CHAPTER 3
AFFECTED ENVIRONMENT

OVERVIEW

O'Sullivan Dam was constructed nearly 50 years ago forming Potholes Reservoir. The reservoir was created as part of the Columbia Basin Project to provide irrigation water to the fertile but arid lands of the Columbia Plateau in central Washington. Potholes Reservoir generally fills up in the winter and early spring months with the water level falling in May through September in response to irrigation demand.

The formation of Potholes Reservoir dramatically changed the existing landscape. North of the dam, pothole wetlands, riparian, and shrub-steppe plant communities and sand dunes characterize the area. A unique system of Sand Islands was created when the shifting sand dunes were inundated. Over time, wetland and riparian plant communities recolonized the dynamic island and reservoir shoreline. Emergent wetland communities developed, and riparian forest and shrub communities dominated by willow matured in these shoreline areas. These changes have created new or enhanced habitat for some wildlife populations along with additional recreation opportunities.

The purpose of this chapter is to describe the existing or affected environment, including conditions and trends, that would be affected by the alternatives described in Chapter 2. The descriptions focus on the lands and waters administered and managed by the Reclamation, the SPRC, and WDFW within this unique 36,200-acre area. Information about the physical, natural, cultural, social and economic setting is provided to describe more fully the statement of needs explained in Chapter 1, and lay the foundation for understanding and evaluating the alternatives discussed in Chapters 2 and 4.

This chapter focuses on those portions of the environment that are directly related to the conditions being addressed by the alternatives. The description is not meant to be a complete portrait of the study area, but is intended to portray the conditions and trends of most concern to the public, Reclamation, and their management partners within the Resource Management Plan (RMP) study area.

RESOURCES NOT AFFECTED BY THE ALTERNATIVES

None of the alternatives and associated management actions would impact regional or local climatic conditions, geology or topography, surface water hydrology or hazardous waste or materials in the area.

Sacred Sites

Executive Order 13007, provides that federal agencies, to the extent practicable, permitted by law and consistent with essential agency functions, accommodate access and avoid impacts to the physical integrity of sacred sites. During the planning process, no site was specifically identified by the Tribes as a sacred site, although the Tribes often consider Traditional Cultural Properties and burials to be sacred sites. These are discussed under the Cultural Resources sections of this document. Further consultation and coordination would continue with the Colville Confederated Tribes and the Yakama Nation during implementation of any alternative. If sacred sites are identified in the future, measures will be taken to comply with EO 13007.

Environmental Justice

Executive Order 12898 (59 FR 7629), *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires that federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs and activities on minority and low-income populations.

With respect to the Potholes Reservoir RMP, environmental justice issues would concern either socioeconomic conditions or health risk exposures. The impact of the preferred or alternative actions on the area economy would be essentially inconsequential, and is not expected to disproportionately affect minority or low-income populations. Proposed management actions would not produce hazardous waste or conditions that might affect human populations, nor result in other disproportionately high and adverse impacts. Alternatives are designed to meet all recreational concerns and needs.

3.1 AIR QUALITY

3.1.1 Introduction

Ambient air quality is a result of the type and amount of pollutants emitted into the atmosphere, the meteorological conditions, and the size and topography of the affected air basin. Federal and state governments have developed ambient air quality standards (AAQS), which when exceeded are considered harmful to public health and the environment.

3.1.2 Ambient Air Quality

The Washington Department of Ecology's (WDOE) Eastern Regional Air Pollution Control Authority Office and the U.S. Environmental Protection Agency (EPA) monitor air quality in the Columbia Basin region under the provisions of the Clean Air Act, as amended. Washington has developed a State Implementation Plan (SIP) in part to maintain AAQS. The status of criteria pollutants, the six principal pollutants regulated by the EPA, are tracked statewide. The six criteria pollutants are particulate matter 10 microns or smaller in diameter (PM_{10}), sulfur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO), ozone (O_3), and lead (Pb).

Grant County does not have permanent or mobile monitoring stations. Therefore, air quality information in the area is limited. The closest monitoring sites to Potholes Reservoir are Spokane to the northeast, and Yakima to the west. These cities also are the nearest non-attainment areas for CO and PM_{10}. Although air quality information for the region is limited, the WDOE and the EPA have designated Grant County as an area currently in attainment for all standards (Seheibner, 1999).

In addition to the six criteria pollutants identified by the CAA, Air Quality Areas are designated by the EPA under Prevention of Significant Deterioration (PSD) guidelines. Class I Air Quality Areas have land and resource use restrictions to prevent damage to visibility, plant, soil, and other resources under the SIP for the Clean Air Act. These areas include all international parks, wilderness areas, memorial parks which exceed 5,000 acres, national parks which exceed 6,000 acres, and some tribal lands. All other areas are Class II Areas. The study area is in a Class II Area. Class I Air Quality Areas within a 100 mile radius of the Potholes Reservoir are Glacier Peak and Alpine Lakes Wilderness Areas to the west, and the Spokane Indian Reservation to the east (WDOE, 1997).

3.1.3 Emissions Sources

Locally, particulates are generated from area sources such as dirt roads and plowed fields. Wind erosion is a significant factor in particulate distribution, particularly in the spring and fall when high winds and dry soil conditions create dust storms. The agricultural practice of burning field residue following harvest can also produce high levels of particulate matter. The burning season lasts about a month in late August and September. Although the typical management practice directs smoke away from population centers, total emissions within the airshed are not reduced (Grant County, 1999).

High ORV use at Potholes Reservoir contributes increased air quality emissions on peak weekends when as many as four thousand ORV recreationists may use the ORV area (Cooke et

al., 1997). Specifically these pollutants include hydrocarbons, particulate matter, nitrogen oxides, carbon monoxide, and carbon dioxide. The amount of pollutants generated by current activities has not been estimated.

3.2 SOILS

3.2.1 Introduction

Grant County resides in a regional structural basin. The County rests on the lower limb of the Grand Coulee Monocline to the north/northwest and the northern limb of the Frenchman Hills Anticline to the southwest. The region to the northeast, including the study area, is subjected to a 0 to 5 degree dip in the southwest direction. The effect of these structural features is the formation of a regional sediment and groundwater cache basin in and around Potholes Reservoir. In addition to groundwater, this structural low has been the deposition location for southwest prevailing wind borne silt and sand, making the area an eolian depositional basin as well.

Nearly all of the soils on the Columbia Plateau and in the Columbia drainage basin have been formed under grassland or shrub-grassland vegetation. Soil parent materials in this region include basalt, volcanic ash, sedimentary deposits, glacial outwash, and alluvial, fluvial, and colluvial deposits. Soils are generally covered with windblown sand and silt. Caliche layers occur in most of the soils and are generally seven feet deep. Loess dominated subsoils are moderately saline and contain a moderate amount of exchangeable sodium.

3.2.2 Broad and General Soil Map Units

The most recent and comprehensive soils data available for the study area was obtained from the *Soil Survey of Grant County Washington* (SCS, 1984) prepared by the U.S. Department of Agriculture's (USDA) Natural Resources and Conservation Service (NRCS), formerly the Soil Conservation Service (SCS). The soil survey is an inventory and evaluation of the soils in the survey area, including the RMP study area. The survey can be used to adjust existing land uses and land use plans to the limitations and natural potentials of soil resources and their environment (USDA, 1984).

Potholes Reservoir is in the southeast part of Grant County. The RMP study area in and around the reservoir includes about 36,200 acres. At high water, about 18,500 acres of soil are exposed, and at low water this number increases considerably. Soils in the RMP study area consist of two broad soil groups and a total of seven general soil map units. Each of the general soil units

identifies a broad area that has a distinctive pattern of soils, relief, drainage, and landscape. There is a total of 56 detailed soil map units within the Potholes Reservoir study area.

3.2.3 General Soil Unit Descriptions

Soils on terraces, active dunes, and alluvial fans are primarily found in the north and western portion of the RMP study area (Units 2-7, see Table 3.2-1).

Soils on benches, terraces, hillsides, and ridgetops in areas of channeled scablands dominate the soil types (Units 11 and 12) found only in the southern portion of the study area.

Erosion Potential

Erosion potential is a measure of an individual soils susceptibility to erosion, and is a pertinent factor in the determination of soil suitability for various land uses. With the exception of general soil units 7 and 12, all of the general units fall under the slight to moderate classification of water erosion susceptibility (see Table 3.2-1). The wind erosion classifications for the general soil units are variable, ranging from no wind erosion potential to extremely erodible. On a more detailed scale the variability is much greater between individual soil units (Soil Resource Report, Planning File).

Table 3.2-1
Soil Unit Erosion Susceptibility
Potholes Reservoir, Washington

Soil Unit	Water Erosion Hazard Range	Wind Erosion Hazard Range
Unit 2: Timmerman-Quincy	Slight to Moderate	Highly Erodible to Extremely Erodible
Unit 4: Ephrata-Malaga	Slight to Moderate	Erodible to Extremely Erodible
Unit 5: Burbank-Quincy	Slight to Moderate	Very Slightly Erodible to Highly Erodible
Unit 6: Quincy	Slight to Moderate	Highly Erodible to Extremely Erodible
Unit 7: Taunton-Scoon	Slight to High	Highly Erodible
Unit 11: Starbuck-Bakeoven-Prosser	Slight to Moderate	None to Highly Erodible
Unit 12: Schawana	Moderate	Slightly Erodible to Highly Erodible

Construction Suitability

The building site development categories evaluated are defined as follows: (1) *shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basement, graves, utility lines, open ditches, and other purposes; (2) *dwellings* are structures built on shallow foundations on undisturbed soil; (3) *local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year; (4) *lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established and maintained; and (5) *septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe.

Table 3.2-2 shows the degree and kind of soil limitations that can affect building site development within the RMP study area. Limitations are classified as slight if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome. Moderate limitations are present if the soil properties and site features are not favorable for the indicated use. These limitations require special planning, design, or maintenance to overcome and minimize hazards. The severe classification is reserved for those soils whose properties and local features are extremely unfavorable or difficult to overcome, requiring that special design, significant increases in construction costs, and possibly increased maintenance be added to construction projects. In addition, special feasibility studies may be required where the soil limitations are severe (SCS, 1984). For detailed soil unit limitations, see Soil Resource Report, planning file.

Table 3.2-2
Soil Unit Limitation Ranges for Building Site Development

Soil Unit	Shallow Excavation	Dwelling Without Basement	Local Roads and Streets	Lawns and Landscaping	Septic Tank Absorption Fields
Unit 2: Timmerman-Quincy	Severe	Slight to severe	Slight to severe	Moderate to severe	Severe
Unit 4: Ephrata-Malaga	Severe	Slight to moderate	Moderate	Slight to severe	Severe
Unit 5: Burbank-Quincy	Severe	Slight to severe	Slight to severe	Moderate to severe	Severe
Unit 6: Quincy	Severe	Slight to severe	Slight to severe	Moderate to severe	Severe
Unit 7: Taunton-Scoon	Severe	Moderate to severe	Moderate to severe	Moderate to severe	Severe
Unit 11: Starbuck-Bakeoven-Prosser	Severe	Moderate to severe	Severe	Severe	Severe
Unit 12: Schawana	Severe	Severe	Severe	Severe	Severe

Prime Farmland

The USDA defines prime farmland as land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It must be producing or be available to produce food and fiber. It has the soil quality, length of growing season, and moisture supply needed to economically produce a sustained high yield of crops when managed properly. A soil is considered prime farmland if it is not excessively eroded or saturated with water for long periods, and is not flooded during the growing season. In addition, prime farmland soils have slopes between 0 and 5 percent. The majority of the prime farmland soils identified at Potholes Reservoir are located proximal to the Lind Coulee Arm in the southern half of the study area.

Wildlife Suitability

Soils can affect the type and amount of vegetative cover that is available. This has a direct correlation to the types and amounts of wildlife that use the vegetation for food and cover. In turn, species distribution and abundance largely depends on the amount and distribution of such resources. Erosion, compaction, or development can reduce productive soil acreage, while revegetation, limits to recreation, and limits to grazing help to bring a soil back to productivity.

Table 3.2-3 rates the soils in the Potholes Reservoir study area according to their potential for providing habitat for various wildlife species. This information can be used when planning parks, wildlife refuges, nature areas, and other developments for wildlife, and in selecting areas with soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat. It can also be used to determine the intensity of management necessary to provide specific habitat elements. Some soils were not rated (for specifics see Soil Resource Report, Planning File).

The potential of each soil unit is rated good, fair, poor, or very poor. A good rating indicates that the element or kind of habitat is easily established, improved or maintained. Few or no limitations affect management, and satisfactory results can be expected. Fair indicates that the habitat can be established or maintained in most places. Moderately intensive management is required for satisfactory results. Poor indicates that the limitations are severe for the designated habitat and management would be difficult and intensive. A very poor rating indicates that restrictions for the element or kind of habitat are very severe and unsatisfactory results can be expected.

Table 3.2-3
General Soil Unit Potential Ranges for Providing Wildlife Habitat at Potholes Reservoir, Washington

Soil Unit	Openland Wildlife	Wetland Wildlife	Rangeland Wildlife
Unit 2: Timmerman-Quincy	Poor to Good	Very Poor	Not Rated
Unit 4: Ephrata-Malaga	Very Poor to Good	Very Poor	Not Rated
Unit 5: Burbank-Quincy	Poor to Fair	Very Poor	Poor
Unit 6: Quincy	Poor to Fair	Very Poor	Poor
Unit 7: Taunton-Scoon	Fair to Good	Very Poor to Fair	Not Rated
Unit 11: Starbuck-Bakeoven-Prosser	Very Poor to Poor	Very Poor	Poor to Fair
Unit 12: Schawana	Very Poor	Very Poor	Very Poor

Recreation Suitability

For each of the general soil map units found in the study area, Table 3.2-4 shows the soil limitation range for recreation development. Data on the detailed soil map units can be found in Appendix C.

The ratings are based on restrictive soil features such as wetness, slope, and texture of the surface layer. The degree of soil limitation is expressed as slight, moderate, or severe. Slight means that soil properties are generally favorable and that limitations are minor and easily overcome. Moderate means that limitations can be overcome or alleviated by planning, design, or special maintenance. Severe means that soil properties are unfavorable and that limitations can be offset through soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

Table 3.2-4
Soil Unit Limitation Ranges for Recreation Development
Potholes Reservoir, Washington

Soil Unit	Camp Areas	Picnic Areas	Playgrounds	Paths and Trails
Unit 2: Timmerman-Quincy	Slight to Severe	Slight to severe	Slight to severe	Slight to Severe
Unit 4: Ephrata-Malaga	Slight to moderate	Slight to moderate	Moderate to severe	Slight to severe
Unit 5: Burbank-Quincy	Slight to Severe	Slight to severe	Moderate to severe	Slight to severe
Unit 6: Quincy	Slight to Severe	Slight to severe	Severe	Slight to severe
Unit 7: Taunton-Scoon	Slight to Severe	Slight to Severe	Slight to Severe	Slight to Severe
Unit 11: Starbuck-Bakeoven-Prosser	Moderate to severe	Moderate to severe	Severe	Severe
Unit 12: Schawana	Severe	Severe	Severe	Slight to moderate

3.3 WATER QUALITY

3.3.1 Introduction

The Columbia Basin Project (CBP) was started in the early 1930's to provide irrigation water to the fertile but arid lands of the Columbia River basin in central Washington. Water for the CBP originates from the Columbia River where it is pumped from Lake Roosevelt at Grand Coulee Dam into Banks Lake - one of the Project's principal reservoirs. At the south end of Banks Lake, irrigation diversions are made into the Main Canal at Dry Falls Dam. Main Canal waters flow through lined and unlined sections, tunnels, and siphons before terminating downstream from Billy Clapp Lake into the East Low Canal and West Canal which more or less form the project's east and west boundaries.

Annually, the CBP diverts about 2.6 million acre-feet of water out of the Columbia River to deliver irrigation water to agricultural lands that normally receive less than 10 inches of precipitation a year. After use in the north half of the CBP (on the Quincy and East Columbia Basin Irrigation Districts), much of the water is collected and returned through a series of wasteways to Potholes Reservoir for reuse in the southern half of the CBP by the South Columbia Basin Irrigation District.

Moses Lake, the largest natural lake in the area, receives its water in the form of natural inflow, irrigation return flows, and canal water originating from the Columbia River. Natural inflow comes from Upper Crab Creek, an intermittent tributary with its headwaters west of Spokane, Rocky Ford Creek, a year-round spring-fed creek that originates southeast of Soap Lake, and a few small drainages to the east. Moses Lake serves as the main supply route for water passing from the East Low Canal, Upper Crab Creek, and Rocky Ford Creek south to Potholes Reservoir.

Created by O'Sullivan Dam, Potholes Reservoir lies immediately downstream of Moses Lake in the Lower Crab Creek Basin. Built as part of the CBP, the reservoir's main water supply is operational waste and irrigation return flow from northern CBP lands irrigated from the East Low and West Canals. This water supply is supplemented by natural flows in Crab Creek, Rocky Coulee, Weber Coulee, and Lind Coulee. Reservoir inflows originate from Moses Lake through the Crab Creek channel on the north side, from the Lind Coulee Wasteway on the east side, and from the Winchester and Frenchman Hills Wasteways on the west side. Shallow groundwater seepage is also a water source entering the reservoir. Irrigation water for the southern part of the CBP is distributed via the Potholes Canal which begins at O'Sullivan Dam.

At a full pool elevation of 1046.5 feet, Potholes Reservoir covers an estimated 27,800 acres and has a total storage capacity of 511,700 acre-feet. Of this capacity, 179,200 acre-feet is inactive, 300 acre-feet is dead pool, and 332,200 acre-feet is active conservation allocated for irrigation use. The reservoir has an average depth of 18 feet and a maximum depth of 142 feet.

When the difference between outflow and inflow (outflow being higher) is greatest from June to August, the reservoir elevation on average is about 12 feet below full pool. At low water levels, many of the dunes/sand islands located in the northern half of the reservoir area become exposed and difficult to access. These islands are very popular for dispersed camping, sunbathing, and other recreational activities in the spring and early summer when reservoir elevations are high and optimal for boat-in accessibility. As reservoir water surface elevations decline, so does recreational visitation and use within the study area.

