											H			
Restrooms														
>300 feet			H											
200-300 feet														
50-200 feet														
0-50 feet				H										
Proximity to Residential														
>150 feet											H			
0-150 feet									H					
Proximity to Commercial/Industrial														
>300 feet				M					H		H			
200-300 feet				H										
0-200 feet				H										
WILDLIFE HABITAT														
Structures														
Food Plots									H					
Pastures									H					
Meadows									H		H			
Shrubs/Trees									H		H			
											H			
RECREATION FACILITIES											H			
Existing			H							H				

(2) Vulnerability--Project Operations.

To determine where project operations might cause impacts, the criteria of wetlands was used.

(3) Compatibility--Project Operations.

The areas of attractiveness and the areas of vulnerability were combined. The only attractiveness area that is located in a vulnerable area is the debris barrier.

b. Recreation.

(1) Attractiveness--Recreation.

As discussed in sections 2 and 3, MCP is unique in the MA because it provides recreation resources that are currently found at no other lands or facilities. From a planning standpoint, it is best to provide outdoor recreation facilities and opportunities that foster the unique qualities of these resources at the project. Visitor activities need to be expanded, as discussed in sections 2 and 3. Table 4-1 lists the proposed criteria for the determination of an attractiveness model for recreation. The following is a list of the recreation activities that were considered in developing a recreation attractiveness model. These activities need some form of development, and generally create a higher density of visitors. They are:

Fishing

Fishing from boat
Fishing from banks or streams

Nature Study

Interpretive Display

Camping

Organized Groups

Sightseeing and Picnicking

Sightseeing*
Picnicking in designated area*

Sports/Games/Other

Playground
Games (Badminton/Volleyball)
Jogging/Running*

Water Activities

Swimming/wading at a designated area
Boating

Hiking/Walking

Day Hiking - trailhead
Walking in parks

Non-Motorized Recreation

Bicycling on paved trails and roads*
Horseback riding along paved trails*

Hunting

Hunting, upland game

Snow Activities

Cross-country skiing*
Sledding/snow play

*Similar form considered under recreation--low density (see paragraph 4.06).

(2) Vulnerability--Recreation.

Table 4-1 lists the proposed criteria used to determine the areas that are vulnerable from recreation development.

(3) Compatibility--Recreation.

Compatibility created from the combination of the attractiveness and vulnerability models was used in the tradeoff analysis.

c. Mitigation.

(1) Attractiveness--Mitigation.

Lands zoned for mitigation are lands that have been specifically acquired, or designated, for mitigation. There are 63.07 acres at MCP that were purchased in 1991 for wildlife mitigation. Section 3, paragraph 3.03.c.(1) , contains detailed information on these lands. They are displayed on plate 3-12. Within these lands, the best areas for development can be determined by adding the criteria of aspect and slope.

(2) Vulnerability--Mitigation.

There were no resources or criteria identified that a mitigation classification would cause to be vulnerable.

(3) Compatibility--Mitigation.

Since no criteria was identified, the attractiveness model also serves as the compatibility model.

d. The ESA's.

(1) Attractiveness--ESA.

This classification is designed to protect unique or sensitive resources. Table 4-1 lists the resources that are environmentally sensitive. These are areas that must not be adversely impacted, or are more susceptible to impact. The areas could include scientific, ecological, cultural, or aesthetic features; as well as wetlands, riparian vegetation areas, slopes over 25 percent, highly erodible soils, and potential historical areas. The value for each of these criterion is shown in table 4-1.

(2) Vulnerability--ESA.

There are no known criteria where ESA's would have vulnerability.

(3) Compatibility--ESA.

Since there is no vulnerability criteria for this land classification, the attractiveness areas are the same as compatibility.

e. The MRM--Recreation, Low Density.

(1) Attractiveness--Recreation, Low Density.

As discussed in paragraph 4.03., it is best to provide outdoor recreation facilities and opportunities that foster the unique qualities of the resources, as well as the project. The following are low density recreation activities that were considered in developing a low density recreation attractiveness map. The activities need little development, and generally have a low density of visitors. Similar forms of these activities are considered under paragraph 3.03.j., *Recreation Facilities and Operations*.

Fishing	**Water Activities**
Fishing from banks or streams	Swimming/wading (no designated areas)
Nature Study	**Hiking/Walking**
Nature study/wildlife observation Outdoor photography	Day Hiking
Snow Activities	**Non-Motorized Recreation**
Cross-country skiing	Bicycling on gravel and dirt trails Horseback riding on gravel and dirt trails
Sightseeing and Picnicking	**Hunting and Shooting**
Sightseeing Picnicking (no designated or developed areas	Hunting, upland game
Sports/Games/Other	
Jogging/Running on gravel/dirt trails	

(2) Vulnerability--Recreation, Low Density.

There were criteria identified that would be vulnerable from low-density recreation, including distance from county and state roads, and developed recreation areas.

(3) Compatibility--Recreation, Low Density.

The compatibility model is the combination of the attractiveness and vulnerability models.

f. The MRM--Wildlife Management General.

(1) Attractiveness--Wildlife Management General.

Table 4-1 lists the proposed criteria to determine those lands most attractive for wildlife management general.

(2) Vulnerability--Wildlife Management General.

There were criteria identified that would be vulnerable from wildlife management general, and involved project structures (UB-P).

(3) Compatibility--Wildlife Management General.

The compatibility map is the combination of the attractiveness and vulnerability models.

g. The MRM--Vegetative Management.

This land classification is designed to care for forest resources. It was not considered any further, since MCP is located in a primarily steppe-shrub forest transition. The only current commercial forest resources are black cottonwood trees located along Mill Creek and the lake.

h. Easement Lands.

The easement classifications are based on lands where the Corps has easement rights for certain specific purposes. Plate 3-11 shows the lands, within the project boundary, where the Corps has easements. The Corps has flowage and canal easements over private lands, and access easements on county lands. With the exception of the free board pool elevation (elevation 1270 outside the project boundary), no other lands have been identified that would require an easement. These existing lands were classified as easement lands.

4.03. Tradeoff Analysis

When all of the compatibility maps were combined, some areas were found to be suitable for more than one land classification. Based on trends, public need, and management objectives, the land classifications were determined by a tradeoff process conducted by an interdisciplinary team. Also, the project RO's were developed at the same time.

Volume 1, section 3, lists the project RO's, while volume 1, section 4, plate 4-1, reflects the land classifications for the project.

4.04. References

Ellsworth, John C., undated

Personal Communication, Utah State University, Department of Landscape Architecture and Environmental Planning, Logan, Utah.

Murray, *et al*., 1971

Honeyhill: A Systems Analysis for Planning Multiple Use of Controlled Water Areas, Volumes 1 and 2. For U.S. Army Institute for Water Resources by the Department of Landscape Architecture Research Office, Harvard Graduate School of Design, Cambridge, Massachusetts.

Supporting Data

Supporting Data - Item 1

Prior Reports on Mill Creek Project

Design Memorandums

Number		Cover Date
1	Master Plan for Mill Creek Reservoir	May 1961
2	Recreation Facilities	February 1962
	Supplement 1, Vault-Type Toilet	May 1965
3	Rehabilitation Reservoir Outlet Canal to Mill Creek	June 1973
	Letter Suppl. 1, Rehabilitation of Outlet Canal to Mill Creek	January 1976
Unnumbered	Plan of Study	March 1978
4	Deleted	
5	GDM - Project Rehabilitation	
	Letter Suppl. 1, Fish and Wildlife Mitigation	August 1979
	Letter Suppl. 2, Rehabilitation of Return Canal to Mill Creek	October 1981
	Letter Suppl. 3, Fiber-Reinforced Shotcrete Hard Surface Lining for the Return Canal	April 1982 .
	Letter Suppl. 4, Combined Risk Analysis	November 1985
	Supplement 1, Fish Passage Facility-Mill Creek .	January 1981 Revised August 1981
	Supplement 2, Postconstruction Seepage	
6	Storage Dam Rehabilitation	February 1980
	Letter Suppl. 1, Embankment Facing	September 1982
7	Main Channel Rehabilitation	December 1982
8	Concrete Aggregate Investigation	May 1982

Supporting Data - Item 2

Public Laws, Executive Orders, and Regulations Pertinent to Resource Management at
The Mill Creek Project

Part I - Application

These paragraphs list the applicable Public Laws (PL), Executive Orders (EO), Corps of Engineers' Engineer Manuals (EM), Engineer Pamphlets (EP), and Engineer Regulations (ER) for the planning, development, and management of natural and cultural resources at Corps of Engineers' Civil Works Projects. Part 2 of this item provides a more detailed annotation of these PL's, EO's, EM's, EP's, and ER's. For an annotation of the authority for the Mill Creek Lake Project, refer to section 1 of this volume.

a. Authority for Mill Creek Project.

PL 75-761	The Flood Control Act of 1938, 28 June 1938, as amended by
PL 77-228	The Flood Control Act of 1941, 18 August 1941.

b. Reservoir Name Change.

PL 102-580	Water Resources Act of 1992.

c. Planning.

PL 79-14	River and Harbor Act of 1945.
Pl 79-526	The Flood Control Act of 1946.
PL 89-80	Water Resources Planning Act of 1965, 22 July 1965.
PL 91-190	National Environmental Policy Act of 1969, 1 January 1970.
EO 11514	Protection and Enhancement of Environmental Quality, 5 March 1970 (Amended by EO 11991).
EO 11990	Protection of Wetlands, 24 May 1977.

EO 11991	Relating to Protection and Enhancement of Environmental Quality, 24 May 1977 (Amended EO 11514).
EP 1105-2-35	Public Involvement and Coordination, 5 February 1982 (Change 1)
EP 1165-2-1	Digest of Water Resource Policies and Authorities.
EP 1165-2-501	Environmental Policies, Objectives, and Guidelines for the Civil Works Program of the Corps of Engineers, 18 December 1988.
ER 202-2-2	Policy and Procedures for Implementing NEPA, 1 November 1971 (Change 3).
1105-2-20	Project Purposes Planning Guidance, 29 January 1982 (Change 3).
ER 1130-2-435	Project Operation Preparation of Master Plans, 30 December 1987.
ER 1165-2-400	Water Resource Policies and Authorities: Recreation Planning, Development, and Management Policies, 9 August 1985.
NPWOM 1130-2-1	Master Plan and Operational Management Plan Procedures, 10 March 1988.
NPWOM 1130-1-1	Marina Development and Design Standards, 5 October 1989.
NPWP 1130-1-2	Marina Development and Design Standards, 5 October 1989

d. Resource Management, General.

PL 86-717	Forestry Management Practices at Corps Reservoirs.
PL 96-366	Fish and Wildlife Conservation Act of 1980, 29 September 1980.
ER 190-1-50	Law Enforcement Policy, U.S. Army Corps of Engineers.
ER 1130-2-401	Visitor Center Program.
ER 1130-2-404	Recreation Use Fees, 2 July 1985.
ER 1130-2-405	Use of Off-Road Vehicles on Civil Works Projects.
ER 1130-2-406	Lakeshore Management of Civil Works Projects.
ER 1130-2-407	Operating and Testing Potable Water Systems.
ER 1130-2-411	Regulation of Seaplane Operations.
ER 1130-2-412	Aquatic Plant Control Program.
ER 1130-2-413	Pest Control Program for Civil Works Projects.
ER 1130-2-414	Recreation-Resource Management System (RRMS).
ER 1130-2-418	Law Enforcement Service Contracts.
ER 1130-2-420	Visitor Assistance Program.
ER 1130-2-428	Interpretive Services.
ER 1130-2-432	Corps of Engineers Resources Volunteer Program (CERV).

e. Aesthetic Resources.

PL 91-190	National Environmental Policy Act of 1969, 1 January 1970.
ER 1105-2-50	Environmental Resources: Aesthetic Resource Considerations, Chapter 5 (draft 1984).
ER 1165-2-501	Environmental Policies, Objectives, and Guidelines for the Civil Works Program of the Corps of Engineers, 18 December 1988.

f. Cultural and Historical Resources.

PL 59-209	Antiquities Act of 1906, 8 June 1906.
PL 74-292	Historic Sites of 1935, 21 August 1935.
PL 86-523	Reservoir Salvage Act of 1960, 27 June 1960.
PL 89-665	National Historic Preservation Act of 1966, 15 October 1966.
PL 91-190	National Environmental Policy Act of 1969, 1 January 1970.
PL 93-291	Preservation of Historical and Archaeological Data, 24 May 1974.
PL 95-341	American Indian Religious Freedom Act of 1978.
PL 96-95	Archaeological Resources Protection Act of 1979, 31 October 1979.
PL 96-515	National Historic Preservation Act, Amendments of 1980, 12 December 1980.
EO 11593	Protection and Enhancement of Cultural Resources, 13 May 1971.
ER 1105-2-50	Environmental Resources, 29 January 1982 (Change 2).
ER 1130-2-438	Historic Preservation Program, 26 October 1987.
ER 1130-2-433	Storage and Curation of Archaeological and Historic Data.

g. Endangered Species.

PL 93-205	Conservation, Protection, and Propagation of Endangered Species, 28 December 1973.
PL 95-632	Endangered Species Act Amendments of 1978, 10 November 1978.
PL 96-159	Endangered Species Act of 1973, 28 December 1979.

h. Fish and Wildlife.

PL 78-534	Flood Control Act of 1944.
PL 85-624	Fish and Wildlife Coordination Act of 1958, 12 August 1958.
PL 89-72	Federal Water Project Recreation Act (also see public laws under Endangered Species).
PL 96-366	Fish and Wildlife Conservation Act of 1980, 29 September 1980.
EL 86-25	Technical Report: U.S. Army Corps of Engineers Wildlife Resources Management Manual.
EO 11990	Protection of Wetlands, 24 May 1977.
ER 1105-2-50	Environmental Resources, 29 January 1982 (Changes 1-2).
ER 1130-2-400	Management of Natural Resources and Outdoor Recreation at Civil Works Water Resource Projects, 1 June 1986.

i. Pest Control.

PL 92-516	Federal Insecticide, Fungicide, and Rodenticide Act.
ER 1130-2-413	Pest Control Program for Civil Works Projects, 1 February 1982.

j. Recreation (see also Resource Management, General).

PL 78-534	Flood Control Act of 1944, 22 December 1944.
PL 79-526	Flood Control Act of 1946, 24 July 1946.
PL 88-578	Land and Water Conservation Fund Act of 1965, 3 September 1964.
PL 89-72	Federal Water Project Recreation Act of 1965, 9 July 1965.
EO 11644	Use of Off-Road Vehicles on Public Lands, 8 February 1972 (Amended by EO 11989).
EO 11989	Off-Road Vehicles in Public Lands, 24 May 1977 (Amends EO 11644).
EM 1110-1-103	Design for the Physically Handicapped, 15 October 1976.
EM 1110-2-400	Design of Recreation Sites, Areas, and Management Policies, 31 May 1988.
EM 1110-2-410	Design of Recreation Areas and Facilities - Access and Circulation, 31 December 1982.
EP 310-1-6	Graphic Standards Manual, December 1980 (Change 1).
ER 70-2-7	Recreation Research and Demonstration System.
ER 1105-2-20	Project Purpose Planning Guidance, 29 January 1982 (Change 3).
ER 1110-1-102	Design for the Physically Handicapped, 15 October 1976.
ER 1120-2-400	Recreation Resources Planning, 1 November 1971 (Change 3).
ER 1130-2-400	Management of Natural Resources and Outdoor Recreation at Civil Works Water Resource Projects, 1 June 1986.
ER 1130-2-405	Use of Off-Road Vehicles on Civil Works Projects, 17 January 1974.
ER 1130-2-411	Regulation of Seaplane Operations at Civil Works Water Resource Development Projects, 15 November 1977.
ER 1130-2-413	Pest Control Program on Civil Works Projects.
ER 1165-2-400	Recreation Planning, Development, and Management Policies, 9 August 1985.
NPDR 1130-2-5	Recreation Cost-Sharing Contracts - Code 710.
NPDR 1130-2-402	Operational Management Plans, 12 April 1988.
NPPR 5-2-1	Recreation Cost-Sharing Contracts, 10 March 1986.

k. Water Supply and Quality.