3.3.2 Surface Water Quality

Updated in November 1997, the surface water quality standards for the State of Washington are described in Chapter 173-201A of Washington's Administrative Code (WAC). The chapter establishes surface water quality standards consistent with public health and enjoyment, and the propagation and protection of fish, shellfish, and wildlife (WAC 173-201A-010). In conformance with present and potential uses of the state's surface waters and in consideration of natural water quality limitations and potential, the state has classified its waters according to

the beneficial uses that can be obtained from them and has established water quality criteria for each classification.

The water quality standards and beneficial use criteria applicable to Potholes Reservoir are defined under the "Lake class" designation. Lake class waters are expected to meet or exceed the requirements for water supply (domestic, industrial, agricultural), stock watering, fish and shellfish (salmonid and fish migration, rearing, spawning and harvesting, and clam, mussel and crayfish rearing, spawning, and harvesting), wildlife habitat, recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment), and commerce and navigation. The applicable "Lake class" water quality criteria are described below either numerically or in the form of a narrative statement. Compliance with the state's water quality standards requires meeting the surface water quality standards outlined in Chapter 173-201A and the sediment management standards outlined in Chapter 173-204.

- **Fecal Coliform**: Organism levels shall both not exceed a geometric mean value of 50 colonies/100 mL, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 100 colonies/100 mL.

- **Dissolved Oxygen**: No measurable decrease from natural conditions.

- **Dissolved Oxygen Saturation**: Total dissolved gas not to exceed 110 percent of saturation at any point of sample collection.

- **Temperature**: No measurable change from natural conditions.

- **pH**: No measurable change from natural conditions.

- **Turbidity**: Not to exceed 5 NTU (nephalometer turbidity units) over background conditions.

- **Toxic, Radioactive, or Deleterious Materials**: Concentrations below those which have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health, as determined by the WDOE. The specific water quality criteria to be applied to all surface waters of the state for the protection of aquatic life are detailed in WAC 173-201A-040 (Toxic Substances). Deleterious concentration of radioactive materials for all classes is determined by the lowest practicable concentration attainable and in no case exceed the criteria outlined in WAC 173-201A-050 (Radioactive Substances).

- **Aesthetics**: Aesthetic values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

In November 1997, the Washington Department of Ecology (WDOE) adopted a procedure for establishing lake nutrient criteria for "Lake class" waters. The procedure was developed to aid in determining a lake's trophic state and the nutrient level required to protect its characteristic beneficial uses. The trophic-state action values established for the Columbia Basin Ecoregion, which includes Potholes Reservoir, are shown in Table 3.3-1.

Although there is a general lack of water quality data specific to Potholes Reservoir, water samples collected from various reservoir locations on September 4 and October 3, 1998 were reviewed to assess potential lake conditions and/or limitations.

Table 3.3-1
Lake Nutrient Criteria, Columbia Basin Ecoregion

Trophic State	If Ambient TP 1/ (ug/L 2/) Range of Lake is:	Then criteria should be set at
Ultra-oligotrophic	0-4	4 or less
Oligotrophic	> 4-10	10 or less
Lower Mesotrophic	> 10-20	20 or less
Upper Mesotrophic	> 20-35	35 or less

Source: Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A WAC, Revised November 18, 1997.
1/ Total Phosphorus
2/ Micrograms per liter

Under the state's Lake Water Quality Assessment Program, a lake specific study was conducted at Potholes Reservoir during the summers of 1998 and 1999 by the WDOE. The assessment was conducted to determine appropriate total phosphorus concentrations to protect characteristic lake uses.

None of the water quality data gathered to date show constituent concentrations above the maximum contaminant levels (MCLs) established under the National Primary Drinking Water Regulations (EPA, 1997). These determinations consider the criteria for chemical, biological, or physical parameters which have been established to provide a level of water quality that supports designated beneficial uses (Planning File).

Environmental Contaminants and Biota

Potholes Reservoir fish and bottom sediment samples were collected and analyzed in 1992-1993. Whole-body largescale suckers were analyzed for EPA priority pollutant metals, organophosphate pesticides, chlorinated pesticides, and polychlorinated biphenyls (PCBs). Fish muscle tissue samples were analyzed for mercury, chlorinated pesticides, organophosphate pesticides, and PCBs. Bottom sediment samples were analyzed for all of the above constituents as well as semivolatile organics and triazine herbicides.

Of the five lakes which underwent the WDOE's comprehensive survey, the overall contamination of sediment and fish at Potholes was the lowest of any. None of the Potholes sediment samples exceeded the Ontario Province Sediment Quality Guidelines for metals or organic compounds, and low concentrations of nine chlorinated pesticides, including five DDT compounds, were detected in Potholes fish. Only lake whitefish and largemouth bass muscle tissues exceeded the EPA human health criterion for dieldrin.

On the basis of the dieldrin concentrations measured, Potholes Reservoir remains listed on the state's 1998 Section 303(d) list submitted to EPA. Under the Clean Water Act, the 303(d) list identifies water quality limited, impaired, and threatened waters needing additional work beyond existing controls to achieve or maintain the surface water quality standards established (WDOE, 1996). Also listed on the 303(d) list are Potholes and East Potholes Canals.

Outstanding Resource Waters

Waters of the state meeting one or more of the following criteria are to be considered for "Outstanding Resource Waters" (ORW) designation. Designations are to be adopted in accordance with the provisions of Chapter 34.05 RCW under the Administrative Procedure Act.

The ORW criteria specific to the Potholes Reservoir area which may qualify the reservoir for this special resource designation include:

- waters in state parks, state natural areas, state wildlife management areas, and state scenic rivers; and

- documented aquatic habitat of priority species as determined by the Washington Department of Fish and Wildlife (WDFW).

Water quality samples have been taken from the inlets and outlets surrounding the Potholes Reservoir approximately four times annually since 1956. Results were obtained from the Storage and Retrieval of U.S. Waterways Parametric Data database (STORET), sponsored by the U.S. Environmental Protection Agency's Office of Water; Office of Wetlands, Oceans, and Watersheds, and Office of Information Resources Management.

Analytes of interest from the sampling effort have included temperature, turbidity, conductivity, dissolved oxygen, pH, alkalinity, ammonia, nitrate/nitrite, total nitrogen, total phosphorus, dissolved calcium, dissolved magnesium, dissolved sodium, dissolved potassium, chloride, dissolved sulfate, and fecal coliform bacteria. Table 3.3-2 lists representative values for these parameters, taken from 1992 data from the Potholes Canal at Headworks (CBP010) sampling location. With the exception of fecal coliform bacteria results, analyte concentrations at inlet and outlet sampling locations were similar.

Table 3.3-2
Representative Water Quality Data for Potholes Reservoir
(Potholes Canal at Headworks Sampling Location)

Parameter	Units	5/19/92 (spring)	7/14/92 (summer)	10/08/92 (fall)
temperature	° Celsius	16.5	22.0	14.7
turbidity	Hach ftu	2.0	4.0	3.0
conductivity	micromho	321	272	338
dissolved oxygen	mg/L	10.0	10.2	10.0
pH	pH units	8.40	8.8	8.08
carbonate ion	mg/L	5	11	5
bicarbonate ion	mg/L	151	114	173
ammonia as N	mg/L	0.08	0.03	0.18
nitrite/nitrate	mg/L	0.6	0.1	0.8
total Kjeldahl N	mg/L	0.540	0.750	0.650
phosphorus-total	mg/L	0.056	0.044	0.056
calcium, dissolved	mg/L	28.5	20.8	29.7
magnesium, dissolved	mg/L	13.4	12.6	16.2
sodium, dissolved	mg/L	18.39	17.24	21.84
potassium, dissolved	mg/L	3.91	3.52	4.69
chloride	mg/L	6	6	8
sulfate, dissolved	mg/L	27.9	24	27.9
fecal coliform bacteria	colonies/ 100 mL	not measured	ND	not measured

ND - not detected; the detection limit for fecal coliform bacteria was 2 colonies/100 mL.

Fecal coliform bacteria have not been analyzed consistently. In addition, it is not possible to select fecal coliform bacteria data which are representative of conditions in the reservoir due to wide variability in these data. Fecal coliform levels have ranged from non-detect (less than 2 colonies per 100 mL) to 5,000 colonies per 100 mL. Fecal coliform bacteria levels in excess of 100-200 colonies per 100 mL have shown discernable health effects in exposed swimmers in other waters. The sampling locations Potholes Canal at Headworks, Moses Lake at Outlet, and Winchester Wasteway at Gaging Station have all shown fewer than 5 exceedances of the 100 colonies/100 mL level during the period 1972-1992. During that time, Frenchman Hills Wasteway at Gaging Station exceeded 100 colonies/100 mL a total of 18 times; Rocky Coulee Drain at O'Sullivan Road Crossing exceeded 100 colonies/100 mL a total of 33 times, and Lind Coulee at Route 17 Crossing exceeded 100 colonies/100 mL a total of 48 times. Extremely high (over 1,000 colonies per 100 mL) fecal coliform levels have not been observed in either the Potholes Canal at Headworks sampling location (a reservoir outlet) or at the Winchester Wasteway at Gaging Station sampling location. All other sampling locations have shown periodic extremely high fecal coliform levels which are hazardous to human health. The Lind Coulee at Route 17 Crossing (CBP011) sampling location has shown the highest fecal coliform levels. However, this sampling location is approximately 10 miles upstream from the Potholes Reservoir and may not be representative of conditions in the reservoir.

In 1997, Reclamation collected additional bacteriological data from sites within the reservoir (Potholes Reservoir State Park boat dock, Mar Don resort swimming beach, Lind Coulee boat launch and O'Sullivan Site). The results were consistent with inlet and outlet sampling in prior years with fecal coliform count ranging from non-detect to extremely high (>2,400 colonies per 100ml). The continuing presence of occasional high levels of fecal coliform bacteria in reservoir waters could limit future recreational use of the reservoir.

3.3.3 Regional and Local Aquifer System Hydrology

The Columbia Plateau regional aquifer system is comprised of four aquifer units and three confining units. Within the study area, three aquifer units and two confining units are present. From youngest to oldest (surface to depth) these units are the Overburden unit, the Wanapum unit, the Wanapum-Grande Ronde interbed (a confining unit), the Grande Ronde unit, and the Basement confining unit. The Basement confining unit defines the base of the regional and local aquifer system.

Ground water movement in the regional aquifer system is affected by several factors including: total area of natural recharge and discharge (water entering the aquifer and water leaving the aquifer), the physical properties of the basalts, the specific ability of each unit to transmit water, recharge from water management practices, and prolonged irrigation pumping. The dominant pattern of ground water movement is from areas of higher land surface elevations toward major

surface drainage features such as the structural basin at Potholes Reservoir or the Columbia River. Ground water is routed away from structural highs (Frenchman Anticline), and toward the regional geologic dip. Interformational movement between units is generally downward with upward flow from or within the Grande Ronde Basalt in the vicinity of the Columbia River, and other major surface water bodies (USGS, 1989).

Water entering the basalts flows both horizontally and vertically through vesicles, joints, fractures, and the intraflow structures that create permeable zones. Rapid ground water flow and horizontal ground water movement generally occurs in the interflow zones consisting of the bases and tops of adjacent lava flows. The more dense, central portions of each lava flow typically have low permeabilities and vertical water movement characteristics (USGS, 1989).

3.3.4 Ground Water Quality

Existing data for the public water supply wells found within or near the RMP study area boundary were reviewed to determine whether the MCLs established for ground water were being met (see Table 3.3-3). Sulfate concentrations ranged from 9.0 to 87.0 mg/L, with a mean of 42.8 mg/L. Sodium ranged from 21.0 to 60.0 mg/L (mean of 38 mg/L); chloride from 5.0 to 58.0 mg/L(mean of 32.8 mg/L); nitrate from 4.2 to 16.7 mg/L (mean of 8.63 mg/L); iron from 0.01 to 1.09 mg/L (mean of 0.20 mg/L); and manganese from 0.01 to 0.07 mg/L (mean of 0.022 mg/L). Cumulatively, these total dissolved solids (TDS) ranged from 286 to 609 mg/L, with an average value of 480 mg/L. In general, ground water from shallow wells were the most contaminated and water taken at depth the least contaminated.

With the exception of the Sunrise Water Association, whose well is screened off below 500 feet, all the public ground water systems examined had water quality problems and MCL exceedances. Of the eleven wells examined, four wells exceeded the 10 mg/L MCL for nitrate, eight wells exceeded the MCL for lead, three exceeded the MCL for TDS, two exceeded the MCL for manganese, and one exceeded the MCL for iron. Overall, the well data generally indicate that ground waters pumped from the shallower Overburden aquifer around Potholes Reservoir are suitable for agriculture and industrial use, and those pumped from depths equivalent to the lower aquifer units are suitable for all beneficial uses including public drinking water supplies.

Nitrate concentrations in ground water supplies are currently monitored by the Washington Department of Health (WDOH), in cooperation with the county health districts, since they are a good indicator of potentially acute public health effects. The WIGWC report noted that irrigation and agricultural practices account for a majority of the nitrogen loading.

Table 3.3-3
Ground Water Quality Data
Potholes Reservoir RMP Study Area and Vicinity

Well ID	GROUP A SYSTEM NAME	1/4, 1/4 SECT, TOWN - RANGE	METER DEPTH (Ft)	SAMPLE DATE	CONTAMINANT	EPA MCL (mg/L)	MEASURED LEVEL (mg/L)
1	Potholes Development Inc	NE, NE 18, 17N - 28E	40	5/3/1999	NITRATE-N	10	16.7
				7/27/1999	LEAD	*Zero	0.002
2	Perch Point Resort	NW, SW 35, 18N - 28E	80	7/16/1992	LEAD	**0.015	0.019
3		NW, SW 35, 18N - 28E	160				
4		SW, SW 35, 18N - 28E	0				
5	Potholes State Park	NE, SE 07, 17N - 28E	180	1/25/1988	LEAD	*Zero	0.01
				1/25/1988	NITRATE-N	10	9.8
6	Sunrise Water Association	NW, SW 17, 17N - 28E	515	NA	NA	NA	NA
7	O'Sullivan Sportsmen's Resort	NE, NE 18, 17N - 28E	98	9/8/1999	NITRATE-N	10	12
				6/16/1993	LEAD	*Zero	0.002
				6/16/1993	***TDS	500	510
8		NE, NE 18, 17N - 28E	150	6/23/1997	NITRATE-N	10	13
				1/27/1993	LEAD	*Zero	0.002
9	Marine View Home Owners Assn	NW, NE 17, 17N - 29E	240	4/20/1998	NITRATE-N	10	12.3
				11/1/1993	BERYLLIUM	0.004	0.02
					LEAD	*Zero	0.002
10	The New Mar Don Resort	NW, SW 16, 17N - 28E	95	12/2/1992	LEAD	*Zero	0.001
				12/2/1992	MANGANESE	0.05	0.052
				12/2/1992	***TDS	500	507
11		NE, NE 17, 17N - 28E	97	12/2/1992	IRON	0.3	1.09
				12/2/1992	LEAD	*Zero	0.01
				12/2/1992	MANGANESE	0.05	0.065
				12/2/1992	***TDS	500	609

MCL **Maximum Contaminant Level (MCL) - The maximum permissible level of a contaminant in the water which is delivered to any user o f a public water system. MCLs are enforceable standards.**

* **Maximum Contaminant Level Goal (MCLG) - The Maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows for an adequate margin of safety. MCLGs are non-enforceable public health goals.**

** **Required Action Level - The action level, which triggers water systems into taking treatment steps if exceeded in more than 10% of tap water samples, for copper is 1.3 mg/L, and for lead is 0.015 mg/L.**

*** **Total Dissolved Solids**

Exceeds EPA MCL primary and secondary drinking water regulations.

Shallow wells (less than 300 feet in depth) appear to be at much greater risk for nitrate contamination than deeper wells. Most larger public water supply wells are drilled deep to maximize the volume of water available, and most private domestic drinking water wells are shallow and rarely exceed the first major water bearing zone encountered. This practice places the shallow domestic wells at higher risk for water quality problems (WIGWC, 1996).

3.4 VEGETATION

3.4.1 Introduction

The Potholes Reservoir study area is within the shrub-steppe vegetation zone described by Franklin and Dyrness (1973). This upland zone is dominated by sagebrush, bitterbrush, and large perennial bunchgrasses such as bluebunch wheatgrass (*Agropyron spicatum*) and Idaho fescue (*Festuca idahoensis*). Community composition depends upon many factors including substrate, topography, wind action, and human disturbances (Franklin and Dyrness, 1973).

Before the construction of O'Sullivan Dam, vegetation within the study area was arranged in zones along a moisture gradient. These zones from dry to wet were: (1) no vegetation on high, dry, shifting sand dunes; (2) *Psoralea* sp. on the windward faces of lower shifting dunes with sand dock and willows on the leeward faces; (3) rabbitbrush, sagebrush, spiny hopsage, cheatgrass, Indian ricegrass and alkali cordgrass on semi-stable sand dunes; (4) Baltic rush-sedge meadows; (5) bulrush-cattail wetlands; and (6) submerged aquatic plants (USFWS 2000). Permanent and temporary potholes (800-1,000), flooded flats, creeks fed by springs fed potholes, and extensive marshlands covered the area (Harris 1954).

Overgrazing in the early part of the century resulted in the destruction of native plant cover and the formation of a broad area of active sand dunes (Zook 1978). Fire also likely impacted the native shrub-steppe plant communities. Due to the area's arid climate and presence of sandy soils, however, native plant community recovery is slow. As indicated by Franklin and Dyrness (1973), such recovery is further hampered in the fragile uplands due to their susceptibility to invader plant establishment on disturbed sites.

The upland vegetation currently found at the reservoir is dominated by native shrubs and introduced annual grasses. There are only remnant patches of native vegetation (as described by Franklin and Dryness 1973) remaining. Since the creation of Potholes Reservoir, the aerial extent of riparian habitat, particularly riparian shrub and riparian forest, has increased considerably and is dominated by woody species such as willow. Large areas of emergent herbaceous wetlands are also present, while some areas have only minimal vegetative cover.

Several recent studies (see Section 3.4 and Appendix E) conducted within the study area have begun to quantify and identify how the presence of a fluctuating reservoir environment, recreation, and other land use activities may influence and shape the vegetative communities present at Potholes Reservoir. Findings from these studies were used to identify and establish the current presence and abundance of the vegetative cover types present, and identify how they have changed or been directly impacted as a result of (1) historic land use patterns (i.e., ORV and other dispersed recreation), and (2) the inability of native plant communities to recover with continued recreation pressure and disturbances. Collectively, these studies also helped address one of the fundamental questions underlying this Final Environmental Impact Statement (FEIS): what effects, if any, do ORV use and dispersed camping have on wildlife?

To assist with the Potholes Reservoir RMP/FEIS study effort, the Reclamation funded the preparation of a detailed vegetation/habitat map (see Figures 3.4-1 and 3.4-2). Using April 28, 1994 aerial photography of the study area, the vegetative cover types present at Potholes Reservoir were delineated, classified and mapped. This mapping effort served as the basis for the vegetation impact analysis detailed in Chapter 4, established the affected environment detailed below, and was used by the USFWS to conduct a Habitat Evaluation Procedures (HEP) analysis to complement the RMP/FEIS effort.

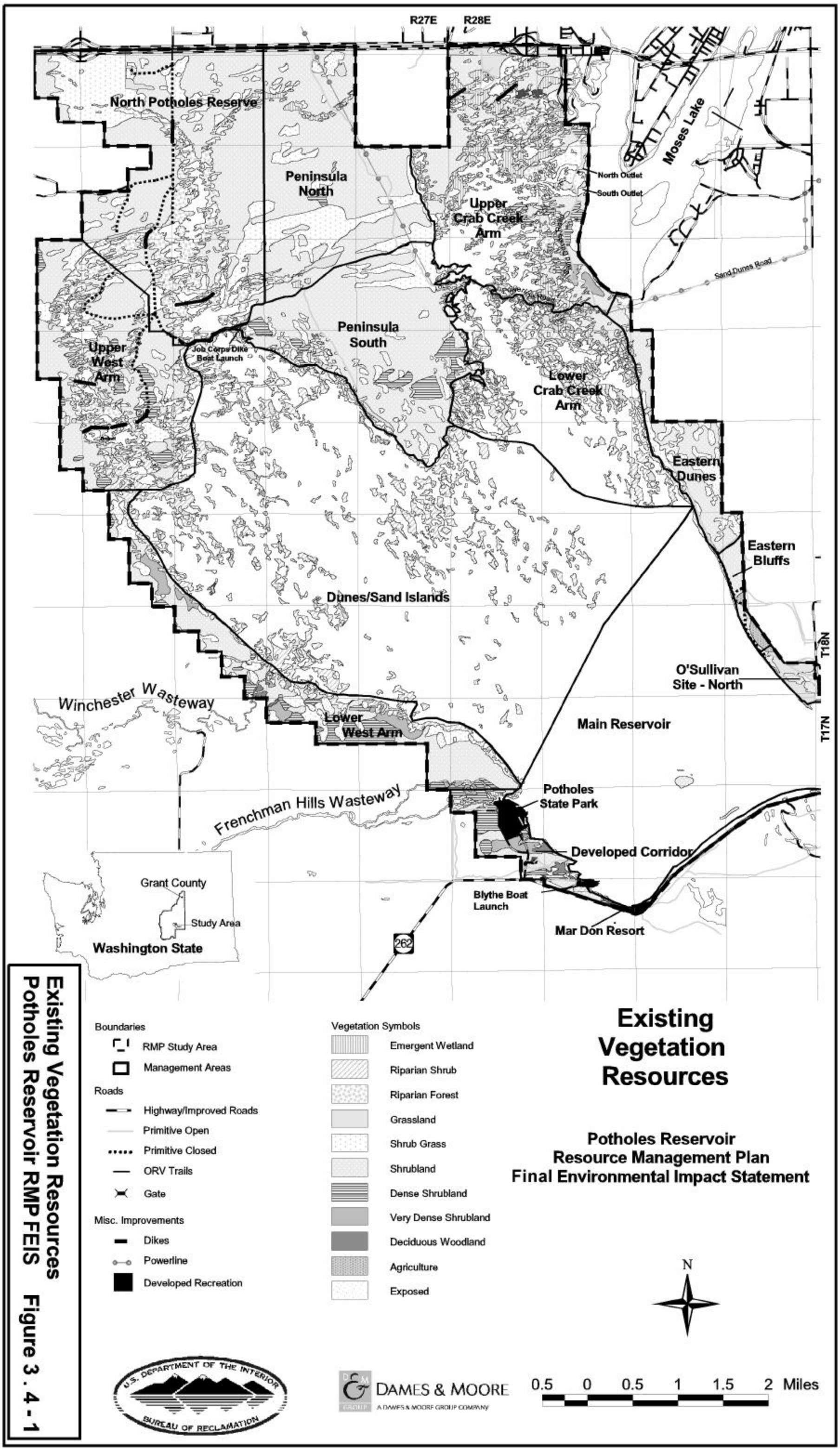
At Potholes Reservoir, the number of acres in land and water change rather dramatically with changes in the reservoir's water surface elevation due to the study area's subdued topography. Recognizing this dynamic environment and the need to establish a "baseline condition" for the impact assessments presented in Chapter 4, the Reclamation study team determined that the vegetation/habitat map provided the most appropriate and accurate baseline data available for this study. Consequently, an estimated 18,500 acres of land and 17,700 acres of open water were established as the baseline condition within the 36,200-acre RMP study area boundary. This represents the amount of land and water present on April 28, 1994, when the reservoir pool elevation was about 1043.5 feet (or 3 feet below the reservoir's full pool elevation of 1046.5 feet). The total amount of open water habitat available at any point in time is determined by the reservoir's water surface elevation and influenced by the inflow and outflow patterns which stem from CBP reservoir system operations.

The Reclamation modified the HEP (USFWS, 1981) and Cowardin et al. (1979) vegetation cover type classification systems in order to identify, quantify and evaluate actual and potential changes to the vegetative cover types present at Potholes Reservoir (Table 3.4-1). Under the modified system adopted for the vegetation and HEP studies conducted for this FEIS, a total of six upland cover types and four wetland and riparian cover types were identified within the study area. To complete the vegetation/habitat map, four other cover types (agriculture, exposed, developed recreation, and urban) were mapped. These, however, were not specifically required for the HEP analysis. These cover types and their associated acreages are summarized in Table 3.4-2.

For the purpose of the following discussion, the reader should note that the terms "vegetation community" or "plant community" are meant to describe an assemblage of plants that occur together and can be found repeatedly throughout a landscape. No successional relationship is implied.

Table 3.4-1
Modified HEP (USFWS, 1981) and Cowardin et al. (1979) Vegetation Cover Type Classification Codes and Descriptions Used for Potholes Vegetation Mapping

Cover Type	Code	Description
Upland types		
Grassland	G	< 5% shrub (ex. Cheatgrass, bluebunch wheatgrass)
Shrub Grass	SG	> 5% to 15 % shrub cover
Shrubland	S	> 15% to 25 % shrub cover
Dense Shrubland	DS	> 25% to 35 % shrub cover
Very Dense Shrubland	VDS	> 35% shrub cover
Deciduous Woodland	DW	>70% deciduous trees, 20-40% canopy cover
Wetland types		
Emergent Wetland	WE	dominated by emergent wetland species
	WE1	(1) cattail/bulrush
	WE2	(2) emergent freshwater
	WE3	(3) salt grass/spike rush, saline wetland
Riparian Scrub Shrub	RSS	hydrophilic shrubs in riparian zone (including Russian olive), a single polygon should include both sides of the stream
Riparian Shrub	RS	hydrophilic shrubs in riparian zone, a single polygon should include both sides of the stream
Riparian Scrub Forest	RSF	> 40% canopy cover trees (including Russian olive) in riparian zone, a single polygon should include both sides of the stream
Riparian Forest	RF	> 40% canopy cover trees in riparian zone, a single polygon should include both sides of the stream
Miscellaneous types		
Agriculture	AG	various grain or hay crops including mowed forbland
Surface Water	W	pond, lake, reservoir, wide river
Exposed	E	sand, ash, mud flat
Island	IS	any permanent substrate separated by > 20 feet from shore
Urban	U	residential or industrial



Existing Vegetation Resources
Potholes Reservoir RMP FEIS Figure 3 . 4 - 1

R28E

5 SE

5 SE

'K' SE

'L' SE

'M' SE

6 SE

T18N

T17N

O'Sullivan Site - South

Sampson's Beach

Sampson's Pit

W. Lind Coulee Arm

E. Lind Coulee Arm

Glen Williams
Boat Launch

Road 'M' Boat Launch

262

Developed Corridor

Existing Vegetation Resources
Potholes Reservoir Resource Management Plan FEIS

Boundaries

- RMP Study Area
- Management Areas
- Developed Recreation

Roads

- Highway/Improved Roads
- Primitive (Closed)
- Primitive (Open)

Vegetation Symbols

- Emergent Wetland
- Riparian Shrub
- Riparian Forest
- Grassland
- Shrub Grass
- Shrubland
- Dense Shrubland
- Very Dense Shrubland
- Agriculture
- Exposed

N

Scale 1:24,000

0.5 0 0.5 Miles

Grant County

Study Area

Washington State

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Existing Vegetation Resources
Potholes Reservoir RMP FEIS Figure 3.4 - 2

Table 3.4-2
Vegetative and Other Cover Types Found Within the Potholes Reservoir RMP Study Area

Cover Type	Acreage
Upland Cover Types	
Grassland	1,031
Shrub Grass	2,337
Shrubland	8,538
Dense Shrubland	929
Very Dense Shrubland	212
Deciduous Woodland	61
Total	**13,108**
Wetland and Riparian Cover Types	
Emergent Wetland	729
Riparian Shrub	2,039
Riparian Forest	1,716
Riparian Shrub Forest	12
Total	**4,496**
Other Cover Types	
Agriculture	129
Exposed	874
Developed Recreation	72
Urban	8
Total	**1,083**

3.4.2 Upland Vegetation

The upland plant communities surrounding Potholes Reservoir are described as being in the edaphic series with deep, sandy soils (Daubenmire 1942, 1970). The presence of active sand dunes plays an integral part in shaping the structure of these shrub-steppe communities. Currently, the original upland overstory which was dominated by big sagebrush has been largely replaced by green and gray rabbitbrush. Grasses are now mainly cheatgrass, needle-and-thread, Indian ricegrass, and some wheatgrasses with big sagebrush and native bunchgrass communities generally found in isolated pockets. Large areas of native shrub-steppe communities are primarily limited to the North Potholes Reserve, Peninsula South, and Upper West Arm management areas.

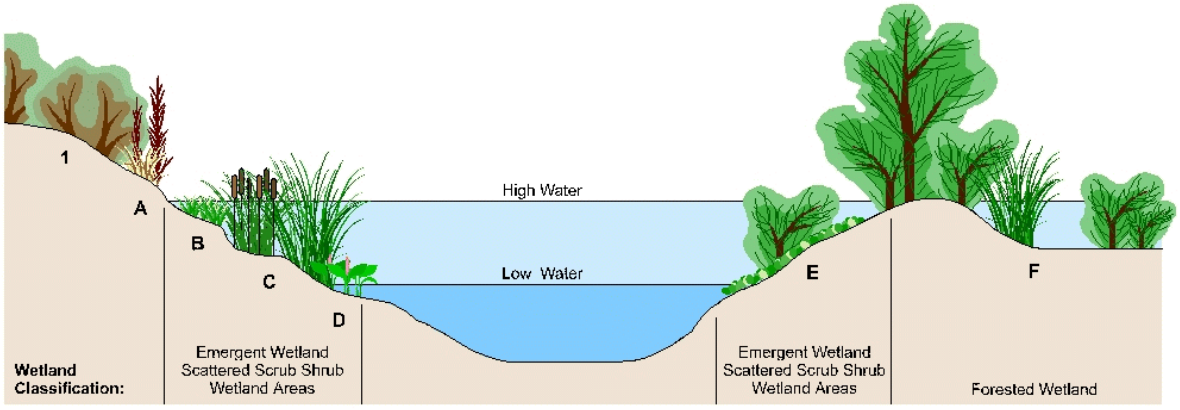
3.4.3 Wetland and Riparian Vegetation

There are four wetland and riparian cover types. Since the vegetation mapping was done from aerial photos taken near full pool, the amount of some cover types (especially emergent wetlands) can be considered the minimum range.

The distribution of all wetland and riparian communities, particularly emergent wetland communities, appears to be largely dependent upon topographic position, substrate, water level, slope, aspect, wind action, and wave action. Seasonal water level fluctuations, which can be up to twenty vertical feet, shape these communities. Wetland communities along the reservoir's islands and shorelines are well represented in Figure 3.4-3, which shows approximate locations of common wetland plants found along the shoreline gradient with the exception of those communities found on mud flats.

Management actions and recreation uses affect wetland vegetation primarily through the amount of disturbance they cause. The greatest agent of change is fluctuating reservoir levels. Numerous observations by biologists (Cooke et al., 1997) also indicate that the number and extent of invasive wetland species are greater in the portions of the reservoir subject to ORV use.

The presence of Potholes Reservoir has increased the abundance of riparian communities with riparian shrub currently more common than riparian forest (see Table 3.4-2). Willow and black cottonwood areas have developed along the reservoir margin, on some islands, and in some of the many wetlands which developed. Russian olive is also an increasing component of the overstory in some areas. Although they do provide food and cover for some wildlife species, its propensity to take over native habitat is not considered desirable since native willow communities provide habitat for a greater diversity of species (Brown 1990, USFWS 1997).



1 Shrub-steppe upland
A Transitional zone: weedy herbs and grasses, tall steppe shrubs
B Salt grass, spikerush, coyote willow
C Bulrush, other sedges and rushes, cattails, coyote willow
D Water smartweed
E Cocklebur, beggar's tick, knot weed, coyote willow
F Peachleaf willow, Pacific willow, coyote willow, and emergents such as cattails

Wetland classification terminology taken from Cowardin et al. (1979)

Figure 3.4-3

3.4.4 Other Cover Types

There are four other cover types that occupy the study area landscape. The first is "agriculture" and encompasses an estimated 129 acres. Included in this category are croplands that are managed under WDFW's agricultural lease program within the West and East Lind Coulee Arm management areas. Most of the remaining acreage is center pivot irrigated cropland located in the Eastern Bluffs management area; this acreage is not currently leased and may represent a trespass encroachment.

The "exposed" cover type occurs on about 874 acres and includes mud flats, sand dunes, and eroding shoreline areas that have minimal vegetation (a minimum cover percentage was not designated). Mud flats are created when the reservoir recedes. As the irrigation season progresses, the mud flats are colonized by fast growing annual plants. Mud flats can be found in the Upper and Lower Crab Creek Arm, the Lind Coulee Arm, and in North Potholes Reserve.

The area's shifting sand dunes create an unstable environment for vegetation (Cooke et al., 1997). Few plant species can tolerate this dynamic environment. Areas where there are extensive sand dunes include the Eastern Dunes, Lower West Arm, Lower Crab Creek Arm, the east side of the Upper West Arm, and the Dunes/Sand Islands management areas. Eroding shoreline areas occur throughout the reservoir area, but are most apparent along the Eastern Bluffs management area.

The "developed recreation" cover type encompasses an estimated 72 acres and includes the developed recreation sites found within the study area. Included are the developed sites and facilities (i.e., gravel/asphalt parking areas, etc.) located at Potholes State Park, Mar Don Resort, and formal boat launch sites (i.e., Glen Williams, Blythe, Powerline, Road "M," etc.).

The last cover type is "urban." This category covers about 8 acres and includes commercial and residential structures and land uses.

3.4.5 Dominant Cover Types and Condition by Management Area

Table 3.4-3 lists the dominant vegetative cover types by management area and identifies their relative condition (very poor to excellent) and acreage. The lesser cover types occurring within the study area are not represented.

Table 3.4-3
Dominant Cover Types, Condition, and Acreage by Management Area

Management Area	Cover Type	Condition	Acreage
North Potholes Reserve	Shrub Grass	good	749
	Shrubland	good	1838
	Riparian Forest	good to excellent	595
Peninsula North	Shrub Grass	good to excellent	454
	Shrubland	good to excellent	1616
Peninsula South	Exposed	poor	189
	Shrub Grass	fair to good	185
	Shrubland	good to excellent	1497
	Dense Shrubland	good to excellent	159
Upper Crab Creek Arm	Shrubland	fair to good	757
	Emergent Wetland	poor to fair	491
	Riparian Forest	fair to good	244
	Shrub Grass	fair to good	201
	Grassland	fair to good	112
	Dense Shrubland	good	79
Lower Crab Creek Arm	Shrubland	fair	124

Table 3.4-3
Dominant Cover Types, Condition, and Acreage by Management Area

Management Area	Cover Type	Condition	Acreage
	Emergent Wetland	poor to good	95
	Riparian Forest	poor to good	99
	Riparian Shrub	poor to good	464
	Grassland	poor to good	93
Eastern Dunes	Exposed	very poor	191
	Shrubland	poor	394
	Shrub Grass	poor to fair	62
Eastern Bluffs	Shrubland	poor to good	82
	Agriculture	good	29
Upper West Arm	Shrubland	good	1027
	Riparian Shrub	good	230
	Riparian Forest	good to excellent	379
	Shrub Grass	good to excellent	128
Lower West Arm	Shrub Grass	fair to good	137
	Shrubland	good	600
	Dense Shrubland	good	200
	Very Dense Shrubland	good	122
	Riparian Shrub	good	135
Developed Corridor	Shrubland	good	143
	Very Dense Shrubland	good to excellent	49
	Riparian Forest	good	41
	Dense Shrubland	good to excellent	117
Dunes/Sand Islands	Grassland	fair	84
	Riparian Shrub	fair to good	1144
O'Sullivan (North and South)	Grassland	very poor	98
	Shrub Grass	poor	21
	Shrubland	poor to fair	39
West Lind Coulee Arm	Grassland	poor	313
	Shrub Grass	poor	108

Table 3.4-3
Dominant Cover Types, Condition, and Acreage by Management Area

Management Area	Cover Type	Condition	Acreage
	Dense Shrubland	poor to good	83
	Shrubland	poor to good	44
	Riparian Shrub	poor to fair	27
	Riparian Forest	poor to fair	14
East Lind Coulee Arm	Grassland	fair to good	190
	Shrub Grass	good	206
	Shrubland	good	333
	Dense Shrubland	good	155
	Riparian Forest	good	102

3.4.6 Invasive Plants and Noxious Weeds

Invasive plants, or weeds, interfere with the maintenance of healthy and diverse ecosystems and can degrade or destroy native plant communities, wildlife habitat, recreational opportunities, and agricultural use of the land. Weeds are a common problem in the study area and generally colonize and occupy sites that have been previously disturbed by fire, livestock grazing, motorized vehicular travel, and/or dispersed camping. Non-native plants can displace natives and generally are of lower forage value to wildlife, livestock, and wildlife requisites such as cover and nesting habitat. They are difficult to control or eliminate once established, and generally colonize and occupy sites where the native plant community or ground cover has been lost or severely disturbed. Consequently, weed control is an integral part of any resource management program.