PL 87-88	Federal Water Pollution Control Act Amendments of 1961, 20 July 1961.
PL 95-217	Clean Water Act of 1977, 15 December 1977.
EO 11990	Protection of Wetlands, 24 May 1977.

l. Real Estate.

EO 12512	Federal Real Property Management.
ER 405-1-12	Real Estate Handbook, 20 November 1985 (Change 23).

Part II - Annotation

These paragraphs present a brief description of many of the key Public Laws, Executive Orders, Engineer Manuals, Engineer Regulations, and Engineer Pamphlets that provide the guidance for resource use, development, and management of Corps of Engineers' Civil Works Projects. The annotated descriptions are not inclusive of all items listed in Part 1.

a. Public Laws.

(1) PL 59-209, Antiquities Act of 1906 (8 June 1906).

This Congressional Act placed the primary responsibility for archaeological investigation on professionals, in cooperation with the Smithsonian Institution and the National Park Service. It applies specifically to the appropriation or destruction of antiquities on Federally-owned, or controlled, lands and has served as a precedent for subsequent legislation (34 Stat. 225).

(2) PL 74-292, Historic Sites Act of 1935 (21 August 1935).

This Act placed the responsibility for the administration and operation of historic and prehistoric preservation activities under the Secretary of the Interior and the National Park Service (49 Stat. 666, 16 U.S.C. 461-467).

(3) PL 78-534, Flood Control Act of 1944 (22 December 1944).

Recreation. Section 4 of this Act authorized the provision for public-use facilities in reservoir areas, including recreation and conservation of fish and wildlife conservation (58 Stat. 889, 16 U.S.C. 460d).

Water Supply. Section 6 of this Act authorized the Secretary of the Army to dispose of surplus water available at reservoirs, for both domestic and industrial uses (33 U.S.C. 708).

(4) PL 79-526, Flood Control Act of 1946 (24 July 1946).

Leases. Section 4 of this Act amended Public Law 78-534 including the authority to grant leases, to nonprofit organizations, at recreation facilities in reservoir areas at either reduced or nominal charges (60 Stat. 642, 16 U.S.C. 460d).

(5) PL 85-624, Fish and Wildlife Coordination Act (12 August 1958).

This Act gave fish and wildlife conservation equal consideration and coordination with other project purposes. Proposals for work affecting any body of water must be coordinated with the Fish and Wildlife Service (FWS) and the state wildlife agency. The recommendations of the FWS, and the state agency, are to be given full consideration, and justifiable means and measures for wildlife purposes, including mitigation measures, will be considered. Adequate provisions are to be given to use of project lands for the conservation, maintenance, and management of wildlife resources, including their improvement and development. The use of project lands for wildlife management will be in accordance with general plans approved jointly by the Departments of the Army and the Interior, and the state wildlife agency (72 Stat. 563, 16 U.S.C. 661).

(6) PL 86-523, Reservoir Salvage Act of 1960 (27 June 1960).

This Act grants authority to the Secretary of the Interior to provide for the preservation of historical and archaeological data that might otherwise be lost as a result of the construction of a dam and its attendant facilities and activities (74 Stat. 220). This Act was further amended by PL 93-291.

(7) PL 87-88, Federal Water Pollution Control Act Amendments of 1961 (20 July 1961).

This law amended the Federal Water Control Act (70 Stat. 498) in order to provide for a more effective program of water pollution control, and for other purposes (75 Stat. 204, 33 U.S.C. 1151).

(8) PL 88-578, Land and Water Conservation Fund Act of 1965 (3 September 1964).

This Act established a fund from which Congress can make appropriations for outdoor recreation. The fund derives its revenue from entrance and user fees, the sale of surplus Federal property, and the Federal motorboat fuel tax. Entrance and user fees at reservoirs were made possible by Section 2(a), which deleted the words "without charge" from Section 4 of the 1944 Flood Control Act, as amended (78 stat. 897, 16 U.S.C. 4601-4). NOTE: This section was amended and restated by Section 101(1), PL 94-422.

(9) PL 89-72, Federal Water Project Recreation Act (9 July 1965).

This Act requires that full consideration be given to opportunities for recreation, and fish and wildlife enhancement. Recreation planning is to be based on coordination of use with existing and planned Federal, state, and local recreation. Non-Federal administration of recreation and enhancement areas will be encouraged. The law requires that, without cost-sharing by a local sponsoring entity, no facilities for recreation and fish and wildlife enhancement can be provided except those justified to serve other project purposes, or as needed for public health and safety. If, in the absence of a local sponsor, lands are acquired to preserve the recreation and fish and wildlife potential of the project and, if 10 years after the initial project operation there is still no local sponsor, the lands may be sold or used for other project purposes. The views of the Secretary of the Interior on the extent to which the proposed recreation and fish and wildlife development conforms to, and is in accord with, the state comprehensive plan shall be included in any project report.

(10) PL 89-80, Water Resources Planning Act of 1965, 22 July 1965.

This Act declares a policy of encouraging the conservation, development, and utilization of water and related land resources. The Act established the Water Resources Council and River Basins Commissions, and provides for financial assistance to states.

(11) PL 89-665, National Historic Preservation Act of 1966 (15 October 1966) Amended PL 74-292.

This Act declared a national policy of historic preservation, including the encouragement of preservation on state and private levels; provided authority for the expansion of the National Register of Historic Places, to include state and local cultural resources, as well as those of national significance; authorized matching Federal grants to the states and the National Trust for Historic Preservation for the acquisition and rehabilitation of National Register properties; established the Advisory Council on Historic Preservation (one of which is the Secretary of Defense); maintained certain procedures to be followed by Federal agencies in the event of a proposal that might have an effect on National Register properties; and defined the term "historic preservation" as the protection, rehabilitation, restoration, and reconstruction of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, or culture.

(12) PL 91-190, National Environmental Policy Act (1 January 1970).

Section 101 of this Act established a broad Federal policy on environmental quality (983 Stat. 852, 42 U.S.C. 4331). The Federal Government shall "...assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings...preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice." (83 Stat. 852, 42 U.S.C. 4331). Section 102 requires an Environmental Impact Statement (EIS) on all proposed Federal actions. "All agencies of the Federal Government shall...identify and develop methods and procedures...which will insure that presently unquantified environment consideration in decision making along with economic and technical considerations..." (83 Stat. 853, 42 U.S.C. 4332).

(13) PL 91-243, 9 May 1970.

This legislation amended the National Historic Preservation Act of 1966 by extending the funding for the program through 1973, increasing the membership of the Advisory Council on Historic Preservation, and authorizing the participation of the United States as a member in the International Center for the Study of Preservation and Restoration of Cultural Property, and authorized funds for that purpose.

(14) PL 93-205, Conservation, Protection, and Propagation of Endangered Species (28 December 1973).

This law repeals the Endangered Species Conservation Act of 1969. It directs all Federal departments/agencies to carry out programs to conserve endangered and threatened species, in consultation with the Secretary of the Interior (or Commerce, in appropriate situations), and to preserve the habitat of such species (87 Stat. 884). NOTE: Section 7 of the Endangered Species Act Amendments of 1978 (PL 95-632) authorizes procedures by which a Federal agency, state governor, or license applicant may apply for an exemption to the Act.

(15) PL 93-291, The Archaeological and Historic Preservation Act of 1974 (24 May 1974).

This Act amended the 1960 Salvage Act, provided for the preservation of significant scientific, prehistoric, historic, and archaeological data (including relics and specimens) that might be lost or destroyed as a result of the construction of dams, reservoirs, and their attendant facilities and activities, or any alteration of the terrain caused as a result of any Federal construction project or Federally-licensed project, activity, or program. It provided that the Secretary of the Interior be notified of impending loss of such resources, and that the agency, or the Secretary, may survey and recover the data and publish the results. It provided for agreement on time limits for initiation and completion of survey and recovery efforts. It requires the Secretary to coordinate, report on, consult with appropriate experts, and distribute funds appropriated for those survey and recovery efforts. It provides that up to 1 percent of the total amount authorized to be appropriated for the Federal activities may be transferred to the Secretary for implementation of the Act, and provides funds for certain other costs. Compliance with this Act presumes prior compliance with Section 106 of the National Historic Preservation Act of 1966 with regard to properties listed in, or eligible for listing in, the National Register of Historic Places (88 Stat. 174).

(16) PL 94-422 (28 September 1976).

This law amended Section 106 of the National Historic Preservation Act to apply to properties eligible for inclusion in the National Register. Additional funding was appropriated to carry out the provisions of the Act, the organization of the Advisory Council was clarified, and the membership was expanded to 29 members. The Council was established as a fully independent agency within the Executive Branch, and authorized to promulgate such rules and regulations it deemed necessary to implement Section 106 of the Act.

(17) PL 95-341, American Indian Religious Freedom Act of 1978.

This act insures the "...inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians including, but not limited to, access to sites, use, and possession of sacred objects and the freedom to worship through ceremonials and traditional rites." The Act requires consultation with Indian leaders (92 Stat. 469, 42 U.S.C. 1996).

(18) PL 95-217, Clean Water Act of 1977 (15 December 1977).

This Act amends the Federal Water Pollution Control Act and extends the appropriations authorization. Section 51 of this Act requires the Environmental Protection agency to enter into written agreements with the Secretaries of Agriculture, Army, and Interior to provide maximum utilization of the laws and programs to maintain water quality. Section 60 of this Act provides for Federal compliance with all Federal, state, interstate, and local requirements, administrative authority, and process and sanctions in the same manner, and to the same extent, as other entities. Section 67 of this Act provides for the processing of permits for dredged or fill material through the Secretary of the Army, acting through the Chief of Engineers and defines requirements to meet in the construction of Federal projects (91 Stat. 1566).

(19) PL 95-632, Endangered Species Act Amendments of 1978 (10 November 1978).

This law amends the 1973 Act (PL 93-205) to establish an Endangered Species Interagency Committee to review proposed actions to determine whether exemptions from certain requirements of the Act should be granted. It prescribes a consultation process between Federal agencies and the Secretary of the Interior, Secretary of Commerce, or Secretary of Agriculture, as appropriate, for carrying out programs for the conservation of endangered and threatened species. It directs agencies to conduct a biological assessment to identify endangered or threatened species that may be present (92 Stat. 3752).

(20) PL 96-95, Archaeological Resources Protection Act of 1979 (31 October 1979).

This Act protects archaeological resources and sites that are on public and Indian lands, and fosters increased cooperation and exchange of information between Governmental authorities, the professional archaeological community, and private individuals. It defined archaeological resources to be any material remains of past human life or activities which are of archaeological resources from public or Indian lands, with special permit and disposition rules for the protection of archaeological resources on Indian lands in light of the American Indian Religious Freedom Act. It provided that information regarding the nature and location of archaeological resources may remain confidential; established civil and criminal penalties, including forfeiture of vehicles and equipment used, fines of up to $100,000 and imprisonment of up to 5 years for second violations for the unauthorized appropriation, alteration, exchange, or other handling of archaeological resources. It also provided rewards for furnishing information about such unauthorized acts. Archaeological resources covered by the Antiquities Act of 1906 are now covered by this Act.

(21) PL 96-159, Endangered Species Act of 1973 (28 December 1979).

This Act expanded the Endangered Species Act to protect endangered plants; required the Secretary of the Interior, when proposing land as critical habitat, to publish a summary of the proposal and a map in the local newspapers; and required Federal agencies to insure their projects "are not likely" to jeopardize an endangered species. It also authorized all those seeking exemptions from the Act to get permanent exemptions for a project, unless a biological study indicates the project would result in the extinction of a species (93 Stat. 1225).

(22) PL 96-366, Fish and Wildlife Conservation Act of 1980 (29 September 1980).

This Act provides funds, to states, to conduct inventories and conservation plans for the conservation of nongame wildlife. It also encourages Federal departments and agencies to use their statutory and administrative authority to conserve and promote conservation in accordance with this Act (94 Stat. 1322).

(23) PL 96-515, National Historic Preservation Act Amendments of 1980 (12 December 1980).

This law amends the National Historic Preservation Act of 1966, and authorizes the Secretary of the Interior to expand and maintain a National Register of Historic Places. Within 1 year after the date of enactment, the Secretary shall establish, in consultation with the Secretary of Defense and other agencies, standards for the preservation of historic properties in Federal ownership or control (94 Stat. 2987).

b. Executive Orders Pertinent to Water Resources.

(1) EO 11514, Protection and Enhancement of Environmental Quality (5 March 1970).

Section 2 of this EO outlines the responsibilities of Federal agencies in consonance with Title I of the National Environmental Policy Act (NEPA) of 1969 (amended by EO 11991, 24 May 1977).

(2) EO 11593, Protection and Enhancement of Cultural Environment (13 May 1971).

Section 2 of this EO outlines the responsibilities of Federal agencies in consonance with NEPA (1969), the National Historic Preservation Act of 1966, the Historic Sites Act of 1935, and the Antiquities Act of 1906. It instructs all Federal agencies to provide national leadership in historic preservation, to assure the preservation of cultural properties in Federal ownership, and to "institute procedures to assure that Federal plans and programs contribute to the preservation and enhancement of non-Federally-owned sites, structures, and objects of historical, architectural, or archaeological significance." It directs all Federal agencies to "locate, inventory, and nominate to the Secretary of the Interior, all sites, buildings, districts, and objects under their jurisdiction or control that appear to qualify for listing in the National Register of Historic Places." The order further established procedures to be followed by all Federal agencies pending completion of the cultural resources inventories.

(3) EO 11644, Use of Off-Road Vehicles on Public Lands (8 February 1972).

This EO establishes a uniform Federal policy regarding the use of vehicles such as trail bikes, snowmobiles, dune buggies, and others on public lands. Section 3 provides guidance for establishing zones of use for such vehicles (amended by EO 11989, 24 May 1977).

(4) EO 11989, Off-Road Vehicles on Public Lands (24 May 1977).

This EO authorized agency heads to close areas or trails within their jurisdiction to off-road vehicles that cause adverse effects to soil, vegetation, wildlife, wildlife habitat, and cultural or historical resources. Fire, military, emergency, and law enforcement vehicles are excluded, when used for emergency purposes. This EO amends EO 11644, 8 February 1972.

(5) EO 11991, Relating to Protection and Enhancement of Environmental Quality (24 May 1977).

Section 1 of this EO amends Section 3(h) of EO 11514 by directing the Council of Environmental Quality to issue guidelines to Federal agencies for implementing procedural provisions of NEPA (1969). These regulations will include procedures for early EIS preparation and require impact statements to be concise, clear, and supported by evidence that the agencies have made the necessary analyses. The Council will resolve conflicts between agencies concerning the implementation of NEPA and Section 309 of the Clean Act, as amended.

(6) EO 11990, Protection of Wetlands (24 May 1977).

This EO restricts Federal agencies from taking action that would destroy or modify wetlands when there is a practical alternative.

(7) EO 12512, Federal Real Property Management (29 April 1985).

This EO requires all executive departments to set annual real property management goals, and designated OMB as the agency to review progress toward those goals. Under the provisions of this EO, project lands are surveyed to identify those areas of real property that are not being utilized, are underutilized, or are not being put to optimum use. Project real property identified as excess to project needs is reported to the General Services Administration for disposal. Revoked EO 12348 of 25 February 1982.

c. Engineer Manuals.

(1) EM 1110-1-103, Design for the Physically Handicapped (15 October 1976).

This manual sets forth criteria for the provision and design of features to make facilities designed by the Corps of Engineers accessible to, and useable by, physically handicapped persons.