Noxious weeds are defined by the Washington State Noxious Weed Control Board (1999) as "non-native plants that are destructive, competitive, or difficult to control due to their aggressive growth and lack of natural enemies." These species are regulated by the Board and are categorized into three classes (A, B, and C) on the State Noxious Weed List. The categories are based on the seriousness of the threat they pose in the state. Class A weeds have the highest priority for control with eradication required by law; followed by Class B and C weeds. For any species in any class, new infestations with limited distribution generally have the highest priority because the potential for containment is greater than for more widely distributed species.

Class A weeds are those that are not yet abundant across the state, so the potential for eliminating them is high. Saltcedar or tamarisk (*Tamarix ramosissima*) is the only Class A weed known to occur at Potholes Reservoir. Because the Potholes environment is suitable for the establishment of salt cedar, a yearly monitoring "search and destroy" program is recommended by the Grant County Noxious Weed Board for this species. *Tamarix* spp. is discussed by Leonard (1996) as the species originally found at Potholes. However, species of this genus are notoriously difficult to identify and have confusing taxonomy and synonymy; it is best to assume that the species in question was the invasive, Class A species.

Class B weeds are limited to small portions of the state. The control emphasis is to prevent new infestations from becoming established in other parts of the state. The Class B weeds known to occur within the study area include kochia, purple loosestrife, puncture vine, perennial pepperweed, Eurasian water milfoil, Swainson pea, and the knapweeds (diffuse, spotted and Russian).

Because they are widespread, Class C weed control is dependent on the feasibility of control and the level of harm the weed poses locally. Class C weeds known to occur at Potholes Reservoir include Canada thistle and reed canary grass.

Weeds are associated with certain kinds of disturbance, plant communities, or land use activities that enhance their ability to proliferate. Roads, ORV travel, and dispersed camping are disturbance activities that promote the proliferation of Russian thistle, kochia, knapweeds, Dalmatian toadflax, and cheatgrass. Roads (vehicular travel) and recreationists function as weed dispersers and serve as vectors for introducing new weed species into new areas. This can be seen at staging areas or dispersed campsites. A typical scenario is the removal of vegetation through ground disturbance, bare soil exposure, and new weed seed deposition - creating ideal conditions for the establishment of a new weed population. Grazing promotes the proliferation of cheatgrass and knapweeds. The knapweeds are dispersed by cattle as the seed heads cling to animal fur. Reservoir fluctuations provide good conditions for purple loosestrife and cocklebur proliferation.

At present, purple loosestrife is firmly established throughout most of the study area; particularly thick stands have become established at the Winchester and Frenchman Hills Wasteway outlets. There is currently no reasonable control method for eliminating this species from areas where it has become established to the extent that has occurred at Potholes Reservoir. Herbicides (those approved for use near water) or hand removals are recommended for controlling individual plants and small populations only (Swearington, 1997). Biological control insects are seen as the most likely method of effective long term control of large populations (Swearington, 1997) due to the high cost and relatively ineffective results of herbicide application.

Cheatgrass, knapweeds, and Canada thistle are currently the most prolific weeds present at Potholes Reservoir regardless of the disturbance level. Canada thistle can invade any moderately wet site although it reaches higher densities in disturbed areas where it can easily outcompete native species. Canada thistle is a particularly difficult weed to control due to its vast underground root system (Whitson et al., 1999).

Weed invasion in wetlands is also a particular problem. In general, weeds are more difficult to eradicate from wetlands because there are a limited number of herbicides that can be used near water. Also, wetlands often have dense vegetation with desirable native species and noxious weeds intermixed. Targeting only the weeds is sometimes impossible.

The proliferation of undesirable plants within the study area is managed through the integrated weed management program established between the Reclamation, the state, and the Noxious Weed Control Board of Grant County. The various Reclamation and state issued land use agreements (i.e., grazing and agricultural leases) require the lessee, licensee or permittee to maintain a weed control program to prevent the spread or establishment of noxious weeds. Herbicides that are highly toxic to people, fish or wildlife are not allowed. Each entity is responsible for either taking appropriate weed control measures or is required to reimburse the administering agency for any weed control costs incurred as a result of their failure to control weeds on the involved property.

According to information obtained from the Noxious Weed Control Board of Grant County, the study area is monitored for weed control by the County, but treatment is administered by the WDFW and the Reclamation. On occasion, subcontractors conduct the county's prescribed weed control measures. The Reclamation is generally concerned with Eurasian water milfoil control because infestation is a source of propagules for other waters in eastern Washington (BOR 1989). Current control measures and management techniques involve water level manipulation, mechanical control, herbicides, biological controls, and light-screening measures (Remaley, 1999). Mechanical control is effective only if all parts of the plant are removed. Light manipulation is done through bankside plantings, dyes, or shade barriers that block light to the plants. Water level manipulations up or down can also be used - raising the level "drowns" the plants by preventing light from reaching them, and lowering the level exposes the plants and roots to the elements. This technique is highly effective in controlling the plant, but has not eliminated it. Complete eradication does not appear to be practical, but one or some combination of these techniques may be the most effective.

3.4.7 Overview of Vegetation Study Results

A "*Historic Vegetation Photo Interpretation Study*" recently completed by the Reclamation team compared the reservoir's present vegetative cover types (1994) to those which existed historically (1964 and 1971). Current and historic (reference) vegetative conditions (see Figures 3.4-1 and 3.4-4, respectively) within the ORV control area; the Green, Yellow and Red ORV zones; and other dispersed use areas were compared against each other. Over the past 30 years (1964-1994), the comparison showed a sharp increase in the riparian forest and shrubland cover types coupled with a notable decline in shrub grass. The increase in riparian shrub and riparian forest can be directly attributed to the presence of the reservoir and the seasonal inundation of former shrub-steppe (upland) cover types.

The data showed an increase of more then 40 percent (see Appendix E) in the amount of exposed area within the Green Zone coupled with a notable reduction in the amount of grassland, riparian forest, and shrubland present. The data also showed that shrubland habitats in the area are being converted to bare, active sand dunes. Areas of similar topography that were not subjected to ORV use did not show a corresponding decline in vegetative cover, and increases in shrub cover were noted in other parts of the study area outside the Green Zone.

A study completed in 1997, by the WDFW entitled "*Effects of Off-Road Vehicle Use on Birds and Vegetation at Moses Lake Sand Dunes ORV Area*" (Cooke et al., 1997) indicated similar trends. The data showed progressively more bare ground when going from the control site with 23% bare ground, to the Red Zone with 31%, Yellow Zone with 41%, and Green Zone with 64%. The percent cover of cryptogams on the soil surface was also linear with 11% in the Green Zone and 55% at the control site. Overall, the study concluded that ORV activity increases the amount of bare ground and dune activity and decreases the amount of ground cover and cryptogams present (Cook et al., 1997).

Within the Yellow Zone declines in the dense shrubland, shrub grass, and wetland emergent cover types were noted. These changes were offset by a small increase in the amount of riparian forest and riparian shrub present. A large increase in the grassland cover type (from 2 acres to 66 acres) was noted. This area is used only seasonally (ORV) with much of the area seasonally flooded. These factors are the unique differences between the green and yellow zone. These differences provide differing successional pathways and vegetative trends which respond differently to disturbance. Field observations along the ORV trail network verified that these grasslands currently are dominated by noxious weeds and other non-native annual grasses and forbs. Large reductions in the shrub grass cover type (from 157 acres to 32 acres) were also noted.

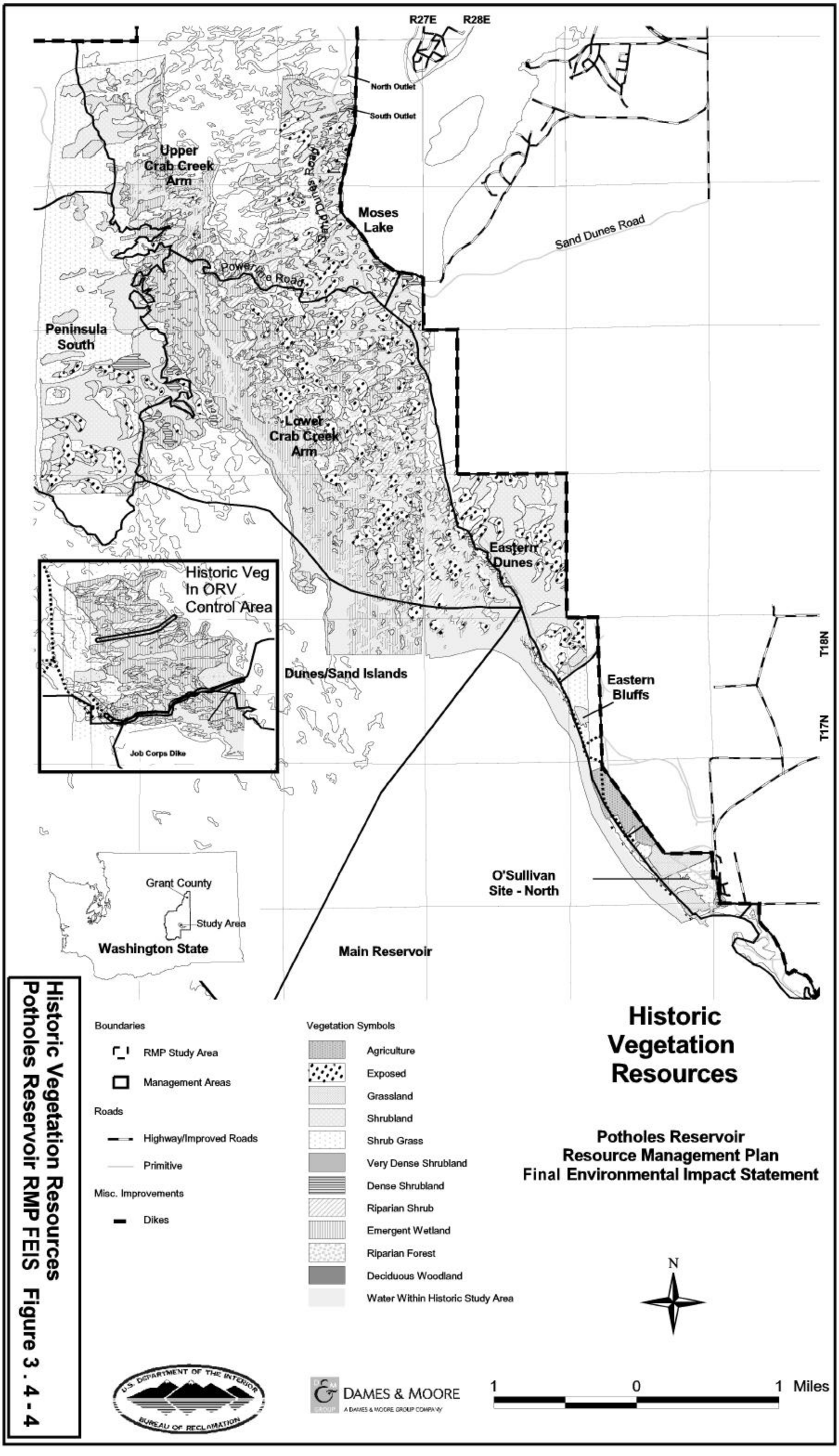
A detailed field inventory conducted in 1999 was used to estimate the number of acres of ORV trail created since ORV riding was introduced into the "Yellow Zone" (an area seasonally open to ORV use from July 1 - October 1). By overlaying the ORV trail data with the present vegetation/habitat map (see Figure 3.4-1), an estimated 37 acres of ORV trail had replaced (in descending order) approximately 13.7 acres of shrubland, 6.8 acres of riparian shrub, 5.4 acres of wetland emergent, 4.8 acres of shrub grass, 4.8 acres of grassland, and negligible amounts of exposed, dense shrub, and riparian forest.

Vegetative trends within the Red Zone and ORV control area (closed to ORV use year-round) showed a dramatic increase over time in the riparian forest, dense shrubland, and shrubland cover types. Concurrently, the most noteworthy decline shown by the data was in the shrub grass and grassland cover types. In the absence of heavy human use and the presence of Potholes Reservoir and a high water table, the slow but continual conversion of upland shrub-steppe and previously disturbed sites to riparian and dense shrubland are to be expected. This trend was further confirmed by the changes noted within the ORV control area which showed a dramatic increase in riparian forest and moderate increases in dense shrubland and shrubland coupled with declines in the riparian shrub, shrub grass, and exposed cover types.

Other vegetative trends noted from field observations made by biologists within the Yellow and Green Zones relate to the high number of weeds, including state listed noxious weeds, which have become a large component of the plant community composition present. Conversely, the plant communities found within the ORV control area (little human disturbance) are composed primarily of native species. Also, the vast network of ORV roads and trails that traverse the Yellow and Green Zones are absent from the historic (reference) map; the present highly fragmented landscape correlates well with current ORV use and trail development.

The USFWS conducted a HEP study at Potholes Reservoir in 1999 (USFWS 2000) to acquire baseline data on current habitat conditions and to determine impacts from recreational use on wildlife and vegetative communities. Based on the vegetative data collected, the USFWS concluded "it appears that recreational activities, especially ORV use, have lowered habitat quality, or at least prevented it from recovering from previous conditions." Specifically, the study showed that the areas subjected to ORV use have less vegetative cover and fewer desirable native species.

Aside from ORV use, other dispersed activities have impacted the area's vegetative communities. These disturbances have also allowed various weeds to proliferate along the edges of roads, "informal" roads leading to popular fishing spots, undeveloped boat launch sites, camping sites, have all removed a certain amount of habitat. Camping and parking areas have caused similar losses and changes (USFWS 2000).



Historic Vegetation Resources
Potholes Reservoir RMP FEIS Figure 3 . 4 - 4

3.5 WILDLIFE

3.5.1 Introduction

The construction of O'Sullivan Dam dramatically changed the existing landscape north of the dam through the formation of Potholes Reservoir. Inundation of pothole wetlands, riparian, and sand dune sagebrush communities created a unique system of Sand Islands and open water. Over the 50 years since the construction of the dam, wetland plant communities colonized the dynamic island and reservoir shorelines. Emergent marsh communities have developed, and tree and shrub willows have matured in these new shoreline areas. In addition, a dense layer of herbaceous plants covers much of the shoreline exposed during the reservoir's annual drawdown. Dam construction caused dramatic vegetative community changes within the RMP boundary. Wetland emergent and riparian habitats increased at the expense of shrub-steppe. This change was beneficial to some wildlife species because it created extensive emergent wetland and riparian habitat in an area where it had been limited.

Dispersed recreation within the Potholes area has also altered the vegetative communities at Potholes. Unlike the vegetative changes caused by dam construction, dispersed recreation has had a negative impact on wildlife habitat within the RMP area. Several studies have been conducted to quantify dispersed recreation effects on Potholes wildlife habitat (see below).

Irrespective of any past or current impacts, Potholes Reservoir provides suitable habitat for several classes of common and sensitive terrestrial game and nongame wildlife species (see Figures 3.5-1 and 3.5-2). The diverse habitat types, ranging from exposed sand dunes to lush riparian forests (see Vegetation section), are utilized by numerous wildlife groups including: mammals, birds, reptiles, and amphibians. Descriptions of the wildlife that occurs at Potholes Reservoir are listed below by group. Sections may be further subdivided into descriptive categories such as "game" or "nongame" where appropriate. An overview of dispersed recreation effects on wildlife within the study area follows the species descriptions.

3.5.2 Mammals

Big Game Species

Big game species within the reservoir area include mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*). Mule deer are more common with a population approaching 300-400 individuals (including the Winchester and Frenchman Hills Wasteways). The mule deer population has increased in the past few years. Fawn/doe ratios climbed to 100 fawns per 100 does in 1996 from a ratio of about 15 fawns per 100 does in the past (Tabor 1996).

White-tailed deer sightings are rare near the reservoir. The most recent sighting was recorded in October 1996 near Potholes State Park (Tabor 1996).

Furbearing Species

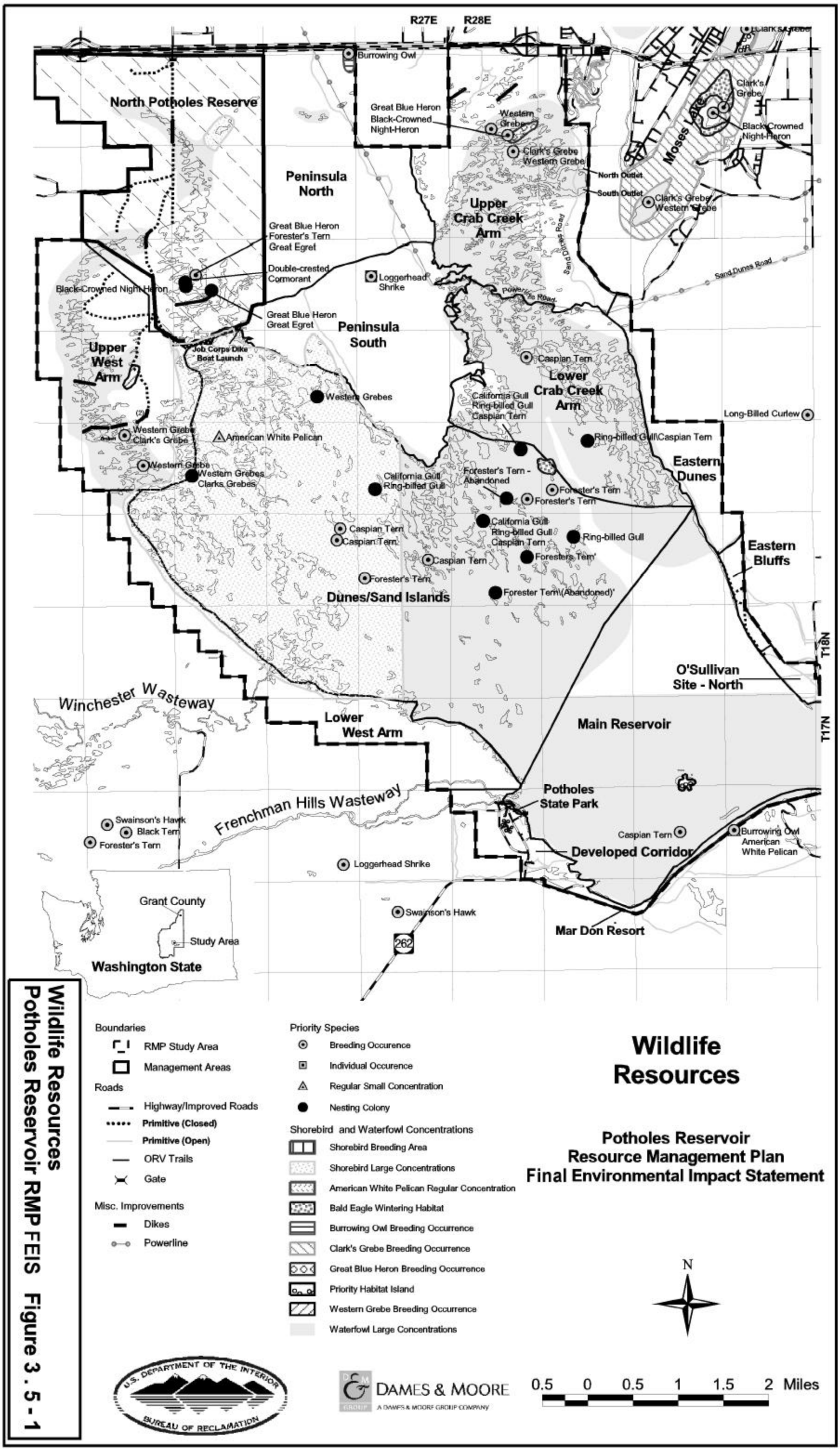
Furbearers in the Potholes Management Area include beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), mink (*Mustela vison*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), long-tailed weasel (*Mustela frenata*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*)(Tabor 1996, Foster *et al.* 1982) and rabbits (black-tailed jackrabbit *Lepus californicus* and Nuttall's cottontail rabbit *Silvilagus nuttallii*). Potholes Reservoir is also considered a major concentration area for beavers (Foster et al. 1982). Although no official surveys have been conducted to quantify beaver population size, incomplete counts and observations indicate that at least one hundred beaver colonies (approximately 500 beaver) populate the Potholes Management Area (Tabor 1996). The highest beaver concentrations occur in the northern section of the study area in the West Arm, North Potholes Reserve, the Dune/Sand Islands, and the Crab Creek Arm. These areas are comprised of numerous pothole wetlands with a mixture of tree and shrub willow cover. Wetland plant community composition and the presence of many ponded areas are closely related to the dam building activities of beaver. Beaver lodges are key habitat structures in Potholes Reservoir. They provide nurseries for fish when the water level drops and shoreline areas are no longer available for cover (Zook 1978), perches for herons and other birds, and basking sites for western painted turtles.

Nongame Species/Small Mammals

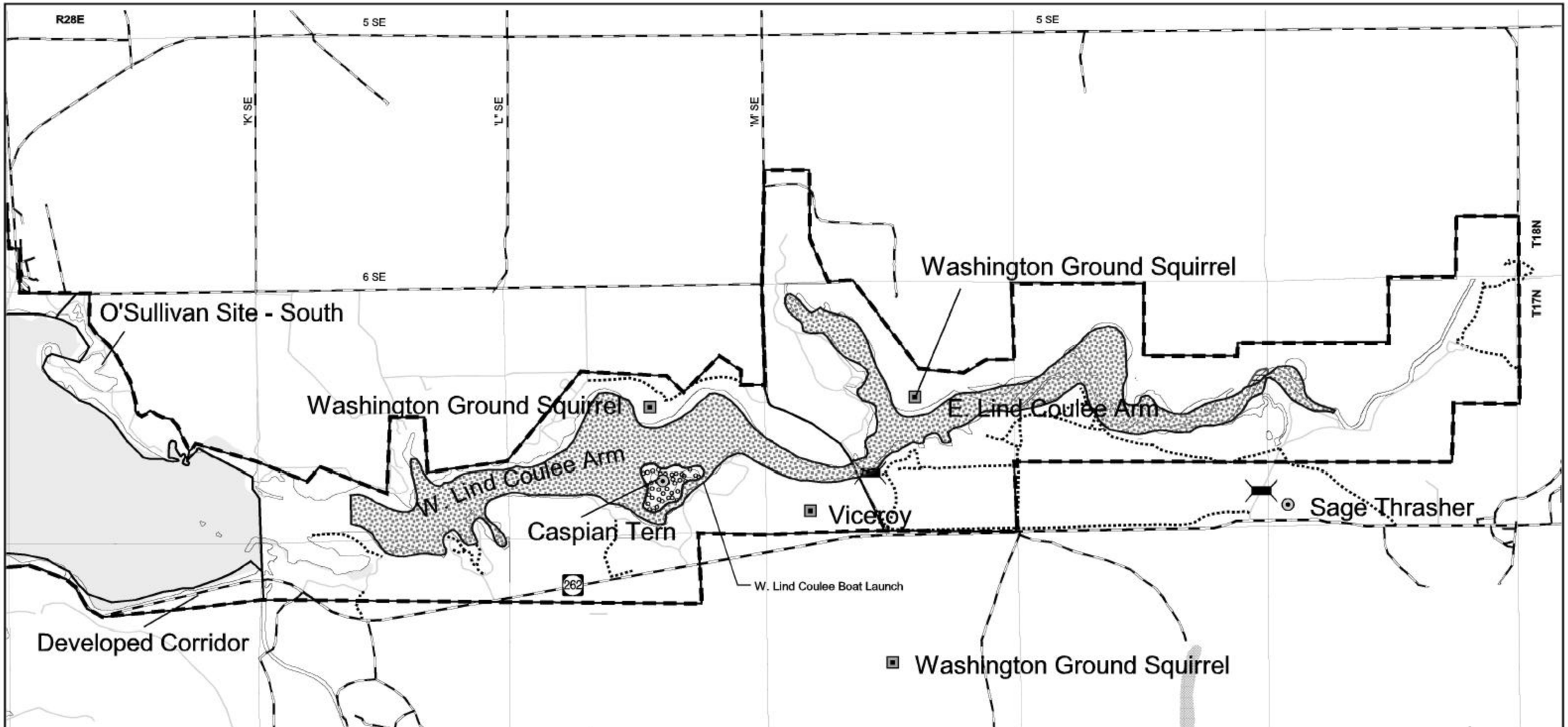
Small mammals known to occur in the Potholes Reservoir region are listed in Appendix D (Clement 1980, Every *et al.* 1981, Foster et al. 1982, USFWS 1997). Pocket mice and pocket gophers are dominant species in sandy areas, and montane voles are abundant at moist sites. Washington ground squirrels are limited to the Lind Coulee Arm where soils are silt loam rather than sand (Figure 3.5-1 and 3.5-2) (WDFW 1997). Several bat species are known to occur in the study area. However, the paucity of caves, rock outcrops, and mature trees limits bat roost sites in the reservoir area.

3.5.3 Birds

Bird species compositions can change over time with changes in habitat structure. When the reservoir was created in the early 1950s, willows and other wetland plants spread along the reservoir perimeter and on the newly formed island shorelines. Russian olive trees were also



Wildlife Resources
Potholes Reservoir RMP FEIS Figure 3 . 5 - 1



Wildlife Resources
Potholes Reservoir Resource Management Plan FEIS

Boundaries
- RMP Study Area
- Management Areas

Roads
- Highway/Improved Roads
- Primitive (Closed)
- Primitive (Open)
- Gate

Priority Species
- Breeding Occurence
- Individual Occurence
- Regular Small Concentration

Shorebird and Waterfowl Concentrations
- Bald Eagle Wintering Habitat
- Waterfowl Breeding Concentrations
- Waterfowl Large Concentrations

N

Scale 1:24,000

0.5 0 0.5 Miles

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

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Wildlife Resources
Potholes Reservoir RMP FEIS **Figure 3.5 - 2**

introduced into the area and continue to spread. As the area's riparian forest habitat continues to mature, increasing numbers of large colonial nesting birds like double-crested cormorants and great egrets are using the area

The reservoir and numerous pothole ponds are used by many birds for nesting, brooding, rearing, wintering, and as stopping points during migration. Bird abundance and diversity is greatest during fall and spring migrations since the reservoir lies along the Pacific flyway, a major north-south waterfowl migration route. Figures 3.5-1 and 3.5-2 illustrate the distribution of nesting bird habitat.

Upland Game Birds

Upland game birds in the Potholes Management Area include ring-necked pheasants (*Phasianus colchicus*), California quail (*Callipepla californica*), mourning dove (*Zenaida macroura*), and gray partridge (*Perdix perdix*). Ring-necked pheasants are locally abundant in wetland and adjacent upland areas. In winter, they congregate under coyote willows in the East Lind Coulee Arm, and in Russian olive thickets (WDFW 1997). Pheasants are hunted in all areas surrounding the reservoir. California quail are most abundant in the Potholes State Park and Crab Creek Arm, and a few quail are hunted along the West Arm each year. Mourning doves nest and winter in the dense wetland habitats surrounding the reservoir (Tabor 1996). The gray partridge population is low but possibly increasing (Tabor 1997).

Waterfowl

Potholes Reservoir is a major waterfowl hunting area of statewide importance. The North Potholes Reserve is located north of the Job Corps Dike and extends north to Interstate 90. No hunting or trapping is allowed in this reserve, which serves as a resting area for thousands of ducks and geese. During the hunting season the reserve promotes hunting on other parts of the reservoir by holding ducks in the area (Foster et al. 1984). The reserve also serves as an important Canada goose rearing area. Appendix D lists waterfowl species known to occur, at least seasonally, at the reservoir (Foster et al. 1982).

Canada geese in the Columbia Basin nest primarily on islands found within the reservoirs and other large water bodies of the region (Foster et al. 1984). At Potholes Reservoir, geese nest at the edges and on the highest points of the Sand Islands, on gull colony islands, on beaver lodges, and in trees also used by nesting herons.

The reservoir has limited high quality breeding habitat and food resources for ducks. Prime breeding and foraging habitat is found predominantly near carp-free waters along the reservoir perimeter. It has been hypothesized that the presence of carp reduces quality duck breeding and foraging habitat. For example, duck brood count numbers were relatively high for several species during a study conducted prior to the construction of O'Sullivan Dam: coots (156 in 1950 and 180 in 1951), mallards (43 in 1950 and 58 in 1951), and blue-winged and/or cinnamon teal (40 in 1950 and 34 in 1951). However, waterfowl were not observed in pothole ponds with carp (Harris 1954). More recently, the presence of carp in Columbia Basin ponds has been correlated with a lack of submergent vegetation, and significantly lower waterfowl abundances (Foster et al. 1984) than carp-free ponds for mallards, gadwalls, northern shovelers, cinnamon teal, blue-winged teal, American coot, ruddy duck, and redheads (Clement 1980, Tabor 1996).

Colonial Nesting Birds

A variety of colonial nesting birds have established nesting colonies in the study area (see Figures 3.5-1 and 3.5-2). Appendix D lists the colonial nesting bird species found at the reservoir (Finger and Tabor 1997).

Various surveys have been conducted at Potholes to estimate numbers of colonial nesting birds (See Table 3.5-1). These surveys suggest that colony nesting bird populations have fluctuated in the study area since the 1970's. A comprehensive survey of all colonial nesting birds was conducted on the reservoir in 1997. Standardized methodology was used in this survey in an effort to count all colonial bird nests on the reservoir. Nest counts made during subsequent years are for comparative purposes to depict general population trends of colonial nesting species.

Three areas are particularly conducive to colony nesting. North Potholes Reserve, the reservoir arms (West Arm, Job Corps, and Crab Creek Arm), and the Sand Islands collectively provide nesting habitat for all the colonial nesting birds that occur at the reservoir (see Figures 3.5-1 and 3.5-2).

Table 3.5-1
Colonial Nesting Birds

Common Name (Scientific Name)	**1997 Nest Count (# nests)**
Western Grebe (*Aechmophorus occidentalis*)	240
Clark's Grebe (*Aechmophorus clarkii*)	12
Double-crested Cormorant (*Phalacrocorax auritus*)	652
California Gull (*Larus californicus*)	595
Ring-billed Gull (*Larus delawarensis*)	2846
Caspian Tern (*Sterna caspia*)	259
Forster's Tern (*Sterna forsteri*)	85
Black Tern (*Chlidonias niger*)	not counted
Great Blue Heron (*Ardea herodias*)	302
Great Egret (*Casmerodius albus*)	78
Black-crowned Night Heron (*Nycticorax nycticorax*)	670

North Potholes Reserve

Many factors make the North Potholes Reserve ideal habitat for large colonial nesting birds. At the North Potholes Rookery (T18N R27E S10), tall peachleaf willow stands loom above a complex of willow shrub, emergent, and open water wetlands. These willow trees, up to 50 feet tall, have matured since the 1970's to provide nesting habitat for black-crowned night herons, great blue herons, great egrets, and double-crested cormorants. The numerous ponds at this site and the reservoir supply these birds with food (i.e., fish and other aquatic organisms). Human

disturbances within the reserve are minimal as motorized boats and automobiles are prohibited except in the vicinity of Job Corps Dike.

The Reserve has provided unique bird watching opportunities for many years. It contains the largest black-crowned night heron rookery, and the first great egret breeding record in Washington state (Clement 1980) (Fitzner et al. 1979). In addition, three of the four main colony nesting birds here have state protective status as monitor species including the black-crowned night heron, great blue heron, and great egret. Breeding areas for all four species are considered priority habitats by the WDFW.

Reservoir Arms

The reservoir arms (West Arm, Job Corps, and Crab Creek Arm) are characterized by scattered tree willows, shrub willow dominated shorelines, and numerous ponds and islands bordered by emergent wetland vegetation. Black-crowned night herons and great blue herons have nested in relatively low densities in Crab Creek rookeries. Fishing and personal watercraft uses are sometimes concentrated in these arms (Finger and Tabor 1997) especially at high water when access is not limited.

Sand Islands

Gulls and terns have nested on the Sand Islands since the 1950's (Harris and Yocom 1952) (Johnsgard 1954). Islands selected by nesting gulls and terns are usually bare to sparsely vegetated with steppe grasses or shrubs. The shorelines may support willows and emergent plants. At Potholes, these ground nesting birds scrape cup-shaped nests into the sand and line them with twigs and feathers (Finger and Tabor 1997). Island colonies are very dynamic, with birds selecting different islands for nest sites, sometimes on a yearly basis.

The abandonment of entire island colonies appears to be relatively common at Potholes. Three out of five gull and tern colony islands containing approximately 673 ring-billed gull, 94 California gull, and 119 Caspian tern nests were abandoned a few weeks after Memorial Day 1997. After these abandonments another island colony was established. However, this newly established colony was also abandoned by June 23. In addition, two out of three Forester's tern island colonies were abandoned in 1997 (Finger and Tabor 1997). It is not known whether the increase in human activity in the spring and summer contributes to the abandonment of nests and colonies.

Western Grebe - Grebe breeding areas are classified as priority habitat by the WDFW. Western grebe observations at Moses Lake and Potholes Reservoir date from the 1950's during early reservoir development (Harris and Yocom 1952, Johnsgard 1954). In 1997, the estimated number of western grebe breeding pairs was greater than 1 000, despite a large percentage of nest failures due to changing water levels, and wave action from boats and other water craft (Field Observations by Jim Tabor, WDFW). Grebes nested primarily in thick stands of bulrush in the Crab Creek Arm in the early 1990's (Tabor 1997).

In 1997, western grebes nested along the West and Job Corps Arms, and Clark's grebes nested along the West Arm (see Figure 3.5-1). West Arm nests were located in T18N R27E S21 and S22, and Job Corps Arm nests were in T18N R27E S14. There were 240 active western grebe nests, and at least 13 Clark's grebes nests. Nests were made of smartweed and bulrush. The first nests were observed on June 29 (Finger and Tabor 1997). Grebes did not nest in the Crab Creek Arm in 1997.

Cormorant - The double-crested cormorant colony became established in the late 1970's. The colony has grown in recent years to become one of the largest fish-eating bird colonies in North Potholes Reserve. Before establishing nesting populations at Potholes, cormorants were noted as common migrants in the area (Johnsgard 1954). In 1978, approximately 16 adult birds were observed in North Potholes Reserve. By 1982, the cormorant population was very productive with at least 30 nests, each containing 3-4 young. The colony grew to approximately 425 nesting pairs in 1991. Nest production was high with many nests containing 4-5 young. Large numbers of non-breeding birds (up to 100 in 1983) were also using the reservoir (Friesz 1997). In 1997, 652 nests were active with incubation in May and hatching in June (Finger and Tabor 1997).