(2) EM 1110-2-400, Design of Recreation Sites, Areas, and Facilities (7 July 1972), Change 1, 13 September 1974.

(3) EM 1110-2-410, Design of Recreation Areas and Facilities - Access and Circulation (31 December 1982).

This manual presents data compiled from experience and research that should be useful in the design of access and circulation to recreation sites, areas, and facilities.

d. Engineer Pamphlets.

(1) EP 310-1-6, Graphics Standards Manual (December 1980), Change 1.

This manual is a reference book for use by all Corps activities. It establishes a unified approach regarding the use of Corps logotype and preparation of visual communications. The manual covers use of the logo in business cards, signs, publications, forms, vehicles, and miscellaneous items.

(2) EP 1105-2-35, Public Involvement and Coordination (5 February 1982), Change 1.

This regulation provides guidance for public involvement and coordination in the Corps planning processes.

(3) EP 1165-2-501, Environmental Policies, Objectives, and Guidelines for the Civil Works Program of the Corps of Engineers (18 December 1988).

This regulation provides a summary of the environmental policies, objectives, and guidelines for the Civil Works Program.

e. Engineer Regulations.

(1) ER 202-2-2, Policy and Procedures for Implementing NEPA (1 November 1971), Change 3.

This regulation provides policy and procedural guidance to supplement the Council of Environmental Quality regulations and requirements, as well as consideration related to NEPA.

(2) ER 405-1-12, Real Estate Handbook (20 November 1985), Change 25.

This handbook provides guidance for real estate activity on Corps of Engineers projects.

(3) ER 1105-2-20, Project Purposes Planning Guidance (29 January 1982), Change 3.

This regulation provides policy guidance to project purposes of navigation, flood damage reduction, shore protection, hydroelectric power, recreation, and water supply. The guidance covers the subject of Federal interest, types of projects and facilities provided, and Federal and non-Federal participation. Guidance for the project purposes of fish and wildlife enhancement and water quality is contained in ER 1105-2-50.

(4) ER 1105-2-50, Environmental Resources (29 January 1982), Change 2.

This regulation is consistent with the national policies to both create and maintain conditions under which human and natural environments can exist in productive harmony, and to preserve important aesthetic, historical, and archaeological resources. This regulation provides requirements for environmental resource planning. Chapter 2 provides guidance for the consideration of fish and wildlife resources in Civil Works planning studies. Chapter 3 discusses historic preservation, chapter 4 discusses water quality issues, and chapter 5 discusses aesthetic resources (draft).

(5) ER 1110-1-102, Design for the Physically Handicapped (15 October 1976).

This regulation stipulates procedures and responsibilities to assure compliance with established criteria.

(6) ER 1110-2-400, Design of Recreation Sites, Areas, and Facilities (31 May 1988), Change 1.

This regulation provides information and criteria related to the planning and design of recreation facilities at water resource projects.

(7) ER 1130-2-400, Management of Natural Resources and Outdoor Recreation at Civil Works Water Resource Projects (1 June 1986), Changes 1-2.

This regulation provides policy and procedural guidance for the administration and management of Civil Works water resource projects. The objectives are to manage natural resources on Corps lands to insure their continued availability, to provide outdoor recreation opportunities, and to provide a safe and healthful environment for project visitors. This regulation also requires, and gives guidance for, operational management plans.

(8) ER 1130-2-405, Use of Off-Road Vehicles on Civil Works Projects (17 January 1974).

This regulation provides uniform policies, procedures, and criteria for designations of project lands where use of off-road vehicles will and will not be permitted.

(9) ER 1130-2-411, Regulation of Seaplane Operations at Civil Works Water Resource Development Projects (15 November 1977).

This regulation is designed to provide uniform policies and criteria for designating Corps projects, or portions thereof, at which seaplane operations are prohibited, restricted, or allowed.

(10) ER 1130-2-413, Pest Control Program for Civil Works Projects (1 February 1982).

This regulation is to assign responsibilities and prescribe procedures concerning the use of chemicals in the Corps' pest control program at all civil works projects.

(11) ER 1130-2-435, Project Operations Preparation of Master Plans (30 December 1987).

This regulation provides policy and procedure for the conduct of the Corps' Civil Works Master Planning Program, as well as guidance for the preparation of master plans.

(12) ER 1165-2-400, Recreation Planning, Development, and Management Policies (9 August 1985).

This regulation defines the objectives and basic policies governing planning, development, and management of outdoor recreation resources, as well as enhancement of fish and wildlife at Corps of Engineers water resource projects.

Supporting Data - Item 3

Pertinent Data (September 1993)

1. General.

Official Name:	Mill Creek, Washington*
U.S. Army Corps of Engineers Reference:	Mill Creek Project
Location:	
State	Washington
County	Walla Walla
Stream	Mill Creek
Construction Completion Dates:	
Dam and appurtenant works	1942
Mill Creek Channel	1949
Owner:	U.S. Government
Managers:	U.S. Army Corps of Engineers and Mill Creek Flood Control Zone District
Authorized purposes	Flood control and recreation
Type of Project	Channelization and off-stream storage
Real Estate**	611.46 acres of fee lands 87.27 acres of easement lands

*Authorizing legislation is Public Law 75-761, as amended by Public Law 77-228.
**These figures represent data from the Walla Walla District's Geographic Information System. Legal real estate documents may vary slightly.

2. Federally-Owned Units.

a. Diversion Works.

Diversion Dam:

Spillway:

Type	Ambursen, ogee crest
Length at crest, feet	250
Crest elevation	1261
Height, feet	14
Design discharge, cfs (with water surface elevation 1268	17,000
Concrete structure top elevation	1270
Stilling basin length, feet	24
Stilling basin invert elevation	1245
Type	Radial sluice gate
Size, feet	6 by 8
Number	1
Sill elevation	1247
Control	Manual, with portable engine drive
Maximum allowable discharge, cfs	400

Fish Ladder:

Width, feet	6.5
Capacity, cfs	42
Operating range elevation	1253 to 1256
Intake invert elevation	1250.25
Exit invert elevation	1245

Stilling Basin:

Length, feet	4
Width, feet	19.5
Floor elevation	1242
End sill elevation	1244

Diversion Levee:

Type	Earthfill with heavy gravel face
Crest elevation, feet	1270 to 1280
Length at crest, feet	2,200
Top width, feet	12
Maximum height, feet	23
Design freeboard (standard project flood), feet	5

b. Debris Facilities:

Debris Barriers:

Location	Diversion Dam forebay
Length, feet	550
Type	Steel crib and cable

Shear Wall:

Location	Headworks Intake Canal
Length, feet	90
Type	Panel

c. Intake Canal Facilities

Headworks:

Type	Concrete non-overflow with radial gates
Gate size, feet	8 by 18
Number	4
Sill elevation	12525
Control	Manual (optional use of portable electric operator)

Canal:

Intake canal end, elevation	1,250
Invert elevation	1,252
Capacity, cfs	7,000
Intake canal base width, feet	60
Intake canal length, feet	1,800

d. Off-Stream Storage Reservoir (Virgil B. Bennington Lake)

Name: Virgil B. Bennington Lake*	
Maximum pool elevation for flood control	1265
Capacity at elevation 1265, acre-feet	8,300
Maximum allowable time for storage above elevation 1235 (due to seepage)	15 days
Capacity at elevation 1235 acre-feet	3,300

e. Storage Dam (Mill Creek Dam)

Type: Earthfill with heavy gravel face

Crest elevation	1,270
Length at crest, feet	3,200
Top width, feet	20
Height above valley floor, feet	125
Toe of embankment, elevation	1,150
Cutoff wall top, elevation	1,214
Top of embankment blanket protection, elevation	1,270
Maximum width at base	800
Embankment toe drains:	.
Date nine wells rehabilitated, year	1,979
Drainage discharge header, elevation	1,135
CMP manhole diameter, inches	48

f. Outlet Works:

Intake Tower:

Slide gate, centerline elevation	1179
Intake tower, weir overflow elevation	1212
Lower sluice gate, centerline elevation	1189

Beneath Dam:

Type	Steel pipe
Diameter, inches	42
Length, feet	900
Discharge pipe, elevation (varies)	1147.5 to 1181

To Mill Creek Return Canal:

Valve type	Butterfly valve
Diameter, inches	42
Length, feet	460
Invert elevation at discharge end	1210

To Russell Creek Canal:

Pipe Diameter, inches	36
Length, feet	125
Howell-Bunger valve, elevation	1147.5

g. Outlet Canals.

Mill Creek Return Canal:

Type	Trapezoidal
Slope	.0008
Lining	Shotcrete
Hydraulic capacity, cfs	190
Invert elevation at discharge end, feet	1210

Russell Creek Canal:

Type	Trapezoidal
Slope	0.01
Lining	Concrete
Hydraulic capacity, cfs	250
Howell-Bunger valve elevation	1147.5

h. Division Works.

First Division Works:

Mill Creek:

Gate type	Vertical lift gate
Size of opening:	.
Total width of openings, feet	97
Height, feet	6
Channel capacity, cfs	3,500
Barrier height, feet	2

To Yellowhawk-Garrison Canal:

Gate type	Radial lift gate
Total width of openings, feet	14
Height, feet	6

Fish Ladder:

Operating elevations:

Width	8
Ladder design capacity, cfs	15
Slope	0
Entrance invert elevation	1170
Exit invert elevation	1170

Second Division Works:

Yellowhawk Creek:

Gate type	Ungated
Channel capacity, cfs	60

Garrison Creek:

Gate type	Slide gate
Channel capacity, cfs	10

*For the purpose of consistency with existing Mill Creek Project documents, the use of the terms "pool," "reservoir," or "lake" is used interchangeable. The body of water currently known as Virgil B. Bennington Lake has, in the past, also been referred to as "pool," "Mill Creek Reservoir," and "Mill Creek Lake."

3. Mill Creek Flood Control Zone District Units

a. Gose Street to Mullan Avenue:

Type	Riprapped levee
Length, miles	1.9
Capacity, cfs	3,500

b. Mullan Avenue to Roosevelt Street:

Type	Concrete-lined
Length, miles	2.2
Capacity, cfs	5,400

c. Roosevelt Street to Diversion Dam:

Type	Riprapped levee
Length, miles	2.8
Capacity, cfs	3,500

4. Hydrologic Data

5-year flood event, natural, cfs	2,000
5-year flood event, regulated, cfs	1,470*
100-year flood event, natural, cfs	7,050
100-year flood event, regulated, cfs	3,500
Standard project flood, cfs	11,300
Largest flood, 1931, cfs	6,000
Mill Creek drainage basin above Mill Creek at Walla Walla stream gage (square miles)	96

*1,400 cfs in Mill Creek and 70 cfs in Yellowhawk and Garrison Creeks.

Supporting Data - Item 4

Geographic Information Systems

a. Regional Files.

	Theme	GIS File
B	Birds Birds Boundary Big Game	regbirds1.dgn regbirds2.dgn regbound.dgn regbgame.dgn
C	Cities	regcities.dgn
D	Dams	regdam.dgn
G	Geology	reggeol.dgn
H	Hydrography Hydrologic Basins	reghydro.dgn regbasins.dgn
L	Land Ownership Land Cover Vegetation Land Use and Cover Level Logs	regowner.dgn regveg.dgn regland.dgn reglevlog.dgn
M	Mammal	regmammal.dgn
P	Physiography Plate Border Precipitation	regphysio.dgn mprbrdr.dgn regprec.dgn
R	Raptors Recreation Areas Regional Market	regraptor.dgn regrec.dgn regmarket.dgn
S	Soils Survey	regsoils.dgn regsurvey.dgn
T	Topography Transportation	regtop2d.dgn regtrans.dgn
U	Upland Game USGS 7 1/2 min. quad index	regupgame.dgn regkey.dgn
W	Waterfowl	regwfowl.dgn

b. Mill Creek Project Files.

	Theme	GIS File
A	Air Photos (1988) Aspect	mclairp88.dgn mclaspect.dgn
B	Boundary	Mclbound.dgn
C	City of Walla Walla City/County Comp Plan Current Project Signs	walla2.dgn mclcccpl.dgn mclcsign.dgn
F	Facilities	mclfacil.dgn
G	Graphic Examples	graphics.dgn
H	Hunting Zones Hydrography Hydro Polygons	mclhuntz.dgn mclhydro.dgn mclhydrop.dgn
L	Land Allocation Land Class (USACE) Land Cover/Veg Elev Land Cover Vegetation Land Ownership Level Logs	mcllallo.dgn mcllclass.dgn mcllcvelv.dgn mcllcveg.dgn mclowner.dgn mcllevlog.dgn
O	Outgrants	mcloutg.dgn
P	Planned Signs Plate Border	mclpsign.dgn mpbrdr.dgn
R	Real Estate Tracts Recreation Faciliites RE Segment Border RE Segment Plates	mcltracts.dgn mclfacil.dgn sgmclbrdr.dgn sgmcl0001.dgn
S	Slope Soils Survey	mclslope.dgn mclsoil.dgn mclsurvey.dgn
T	Topography Transportation	mcltopo.dgn mcltrans.dgn
U	Utilities	mclutil.dgn
V	Vegetation Development	mclvegdev.dgn
W	Wildlife Wildlife Facilities	mclwlife.dgn mclfacil.dgn

c. Project Features.

Name	Code	Table	Type	LV	ST	WT	CO	Cell
Category Name: aspect								
aspect_outline	060003	.	boundary	3	0	1	0	
aspect_text	060004	.	label	4	0	0	0	
aspect_centroid	060005	aspect_zones	centroid	5	0	3	7	
Category Name: boundaries								
boundary_state	500003	.	line	3	6	5	0	
boundary_state_text	500004	.	label	4	0	1	0	
boundary_county	500006	boundary	line	6	6	1	3	
boundary_county_text	500007	.	label	7	0	0	3	
boundary_unicorp_county_outline	500009	boundary	boundary	9	0	0	4	
boundary_unicorp_county_text	500010	.	label	10	0	0	4	
boundary_unicorp_county_centroid	500011	boundary	centroid	11	0	3	8	
boundary_city_outline	500012	.	boundary	12	8	2	1	
boundary_city_text	500013	.	label	13	0	0	1	
boundary_city_centroid	500014	boundary	centroid	14	0	3	8	
boundary_wwcc_wwregairport_text	500016	.	label	16	0	0	0	
boundary_usace_non_mon	500033	boundary	line	33	7	1	2	
boundary_usace_non_mon_distance	500034	.	label	34	0	0	2	
boundary_usace_monumented	500036	boundary	line	36	7	3	3	
boundary_usace_monum_distance	500037	.	label	37	0	1	3	
boundary_usace_flow_ease_non_mon	500042	boundary	line	42	7	1	1	
boundary_usace_flow_e_non_mon_tx	500043	.	label	43	0	1	1	
boundary_usace_canalroad_non_mon	500045	boundary	line	45	7	1	200	
boundary_usace_cenalroad_nmon_tx	500046	.	label	46	0	1	200	
boundary_usgs_7.5_map_index	500060	maps	line	60	0	0	2	
boundary_usgs_7.5_map_index_text	500061		label	61	0	0	2	
Category Name: city_cnty_zoning								
cc_comp_plan_wwcounty_outline	940003	.	boundary	3	0	1	0	
cc_comp_plan_wwcounty_text	940004	.	label	4	0	0	6	
cc_comp_plan_wwcounty_centroid	940005	zoning	centroid	5	0	3	8	
cc_comp_plan_wwcity_outline	940033	.	boundary	33	0	1	2	
cc_comp_plan_wwcity_text	940034	.	label	34	0	0	2	
cc_comp_plan_wwcity_centroid	940035	zoning	centroid	35	0	3	7	