Double-crested cormorants are diving foragers rather than shallow water waders (Terres 1995). The double-crested cormorant is now one of the dominant fish-eating birds nesting in the tree willows. During the past ten years, the cormorant and egret colonies have had the highest growth rates of all of the colony nesting birds.

Other Water Birds and Shorebirds

Other water birds and shorebirds that use Potholes Reservoir are listed in Appendix D. Water bird and shorebird breeding at Potholes include sora rail, Virginia rail, American coot, killdeer, long-billed curlew, common snipe, and spotted sandpiper. Long-billed curlews nest in steppe grasslands and in high quality shrub-steppe habitat such as found within the Peninsula North, Peninsula South, and North Potholes Reserve management areas.

The white pelican is a state endangered species and is one of the more sought after birds by bird watchers. As such, the white pelican is a "high profile" species of concern at the reservoir. White pelicans are very opportunistic foragers and they will flock to areas with a rich supply of available fish. At Potholes Reservoir this supply of fish is most readily available when the water levels are low, causing fish to be restricted to pools where they are more vulnerable to predation. Significant numbers of white pelicans are present in the late summer and early fall, and in recent years their summer presence has increased. Counts of white pelicans have varied between 200 and 1,600 birds from 1978 to 1990 (WDFW 1997). About 1,000 pelicans were observed in September 1996 foraging and resting in the wasteways. Part of the population is believed to be associated with the breeding colony of William Lake, B.C., estimated to be around 200-300 birds (Personal Communication with Jim Tabor, WDFW).

3.5.4 Reptiles and Amphibians

Several reptile and amphibian species occur in the Potholes Reservoir management areas (Appendix D). Table 3.5-2 summarizes the reptiles and amphibians found within the study area, their status, and typical habitat preference.

Reptiles

Sagebrush lizards (*Sceloporus graciosus)* are found in shrub-steppe habitats surrounding the reservoir. The Sand Islands and the uplands around the reservoir provide habitat for Northern sagebrush lizards, horned lizards (*Phrynosoma douglassii*), racers (*Coluber constrictor*), gopher snakes (*Pituophis catenifer*), and garter snakes (*Thamnophis spp*.). Painted turtles (*Chrysemys picta*) are abundant in the North Potholes Reserve and Crab Creek Arm. Painted turtles are often seen sunning themselves on logs or hummocks in the pothole wetlands, and their tracks are often visible crossing the sandy ORV trails within the "Yellow Zone."

Although there are no known records of night snakes (*Hypsiglena troquata*) within the Potholes Management Area, habitat is available in basalt rocks at the southern end of the reservoir and in rodent burrows in the sandy soils found throughout the area. There is a record of a night snake south of the West Lind Coulee Arm (WDFW 1997).

Table 3.5-2
Reptiles and Amphibians
Found at Potholes Reservoir, Washington
(Clement 1980 and Tabor 1996)

Common Name / Scientific Name	Status and/or location in 1996
Tiger Salamander/ *Ambystoma tigrinum*	Fish free water along reservoir perimeter
Great Basin Spadefoot/ *Scaphiopus intermontanus*	Common around reservoir perimeter
Pacific Treefrog/ *Pseudacris regilla*	Common
Columbia Spotted Frog/ *Rana luteiventris*	No current records
Northern Leopard Frog/ *Rana pipiens*	Uncommon. One of few locations documented in Grant County
Painted Turtle/ *Chrysemys picta*	Common
Short-horned Lizard/ *Phrynosoma douglassii*	Uncommon on high ground next to reservoir
Northern Sagebrush Lizard *Sceloporus graciosus graciosus*	Common on high ground next to reservoir
Western Skink *Eumeces skiltonianus*	Uncommon
Racer *Coluber constrictor*	Common on high ground next to reservoir
Gopher Snake *Pituophis catenifer*	Common on high ground next to reservoir
Garter Snake *Thamnophis* sp.	Rare, but common next to dam
Western Rattlesnake *Crotalus viridis*	Common in rocky areas next to O'Sullivan Dam

Amphibians

Northern leopard frogs (*Rana pipiens*)are only known to occur in two Washington state locations. These most recent records are at Potholes Reservoir and in parts of Crab Creek north of Moses Lake. The study area's small, localized population is found in the Crab Creek Arm and North Potholes Reserve where they seem to prefer moist soil grown over with cockleburs during late summer and fall. Little is known about their breeding habits here (Friesz 1997).

Tiger salamanders (*Ambystoma tigrinum*)are found in and near fish free ponds along the reservoir perimeter. They attach their eggs to submerged vegetation in shallow water where larva may take from one to two summers to metamorphose into terrestrial adults.

3.6 FISH

3.6.1 Introduction

Potholes Reservoir occupies a unique landscape different from many other reservoirs found in the region. Before O'Sullivan Dam was constructed, shifting sand dunes and hundreds of pothole wetlands were dominant features of the area with woody vegetation limited to trees lining the Crab Creek channel and the shorelines of some small pothole lakes (Zook, 1978). After construction, the existing potholes were inundated and an extensive system of Sand Islands and new pothole wetlands were created within the large reservoir. Because of the area's unique sand dune topography, the amount of shoreline created greatly exceeded what is normally found in reservoir systems. Reservoirs and lakes with high "shoreline development" are typically the most productive.

Topography, substrate, wind action, and water fluctuations are some of the factors affecting the reservoir's physical and biological development. Fish habitat is directly related to these physical and biological parameters. There are two habitat types used by fish at Potholes Reservoir - the reservoir body and the terrestrial-aquatic interface or shoreline wetlands.

3.6.2 Fish Habitat

Shoreline Wetland and Riparian Habitat

After the reservoir was created, wetland plants colonized the dynamic island and reservoir shorelines. Emergent herbaceous plant communities have developed, as have wetlands and riparian areas dominated by shrubs and trees, particularly willow species. Vegetated wasteways,

reservoir, and island shorelines are potential breeding, spawning, and rearing areas for fish. Vegetated shoreline areas are also important sources of food and cover for some species. For example, walleye, bass, crappie, and bluegill generally inhabit shoreline areas. Walleye are also found in deeper water, as well as trout, whitefish, and perch (Wydoski and Whitney 1979).

Currently, there are about 729, 2,039, and 1,716 acres of wetland emergent, riparian shrub, and riparian forest habitat, respectively, within the study area at high water. Of course, not all of this habitat is available to fish as some areas are separated from the water, and the quantity of these habitats available to fish varies considerably with changes in reservoir elevation.

Fish habitat at Potholes Reservoir is changing over time. Willows and water smartweed are increasing along the shoreline. These plants provide cover for fish from winter through early summer. Bulrushes and other emergent and aquatic plants provide cover and sites for insect eggs. When water levels drop in the summer, fish often must move to open water with less cover where they are more vulnerable to predation (McMahon and Bennett 1996). A lack of available cover during low water levels could be a limiting factor for adult fish populations, particularly for black crappie and largemouth bass (Zook 1978).

Beaver lodges provide considerable cover for fish, especially during low water levels. Zook (1978) has found up to one hundred bass at a single beaver lodge site. Beaver structures provide some of the limited cover at low water. Beaver numbers generally fluctuate depending upon annual trapping pressure, and their lodges break down quickly once abandoned. Fewer beavers means less structural cover for fish during low water.

Recreational users can affect shoreline habitats. In particular, personal watercraft (PWC), due to their low draft and internal water jet design, are able to travel into areas too shallow for other boats. When they jet around in these shallow and sometimes vegetated shoreline areas, their fast movement creates waves that disturb and erode shorelines, and they may uproot emergent plants and disturb submerged plants and shoreline animals like fish and aquatic insects. These watercraft can therefore have a detrimental effect on shoreline habitat, especially during low water levels (Field Observations by Jim Tabor, WDFW).

Main Reservoir

Potholes Reservoir is a dynamic system, of which the most dramatic aspect is water level fluctuation. Fluctuations are related to irrigation management causing the water level to drop up to twenty feet annually, which in turn, causes changes in available fish habitat. Water levels are generally highest in May and lowest in September. Water levels are lowered during the irrigation season from a normal high water elevation of 1046.5 feet (403,800 acre-ft) to a low

water level elevation of 1025 feet (89,900 acre-feet), a 78 percent reduction in volume. However, these water level changes are not uniform throughout the whole Potholes Reservoir system. USFWS field studies in 1986 and 1987 found water level elevations to be higher during the irrigation season (10-14 feet higher) in nine ponds along the north and east shores of Potholes Reservoir than in the main reservoir. Water level also varies across the reservoir. For example, the water elevation immediately south of the Job Corps Dike was 6.4 feet higher than at O'Sullivan Dam (USFWS 1986 & 1987).

The reservoir bottom, made up predominantly of sand, is generally described as a series of ridges and troughs.

Water conditions such as temperature, pH, and other factors also vary. The water is alkaline with average pH values of 8.0-9.0 - a range typical of productive fisheries. Water temperatures vary throughout the reservoir, with temperatures reaching 80-85° F in the sand dune area in August and September. Water temperatures generally remain cooler in the open water portion of the main reservoir (Zook 1978), and the reservoir stratifies during summer months. The reservoir surface often freezes over during the winter. Changes in the irrigation schedule since the 1970's have resulted in greater overall water level fluctuations and a higher rate of water turn over.

3.6.3 Species Composition and Status

A biological fish survey was conducted in September 1978 to collect age composition and growth data for major game species, and the relative abundance of all major fish species in the reservoir (Zook 1978).

The most recent biological survey of fish at Potholes Reservoir was conducted September 11-21, 1978. The goal of the preliminary survey was to determine species composition, relative abundance of warmwater fishes, and age class and growth data for game fishes. North Potholes, Winchester-Frenchmen Hills Wasteway outlets, Lind Coulee Arm, Crab Creek Arm, and O'Sullivan Dam. Perch were the most abundant species, and carp were second in abundance (Zook 1978). Other species found at Potholes were largemouth and smallmouth bass, bluegill, long-nose sucker, black crappie, pumpkinseed, sculpin, rainbow trout, brown bullhead, and walleye. The same fish species are present today, but the relative abundances likely are considerably different than they were 22 years ago. For example, anglers at Potholes Reservoir have reported a substantial decline in the abundance of yellow perch.

3.6.4 Fishery Management

History

Fish introduced into the Columbia River system have the potential to enter Potholes Reservoir from Moses Lake via the Crab Creek Arm. Most reservoir fish species were introduced into the Columbia River system in the late 1800's and early 1900's (Wydoski and Whitney 1979).

Although Potholes Reservoir is one of the most diverse and highly utilized fisheries in the Columbia Basin (BOR 1989), fisheries management activities have been limited to annual trout stocking, 1970's fish surveys, and relatively small scale diking projects to enhance game fish habitat. The diking projects have created some carp-free management areas. Intensive fisheries management activities have not been required in the past because of the good and steady success of this fishery.

Prior to beginning this RMP process, the last creel census was conducted in 1973-74. A stomach content study conducted on major game fish at the reservoir was completed in 1973 (Tate). Growth was considered average for perch and bluegill and higher than in other eastern Washington waters for black crappie and largemouth bass.

The WDFW has stocked the reservoir with rainbow trout since 1959 (Zook 1977). Approximately 100,000 to 150,000 trout have been stocked each year since the 1970's. Fish are generally stocked in the fall at 5-6 inches in length. To improve growth and recruitment, 60,000 trout were retained in net pens in 1996 for a spring release of trout in 1997 averaging 9-10 inches. Rather than stocking rainbow trout directly into the reservoir, these fish are transferred into net pens to enhance survival and growth before release into the reservoir. This net pen experiment appeared to have worked well with trout making up the majority of fish caught at the reservoir through mid-July that year. More pens will likely be added until all 150,000 trout can be accommodated (Personal Communication with Jeff Korth, WDFW). Small numbers of walleye have also been stocked, but other reservoir fisheries are not maintained by stocking.

Lower water levels from August through October reduce available fish habitat in the reservoir by leaving dense shoreline vegetation above the water surface. Shoreline vegetation provides cover for fish in the spring, but when the reservoir water level drops during the irrigation season, cover for fish becomes limited to scattered beaver lodges, brush piles, and submerged logs or "stick-ups." With limited cover, fish may be forced into more open habitats making them more vulnerable to predation.

Although water level fluctuations are likely detrimental to fish recruitment due to limited summer cover, most spawning is complete by the end of June when water levels are still

relatively high. Cool water fish, like perch and walleye, spawn as soon as the ice melts in late March to early April, while the warm water species like crappie and bluegill spawn later in the spring (Field Observations by Jeff Korth, WDFW). However, Zook (1978) noted the late spawning tendency in addition to spring spawning of some Potholes bluegill in July and August as opposed to May and June in other waters.

Twenty-two years ago Zook (1978) attributed the continued success of the Potholes fishery in part to the water level fluctuations at that time. He asserted that high spring water levels promoted fish reproduction and the slow water level change prevented stagnation of the fishery. Drawdown and flooding schedules have been used to increase production at fish culture ponds (Henderson-Sellers and Markland 1987).

Predation

Fish predators in Potholes Reservoir include predatory fish, birds, and humans. Walleye, bass, and bullheads are some of the main fish predators present. Walleye, first observed in the reservoir in 1973, continue to feed all year while other species slow down during cooler months. They feed heavily on yellow perch, bullheads, and sculpins (Wydoski and Whitney 1979).

Some fish-eating bird populations like double-crested cormorants and great egrets have increased in recent years. Cormorants have recently become one of the most abundant colony nesting, fish-eating birds at the reservoir. The number of cormorant nests surveyed increased from 30 nests in 1983 to 652 nests in 1997. The diet of cormorants may include yellow perch, bullheads, crappies, carp, and sunfishes. Other fish-eating birds found in large breeding colonies include grebes, gulls, terns, and herons. The Western grebe consumes carp, perch, bluegills, grasshoppers, mayflies, and beetles (Terres 1995). Large flocks of white pelicans can sometimes be found foraging in the reservoir or wasteways in late summer. Many other fish-eating marsh and shorebirds migrate through the area in fall and spring. Overall, these breeding and migrating birds consume large numbers of juvenile and small adult fish.

Angling pressure by humans may also have an effect on fish populations. While most fish are released, fishing contests still may have an impact on target populations. Rough estimates of visitors from car counter data, field observations, and questionnaires show an increase from 130,000 anglers in 1981 to 245,915 anglers in 1995 (Columbia Basin Wildlife Area Use Report Data).

Competition

All fish in the reservoir compete with other fish for space and food, but the species of greatest concern for fish managers is the common carp. In Zook's 1978 biological survey, carp were the second most abundant fish, making up a large percentage of the total aquatic biomass at Potholes. Carp are very effective competitors for space and food in shallow shoreline areas because they have a long life span, a high reproductive rate, low mortality, and a fast growth rate (Zook 1978). Also, they are more tolerant of poor water conditions like low dissolved oxygen, high turbidity, extreme temperature changes, and pollution than other fish species. Carp consume a wide variety of plant and animal material (mostly zooplankton and aquatic insects) (Wydoski and Whitney 1979). Their disruptive foraging behavior tends to increase water turbidity while decreasing aquatic invertebrate production (Zook 1978). Carp presence and abundance has been shown to be directly related to the lack of submersed aquatic vegetation in Columbia Basin waters (Foster et al. 1984). Since the late 1970's, Moses Lake has experienced an increase in carp which may overflow into Potholes Reservoir (Personal Communication with Doug Fletcher, WDFW).

The Job Corps Dike effectively isolated the North Potholes portion of the reservoir from the main reservoir body. This enabled biologists to eliminate all carp and other fish in the area. Largemouth bass and bluegill were subsequently restocked there in 1977. Soon after carp were removed, the density of aquatic plants, invertebrates, muskrat, waterfowl, and other wildlife increased dramatically and the water became visibly clearer (Zook 1978, Field Observations by Jim Tabor, WDFW). Bass and bluegill reproduced and showed a higher initial growth rate than in the main reservoir (Zook 1978).

Concerns or Trends

Anglers fish year-round in Potholes Reservoir, Crab Creek, and the adjoining wasteways. More people fish at the reservoir edges than in the middle because fish are usually easier to find and catch in shoreline areas. The angling pressure tends to be highest in the northern and western ends of the reservoir where the catch generally includes bass, bluegill, and crappie (Personal Communication with Jeff Korth, WDFW). The eastern shore is the most popular spot for perch and trout fishing. Some crappie, trout, and walleye are also caught on the reservoir's east side and in the Lind Coulee Arm. People fish on the dam, Frenchman's Wasteway, Winchester Wasteway, and Crab Creek for smallmouth bass (Personal Communication with Doug Fletcher, WDFW). Largemouth bass are caught throughout the reservoir, and trout are found in open water (Personal Communication with Jim Tabor, WDFW).

Compared with other Washington waters, Potholes Reservoir hosts a relatively high number of bass fishing tournaments each year. Between 14 and 19 tournaments were held each year from 1991 through 1995. Fewer walleye fishing tournaments are held each year (one in 1995). All fishing contests are catch and release (Strahle 1996). According to the Volunteer Angler Diary Data Report in 1992, anglers caught a much greater number of largemouth bass at Potholes than at any other Washington lake or reservoir, with 747 bass (≥ 12" in length) caught in 985 hours (Zook and Fletcher 1993). Spiny ray fish continue to attract many anglers to the reservoir despite angler reports of declining catch rates in the 1990's.

The last creel census was conducted from March 1, 1973 through February 28, 1974 with monthly surveys. Fishing activity was estimated at 150,000 days during this survey year. The relatively recent downturn of the fishery prompted surveys on Potholes Reservoir, including a creel survey in 1996-97 and several preliminary biological surveys in 1997.

Although the Potholes Reservoir remains a popular fishing area, experienced Potholes anglers claim that some game species like perch, bluegill, crappie, and even largemouth bass appear to be declining while carp, bullhead, smallmouth bass, and walleye populations appear to be on the rise this decade. Many factors may be contributing to the apparent declines in some species, including interactions of predatory fish, fish-eating birds, increased carp abundance, changes in habitat structure, water quality changes, reservoir productivity, annual water level fluctuations, and reservoir management. Fish diseases or parasites could also be factors. No systematic studies have been conducted to identify causal factors.