Category Name: facilities								
dam_mcl_outline	800003		boundary	3	0	1	140	
dam_mcl_text	800004		label	4	0	0	140	
dam_mcl_centroid	800005	.	centroid	5	0	3	7	
water_struct_misc	800006	.	line	6	0	1	3	
water_struct_misc_text	800007	water_struct	label	7	0	0	3	
water_struct_misc_centroid	800008	water_struct	centroid	8	0	3	7	
building_outline	800009	.	boundary	9	0	2	2	
building_text	800010	water_struct	label	10	0	0	2	.
building_centroid	800011	.	centroid	11	0	3	7	.
building_restroom_outline	800012	.	boundary	12	0	0	1	.
building_restroom_text	800013	buildings	label	13	0	1	1	.
building_restroom_centroid	800014	.	centroid	14	0	3	7	.
building_off_project	800015	.	line	15	0	1	4	.
building_off_project_text	800016	buildings	label	16	0	0	4	.
sidewalk_curb_walls	800018	buildings	line	18	0	0	7	.
sidew_curb_wall_text	800019	.	label	19	0	0	7	.
fence_usace_inside_project	800021	trail_walks	line	21	4	1	6	.
fence_on_usace_boundary	800024	.	line	24	1	1	1	.
fence_off_project	800026	fences	line	26	4	2	4	.
irrigation_facilities	800030	fences	line	30	4	0	0	.
lightpole_exteriorlights	800033	fences	line	33	0	2	0	.
culvert_drains_etc	800035	.	line	35	5	0	4	.
guardrail	800037	.	line	37	0	0	6	.
telephone_booth	800039	.	line	39	0	2	5	.
telephone_booth_text	800040	fences	label	40	0	2	5	.
playground	800046	.	line	46	0	2	5	.
playground_text	800047	.	label	47	0	2	5	.
volleyball_court	800048	.	line	48	0	2	2	s00020
volleyball_court_text	800049	.	label	49	0	1	2	
traffic_counter_survey_area	800052	.	line	52	0	1	5	
traffic_counter_survey_area_text	800053	.	line	53	0	0	5	
boat_dock_outline	800054	.	line	54	0	2	0	
wildlife_structure_point	800057	.	point	57	0	1	6	
wildlife_structure_text	800058	.	label	58	0	1	6	
fish_passage_outline	800060	habitat_struct	line	60	0	1	2	
fish_passage_text	800061		label	61	0	1	2	
Category Name: hunt_zone								
hunting_zones_usace_outline	930003	.	boundary	3	0	0	0	
hunting_zones_usace_text	930004	.	label	5	0	0	0	
hunting_zones_usace_centroid	930005	boundary	centroid		0	3	7	

Category Name: hydrography								
stream_perenial_major_outline	200003	.	boundary	3	0	1	7	
stream_per_major_text	200004	.	label	4	0	1	7	
stream_per_major_centroid	200005	hydrography	centroid	5	0	3	7	
stream_perennial_minor_outline	200006	hydrography	line	6	0	1	10	
stream_perennial_minor_text	200007	.	label	7	0	1	10	
stream_intermit_outline	200008	.	boundary	9	0	1	9	
stream_intermittent_text	200009	.	label	10	0	1	9	
stream_intermittent_centroid	200010	hydrography	centroid	11	0	3	7	
lake_perennial_reservoir_outline	200011	.	boundary	12	0	0	6	
lake_perennial_reservoir_text	200012	.	label	13	0	1	6	
lake_perennial_reservoir_centrd	200013	hydrography	centroid	14	0	3	7	
millcrk_pre1941_utline	200014	.	boundary	18	1	0	2	
millcrk_pre1941_text	200018	.	label	19	0	1	2	
millcrk_pre1941_centroid	200019	hydrography	centroid	20	0	3	7	.
river_mile	200020	.	point	30	0	0	0	.
river_mile_text	200030	.	label	31	0	1	0	.
lake_vbb_elev_1270_freeboard_ou	200036	.	boundary	36	0	0	124	.
lake_vbb_elev_1270_freeboard_tex	200037	.	label	37	0	0	124	.
lake_vbb_elev_1270_freeboard_cen	200038	hydrography	centroid	38	0	3	7	.
lake_vbb_elev_1265_max_outline	200039	.	boundary	39	0	0	129	.
lake_vbb_elev_1265_max_text	200040	.	label	40	0	0	129	.
lake_vbb_elev_1265_max_centroi	200041	hydrography	centroid	41	0	3	7	.
lake_vbb_elev_1257_5_flood_outl	200042	.	boundary	42	0	0	42	.
lake_vbb_elev_1257_5_flood_text	200043	.	label	43	0	0	42	.
lake_vbb_elev_1257_5_flood_cent	200044	hydrography	centroid	44	0	5	7	.
lake_vbb_elev_1217_outline	200045	.	boundary	45	1	0	0	.
lake_vbb_elev_1217_feet	200046	.	label	46	0	0	0	.
lake_vbb_elev_1217_centroid	200047	hydrography	centroid	47	0	3	7	s00006
lake_vbb_elev_1214_line_outline	200048	.	boundary	48	0	0	2	
lake_vbb_elev_1214_line_text	200049	.	label	49	0	0	2	
lake_vbb_elev_1214_line_centroid	200050	hydrography	centroid	50	0	3	7	
lake_vbb_elev_1212_pro_con_outl	200051	.	boundary	51	4	0	6	
lake_vbb_elev_1212_pro_con_text	200052	.	label	52	0	0	6	
lake_vbb_elev_1212_pro_con_cent	2000053	hydrography	centroid	53	0	3	7	
lake_vbb_elev_1205_conserv_outli	200054	.	boundary	54	0	0	24	
lake_vbb_elev_1205_conserv_text	200055	.	label	55	0	1	24	
lake_vbb_elev_1205_conserv_cent	200056	hydrography	centroid	56	0	3	7	
lake_vbb_elev_1185(87.6)_min_out	200057	.	boundary	57	0	0	9	
lake_vbb_elev_1185(87.6)_min_text	200058	.	label	58	0	0	9	
lake_vbb_elev_1185(87.6)_min_cen	200059	hydrography	centroid	59	0	3	7	
lake_vbb_name_text	200061	hydrography	label	61	0	0	0	
Category Name: land_ownership								
land_ownership_outline	600003	.	boundary	3	0	1	0	
land_ownership_text	600004	.	label	4	0	0	0	
land_ownership_centroid	600005	ownership	centroid	5	0	3	7	
Category Name: landcover								
land_cover_veg_outline	300003	.	boundary	3	0	1	0	
land_cover_veg_text	300004	.	label	4	0	0	0	
land_cover_veg_centroid	300005	non_forest_veg	centroid	5	0	3	7	

Category: outgrants								
outg_reservations_public	620015	.	boundary	15	4	2	139	
outg_reservation_public_text	620016	.	label	16	0	0	139	
outg_reservation_public_centroid	620017	out_grants	centroid	17	0	3	139	
outg_reservation_private_outline	620018	.	boundary	18	4	2	177	
outg_reservation_private_text	620019	.	label	19	0	1	177	
outg_reservation_private_cent	620020	out_grants	centroid	20	0	3	7	
outg_permit_area_outline	620027	.	boundary	27	0	2	3	
outg_permit_text	620028	.	label	28	0	0	3	
outg_permit_area_centroid	620029	out_grants	centroid	29	0	3	7	
outg_easement_public_area	620045	out_grants	boundary	45	0	2	231	
outg_easement_public_text	620046	.	label	46	0	0	231	
outg_easement_public_centroid	620047	out_grants	centroid	47	0	3	7	
outg_easement_private_outline	620048	.	boundary	48	0	2	139	
outg_easement_private_text	620049	.	label	49	0	0	139	
outg_easement_private_centroid	620050	out_grants	centroid	50	0	3	7	
outg_easement_underground_outl	620051	out_grants	boundary	51	3	2	6	
outg_easement_underground_text	620052	.	label	52	0	0	6	
outg_easement_underground_cent	620053	out_grants	centroid	53	0	3	7	
outg_easement_flowage_outline	620054	.	boundary	54	0	2	234	
outg_easement_flowage_text	620055	.	label	55	0	0	234	
outg_easement_flowage_centroid	620056	out_grants	centroid	56	0	3	7	
outg_easement_outlet_canal_outl	620057	.	boundary	57	1	2	238	
outg_easement_outlet_canal_text	620058	.	label	58	0	0	238	
outg_easement_outlet_canal_cent	620059	out_grants	centroid	59	0	3	7	
outg_easement_rooks_park_rd_outl	620060	.	boundary	60	0	2	4	
outg_easement_rooks_park_rd_text	620061	.	label	61	0	0	4	
outg_easement_rooks_park_rd_ce	620062	out_grants	label	62	0	3	7	
Category Name: slope								
slope_outline	050003	.	boundary	3	0	1	0	
slope_text	050004	.	label	4	0	0	0	
slope_centroid	050005	slope_areas	centroid	5	0	3	7	
Category Name: soils								
soil_area_outline	150003	.	boundary	3	0	1	0	
soil_area_text	150004	.	label	4	0	0	0	
soil_area_centroid	150005	soil_map_units	centroid	5	0	3	7	

Category Name: survey								
survey_plss_mon_township_range	550003		point	3	0	3	3	s00033
survey_plss_town_range_text	550004		label	4	0	1	3	.
survey_plss_town_range_outline	550005		boundary	5	3	4	3	.
survey_plss_town_range_centroid	550006		centroid	6	0	3	7	.
survey_plss_section_corners	550007		point	7	0	3	3	s00006
survey_plss_section_number	550008		label	8	0	0	3	.
survey_plss_section_outline	550009		boundary	9	2	0	3	.
survey_plss_section-cent	550010		centroid	10	0	3	7	.
survey_plss_subsection_monument	550011		point	11	0	1	6	s00033
survey_plss_subsections_text	550012		label	12	0	3	6	.
survey_plss_lots_monumentation	550015		point	15	0	1	4	s00033
survey_plss_lots_text	550016		label	16	0	3	0	.
survey_plss_lots_outline	550017		boundary	17	4	4	4	.
survey_plss_lots_centroid	550018		centroid	18	0	0	7	.
coordinates_state_plan	550030		point	30	0	0	1	s00006
survey_usace_project_monuments	550033		point	33	0	3	3	s00033
survey_usace_project_mon_text	550034		label	34	0	3	3	.
survey_usace_airphoto_monuments	550036		point	36	0	1	1	s00033
survey_usace_airphoto_control_tx	550037		label	37	0	1	1	.
survey_usace_sedim_range_monumen	550039		point	39	0	1	5	s00033
survey_usace_sediment_range_text	550040		label	40	0	1	5	.
survey_usace_cbl_monuments	550042		point	42	0	1	2	s00033
survey_usace_cbl_mon_text	550043		label	43	0	1	2	.
survey_usace_mics_monuments	550045		point	45	0	1	39	s00033
suvey_usace_mics_mon_text	550046		label	46	0	1	39	
Category Name: topography								
elevation_spot	020003	.	point	3	0	0	7	
elevation_spot_text	020004	.	label	4	0	0	7	
countours_2_ft	020009	.	line	9	0	0	217	
contours_10_f	020015	.	line	15	0	0	232	
contours_10_ft_text	020016	.	label	16	0	0	232	s00012
countours_10_ft_outline	020017	.	boundary	17	0	0	232	
countours_50_ft	020024	.	line	24	0	0	232	
countours_50_ft_text	020025	.	label	25	0	0	232	
countours_50_ft_outline	020026	.	boundary	26	0	0	232	
countours_50_ft_centroid	020027	elevation_zone	centroid	27	0	3	7	
Category Name: tract_real_estate								
real_estate_tract_pre1943_out	610003	.	boundary	3	0	1	0	
real_estate_tract_pre1943_text	610004	.	label	4	0	0	0	
real_estate_tract_centroid	610005	tract	centroid	5	0	3	7	
real_estate_tract_post1943_out	610006	.	boundary	6	0	1	2	
real_estate_tract_post1943_text	610007	.	label	7	0	0	2	
real_estate_tract_post1943_cent	610008	tract	centroid	8	0	3	7	
real_estate_disposal_outline	610033	.	boundary	33	0	0	5	
real_estate_disposal_text	610034	.	label	34	0	0	5	
real_estate_tract_disposal_cent	610035	disposal	centroid	35	0	3	7	
real_estate_proposed_disposal_o	610053	.	boundary	53	0	0	6	
proposed_disposal_text	610054	.	label	54	0	0	6	
real_estate_proposed_disposal_c	610055	tract	centroid	55	0	3	7	

Category Name: transportation								
highway_us_outline	700006	.	boundary	6	0	3	3	
highway_us_text	700007	.	label	7	0	0	3	
highway_us_centroid	700008	roads	centroid	8	0	3	7	
highway_state_outline	700009	.	boundary	9	0	2	2	
highway_state_text	700010	.	label	10	0	0	2	
highway_state_centroid	700011	roads	centroid	11	0	3	7	
road_major_citycounty_outline	700012	.	boundary	12	0	1	5	
road_major_citycnty_text	700013	.	label	13	0	0	5	
road_major_citycounty_centroid	700014	roads	centroid	14	0	3	7	
road_secodnary_citycounty_outl	700015	.	boundary	15	0	0	0	
road_secondary_citycounty_text	700016	.	label	16	0	0	0	
road_secondary_citycnty_centroid	700017	roads	centroid	17	0	30	7	
road_private	700018	roads	line	18	0	0	1	
road_wwcommcollege	700024	roads	line	24	0	0	4	
road_port_wallawalla	700027	roads	line	27	0	0	200	
road_port_ww_text	700028	.	label	28	0	0	200	
airport_runway	700030	.	line	30	0	0	33	
airport_runway_text	700031	.	label	31	0	0	33	
road_usace_major_paved_outline	700033	roads	boundary	33	0	4	3	
road_usace_major_paved_text	700034	.	label	34	0	2	3	
road_usace_major_paved_centroid	700035	roads	centroid	35	0	3	7	
road_usace_paved_minor_outline	700036	.	boundary	36	0	2	2	
road_usace_minor_paved_text	700037	.	label	37	0	3	2	
road_usace_minor_paved_centroid	700038	roads	centroid	38	0	3	7	
road_usace_gravel	700039	roads	line	39	3	0	5	
road_usace_gravel_text	700040	.	label	40	0	1	5	
road_usace_gravel_centroid	700041	roads	centroid	41	0	3	7	
road_usace_dirt	700042	roads	line	42	2	0	0	
road_usace_dirt_tet	700043	.	label	43	0	1	0	
raod_usace_dirt_centroid	700044	roads	centroid	44	0	3	7	
trail_usace_constitutional	700045	trail_walks	line	45	0	0	4	
trail_usace_constit_text	700046	.	label	46	0	1	4	
trail_usace_constit_centroid	700047	trail_walks	centroid	47	0	3	7	
trail_usace_mill_cr_recreation	700048	trail_walks	line	48	0	0	6	
trail_usace_mc_recreation_text	700049	.	label	49	0	1	6	
trail_usace_south_levee_line	700051	trail_walks	line	51	0	0	2	
trail_usace_south_levee_text	700052	.	label	52	0	1	2	
trail_other	700054	trail_walks	line	54	0	0	0	
trail_other_text	700055	.	label	55	0	0	0	
trail_on_road	700056	trail_walks	line	56	5	0	4	
trail_on_road_text	700057	.	label	57	5	0	4	
railroad	700058	roads	line	58	0	0	1	
railroad_text	700059		label	59	0	0	1	