Goals or Desired Condition

Today the goals of fisheries management at Potholes Reservoir include maintaining game fish species diversity and abundance with an emphasis on warm water species, and maintaining and enhancing recreational fishing opportunities. Although rainbow trout stocking is currently a major component of fisheries management, it is of secondary importance to maintaining other desired fish like perch, walleye, bluegill, crappie, and bass.

3.7 THREATENED AND ENDANGERED SPECIES

3.7.1 Introduction

Information on federal and state special status plant and wildlife species in the study area was obtained from databases maintained by the Washington Natural Heritage Program (WNHP) and FWS. Included are those federally listed as Threatened or as "Species of Concern", and those with Endangered, Threatened, Sensitive or Review state status. Table 3.7.1 summarizes the special status wildlife which may occur within the study area. In general, however, the presence or absence of a special status species at the site-specific location remains undetermined without additional field inventories.

3.7.2 Special Status Plant Species

Species with Federal Status

The WNHP indicated that there are no federally listed species known or suspected to occur in the project area (1996, 1999). However, the USFWS (March 29, 1999) included Ute ladies'-tresses (*Spiranthes diluvialis*) in their list of federally listed species that may occur at Potholes Reservoir.

Ute ladies'-tresses, a perennial orchid, was federally listed as Threatened in 1992. Its presence was confirmed in southeastern Idaho in 1996 along the upper Snake River and in northern Washington in 1997. Before these discoveries, Ute ladies'-tresses was known only from a few locations in Montana, Colorado, Wyoming, and Nebraska.

The orchid is a lowland species typically found in wetland and riparian areas including spring habitats, mesic and wet meadows, river meanders, and flood plains (USFWS 1998). It occurs beside moderate gradient streams and rivers in the transition zone between the mountains and plains. It has been found between 1500 and 7000 feet, the lower elevation in the more western part of its range. This species is generally found in full sun to partial shade in early- to mid-seral communities subject to flooding or periodic inundation. In these communities, early successional conditions are perpetuated as other vegetation is limited by natural disturbance.

Although the plant community composition and structure associated with this species differs from site to site, beaked spike rush (*Eleocharis rostellata*) appears to be dominant in occupied habitat in Washington and is a good indicator across its range (USFWS 1998). Species most commonly associated with the orchid include creeping bentgrass (*Agrostis stolonifera*), Baltic rush (*Juncus balticus*), long-styled rush (*Juncus longistylis*), bog orchid (*Habenaria hyperborea*),

and scouring-rush (*Equisetum laevigatum*). Other species commonly associated include rushes (*Juncus* spp.), paint-brushes (*Castilleja* spp.), thinleaf alder saplings (*Alnus incana*), sweetclover (*Melilotus* spp.), sedges (*Carex* spp.), red clover (*Trifolium pratense*), and western goldenrod (*Solidago occidentalis*). Also, "scraggly" willow shrubs (*Salix exigua, S. lutea*) are commonly present in small numbers.

Most of the species that are commonly associated with Ute ladies'-tresses listed above do not occur at Potholes Reservoir. Exceptions are creeping bentgrass, Baltic rush, sweet clover, rushes, sedges, and western goldenrod. Coyote willow shrubs that do occur at Potholes are not "scraggly" because they are not subject to periodic flooding events; in fact, coyote willow grows in dense, robust thickets at Potholes. The presence of these species alone should not be taken as an indicator of appropriate habitat since they are very common species throughout the western U.S.

Sites at Potholes Reservoir where Ute ladies'-tresses are most likely to occur are riparian forest, riparian shrub, wet areas in open shrub or grassland; created wetland habitat (i.e., gravel/borrow pits); or graminoid (grasses, rushes, and sedges) dominated openings in wetland shrub communities. Wet meadow mosaics and wet meadows fed by freshwater springs may also provide habitat, but they are not known to occur at Potholes.

The probability is very low that Ute ladies'-tresses occur in the study area due to the lack of appropriate habitat conditions. The USFWS (1998) states that Ute ladies'-tresses do not occur along slow meandering streams out in the flats - a good description of the streams near the area. Most wetlands within the study area are subject to long periods of inundation followed by severe drawdowns during the irrigation season, another condition specifically discussed by the USFWS as inappropriate. Lastly, the microclimates and elevations found at Potholes Reservoir are generally not conducive to the species.

Species with State Status

According to the WNHP (WNHP, 1999), gray cryptantha (*Cryptantha leucophaea*), an upland forb and state sensitive species, occurs at one location in the Peninsula South management area and west of the Lower West Arm management area near the Winchester Wasteway. A Washington State Sensitive Species is defined by WNHP as "a species that is vulnerable or declining and could become Endangered or Threatened in the state without active management or removal of threats." It typically grows in dry, often sandy places and is associated with rabbitbrush (*Chrysothamnus* spp.) and/or sagebrush (*Artemisia tridentata*) shrub communities and with cheatgrass (*Bromus tectorum*) and bluebunch wheatgrass (*Agropyron spicatum*) (WNHP 1981). There is a large amount of this habitat type in the study area, though most of it

is degraded. The cause of its rarity is unknown. Also, it is unknown how this species responds to disturbance.

3.7.3 Special Status Wildlife Species

Potholes Reservoir provides suitable habitat for four classes of sensitive terrestrial wildlife species. Thirty-three special status species occur or potentially occur within the Potholes Reservoir area (see Table 3.7-1). Special status species are species that have been classified by the USFWS or WDFW as Threatened, Endangered, Species of Concern, or Monitor species. Specific species descriptions may be found above in the respective wildlife sections.

Species with Federal Status

The bald eagle is the only federally listed Threatened species that occurs within the study area. There are no federal Endangered species within the study area since the de-listing of the peregrine falcon.

Up to 35 bald eagles (federally and state listed as threatened) have been observed foraging, roosting, and perching at the reservoir during the winter months (late October-early April) (see Figure 3.5-1). Abundant prey, mainly thousands of ducks and geese, in the East and West Lind Coulee Arms, Main Reservoir, Dunes/Sand Islands, West Arm, and North Potholes Reserve management areas attract wintering bald eagles. The bald eagles perch on ice shelves, and in willows and cottonwoods while foraging (WDFW 1997). The large willow trees in the North Potholes Reserve colonial bird rookery appear to be a major winter roost site with up to 20 birds (T18N R27E S10) observed. Another possible night roost (up to 15 birds) is located on a sand dune island at the southern edge of the Crab Creek Arm (T18N R28E S20) (WDFW 1997) (see Figure 3.5-1). Other important perching sites include willow and cottonwood trees along the Crab Creek channel (Field Observations, WDFW).

Individual adult bald eagles have been observed during the spring and summer months around the North Potholes Rookery area in the last five years, leading to the speculation that at least one pair may be attempting to nest in the area. No nest has been found (Field Observations, WDFW).

There is one federal Candidate species (Washington ground squirrel) on the ESA list.

Species with State Status

There are three state listed Endangered species (American white pelican, sandhill crane, and peregrine falcon) and two state listed Threatened species (Ferruginous hawk and bald eagle) that use the study area. In addition, there are nine state candidates for listing as Threatened and Endangered and fifteen species on the state Monitor list. (See Table 3.7-1).

Table 3.7-1
Special Status Species Which May Occur in the Potholes Area
(Clement 1980, Embrey and Block 1995, USFWS 1996, WDFW 1996b, and Tabor 1996)

Species	Status	Habitat	Ecology
MAMMALS			
Fringed Myotis (bat) *Myotis thysanodes*	Federal concern & State monitor	may roost in basalt rock crevices near the O'Sullivan Dam & Lind Coulee	colonial, 1 young born June or July
Pale Townsend's (western) big-eared bat *Corynorhinus(Plecotus) townsendii pallescens*	Federal concern & State candidate	roosts primarily in caves, mines, buildings and bridges	colonial in nurseries and hibernation, 1 young born April to July
Small-footed Myotis (bat) *Myotis ciliolabrum*	Federal concern & State monitor	may roost in basalt rock crevices near the O'Sullivan Dam & Lind Coulee	colonial or solitary, appears early in evening, 1 young born May to July
Yuma Myotis (bat) *Myotis yumanensis*	Federal concern	roosts primarily in caves, mines, buildings and bridges	colonial, late flyers, flies close to ground, 1 young born May to June
Kincaid's Meadow Vole *Microtus pennsylvanicus kincaidi*	Federal concern & State monitor		active day or night, feeds on grasses, seeds, grain, bark, nests above or below ground, 1-9 young born any month of year
Washington Ground Squirrel *Spermophilus washingtoni*	Federal candidate & State candidate	Limited to silt loam soils of the Lind Coulee Arm	colonial, feeds on vegetation and seeds, stores some seeds in late summer, 5-10 young born March

Table 3.7-1
Special Status Species Which May Occur in the Potholes Area
(Clement 1980, Embrey and Block 1995, USFWS 1996, WDFW 1996b, and Tabor 1996)

Species	Status	Habitat	Ecology
BIRDS			
Common Loon *Gavia immer*	State candidate	have been sited throughout the year at the reservoir, no breeding records have been reported at Potholes	1-2 eggs laid in a wet mass of aquatic vegetation, feeds mainly on fish, wintering birds solitary by day, gathers in rafts at night
Western Grebe *Aechmophorus occidentalis*	State monitor	nest in thick bulrush stands in the Crab Creek, West, and Job Corps Arms	3-4 eggs laid in a smartweed and bulrush nest, feeds mainly on fish, winters in Mexico
Clark's Grebe *Aechmophorus clarkii*	State monitor	nest in thick bulrush stands in the Crab Creek, West, and Job Corps Arms	3-4 eggs laid in a smartweed and bulrush nest, feeds mainly on fish, winters in Mexico
American White Pelican *Pelecanus erythrorhnchos*	State endangered	significant numbers of white pelicans are present at Potholes and the Winchester wasteway at low water levels as fish become trapped in shallow pools	colonial often associates with double-crested cormorant, feeds mainly on fish, winters through lowlands of Nicaragua
Forster's Tern *Sterna forsteri*	State monitor	nest on small Sand Islands in the outer Crab Creek Channel and near the Winchester Wasteway outlet	3 eggs laid in a rounded woven nest, feeds on insects, colonial, often associated with other terns, winters in Guatemala
Black Tern *Chlidonius niger*	Federal concern	nest in the Frenchman Hills and Winchester Wasteways	3 eggs laid in a nest of dense emergent vegetation, nest often floating vegetation mat, feeds on insects, small loose colony often associated with Forster's tern

Table 3.7-1
Special Status Species Which May Occur in the Potholes Area
(Clement 1980, Embrey and Block 1995, USFWS 1996, WDFW 1996b, and Tabor 1996)

Species	Status	Habitat	Ecology
Great Blue Heron *Ardea herodias*	State monitor	nest in the tree willows of the North Potholes Reserve and the Crab Creek Arm	3 eggs laid in an interwoven stick nest, feeds mainly on fish, colonial
Great Egret *Casmerodius albus*	State monitor	nest in the tree willows of the North Potholes Reserve among nesting herons	3 eggs laid in a frail stick nest, forages in mixed flocks, feeds mainly on insects and other invertebrates, winters in Central America
Black-crowned Night Heron *Nycticorax nycticorax*	State monitor	nest low in tree willows and sometimes in shrub willows of the North Potholes Reserve and the upper Crab Creek Arm	3-5 eggs laid in a stick nest, feeds mainly on fish, winters in South America
Sandhill Crane *Grus canadensis*	State endangered	occasionally seen in the sand dunes area during fall migrations	2 eggs laid in a stick nest, opportunistic feeder, feeds mostly on aquatic invertebrates, winters in Mexico
Black-necked Stilt *Himantopus mexicanus*	State monitor	breeding records exist at Potholes, likely nest in Dunes and Sand islands	4 eggs laid in an open or partially concealed nest, feeds mainly on aquatic invertebrates, loosely colonial
Long-billed Curlew *Numenius americanus*	State monitor	nest in the steppe grasslands of Peninsula North and South and North Potholes Reserve	4 eggs laid usually on grassy meadow, feeds mainly on insects, winters Honduras and Costa Rica
Ferruginous Hawk *Buteo regalis*	Federal concern & State threatened	no known breeding accounts in the Potholes vicinity	2-4 eggs laid in a tree nest with a commanding view, feeds mainly on mammals
Bald Eagle *Haliaeetus leucocephalus*	Federal & State threatened	roost in the North Potholes Reserve, the Lind Coulee provides wintering habitat	2 eggs in a tree or cliff nest, feeds mainly on fish and mammals

Table 3.7-1
Special Status Species Which May Occur in the Potholes Area
(Clement 1980, Embrey and Block 1995, USFWS 1996, WDFW 1996b, and Tabor 1996)

Species	Status	Habitat	Ecology
Peregrine Falcon *Falco peregrinus*	State endangered	nesting habitat is limited, however, large waterfowl concentrations may attract individuals	3-4 eggs laid in a nest on cliff ledge, cliff sites used for many years, feeds mainly on birds including doves and waterfowl
Prairie Falcon *Falco mexicanus*	State monitor	nesting habitat is limited, however, large waterfowl concentrations may attract individuals	4-5 eggs laid in nest on cliff ledge or rock crevice, feeds mainly on birds
Western Burrowing Owl *Athene cunicularia hypugea*	Federal concern & State candidate	found in the Lind Coulee and sand dune areas of the Crab Creek Arm and Peninsula South, forage over shrub steppe habitat	7-9 eggs laid in a mammal burrow, Active day or night, feeds on small mammals and insects
Olive-sided Flycatcher *Contopus borealis*	Federal concern		3 eggs laid in nest high on lateral branch of a conifer or deciduous tree, feeds exclusively on insects, vigorously defends nest area
Sage Thrasher *Oreoscoptes montanus*	State candidate	shrub steppe in the Crab Creek Arm, Peninsula North and South, and North Potholes Reserve	3-5 eggs laid in a nest concealed by sagebrush, feeds mainly on berries and insects, highly terrestrial
Loggerhead Shrike *Lanius ludovicianus*	Federal concern & State candidate	shrub steppe in the Crab Creek Arm, Peninsula North and South, and North Potholes Reserve	5-6 eggs, twig nest in tree, feeds mainly on insects and birds, nests earlier than most passerines
Grasshopper Sparrow *Ammodramus savannarum*	State monitor	shrub steppe in the Crab Creek Arm, Peninsula North and South, and North Potholes Reserve	4-5 eggs laid in a ground nest, feeds mainly on invertebrates, grass, and seeds

Table 3.7-1
Special Status Species Which May Occur in the Potholes Area
(Clement 1980, Embrey and Block 1995, USFWS 1996, WDFW 1996b, and Tabor 1996)

Species	Status	Habitat	Ecology
Sage Sparrow *Amphispiza belli*	State candidate	shrub steppe in the Crab Creek Arm, Peninsula North and South, and North Potholes Reserve	2-4 eggs, nest usually in sagebrush, feeds mainly on insects and spiders, mixed age flocks often seen at water sources
REPTILES			
Northern Sagebrush Lizard *Sceloporus graciosus*	Federal concern	inhabits shrub steppe habitat surrounding the reservoir, requires open ground and scattered low bushes	One or 2 clutches of 2-8 eggs laid in late June, feeds on insects, spiders, mites, ticks, and scorpions, a ground dweller
Night Snake *Hypsiglena torquata*	State monitor	basalt rocks at the southern end of the reservoir and in rodent burrows throughout the area provide habitat	clutch of 2-9 eggs laid April to August, feeds on lizards, small snakes, frogs, and salamanders, nocturnal and crepuscular, venomous
AMPHIBIANS			
Tiger Salamander *Ambystoma tigrinum*	State monitor	found in and near fish-free ephemeral ponds at the reservoir perimeter	breeds spring to summer, eggs attached to objects, may be laid singly or in clusters of up to 120
Columbia Spotted Frog *Rana luteiventris*	Federal concern & State candidate	no current records	breeds in spring, eggs laid in a cluster up to 8" in diameter, eggs float on water surface
Northern Leopard Frog *Rana pipiens*	State candidate	breeds in ephemeral ponds in the North Potholes Reserve and upper Crab Creek Arm	up to 6,000 eggs per clutch in a flattened sphere, usually attached to vegetation in shallow water

3.7.4 Special Status Fish Species

No fish species with state or federal status (Endangered, Threatened, Species of Concern, or Monitor) are known to occur within the study area. However, state priority game fish including large and smallmouth bass, walleye, and rainbow trout are present and are discussed in Section 3.6, Fish.

3.8 CULTURAL

3.8.1 Introduction

Cultural resources are defined as buildings, sites, structures, or objects, each of which may have historical, architectural, archeological or scientific importance. There are several laws and regulations directing federal agencies to locate, identify, evaluate, preserve, protect and manage cultural resources significant to the nation's heritage and history, the focus of which, is the National Register of Historic Places.

The laws germane to an FEIS includes the National Historic Preservation Act of 1966, As Amended, especially Sections 106 and 110, and its implementing regulations found at 36 CFR 800; and the Archeological Resources Protection Act of 1979. These regulations require federal agencies to make determinations of eligibility, effect, and treatment in consultation with the State Historic Preservation Officer, interested Indian tribes, and the Advisory Council on Historic Preservation. In addition to authorizing federal agencies to take cultural resources into account during project activities, these mandates also directs agencies to develop a program to actively manage cultural resources, as well as to coordinate with those segments of the American public or Tribal Governments management of Traditional Cultural Properties (TCPs) significant for their traditional cultural values. Additionally, compliance with the Native American Graves Protection and Repatriation Act (NAGPRA) in protection or removal of human burials if they are found or reported.

3.8.2 Findings

A Class III cultural resource survey was conducted of the Potholes RMP area (37,169 acres) in 1999. Of the 18,597 acres of dry land, including islands, 13,235 acres were surveyed. The 5,362 acres not covered by on-the-ground reconnaissance are inaccessible. Ten sites, all dating to the historic era, were recorded, along with 44 isolated finds (Axton *et al* 2000). Of the 44 isolated finds, all but four also dated to the historic era. The four non-historic represented American Indian occupations. Thus the dominant human occupation of the Potholes area, as determined by cultural resources surveys, relates to the post American Indian occupation, especially the 20th

century. No cultural resources identified were deemed eligible for National Register consideration.