Category Name: usace_land_class								
usace_land_class_1961_outline	900006	.	boundary	6	0	1	0	
usace_land_class_1982_outline	900012	.	boundary	12	0	1	0	
usace_land_class_1982_text	900013	.	label	13	0	0	0	
usace_land_class_1982_centroid	900014	proj_mgt_unit	centroid	14	0	3	7	
usace_land_class_1992_outline	900015	.	boundary	15	0	1	0	
usace_land_class_1992_text	900016	.	label	16	0	0	0	
usace_land_class_1992_centroid	900017	proj_mgt_unit	centroid	17	0	3	7	
management_units_outline	900018	.	boundary	18	0	1	0	
management_units_text	900019	.	label	19	0	1	0	
management_units_centroid	900020	proj_mgt_unit	centroid	20	0	3	7	
Category Name: wildlife								
columbia_ground_squirrel_outline	450003	.	boundary	3	0	1	0	
columbia_ground_squirrel_text	450004	.	boundary	4	0	1	0	
columbia_ground_squirrel_centrod	450005	wildlife_ranges	boundary	5	0	3	0	

Supporting Data - Item 5

List of Aerial Photography

List of Aerial Photography								
49-2V	93-153	11/3	12700	305	Del	12000	xx	.
56-54V	1-33	9/22	16500	153.21	PAS	30000	xx	WW to Blue Cr & Ore line
58-72V	146-167	6/5	11500	153.21	PAS	21000	xx	.
65-4	17-18	3/17	2700	152.62	WWD	3000	x	Rook Park Vic
68-1	155-186	1/26	4300	152.62	WWD	6000	xx	Walla Walla Area
68-15	131-157	11/14	6000	152.62	WWD	5000	x	Near Walla Walla
69-11	138-145	9/22	4100	152.62	WWD	5000	x	Walla Walla Area
70-2	154-170	2/19	4000	152.62	WWD	6000	xx	Rec Study
70-5	221-229	4/27	3350	152.42	WWD	4200	x	Reservoir
70-6	179-192	5/16	4000	152.42	WWD	6000	x	Reservoir
71-5	4-41	6/16	4500	152.42	WWD	5000	xx	.
72-3	15-27	3/30	4000	152.42	WWD	5000	xx	Kooskooskie Area
73-5	126-151	4/10	4000	152.92	WWD	6000	xx	Reservoir Area
75-3	93-114	4/1	4000	152.28	Map	5500	xx	Reservoir & Rooks Park Area
76-1	106-113	3/4	7000	152.25	Map	12000	xx	Reservoir
76-1	114-140	3/4	3700	152.25	Map	5000	xx	Reservoir Area
76-1	156-163	3/23	4000	152.25	Map	5600	xx	Levee Area U/S Rooks Park
76-10	70-78	10/8	3600	152.25	Map	4800	x	Reservoir Outlet-FALSE COLOR
76-10	156-164	10/8	3600	152.25	Map	4800	x	Reservoir Outlet
77-1	55-61	2/15	4000	152.25	Map	5500	xx	Levee Area U/S Rooks Park
77-5	177-186	6/14	3500	152.25	Map	4800	xx	Reservoir Outlet
77-5	187-193	6/14	3500	152.25	Map	4800	xx	Reservoir Outlet Channel
77-6	136-142	8/5	3500	152.25	Map	4800	xx	Reservoir Outlet Channel
77-6	143-147	8/5	2750	152.25	Map	3600	xx	Reservoir
77-20	200-259	10/4	37/4500	152.25	Map	6000	xx	Mouth to Blue Creek
77-22	161-189	11/30	2700	152.25	Map	3000	xx	Inlet, Outlet, Reservoir
78-1	45	1/23	10500	152.25	Map	18000	x	Reservoir
78-1	69-87	3/10	7200	152.25	Map	12000	xx	Reservoir & Titus Creek
78-1	109-126	3/10	7750	152.25	Map	12000	xx	Blue Creek to State Line
79-1	233-272	3/13	13500	304.80	Map	12000	xx	Mouth to State Line
79-2	1-28	4/5	7200	152.25	Map	6000	x	Reservoir-Inlet and Outlets
79-6	24-40	9/7	13800	304	Map	12000	x	Mill Crk-Blue Crk to State Line
1980								
80-1	107-115	2/4	3400	152.25	Map	3000		Mill Crk, Wichershak Bridge Area U/S
1981								
81-3	189-192	8/28	7200	153.23	AMC	1;12000	x	Mill Creek Reservoir (looking only)
1982								
82-17	15	8/19			Map	1;6000		Mill Creek Dam (color) P.P.
82-17	46	9/16			WAC	1;6000		Mill Creek Dam P.P.
1983								
83-1	31-41	1/11		152.35	WAC	1;6000		Mill Creek Dam and Reservoir
1984								
84-1	175-274	1/29			WAC	1;12000		Mill Creek Reservoir (Partial flight) 60 + %
84-3	32-255	5/7			WAC	1;12000		Mill Creek Reservoir
84-3	256-310	5/7			WAC	1;6000		Mill Creek Reservoir
84-4	59	6/1			WAC	1;12000		Mill Creek Dam P.P. (Infra-red color)
84-4	60-77	6/1			WAC	1;6000		Dam Area & D/S Seepage (Infra-red color)
84-4	78	6/1			WAC	1;12000		Mill Creek Dam P.P.
84-4	79-84	6/1			WAC	1;6000		Dam Area, Concrete Outlet Channel
84-5	1-9	7/26			WAC	1;12000		Mill Creek "Seepage" (Color "IR")
84-5	10-33	7/26			WAC	1;6000		Mill Creek "Seepage" (Color "IR")
84-5	101-132	7/26			WAC	1;6000		Mill Creek "Seepage" (Color)

1985								
85-7	78-80 87-90	8/31 9/3			WAC WAC	1;12000 1;12000		Mill Creek Reservoir (20%) Mill Creek Channel Area (20%)
1987								
87-9 87-9 87-9	1-8 10-13 14-29	11/17 11/17 11/17			Map Map Map	1;12000 1;2400 1;2400		Mill Creek Dam & Reservoir (60%) Mill Creek Dam Parking Area (60%) Mill Creek, Vic Rooks Park (60%)
1988								
88-1	234-257 258-274 275-282	2/18 2/18 2/18			Map Map Map	1;6000 1;12000 1;24000		Mill Creek Dam (60%) for Topo, all flights Mill Creek Dam (60%) are controlled for Mill Creek Dam (60%) stero work

Supporting Data - Item 6

Mill Creek Lake - Total Monthly Evaporation
Whitman Mission, Washington
(Elevation 623)

Year	April	May	Jun	Jul	Aug	Sep	Apr-Sep Total
1963	4.22	6.65	10.47	10.49	9.63	5.93	47.39
1964	5.84	7.10	8.77	10.43	9.09	6.00	47.23
1965	5.06	6.71	9.10	10.87	9.01	5.84	46.59
1966	5.43	7.27	8.72	10.23	9.98	6.12	47.75
1967	3.67	6.21	7.77	11.86	10.97	6.80	47.28
1968	5.01	7.49	8.99	11.43	7.74	5.28	45.94
1969	4.06	6.28	9.18	10.95	9.78	5.82	46.07
1970	4.64	7.21	8.21	10.97	10.35	5.68	47.06
1971	4.75	6.92	6.71	10.73	9.95	5.02	44.08
1972	4.81	6.63	8.46	10.14	8.86	5.99	44.89
1973	5.57	8.07	9.05	11.83	10.67	5.65	50.84
1974	4.31	7.10	9.61	9.90	9.97	6.68	47.57
1975	4.36	6.79	7.63	9.93	9.41	5.90	44.02
1976	3.74	7.05	7.86	10.25	7.38	6.10	42.38
1977	6.59	6.51	10.23	11.83	10.17	4.64	49.97
1978	4.11	6.84	9.91	9.84	8.38	4.57	43.65
*1979	5.04	7.81	10.33	12.63	9.10	6.40	51.31
1980	5.40	5.49	7.31	10.31	9.33	5.46	43.30
1981	5.00	5.64	6.56	10.97	9.43	6.16	43.76
1982	4.78	6.73	7.79	9.90	8.97	4.48	42.65
1983	4.30	6.42	7.61	8.98	8.09	4.91	40.31
**1984	4.27	5.30	6.40	9.69	8.73	4.82	39.21
1985	4.53	6.83	8.97	11.61	7.58	4.12	43.64
1986	4.68	6.50	9.30	9.55	9.49	4.84	44.36
1988	4.81	6.81	7.75	10.85	10.29	6.13	46.64
1989	4.77	6.00	9.00	10.13	8.14	5.58	43.62
1990	5.14	5.85	7.846.64	10.30	8.19	6.12	43.44
1991	4.86	5.52	9.28	9.76	8.99	5.76	41.53
1992	4.42	7.96		9.88	8.84	4.41	44.79
Statistics 1963 - 1992 (29 Years)							
N	29	29	29	29	29	29	29
Mean	4.76	6.68	8.46	10.56	9.19	5.56	45.22
Maximum	6.59	8.07	10.47	12.63	10.97	6.80	51.31
Minimum	3.67	5.30	6.40	8.98	7.38	4.12	39.21

*Highest Year
**Lowest Year
Source: Climatological Data, Washington

Supporting Data - Item 7

Vegetation Inventories

7.01. Vegetation Inventory.

The following table lists plant species found in the terrestrial habitats at Mill Creek Project. The source for this table was the Mill Creek Lake Final Environmental Impact Statement (1975).

Vegetation inventory for five areas at Mill Creek Project, Walla Walla, Washington.

/a/ Units are as follows:

1-Forebay
2-Diversion Canal
3-Lake
4-Lake Road
5-Mill Creek Channel

		Areas				
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**
Trees						
Douglas Maple	*Acer glabrum*	X				X
White Alder	*Alnus rhombifolia*	X		.		.
Netleaf Hackberry	*Celtis reticulata*	.		.		.
Redosier Dogwood	*Cornus stolonifera*	.	.	X	.	.
Columbia Hawthorn	*Crataegus columbiana*	.	.	.	.	.
Douglas Hawthorn	*Crataegus douglasii*	X	X	X	.	X
Russian Olive	*Elaeagnus angustifolia*	X	.	X	.	X
Rocky Mountain Juniper	*Juniperus scopulorum*	.	X	X	.	X
Austrian Pine	*Pinus nigra*	X	X	.	X	X
Ponderosa Pine	*Pinus ponderosa*	.	X	X	X	X
Black Cottonwood	*Populus trichocarpa*	X	.	.	.	X
Sweet Cherry	*Prunus avium*	.	X	X	X	X
Sour Cherry	*Prunus cerasus*	.	.	.	.	X
Cultivated Pear	*Pyrus communis*	.	X	.	.	.
Cultivated Apple	*Pyrus malus*	X	.	X	.	X
Black Locust	*Robinia pseudo- acacia*	X	.	.	.	X
Bebb Willow	*Salix bebbiana*	.	.	X	.	X
Coyote Willow	*Salix exigua*	X	.	.	X	X
Pacific Willow	*Salix lasiandra*	X	X	X	X	X
Mackenzie Willow	*Salix rigidia*	X		X		X
Chinese Elm	*Ulmus parvifolia*	X				X

Shrubs						
Saskatoon Serviceberry	*Amelanchier alnifolia*	X	X	X	X	.
Siverian Peashrub	*Caragana arborescens*	.	X	X	X	.
Tam Juniper	*Juniperus sabina*	.	.	.	.	X
Utah Honeysuckle	*Lonicera utahensis*	.	X	X	X	.
.	*Mahonia a*	.	.	.	.	X
Matrimonyvine	*Lycium halimifolium*	.	X	X	X	.
Cultivated Plum	*Prunus domestica*	.	X	X	X	.
Common Chokecherry	*Prunus virginiana*	X	X	X	X	X
Smooth Sumac	*Rhus glabra*	X	X	X	X	X
.	*Rhus typina*	.	.	.	.	.
Cultivated Rose	*Rosa multiflora*	.	X	X	X	.
Nootka Rose	*Rosa nutkana*	X	X	X	X	X
Wood's Rose	*Rosa woodsii*	X	.	.	X	X
Red Raspberry	*Rubus idaeus*	X	.	.	.	.
Evergreen Blackberry	*Rubus laciniatus*	.	.	.	.	X
Thimbleberry	*Rubus parviflorus*	X	.	.	.	.
Pacific Blackberry	*Rubus ursinus*	X	.	.	.	X
Blue Elderberry	*Sambucus cerulea*	X	X	X	X	X
Mountain Snowberry	*Symphoricarpos oreophilus*	X	X	X	X	X
Forbs						
Yarrow	*Achillea millefolium*	X	X	X	X	X
Bastard Indigo	*Amorpha fruticosa*	X	.	.	.	X
Tarweed Fiddleneck	*Amsinckia lycopsoides*	X	X	X	X	X
Rigid Fiddleneck	*Amsinckia retrorsa*	X	X	X	X	X
Mayweed Chamomile	*Anthemis cotula*	X	X	X	X	X
Hemp Dogbane	*Apocynum cannabinum*	.	X	X	.	.
Common Burdock	*Arctium minus*	X	.	.	X	X
Showy Milkweed	*Asclepias speciosa*	X	X	X	X	.
Asparagus	*Asparagus officinalis*	X	X	X	X	X
Shepherd's Purse	*Capsella bursa-pastoris*	X	.	.	X	X
Bachelor's Button	*Centaurea cyanus*	X	.	.	.	X
Yellow Star-Thistle	*Centaurea solsytitiallis*	X	X	X	X	X
Lambsquarter	*Chenopodium album*	X	X	X	X	X
Hairy Goldaster	*Chrysopsis villosa*	X	X	X	X	.
Wild Succory	*Cichorium intybus*	X	.	.	.	X
Canada Thistle	*Cirsium arvense*	X	X	X	X	X
Bull Thistle	*Cirsium vulgare*	X	.	.	.	.
Western Virginsbower	*Clematis ligusticifolia*	X	X	X	X	X
Narrow-Leaf Collomia	*Collomia linearis*	.	X	X	.	.
Poison Hemlock	*Conium maculatum*	X	X	X	X	X
Hare's-Ear Mustard	*Conringia orientalis*	X	X	X	X	X
Field Morning Glory	*Convolvulus arvensis*	X	X	X	X	X
Wild Carrot	*Daucus carota*	X	X	X	X	.
Teasel	*Dipsacus sylvestris*	X	X	X	X	X
Autumn Willow-Weed	*Spilobium paniculatum*	X	X	X	X	X
Field Horsetail	*Equisetum arvense*	X	.	.	.	X
Smooth Scouring-Rush	*Equisetum laevigatum*	X	X	X	X	X
Stork's Bill	*Erodium cicutarium*	X	X	X	X	X
Gaillardia	*Gaillardia aristata*	.	.	.	X	.
Cleavers	*Galium aparine*	X	X	X	X	X
Sticky Purple Geranium	*Geranium viscosissimum*	.	X	X	.	.
Resinweed	*Grindelia squarrosa*	.	X	X	.	.

Common Sunflower	*Helianthus annuus*	.	X	X	.	.
Cow-Parsnip	*Heracleum lanatum*	X	.	.	.	.
Klamath Weed	*Hypericum perforatum*	X	X	X	X	X
Streambank Mallow	*Iliamna rivularis*	X	.	.	.	X
Drummond's Rush	*Juncus drummondii*	.	.	.	.	X
Dagger-Leaf Rush	*Juncus ensofolius*	X	.	.	.	X
Prickly Lettuce	*Lactuca serriola*	X	X	X	X	X
Few-Flowered Peavine	*Lathyrus pauciflorus*	.	.	.	X	.
Clasping Pepperweed	*Lepidium perfoliatum*	X	.	.	X	X
Fern-LEaved Lomatium	*Lomatium dissectum*	.	X	X	.	X
Velvet Lupine	*Lupinus leucophyllus*	X	X	X	X	.
Sweep's Brush	*Luzula campestris*	.	.	.	.	X
Dwarf Mallow	*Malva neglecta*	X	.	.	.	X
Common Horehound	*Marrubium vulgare*	X	.	.	.	X
Pineapple Weed	*Matricaria matricarioides*	X	X	X	X	X
Black Medic	*Medicago lupulina*	X	X	X	X	X
Alfalfa	*Medicago sativa*	X	X	X	X	X
Yellow Sweetclover	*Melilotus officinalis*	X	X	X	X	.
Peppermint	*Mentha piperita*	X	.	.	.	X
Spearmint	*Mentha spicata*	.	.	.	.	X
Yellow Monkey Flower	*Mimulus guttatus*	.	.	.	.	X
Miner's Lettuce	*Montia perfoliata*	.	.	.	.	X
Catnip	*Nepeta cataria*	X	X	X	X	X
Scotch Thistle	*Onopordum acanthium*	X	X	X	X	X
Corn Poppy	*Papaver rhoeas*	X	.	.	.	.
Virginia Creeper	*Parthenocissus quinquefolia*	.	.	.	.	X
Whiteleaf Phacelia	*Phacelia hastata*	.	.	.	.	X
Mockorange	*Philadelphus lewisii*	X	.	.	X	X
Buckhorn Plantain	*Plantago lanceolata*	X	X	X	X	X
Rippleseed Plantain	*Plantago major*	.	.	.	.	X
Prostrate Knotweed	*Polygonum aviculare*	X	X	X	X	X
Self-Heal	*Prunella vulgaris*	.	.	.	.	X
Bracken Fern	*Pteridium aquilinum*	X	.	.	.	X
Creeping Buttercup	*Ranunculus repens*	.	.	.	.	X
Sheep Sorrel	*Rumex acetosella*	X	X	X	X	X
Curly Dock	*Rumex crispus*	X	X	X	X	X
Willow Dock	*Rumex salicifolius*	X	X	X	X	X
Russian Thistle	*Salsola kali*	X	X	X	X	X
Bouncing Bett	*Saponaria officinalis*	.	.	.	.	X
Jim Hill Mustard	*Sisymbrium altissimum*	X	X	X	X	X
Hedge Mustard	*Sisymbrium officinale*	X	.	.	.	X
Climbing Nightshade	*Solanum dulcamara*	X	X	X	.	X
Smooth Goldenrod	*Solidago gigantea*	X	.	.	.	.
Goldenrod	*Solidago sp.*	X	X	X	.	X
Common Sow-Thistle	*Sonchus oleraceus*	X	.	.	.	X
Chickweed	*Stellaria media*	.	.	.	.	X
Common Dandelion	*Taraxacum officinale*	X	X	X	X	X
Yellow Salsify	*Tragopogon dubius*	X	X	X	X	X
Meadow Salsify	*Tragopogon pratensis*	X	.	.	.	X
Puncture-Vine	*Tribulus terrestris*	X	.	.	.	X
Twin Clover	*Trifolium latifolium*	.	.	.	.	X
Common Cattail	*Typha latifolia*	X	X	X	.	X
Big Stinging Nettle	*Urtoca dioica*	X	.	.	.	X
Moth Mullein	*Verbascum blattaria*	X	.	.	.	X
Flannel Mullein	*Verbascum thapsus*	X	.	.	X	X

Bracted Verbena	*Verbena bracteata*	X	X	X	X	X
American Brooklime	*Veronica americana*	.	.	.	.	X
Purslana Speedwell	*Veronica peregrina*	.	.	.	.	X
Hairy Vetch	*Vicia villosa*	X	X	X	.	.
Grasses						
Tall Wheatgrass	*Agropyron elongatum*	X	X	X	X	X
Intermediate Wheatgrass	*Agropyron intermedium*	X	X	X	X	X
Wild Oat	*Avena fatua*	X	X	X	X	X
Rattlesnake Grass	*Bromus brizaeformis*	.	X	X	X	X
Ripgut	*Bromus rigidus*	X	X	X	X	X
Cheat Grass	*Bromus tectorum*	X	X	X	X	X
Orchard Grass	*Dactylis glomerata*	X	X	X	X	X
Giant Wildrye	*Elymus cinereus*	X	X	X	X	X
Blue Wildrye	*Elymus glaucus*	X	X	X	X	X
Purple Eragrostis	*Eragrostis pectinacea*	.	.	.	.	X
Idaho Fescue	*Festuca idahoensis*	.	.	.	.	X
Fescue Grass	*Festuca sp.*	X	X	X	X	X
Sweetgrass	*Hierochloe odorata*	.	.	.	.	X
Charming Barley	*Hordeum leporinum*	X	X	X	X	X
Perennial Ryegrass	*Lolium perenne*	.	.	.	.	X
Common Witchgrass	*Paniculum capillare*	X	.	.	.	.
Reed Canarygrass	*Phalaris arundinacea*	X	X	X	X	X
Common Timothy	*Phleum pratense*	.	.	.	.	X
Canada Bluegrass	*Poa compresa*	.	.	.	.	X
Alkali Bluegrass	*Poa juncifolia*	X	X	X	X	.
Kentucky Bluegrass	*Poa pratensis*	X	X	X	X	X
Bluegrass	*Poa sp.*	X	X	X	X	X
Cultivated Rye	*Secale cereale*	.	X	X	X	X
Cultivated Wheat	*Triticum aestivum*	X	X	X	X	X

Supporting Data - Item 8

Songbird Inventory

8.01. Songbird Inventory.

The following table lists songbird species found or believed to occur in terrestrial and/or adequate habitats at the Mill Creek Project.

Species		Season*			
Common Name	Scientific Name	Sp	Su	F	W
Red-Eyed Vireo	*Vireo olivaceus*	O	O	R	.
Warbling Vireo	*Vireo glivus*	O	O	R	.
Orange-Crowned Warbler	*Vermivora celata*	U	U	O	.
Nashville Warbler	*Vermivora ruficapilla*	O	O	O	.
Yellow Warbler	*Dendroica petechia*	C	C	U	.
Gray Catbird	*Dumetalla carolinensis*	U	U	R	.
Yellow-Rumped Warbler	*Dendroica coronata*	U	U	U	O
Townsend's Warbler	*Dendroica towndendi*	O	O	O	.
MacGillivray's Warbler	*Oporornis tolmiei*	O	O	O	.
Common Yellowthroat	*Geoghlpos trichas*	R	R	R	.
Yellow- Breasted Chat	*Icteria virens*	R	R	R	.
Wilson's Warbler	*Wilsonia pusilla*	O	O	O	.
House Sparrow	*Passer domesticus*	C	C	C	C
Western Meadowlark	*Sturnella neglecta*	U	C	U	U
Yellow-Headed Blackbird	*Agelaius xanthomus*	R	R	.	.
Red-Winged Blackbird	*Agelaius phoeniceus*	U	U	U	O
Brewer's Blackbird	*Euphagus cyanocephalus*	U	U	U	U
Brown-Headed Cowbird	*Molothrus ater*	U	U	U	.
Northern Oriole	*Icterus galbula*	U	U	.	.
Black-Headed Grosbeak	*Pheucticus melanocephalus*	U	U	.	.
Evening Grosbeak	*Coccothraustes vespertinus*	U	O	O	U
Lazuli Bunting	*Passerina amoena*	U	U	.	.
Purple Finch	*Carpodacus purpureus*	.	.	.	R
Cassin's Finch	*Carpodacus cassini*	.	.	.	R
House Finch	*Carpodacus mexicanus*	U	U	U	O
Rosy Finch	*Leucosticte arctoa*	.	.	.	R
Pine Sisken	*Carduelis pinus*	O	.	.	O
American Goldfinch	*Carduelis tristis*	C	U	U	C
Rufous-Sided Towhee	*Pipilo erythrophthalmus*	O	O	O	O
Savannah Sparrow	*Passerculus sandwishensis*	O	O	.	.
Vesper Sparrow	*Pooecetes gramineus*	R	R	.	.
Lark Sparrow	*Chondestes grammacus*	R	R	.	.
Chipping Sparrow	*Spizella passerina*	O	O	O	.
White-Crowned Sparrow	*Zonotrichia leucophrys*	U	O	O	U
Golden-Crowned Sparrow	*Zonotrichia atricapilla*	R	R	R	R
Fox Sparrow	*Passerella iliaca*	R	R	R	.
Song Sparrow	*Melospiza melodia*	U	U	U	U
Dark-Eyed Junco	*Junco hyemalis*	C	.	U	C
Eastern Kingbird	*Tyrannus tyrannus*	U	U	U	.
Western Kingbird	*Tyrannus verticalis*	U	C	U	.
Say's Phoebe	*Sayornis saya*	U	U	U	.
Western Flycatcher	*Empidonax difficilis*	U	U	.	.

Hammond's Flycatcher	*Empidonax hammondii*	U	U	.	.
Western Wood Pewee	*Contopus sordidulus*	U	U	.	.
Violet-Green Swallow	*Tachycineta thalassina*	U	U	.	.
Tree Swallow	*Tachycineta bicolor*	O	O	.	.
Bank Swallow	*Riparia riparia*	U	U	.	.
Northern Rough-Winged Swallow	*Stelgidopteryx serripennis*	U	U	.	.
Barn Swallow	*Hirundo rustica*	C	C	.	.
Cliff Swallow	*hirundo pyrrhonota*	A	A	.	.
Steller's Jay	*Cyanocitta stelleri*	.	.	.	O
Black-Billed Magpie	*Pica pica*	C	C	C	C
Common Raven	*Corvus corax*	R	R	R	O
Common Crow	*Corvus brachyrhynchos*	O	O	O	O
Black-Capped Chickadee	*Parus atricapillus*	U	.	U	C
Mountain Chickadee	*Parus gambeli*	R	.	R	O
Chestnut-Backed Chickadee	*Parus rufescens*	X	.	X	X
White-Breasted Nuthatch	*Sitta carolinensis*	R	.	.	R
Red-Breasted Nuthatch	*Sitta carolinensis*	O	.	.	O
Brown Creeper	*Certhia americana*	O	.	.	O
House Wren	*Troglodytes aedon*	U	U	.	.
Winter Wren	*Troglodytes troglodytes*	O	O	O	O
Bewick's Wren	*Thryomanes bewickii*	U	U	U	U
American Robin	*Turdus migratorius*	C	U	U	C
Varied Thrush	*Ixoreus naevius*	O	R	R	O
Hermiot Thrush	*Catharus guttatus*	R	R	R	R
Western Bluebird	*Sialia mexicana*	U	U	U	O
Mountain Bluebird	*Sialia currucoides*	O	O	R	.
Townsend's Solitaire	*Myadestes townsendi*	O	.	O	O
Golden-Crowned Kinglet	*Regulus satrapa*	U	.	U	C
Ruby-Crowned Kinglet	*Regulus calendula*	U	U	U	U
Bohemian Waxwing	*Bombycilla garrulus*	C	U	U	C
Cedar Waxwing	*Bombycilla cedrorum*	C	U	U	C
Northern Shrike	*Lanius excubitor*	U	O	O	U
Loggerhead Shrike	*Lanius ludovicianus*	O	R	R	O
European Starling	*Sturmus vulgaris*	C	C	C	C

***Seasonal appearance and abundance area coded as follows:**
Sp - Spring (March to May)
Su - Summer (June to August)
F - Fall (September to November)
W - Winter (December to February
A - Abundant = occurs in large numbers
C - Common = occurs regularly in moderate numbers
U - Uncommon = occurs regularly in small numbers
O - Occasional = a few noted each year
R - Rate = a few noted, but not every year
X - Accidental = out of normal range

Supporting Data - Item 9

Fish Inventory

9.01. Fish Inventory.

The following table lists 22 fish species found or believed to occur in Mill Creek or Virgil B. Bennington Lake.

Fish Species		Area	
Common Name	**Scientific Name**	**MC**	**VBB LAKE**
Brook Lamprey	*Lampetra richardsoni*		.
Pacific Lamprey	*Entosphenus tridentatus*		.
Largescale Sucker	*Catostomus macrochelilus*		X
Longnose Sucker	*Catostomus catostomus*	X	X
Bridgelip Sucker	*Catostomus columbianus*	X	X
Redside Shiner	*Richardsonius Balteatus*	X	X
Chiselmouth	*Acrocheilus alutaceus*	X	X
Sculpin	*Cottus sp.*	X	X
Speckled Dace	*Rhinichthys osculus*	X	X
Leopard Dace	*Rhinichthys falcatus*	X	X
Brown Bullhead	*Ameiurus nebulosus*	X	X
Rainbow Trout	*Oncorhynchus mykiss*	X	X
Steelhead Trout	*Oncorhynchus mykiss*	X	.
Dolly Varden	*Salvelinus malma*	X	.
Mountain Whitefish	*Prosopium williamsoni*	X	.
Bluegill	*Lepomis macrochirus*	X	X
Pumpkinseed	*Lepomis gibbosus*	X	X
Largemouth Bass	*Micropterus salmoides*	X	X
Smallmouth Bass	*Micropterus dolomieu*	X	X
Yellow Perch	*Perca flavescens*		X
White Crappie	*Pomoxis annularis*		X
Black Crappie	*Pomoxis nigromaculatus*		X

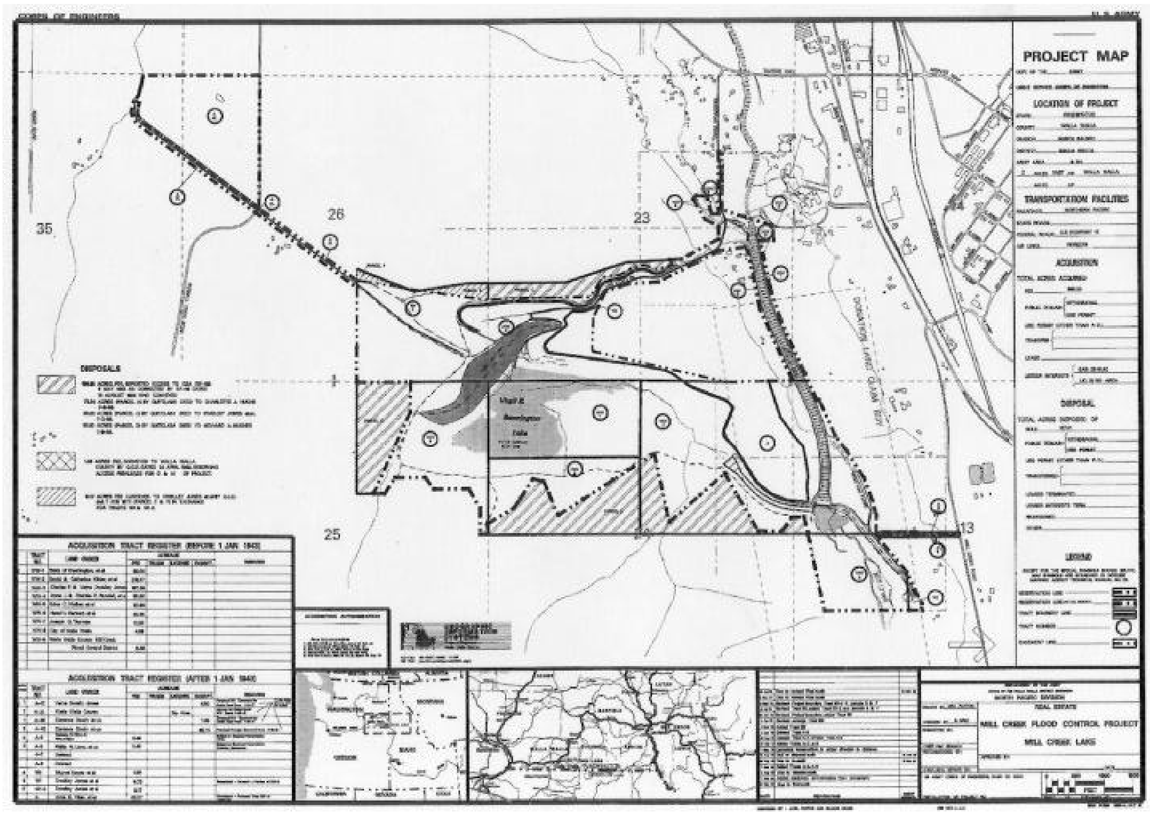
9.02. Endangered Species.

At this time, no endangered or threatened species occur at Mill Creek or Virgil B. Bennington Lake, but bull trout have been petitioned for listing.

Supporting Data - Item 10

Real Estate Map

Mill Creek Project Real Estate Map



Supporting Data - Item 11

Carrying Capacity Methodology
Project Recreation Capacity

1. Carrying Capacity Concept.

A knowledge of the carrying capacity of a recreation area is an important step in making decisions concerning the planning, use, management, and development of the area. Methodology for determining carrying capacity at the Mill Creek Project was taken from *Recreation Carrying Capacity Handbook: Methods and Techniques for Planning, Design, and Management*, published by the U.S. Army Corps of Engineers Waterways Experiment Station (Instruction Report R-80-1, July 1980).

Recreation carrying capacity is a measure of the capability of a recreation resource to provide the opportunity for satisfactory recreation experiences, over a period of time, without significant degradation of the resource. Carrying capacity has two components: 1) social capacity; and 2) resource capacity. Social capacity is the amount of usage a recreation resource can receive before the users no longer achieve a reasonable level of satisfaction. Overcrowding occurs when the social capacity is exceeded. Resource capacity is the amount of usage a recreation resource can receive before irreversible biological deterioration takes place, or degradation of the resource makes it unsuitable or unattractive for recreation use. Overuse occurs when the resource capacity is exceeded. If there is a difference between resource and social capacities, then the capacity is determined by the lesser of the two. There may not be sufficient user demand to sustain the level of use at carrying capacity, and such a level of use may not be cost-effective.

2. Social Carrying Capacity.

a. Methodology.

The methodology for determining social carrying capacity, as outlined in the handbook referenced above, was used to establish the social capacity of Virgil B. Bennington Lake to support non-motorized boating, boat fishing, shoreline fishing, swimming, camping, picnicking, and trail use.

The methodology provides a step-by-step process for determining the distance users prefer between themselves and other user groups. The results of the process should not be considered absolute measures of social capacity but, rather, guidelines to be measured against other factors (*i.e.*, resource capacity, management objectives, cost and demand) in determining ultimate facility development levels.

The methodology has two basic elements: 1) preference distribution; and 2) social capacity factors. Both were developed based on a survey of visitors at selected Corps of Engineers projects nationwide. Preference distributions define, for a variety of recreation activities, the range of distances (planning range) that the majority of users have indicated they prefer to have between themselves and other users. Each preference distribution is further divided into several preference groupings. Each grouping identifies the percentage of users who prefer to be in the distance range of that grouping. In other words, preference groupings identify the amount of spacing preferred by different percentages of users. Some users have a higher density social capacity than others.

Social capacity factors for each activity consist of a list of site and user characteristics that affect the spacing preferences of users (see table SD11-1). Each factor has different levels (*e.g.*, in table SD11-1, the factor "Level of Development" has three levels: "High," "Moderate," and "Limited"). Each factor level has a variance value. This variance value is the number of units of distance that the factor level will shift the preference distribution (*e.g.*, in table SD11-1, a "High" level of development has a variance value of -2). This indicates a need to shift the planning range two units to the left because less spacing between user groups is required.

Table SD11-1. Social Capacity Factors			
Site Characteristics	**Variance**	**User Characteristics**	**Variance**
Level of Development	.	**Age of Users**	.
High	-2	<25 (20%)	+2
Moderate	0	26-55 (65%)	0
Limited	+1	56+ (15%)	1
Distance from Highway Access	.	**Travel Time to Project Area**	.
0-5 miles	-1	<30 min (40%)	0
>5 miles	+2	>30 min (60%)	+2
Maintenance of Facilities	.	**Number of Other Activities Engaged In**	.
Pleasant	0	1-3 (65%)	0
Unpleasant	+1	4+ (35%)	+1

In order to tailor the preference distribution to a particular activity area, in this case the Mill Creek Project, the social capacity factors are subjectively evaluated based on the existing and expected conditions of the lake. Variance values are assigned that best represent these conditions. The values are then totaled and used to determine the net effect of the social capacity factors on preference distribution. The preference distribution for the activity is then shifted by the number of distance units equal to the net effect. A positive net effect will shift the preference distribution to the right (greater spacing and lower density), while a negative net effect will shift the preference distribution to the left (closer spacing and higher density). The modified distribution chart illustrates the new group ranges, midpoints, and areas/densities.

Midpoints are used for distance guidelines. It is important to recognize that the system will yield a guideline that satisfies the preferences of each separate grouping. Therefore, in table SD11-2, 25 percent of the users prefer spacing of ½ unit, 20 percent prefer spacing of 2 units, 30 percent prefer 4 units, and 25 percent prefer 6 units. Ideally, areas should be developed to meet these preferences, but each recreation area need not provide for every preference grouping.

Table SD11-2 Work Space				
Factors	**Observed Conditions (Step 1)**		**Effect of Observed Conditions (Step 2)**	
Site Characteristics				
Level of Development	High		-2	
Distance from Highway Access	2 miles		-1	
Maintenance of Facilities	Pleasant		0	
User Characteristics				
Age	All ages		--	
Travel Time	90% will travel 1 hour		+2	
Number of Other Activities	50% will do 5+ activities		--	
	Net Effect (Step 3)		**-1**	
Modified	**A'**	**B'**	**C'**	**D'**
Group Ranges (Step 4) Midpoints Areas/Densities*	0-1 1/2 ¼/4	1-3 2 4/0.25	3-5 4 16/0.06	5-7 6 36/0.03
*A distance/area/density conversion table is provided in appendix C.				

Distance guidelines are converted to area guidelines by squaring the number of units in the distance guideline. Figure SD11-1 contains the area guidelines in this example (¼ square unit, 4 square units, 16 square units, and 36 square units).

RESOURCE BASE CONCERNS

FACTORS AFFECTING RESOURCE CAPACITY	WATERBODY							SOILS		ANIMALS			VEGETATION			OTHER				
● Major Impact ○ Impact										Type, No., and Habits			Type, No., and Condition							
	Particulate Matter	Chemical Pollution	Eutrophication/Bacteria	Obstacles/Hazards	Type & Amount of Vegetation	Flow	Temperature	Compaction	Erosion	Endangered Species	Game	Other	Ground Cover	Understory	Trees	Excessive Water to Corps Facilities	Level of Scenic Quality	Amount of Usable Space	Noise Level	Air Quality
ENVIRONMENTAL																				
Type of Wildlife			○		○					●	●	●	●	●	●		○		○	
Type of Vegetation	○		○	○	○	○	○	○	○	●	●	●	●	●	●		○	○	○	
Amount of Tree Cover/Shade							○	●	●	○	○	○	●	●	●		○			
Type of Ground Surface	●				○	○	○	●	●	○	○	○	●	●	●	○		○		
Slope/Drainage	●		○			●	○		●				●	○	○			●		
Wind/Amount of Wave Action	●			○		○	○		●							●			○	○
Climate/Microclimate			●		●	○	●	○	●	●	●	●	●	●	●	●	○			○
DEVELOPMENT/PHYSICAL																				
Level of Development	○	○	○	○	○	○	○	○	○	●	●	●	○	○	○	○	●	○	●	○
No. of Activity Areas	○									○	○	○	○	○	○		○	○	●	○
Activity Area Size	○									○	○	○	○	○	○		○	●	○	○
Activity Area Shape										○	○	○	○	○	○		○	●	○	
Activity Area Design	○	○	○					●	●	○	○	○	○	○	○	●	○	○	○	
WATER BODY																				
Depth of Water	○	○	○	○	○	○	○			●	●	●								
Shoreline Configuration	○			○		○	○		○	○	○	○						○	○	
Pool Fluctuation	●	○		●	○	●	○		●							●	○	○		
Water Quality	○	○	○	○	●	○	○			●	●	●				○	○			
MANAGEMENT																				
Degree of Control	○	○	○	○				●	●	○	○	○	●	○	○	●	○	○	●	●
Degree of Maintenance				○				○	●	○	○	○	●	○	○	●	○	○		
Degree of Off-Season Restoration	○	○	○	○				○	●	○	○	○	●	○	○	●	○			
USER																				
Type of Activity	●	○	○					●	○	●	●	●	○	○	○	○		○	●	○
Type of Equipment	○	○						●	●	○	○	○	●			○		○	○	○
Group Size								○	○				○			○		○	○	

Figure SD11-1. Resource Capacity Guidelines

Area guidelines can be converted to density guidelines by dividing the area guidelines into 1 unit of area. The examples found in figure SD11-1 show 4 sites per square unit (1-:-1/4); .25 sites per square unit (1-:-4); .06 sites per square unit (1-:-16) and .03 sites per square unit (1-:-36). If acres are used, preference group D will yield 1,210 units per acre (43,560-:-36).

b. Social Carrying Capacity at Virgil B. Bennington Lake.

Tables 3-43 through 3-52 provide social carrying capacity densities for each activity and location considered. Table 3-53 summarizes the social carrying capacity determinations for a variety of activities at different locations on the project.

3. Resource Carrying Capacity.

Carrying capacity analysis supplies the information needed to help project managers provide satisfactory recreation experiences for users, while protecting recreation resources so that the quality and quantity of recreational opportunities is protected for the future. Usage must not exceed the capacity of the resource to withstand repeated use and recovery periods without deterioration.

Resource capacity is a function of environmental, physical, developmental, managerial, and user characteristics. The development of a resource capacity model is difficult because a large number of factors affect resource capacity, each factor has many variations, and the factors interact with each other in a complex manner. In addition, many factors that have a significant impact on resource capacity cannot be controlled or modified by management.

Table SD11-2 depicts the potential impacts that various factors have on the resource base. The left column includes five groups of factors. Each factor has an impact on some aspect of the resource base. The remaining columns in table SD11-2 are organized into five aspects of the resource base. Each aspect is divided into areas of concern. Some aspects are problems, while others are the subject of problems.

The information in the figure is useful in suggesting potential concerns for existing or proposed development, indicating possible sources of observed problems, and identifying appropriate management actions for addressing problem areas. The analysis that follows will consider the principle impacts for existing or potential resource uses. These guidelines willalso play a role in directing the development of appropriate design and management concepts.

Supporting Data - Item 12

Mill Creek Soil Capability Classes

Soil capabilities definitions for the Mill Creek Project are interpreted in this section, both in an overview and in more specific definitions. The U.S. Department of Agriculture, Soil Conservation Service, in cooperation with the Washington Agricultural Experiment Station, compiled the soil capability and soil type data. A matrix has been prepared for this data, and can be found in table SD12-1.

Table SD12-1
Mill Creek Project Soil Capability Classes

Management Units	Soils										
	AtE2	**CaA**	**Bp**	**Ma**	**OnA**	**WaB**	**WaD**	**WIB**	**WID**	**YkA**	**YmA**
Project Operations											
Mill Creek Diversion	IVe-2						IIIe-7				IIIs-1
Mill Creek Dam				VIIIs-1							
Virgil B. Bennington Lake								IIc-2	IIIe-7		
Mill Creek Office and Information Center											IIIs-1
Mill Creek Channel											IIIs-1
Recreation											
Rooks Park**											IIs-3
Bennington Lake Recreation Area			VIIIs-1				IIIe-7				.
Bennington Lake Road							IIIe-7	IIc-2			IIIs-1
Yellowhawk Park**											IIs-3
Mill Creek Recreation Trail											IIIs-1
Mitigation											
Fort Walla Walla Timber Reserve Habitat							IIIe-7				
Environmental Sensitive Areas											
Mill Creek ESA	IVe-2										IIIs-1
Yellowhawk-Garrison ESA											IIIs-1
Multiple Resource Management--Recreation, Low Density											
South Mill Creek Trail	Ive-2									Vis-2	IIIs-1
Multiple Resource Management--Wildlife Management General											
Bennington Habitat	IVe-2		VIIIs-1			IIc-2	IIIe-7	IIc-2	IIIe-7		
Russell Creek Habitat						IIc-2	IIIe-7				
Easement											
Rooks Park Road		IIW-1			IIc-1					VIs-2	IIIs-1
Russell Creek Canal		IIw-1			IIc-1						
Russell Creek Flowage											
**Irrigated											

a. Dryland Soils.

(1) Overview.

(a) Class II.

Class II soils have some limitations that reduce the choice of plants or require moderate conservation practices.

1. Subclass IIe.

Subclass IIe soils are subject to moderate erosion if they are not protected.

- **Capability Unit IIe-1.** Deep, medium-textured, moderately permeable soils that have formed in loess and have slopes up to 8 percent. Precipitation ranges from 16 to 19 inches per year.
- **Capability Unit IIe-2.** Deep, dark-colored, medium-textured soils that have formed in loess and have slopes up to 8 percent. Precipitation ranges from 19 to 24 inches per year.
- **Capability Unit IIe-3.** Dark-colored, medium-textured soils on uplands underlain by basalt at a depth of 30 to 48 inches below the surface. Precipitation ranges from 19 to 24 inches per year.

2. Subclass IIw.

Subclass IIw soils have moderate limitations because of excess water.

- **Capability Unit IIw-1.** Medium-textured, imperfectly drained soils on bottom lands and in low basins. The seasonal high water table is within 36 inches of the surface, or the soils may be flooded once every 6 to 8 years.

3. Subclass IIc.

Subclass IIc soils have moderate limitations caused by climate.

- **Capability Unit IIc-1.** Deep and moderately deep, well-drained alluvial soils. Precipitation ranges from 12 to 16 inches per year.
- **Capability Unit IIc-2.** Deep and moderately deep, medium-textured soils that have formed in loess on uplands and have slopes up to 8 percent. Precipitation ranges from 12 to 16 inches per year.

(b) Class III.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

1. Subclass IIIe.

Subclass IIIe soils are subject to severe erosion if they are cultivated and not protected.

- **Capability Unit IIIe-1.** Deep, medium-textured soils that have developed in loess on hilly uplands; with slopes of 8 to 20 percent. Precipitation ranges from 16 to 19 inches per year.
- **Capability Unit IIIe-2.** Moderately deep, medium-textured soils over moderately fine textured, slowly permeable substratum. Precipitation ranges from 24 to 30 inches per year.
- **Capability Unit IIIe-3.** Medium-textured soils with slopes up to 30 percent. Precipitation is 9 to 12 inches per year.
- **Capability Unit IIIe-4.** Deep, medium-textured soils that have formed in loess and have slopes of 8 to 30 percent. Precipitation ranges from 19 to 24 inches per year.
- **Capability Unit IIIe-5.** Moderately deep, medium-textured soils underlain by basalt. Precipitation ranges from 10 to 12 inches per year.
- **Capability Unit IIIe-6.** Medium-textured, moderately deep soils that have formed in loess and have slopes up to 30 percent. Precipitation ranges from 10 to 12 inches per year.
- **Capability Unit IIIe-7.**Medium-textured soils that have formed in loess and have slopes to 30 percent. Most of these soils have a hardpan; a hard, columnar subsoil; or overlie calcareous lake sediment. Precipitation ranges from 12 to 16 inches per year.

2. Subclass IIIs.

Subclass IIIs soils have severe limitations of moisture capacity or tilth.

- **Capability Unit IIIs-1.** Medium-textured soils over gravel.

3. Subclass IIIc.

Subclass IIIc soils are subject to moderate limitations because of dry climate.

- **Capability Unit IIIc-1.** Deep, medium-textured soils on gentle slopes. Precipitation ranges from 9 to 12 inches per year.

(c) Class IV.

Class IV soils have very severe limitations that restrict the choice of plants, require very careful management, or both.

- **Subclass IVe.**

  Subclass IVe soils are subject to very severe erosion if they are cultivated and left unprotected.

  - **Capability Unit IVe-1.** Deep and moderately deep, medium-textured and moderately coarse-textured soils that have slopes of 30 percent. Precipitation ranges from 8 to 10 inches per year.
  - **Capability Unit IVe-2.** Severely eroded soils that have slopes up to 45 percent, have formed in loess, and are more than 24 inches deep.
  - **Capability Unit IVe-3.** Deep to moderately deep, medium-textured soils with slopes of 30 to 45 percent. Precipitation ranges from 16 to 24 inches per year.
  - **Capability Unit IVe-4.** Eroded, moderately deep, medium-textured soils that have slopes up to 15 percent. These soils are underlain by dense, slowly-permeable substratum. Precipitation ranges from 24 to 30 inches per year.
  - **Capability Unit IVe-5.** Moderately deep, medium-textured soils that are underlain by dense, slowly-permeable substratum. These soils occupy north-facing slopes. Precipitation ranges from 24 to 30 inches per year.
  - **Capability Unit IVe-6.** Medium-textured soils, mostly eroded, that have slopes up to 30 percent. Precipitation ranges from 9 to 12 inches per year.
  - **Capability Unit IVe-7.** Deep, medium-textured soils that have slopes up to 15 percent. These soils occupy gently sloping ridges in the Blue Mountains. Precipitation ranges from 30 to 40 inches per year.
  - **Capability Unit IVe-8.** Medium-textured soils that have formed in loess on steep uplands, mainly on north- and west-facing slopes. Precipitation ranges from 10 to 12 inches per year.
  - **Capability Unit IVe-9.** Shallow to moderately-deep soils that have formed in loess underlain by old calcareous lake deposits on nearly level to steep upland terraces. Precipitation ranges from 6 to 9 inches per year.

- **Capability Unit IVe-10.** Deep, medium-textured, eroded soils that have formed in volcanic ash and loess. Precipitation ranges from 12 to 16 inches per year.
- **Capability Unit IVe-11.** Deep, dark-colored, medium-textured soils. Precipitation ranges from 12 to 16 inches per year.

(d) Class VI.

Class VI soils have severe limitations that make them generally unsuitable for cultivation; and limit their use primarily to pasture or range, woodland, or wildlife food and cover.

1. Subclass VIe.

Subclass VIe soils are severely limited, chiefly by risk of erosion if protective cover is not maintained.

- **Capability Unit VIe-1.** Moderately coarse, gently sloping to steep soils of the uplands. Precipitation ranges from 8 to 10 inches per year.
- **Capability Unit VIe-2.** Medium-textured, rolling to steep soils of the uplands. Precipitation ranges from 9 to 12 inches per year.
- **Capability Unit VIe-3.** Medium-textured, gently sloping to very steep soils of the uplands. Precipitation ranges from 12 to 15 inches per year.
- **Capability Unit VIe-4.** Deep, medium-textured, rolling to very steep soils of the uplands. Precipitation ranges from 19 to 24 inches per year.
- **Capability Unit VIe-5.** Moderately deep, medium-textured, steep to very steep soils of the uplands. Precipitation ranges from 19 to 24 inches per year.
- **Capability Unit VIe-6.** Medium-textured, rolling to very steep soils of the uplands. Precipitation ranges from 24 to 30 inches per year.
- **Capability Unit VIe-7.** Medium-textured, rolling to very steep soils of the uplands. Precipitation is usually more than 30 inches per year.
- **Capability Unit VIe-8.** Medium-textured, rolling to steep soils of the uplands. Precipitation ranges from 6 to 9 inches per year.

2. Subclass VIs.

Class VIs soils are generally unsuitable for cultivation; and are limited for other uses by their moisture capacity, stones, and other features.

- **Capability Unit VIs-1.** Medium-textured, very gently sloping soils of the bottom lands that are slightly to strongly saline-alkali. Precipitation ranges from 8 to 14 inches per year.
- **Capability Unit VIs-2.** Gravely and cobbly, medium-textured, very gently sloping soils underlain by gravel at shallow depths. Precipitation ranges from 6 to 12 inches per year.
- **Capability Unit VIs-3.** Cobbly, medium-textured, very gently sloping soils of the bottom lands. Precipitation ranges from 12 to 24 inches per year.

(e) Class VIII.

Class VIII soils and landforms have limitations that preclude their use for commercial plant production; and restrict their use to recreation, wildlife, water supply, or aesthetic purposes.

1. Subclass VIIIe.

Subclass VIIIe soils are severely limited, chiefly by risk of erosion if protective cover is not maintained.

- **Capability Unit VIIIe-1.** Soils and land types that are sandy and suitable only for wildlife habitat, watershed, recreational, or other non-agricultural uses.

2. Subclass VIIIw.

Subclass VIIIw soils are extremely wet or marshy land.

- Capability Unit VIIIw-1. Land types that are unsuitable for crops, mainly because they are subject to overflow.

3. Subclass VIIIs.

Subclass VIIIs soils are rock or soil materials that have little potential for the production of vegetation.

- Capability Unit VIIIs-1. Soils and land types that are too steep, sandy, or rocky for uses other than wildlife habitat, watershed, recreation, or other nonagricultural purposes.

(2) Detailed Descriptions of Capability Units.

(a) Capability Unit IIw-1.

This unit consists of medium-textured, imperfectly-drained soils on bottom lands and in low basins. These soils have a seasonally high water table that rises to within 36 inches of the surface, or they may be flooded once every 6 to 8 years. The Pedigo soils of this unit are moderately to strongly alkaline and are, in some places, slightly saline. However, when drainage is established, the alkalinity and salinity only slightly affect the production of crops. The soils in this unit are Catherine silt loam, with 0 to 3 percent slopes; and Pedigo silt loam, with 0 to 3 percent slopes.

The largest occurrence of these soils is in irrigated areas. If adequate drainage is established and floodwaters are diverted, good yields of wheat and green peas can be grown without irrigation. These soils can be cropped every year. A suitable rotation consists of three crops of wheat or barley followed by one crop of green manure. A cropping system that will maintain the supply of organic matter is winter wheat-summer fallow for 4 to 6 years, followed by a legume-grass mixture for green manure.

The main management problems incurred with this type of soil are providing adequate drainage, diverting floodwater to keep off deposits of fresh sediment, and maintaining enough organic matter in the soil.

(b) Capability Unit IIc-1.

This unit consists of deep and moderately deep, well-drained soils that have formed in alluvium. These soils occur in narrow strips along the large streams. Precipitation ranges from 12 to 16 inches per year. The soils in this unit are Hermiston silt loam, with 0 to 3 percent slopes; Hermiston very fine sandy loam, with 0 to 3 percent slopes; Onyx silt loam, with 0 to 3 percent slopes; Patit Creek silt loam, with 0 to 3 percent slopes; Pedigo silt loam, overwashed, with 0 to 3 percent slopes; and Touchet silt loam, with 0 to 3 percent slopes.

Because of limited rainfall or restricted depth, these soils are suited to only a few crops. Yields of wheat and green peas are good, while yields of grasses and alfalfa are fair.

The main management problems caused by this soil are maintaining supplies of organic matter and available nitrogen, and controlling wind erosion on the very fine sandy loam. Management needs consist of utilizing crop residue, using minimum tillage to avoid breaking up soil aggregates, and applying nitrogen in moderate amounts to the nonleguminous crops.

(c) Capability Unit IIc-2.

This unit consists of deep and moderately deep, medium-textured soils on uplands that have formed in loess. Slopes range up to 8 percent. Precipitation ranges from 12 to 16 inches per year. The amount of clay in these soils is fairly low, so the formation of durable aggregates depends on organic matter. The soils in this unit are Walla Walla silt loam, with 0 to 8 percent slopes; and Walla Walla silt loam, lacustrine substratum, with 0 to 8 percent slopes.

These soils can be cropped every year. Winter wheat and barley are the main crops, and high yields are produced. Green peas are grown for canning and freezing. Yields are generally high, but early hot weather ripens peas too fast and occasionally spoils the crops. Processors allot a certain percentage of pea acreage to the soils of this unit in order to take advantage of the early maturation of the crop.

Cropping systems consist of winter wheat followed by green peas, or of wheat grown every year. If wheat is grown every year, green manure may be needed occasionally to maintain the supply of organic matter. Cropping systems that will maintain organic matter are winter wheat-summer fallow for 4 or 6 years, followed by a legume-grass mixture for green manure, or wheat followed by a biennial legume.

The main management problems involved with this type of soil are controlling erosion early in the spring, maintaining granular soil structure, and supplying enough organic matter and available nitrogen. Moderate amounts of nitrogen are needed to produce high yields of crops. The management needs consist of using crop residue and stubble-mulch tillage, tilling only to control weeds and prepare the seedbed, and seeding along the contour.

(d) Capability Unit IIIc-7.

This capability unit consists of medium-textured soils that have formed in loess and have slopes up to 30 percent. Most of the soils are underlain by calcareous lake sediment, hardpan, or hard, columnar subsoil. These soils have a slight to moderate hazard of erosion. Considerable runoff occurs late in winter and early in spring if the soils are frozen or finely pulverized. Soils in this unit are Spoffard silt loam, with 0 to 3 percent slopes; Spoffard silt loam, with 3 to 8 percent slopes; Walla Walla silt loam, with 8 to 30 percent slopes; Walla Walla silt loam, hardpan variant, with 0 to 8 percent slopes; and Walla Walla silt loam, lacustrine substratum, with 8 to 30 percent slopes.

These soils produce good crops of winter wheat, and fair crops of spring wheat and barley. Small quantities of early green peas are grown, but the acreage of this crops is limited by the capacity of the processing plants. Most farmers use a rotation consisting of winter wheat and summer fallow. This rotation helps to control erosion if stubble mulch, minimum tillage, contour seeding, and weed control are practiced. Green peas may be grown instead of practicing summer fallow.

A rotation consisting of winter wheat and summer fallow for 4 to 5 years, followed by biennial or perennial legumes and grass grown as green manure, helps to control erosion and increases the yields of wheat. This rotation, with sweetclover as the legume, was once popular in this area. In recent years, farmers have been using the winter wheat-summer fallow system. Wheat is given moderate amounts of nitrogen. It is advisable, however, to include a green manure crop where the winter wheat-summer fallow does not maintain enough organic matter.

The main management problems are controlling runoff and erosion, maintaining granular soil structure, and supplying adequate amounts of nitrogen. The management needed to control erosion consists of stubble mulching that keeps all residue on the surface; tilling a field not more than five times, including the tillage required for seeding; seeding along the contour; divide-slope farming (field stripcropping) in fields more than 400 feet long; and applying sulfur to legumes and nitrogen to wheat and grass in amounts determined by soil tests.

(e) Capability Unit IIIs-1.

This unit consists of two medium-textured soils over gravel. In one soil, the gravel is 12 to 24 inches below the surface. In the other soil, gravel is scattered throughout the profile. The moisture-supplying capacity of these soils is limited by these conditions. The soils in this unit are Touchet gravely silt loam, with 0 to 3 percent slopes; and Yakima silt loam, with 0 to 3 percent slopes.

These soils are best suited to wheat and grass. A suitable cropping system is intermediate wheatgrass or big bluegrass for 4 to 6 years, followed by wheat and fallow until three crops of wheat have been grown. Yields of nonirrigated crops are almost entirely dependent on May and June rains.

Management needed to conserve moisture and maintain or increase fertility and organic matter consists of the use of all crop residue, the use of stubble-mulch tillage, and the application of nitrogen fertilizer to the wheat.

(f) Capability Unit IVe-2.

This unit consists of severely eroded soils that have slopes up to 45 percent, have formed in loess, and are more than 24 inches deep. Soils in this unit are Athena silt loam, with 8 to 30 percent slopes, eroded; Athena silt loam, with 30 to 45 percent slopes, eroded; and Palouse silt loam, moderately deep, with 8 to 30 percent slopes, eroded.

These soils are suitable for a long-term rotation that consists of the soil-improving crops (smooth bromegrass and alfalfa) for 3 to 6 years, followed by grain and summer fallow for 6 years. For the first two cycles, grass and alfalfa should be grown for 6 years. As yields of grain improve, the rotation can be adjusted to 4 years of grass and alfalfa followed by 4 years of grain and summer fallow. Nitrogen will be needed for the wheat crop that immediately follows the plowing under of a large growth of grass and alfalfa. The crops of wheat in the following years will need less nitrogen. The amount can be determined by a soil test. Sulfur is needed for the best growth of alfalfa.

The main management problems include controlling erosion, increasing supplies of organic matter, and maintaining the supply of plant nutrients. The management practices needed consist of rough tillage in the fall, the use of all crop residue, plowing under the growth of soil-improving crops in the last year of the cycle, seeding along the contour, improving the supply of plant nutrients, and plowing by turning the furrow slice uphill.

(g) Capability Unit VIs-2.

This unit consists of gravely and cobbly, medium-textured, very gently sloping soils of the bottom lands. These soils are underlain by gravel at shallow depths. Precipitation is 6 to 12 inches per year. The soils in this unit are Yakima gravely silt loam, with 0 to 3 percent slopes; and Yakima cobbly loam, with 0 to 3 percent slopes.

These soils are best suited to range unless irrigated. They are in the bottomland range site, with 6 to 12 inches of precipitation each year.

(h) Capability Unit VIIIs-1.

This capability unit consists of soils and land types that are too steep, sandy, or rocky for uses other than wildlife habitat, watershed, recreation, or other nonagricultural purposes. In this unit are badlands; basalt rock lands, very steep; basalt rock outcrops; borrow pits; Hezel loamy fine sand, with 30 to 45 percent slopes, eroded; the Klicker-Gwin-Rock land complex, with 60 percent and steeper slopes; made lands; terrace escarpments; volcanic ash land, undulating to hilly.

b. Irrigated Soils.

(1) Overview--Class II.

Class II soils have some limitations that reduce the choice of plants or require moderate conservation practices.

(a) Subclass IIe.

Subclass IIe soils are subject to moderate erosion if left unprotected.

- Capability Unit IIe-5. Well-drained, medium-textured, deep and moderately deep soils on gently sloping uplands.

- Capability Unit IIe-6. Well-drained, medium-textured soils on bottom lands and terraces.

(b) Subclass IIw.

Subclass IIw soils have moderate limitations because of excess water.

- Capability Unit IIw-1. Dark-colored, medium-textured, imperfectly drained soils along streams. In places, the water table is near the surface during a portion of the growing season.

(c) Subclass IIs.

Subclass IIs soils have moderate limitations of moisture capacity or tilth.

- Capability Unit IIs-2. Medium-textured, moderately well-drained, saline-alkali soils.

- Capability Unit IIs-3. Medium-textured soils underlain by gravel.

(2) Detailed Description of Capability Units.

- **Capability Unit IIs-3.**

  This unit consists of medium-textured soils underlain by gravel. The Touchet soil in this unit is gravely throughout, and is underlain by coarse gravel below a depth of 48 inches. The Yakima soil is underlain by coarse gravel below a depth of 15 inches, and the Patit Creek soil is underlain by gravel at a depth of 24 inches. these soils can hold only small amounts of water. The hazard of erosion is slight. The soils in this unit are Patit Creek silt loam, with 0 to 3 percent slopes; Touchet gravely silt loam, with 0 to 3 percent slopes; and Yakima silt loam, with 0 to 3 percent slopes.

  Alfalfa hay and pasture are the most important crops on these soils. Sugar beets, strawberries, and truck crops are grown on small parcels of land. Farmers prefer to grow crops that require little tillage. A suitable rotation is 2 to 4 years of alfalfa grown for hay or a grass-legume mixture grown for pasture, 4 years of row crops, and 1 year of a small grain. Frequent, light applications of irrigation water and split applications of fertilizer are most efficient. This also results in less leaching of fertilizer than infrequent, heavy applications of water and fertilizer. Plowing under all crop residue helps to maintain or increase the supply of organic matter and improves soil structure.