Because there is meager physical evidence for pre-contact American Indian occupations, a lengthy treatment is not warranted. in this document. This is not to say that there were no pre-contact human activities or occupations in the study area; a discussion of it is commensurate with the information discovered through the cultural resource survey. The following discussion is abstracted from: *A Cultural Resources Overview of The United States Bureau of Reclamation's Scattered Tracts/Potholes Study Area; Adams, Franklin, Grant and Walla Walla Counties, Washington* (Grundy, ed. 1998). The prehistory of the Potholes area is inferred from the patterns typical for much of the interior Columbia Plateau, which posits a record of human occupation stretching back for some 12,000 years. In fact, the early human occupation of the interior Columbia Plateau is based, in part, on investigations at sites with early components lying along nearby Crab Creek and Lind Coulee. The human record seems to display a largely semi-nomadic lifestyle of the people, relying on large mammal hunting, early on, which, over millenia, develops into the classic interior Columbia Plateau pattern chronicled by early explorers, settlers, and military expeditions, notably those of Lewis and Clark of 1805 - 1806.

The following brief discussion of the ethnography of the RMP area is taken from *An Ethnographic Overview of the Potholes Reservoir Study Area of Central Washington* (Ellis and Fagan 2000):

> The Potholes area is today mapped as part of the homeland of the Sinkayuse people (Miller 1998), but neither the historical nor the ethnographic records provide a clear picture of the native peoples of the area. Limited data can be partially attributed to the relative scarcity of Euroamerican observations of much of the interior portion of the project area until the later part of the nineteenth century.
>
> Most of the study area lies within lands ceded to the United States in the 1855 treaty with the "confederated tribes and bands of Indians...who for purposes of this treaty are to be considered one nation, under the name of 'Yakama'" (Kappler 1904:698).
>
> Curtis (1922:66) described the Sinkayuse as occupying the area between the Columbia River and grand Coulee and extending southward to 'a number of small closed lakes, the lower course of Crab creek, Moses lake, and the sink of Crab creek.
>
> In the 1850's and 1850's, it appears that the various Sinkayuse bands consolidated under the leadership of Chief Moses. Moses played a prominent role in the region until his death in 1899. After attempts to establish a Sinakyuse reservation in the Big bend area failed in 1877 - 1878, Chief Moses persuaded President Hayes to create a reservation for the Sinkayuse west of the existing Colville

Reservation in 1879. The Columbia reservation was terminated after only four years and the Sinakyuse relocated to the Colville Reservation.

The post-contact history of the RMP area is described in detail in *A Cultural Resources Overview...* (Gundy, ed. 1998:63-150). Briefly, during the span of time between euroamerican contact and the construction of Potholes Reservoir and associated irrigation developments, the RMP area was marginal to the events and interests of the times. The dry, sandy terrain elicited scant interest from all but a few stockmen and ranchers. Farming, away from Moses Lake, was doomed to failure due to the lack of precipitation. Nevertheless, after the coming of the railroads around the turn of the twentieth century, small, agricultural and ranching communities developed. Coulee City, Ephrata, Soap Lake, and Moses Lake are among those towns owing their origins to the location of rail corridors.

Potholes Reservoir, constructed behind O'Sullivan Dam (1947-1948) is the centerpiece of a redistribution system for the Columbia Basin Project, which collects drainage and overflow from the primary feeder system which originates in Banks Lake. Were it not for the completion of Grand Coulee Dam in 1942, and the development of the vast agricultural potential of the Columbia Basin, the Potholes area would have likely remained the dry, sand-blown desert described by those who traveled through the region a century before. Because of both the importance to the success of the Columbia Basin Project, as well as meeting the minimum 50 year-old criterion, O'Sullivan Dam itself is potentially eligible for the National Register.

3.9 INDIAN TRUST ASSETS

3.9.1 Introduction

Indian Trust Assets (ITAs) are legal interests in property held in trust by the United States for Indian Tribes or individuals. While most ITAs are on-reservation, they may also be found off-reservation. Examples of trust assets include lands, minerals, hunting and fishing rights, and water rights. Sometimes there is disagreement between the government and the tribes on what is considered to be an ITA, and who holds the right. This document does not judge the validity of rights claimed by any tribe.

The United States has a trust responsibility to protect and maintain rights reserved or granted to Indian Tribes or individuals by treaties, statutes and executive orders. This responsibility is sometimes further interpreted through court decisions and regulations. This trust responsibility requires that Federal agencies take reasonable actions to protect trust assets when administering programs under their control.

3.9.2 Findings

The study area falls within the area ceded under the Treaty of 1855 in which rights to fishing and privileges for hunting and gathering of roots and berries were retained by the tribes signing the treaty.

While much of the Potholes Reservoir area retains resources that support hunting, fishing and gathering activities, some areas may have been disturbed to the extent that they no longer can support such traditional uses. Currently, these activities are allowed throughout the study area except that hunting is not permitted in Potholes State Park and in the North Potholes Reserve.

3.10 VISUAL QUALITY

3.10.1 Introduction

This section summarizes the visual resources in the Potholes Reservoir study area. The methodology generally conforms to the BLM Visual Resource Management system (VRM). This system established the existing visual qualities of the affected landscape, key viewpoints, and the general sensitivity of people to changes in the landscape. Fieldwork to inventory the scenic quality consisted of driving and hiking the area surrounding the reservoir as well as boating on Potholes Reservoir to qualitatively determine general visibility of the major landforms, recreation facilities, man-made structures, and reservoir-related facilities. The "Scenic Quality Inventory" is located in Appendix I, and the "Scenic Quality Ratings" for each management area are summarized in Table 3.10-1. The 1999 "Potholes Reservoir Visitor Profile and Recreational Use Study" provided information on viewer sensitivity and key viewpoints.

3.10.2 Visual Character

Landscape character gives a geographic area its visual and cultural image, and consists of the physical, biological and cultural attributes that make each landscape identifiable or unique. (SMS, 1995). The upland landscape surrounding Potholes Reservoir is semi-arid and characterized by upland shrub-steppe cover types that include native shrubs and introduced annual grasses. Typically, these appear homogenous to the casual viewer and are not highly regarded. However, changes are more noticeable in this landscape type than in other more diverse landscapes.

Widely dispersed ranches, orchards, and farm operations are visible along the eastern boundary of the study area. Riparian forest and riparian shrub cover types are common along reservoir and island shorelines, in natural drainages, and along wasteways. Wind breaks and shade trees are found in developed areas where they have been planted and irrigated. Sandy beaches, wind-

blown dunes, and mudflats (at low water) characterize many of the undeveloped shoreline areas found around the reservoir. Most of the dispersed campsites have fire rings, and some are visually compromised each season by the presence of trash and human waste.

Table 3.10-1
Scenic Quality Ratings
Potholes Reservoir, Washington

Management Area		Scenic Quality Rating	Description
1	North Potholes Reserve	A	Undulating landform; riparian forest vegetation provides visual interest; highly unique habitat area within the region; natural appearing landscape with virtually no apparent modification
2	Upper West Arm Lower West Arm	A	Undulating landform; lush, low wetland vegetation in low water period provides visual interest; highly unique habitat area within the region; natural appearing landscape with subtle modifications
3	Peninsula North Peninsula South Upper Crab Creek Arm Lower Crab Creek Arm Dunes/Sand Islands Eastern Bluffs	A/B	Slightly more relief than in above areas; relatively dramatic relief in Eastern Bluffs area; low wetland vegetation and mud flats where seasonally inundated; expansive sand dune areas during low water are unique within the region; ORV damage and transmission line detract from, but do not negate scenic resources
4	Eastern Dunes Main Reservoir O'Sullivan Site North O'Sullivan Site-South East Lind Coulee Arm	B	Undulating landform; expansive dunes in Eastern Dune area; sandy beaches near water; typical shrub-steppe and grasses farther away; subtle color variations; cultural modifications are apparent, and in some areas detract from dominant "natural" scenic resources
5	Developed Corridor West Lind Coulee Arm	C	Relatively flat landform; planted and irrigated vegetation screens adjacent scenery in some areas; reservoir provides some visual interest; cultural modifications dominate and detract from "natural" scenic resources

Overhead utilities, including local electrical distribution lines and electrical transmission lines, are often conspicuous. One of the more visually prominent transmission lines is a 500kV line supported on double wooden pole structures that cross the northern portion of the study area (Photo 3.10-1).

Photo 3.10-1

The management areas within the study area broadly can be defined in terms of scenic quality (see Table 3.10-1). The islands in the north portion of the study area (i.e., North Potholes Reserve, Dunes/Sand Islands, and Lower Crab Creek Arm) are unique due to the presence of wetland areas dominated by trees and willow thickets. A labyrinth of water trails and vegetated mounds contrast with the open water portion of the reservoir. As the reservoir recedes during the summer months, wide, sloped sandy areas become exposed (Photo 3.10-2). Islands within the Peninsula South, east side of the Upper West Arm, and Lower West Arm management areas are less vegetated, but also expose sandy beaches and mud flats late in the summer.

Photo 3.10-2

The Eastern Dunes management area located on the northeastern edge of the reservoir encompasses a wide, open sand dune area. Grasses, low shrubs and some wetland areas persist near the water's edge. However the visual quality of much of the vegetation has been degraded by ORV use (Photo 3.10-3).

Photo 3.10-3

Within the Eastern Bluffs management area, large earthen bluffs dominate the viewscape. The bluffs are the major topographic feature within the area and are impressive when viewed from the reservoir (Photo 3.10-4). The panoramic view from the top of the bluffs is also spectacular.

The Lind Coulee Arm is characterized by low-lying, undulating topography. The reservoir winds through the area creating small-scale coves and promontories that are popular for dispersed camping and day use recreation. Shrub-steppe plant communities dominate the higher ground. Sandy areas become exposed when the water recedes.

Photo 3.10-4

The Developed Corridor includes the Mar Don Resort, Potholes State Park, and Blythe Boat Launch. These areas have been modified for developed recreation opportunities and access. Potholes State Park is a heavily landscaped site characterized by irrigated green lawns, trees and shrubs (Photo 3.10-5) Developed campsites, boat launches, and other recreation amenities and asphalt drives further differentiate the site from its contextual landscape. This contrast does, however, serve to identify the State Park as a destination point.

Photo 3.10-5

The Mar Don Resort, located at the western edge of O'Sullivan Dam has irrigated vegetation, structures, fences, multi-colored lighting and high intensity overhead lights that contrast with the dominant landscape character (Photo 3.10-6). The resort has boat docks, moorage areas and campsites along the reservoir shoreline. These amenities visually dominate the landscape (Photo 3.10-7).

Photo 3.10-6

3.10.3 Visual Sensitivity

Visual sensitivity is defined as a measure of viewer concern for both the scenic resource and the potential changes to the resource. The three primary principles influencing visual sensitivity are: Use Volume, User

Attitude, and Distance. Sensitive viewpoints, where people are most aware of the visual quality of their surroundings, tend to have the most visitors. At Potholes Reservoir, sensitive viewpoints include the following.

Photo 3.10-7

Travel Routes - Primary roadways near the project area include SR 262, SR 17, and Dodson Road. In addition, there is an established network of primitive dirt, sand, or gravel surfaced roads visible throughout the project area.

Recreation Sites and Areas - Most recreation users at Potholes Reservoir are boaters and campers who utilize the facilities in the Developed Corridor. These visitors expect developed amenities and modifications to the landscape. Visitors who camp at dispersed areas tend to prefer a more primitive experience and tend to be sensitive to changes in landscape character. The ORV Area, particularly in the "Green" zone on the shore of Moses Lake, experiences high use during the Memorial Weekend, but residual trash would suggest a general disregard for the visual quality of the area.

3.11 NOISE

3.11.1 Introduction

Noise (generally defined as undesirable sound) can be annoying to study area visitors as well as wildlife. Unfortunately, the subjective effects of noise (annoyance, nuisance, dissatisfaction) cannot as yet be measured in any completely satisfactory way. This is primarily because of the wide variation in individual thresholds of annoyance and the habituation to noise of differing individuals due to their past experiences. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by those hearing it.

The most sensitive noise receptors in the Potholes Reservoir area are the existing developed recreation areas (Potholes State Park and Mar Don Resort) and important wildlife areas (Dunes/Sand Islands and North Pothole Reserve). Ambient sound levels throughout most of the study area are generally rural to residential in nature. These ambient levels are affected by noise from vehicular traffic on nearby roads, motor boats and personal watercraft (jet skis) on the reservoir, and general recreational activities (ORVs), all of which exert a greater influence, individually and cumulatively, during summer peak-use periods.

The impacts of noise on colonial nesting birds, Neotropical Migratory Birds (NTMB), large and small mammals, and other wildlife species are not well understood. While various species probably adapt to some noise, the limits to the amount of adaption that can be made are not known. Although some species have little tolerance of noise (e.g., Canada geese) and others tolerate noise at very high levels (e.g., great egrets), noise can have other effects that are not readily apparent, such as relocation or prevention of mating and nesting behavior.

3.11.2 Motor Vehicles

Vehicular traffic noise is always changing with the number, type, and speed of the vehicles which produce the noise (DOT, 1980). While traffic on State Route 262 produces the most intrusive roadside noise levels, the relatively low traffic volume would indicate that motor vehicles are not a significant noise emitter at Potholes. The higher sound levels common along highways and primary access routes drop to more tolerable levels the greater the distance a receptor is from the road source. Traffic noise levels are also reduced by terrain, vegetation, and natural and manmade objects.

Off-road vehicles in the Grant County ORV Area are substantial noise emitters at Potholes Reservoir. ORV noise levels are greatest during peak summer visitation weekends (Memorial Day, Forth of July, and Labor Day) when hundreds of people gather in the "Green Zone" to camp and ride ORVs. Noise levels generated by ORVs vary with visitation to the Grant County ORV Area. In the warmer months, levels are probably higher on the weekends than on weekdays due to increased use. However, local residents often visit the ORV Area on summer weeknights after work. Non-peak weekend and week day noise levels probably never exceed those produced on peak summer weekends.

3.11.3 Watercraft

Water based recreation is extremely popular at Potholes Reservoir. Based on a recreation user survey conducted at the reservoir during 1999, 38 percent used powerboats and 21 percent of those surveyed said they came to Potholes to ride PWCs. Powerboat and PWC operation occurs across the reservoir. However, PWC concentrations are highest within the Dunes/Sand Islands management area. A PWCs shallow draw allows it to operate in this area longer into the summer months as water levels decline.

Motor Boats

Individually, motor boats produce noise levels between 69 and 76 dBA during a 36 mph drive-by at 100 feet. Several boats passing by at the same time can produce noise levels as high as 80 dBA. Jet boats and boats with dry exhaust and improper mufflers are considerably louder, exceeding 90 dBA. Motor boat activity at Potholes is dispersed and not a significant noise emitter since it occurs a substantial distance from the shoreline and sensitive receptors. However, motor boats do produce intrusive and annoying noise levels as they pass by land-based recreationists. Existing regulations are not sufficient to protect sensitive noise receptors from such noise levels.

Personal Watercraft

The design of personal watercraft (PWCs or jetskis) results in noise emissions that are particularly abrasive. Operated with frequent course and speed changes, and changes in loudness and pitch when jumping wakes or riding over waves, make PWCs much more disturbing to sensitive receptors than constant sounds. Jetskis produce noise levels in the range of 85-105 dB(A) per unit.

This sheds some light on why jetskis seem to annoy more people than other watercraft. The changes in loudness and pitch for jetskis are far greater than for most other watercraft (Lakeline, 1994). The unpredictability of these sounds is probably more aversive than any single physical feature of the sound, such as its frequency or absolute level (Gentry, 1996). Lake users as well as wildlife enthusiasts, campers, and anglers often complain that the high-pitched, mosquito-like whine of PWCs often ruin their recreational experience. For example, conflicts between boaters and PWCs was ranked highest of all recreation conflicts reported at Potholes. Fifty-nine percent of all boaters encountering PWCs had a problem with noise and disruption of the watercraft.

3.12 LAND USE

3.12.1 Introduction

The Potholes Reservoir RMP study area encompasses approximately 36,200 acres of land (18,500 acres) and water (17,700 acres). Of this total, an estimated 34,920 acres are under Reclamation's jurisdiction with the remaining acreage under the jurisdiction of the Washington Department of Natural Resources (WDNR).

Although the lands and waters under the Reclamation jurisdiction were transferred to the State of Washington for administration and management under a Memorandum of Agreement (MOA) with the United States, the Reclamation maintains a basic interest in the uses authorized on them.

The Reclamation's continued interest and involvement insure that (1) nothing is done which conflicts with the primary purposes of the project, and (2) the land receives proper use in accordance with appropriate land management principles and practices.

The Reclamation's Ephrata Field Office is responsible for providing the oversight and approval of proposed land use activities on Reclamation properties within the study area. The SPRC and WDFW are the state agencies currently responsible for most of the day-to-day activities and decisions which directly affect the study area. Of the 34,920 acres under Reclamation jurisdiction, approximately 6,620 acres (18 percent) were withdrawn from the public domain and 28,300 acres (78 percent) were acquired in fee title for the construction and operation of Potholes Reservoir and other Columbia Basin Project purposes.

The following sections describe the management agreements, land use agreements, and land use activities which directly affect the study area's present landscape and resources. Existing management plans, applicable state and local laws and ordinances, county comprehensive plans, and adjacent land uses are identified and described. Figures 3.12-1 and 3.12-2, "Land Use and Recreation" show the primary land uses, leases, and permits currently affecting the study area and adjacent lands.

3.12.2 Management Agreements

When management responsibilities are transferred from one government agency to another, or involve interagency coordination, a MOA is the instrument typically used. Since the creation of Potholes Reservoir, two MOAs have provided the underlying framework used by Washington State to administer and manage the RMP study area.

Memorandum of Agreement between the United States and Washington State

Under the terms of a 50-year MOA dated July 10, 1952, between the United States and the State of Washington, the state assumed management responsibility for the recreational, fish, and wildlife resources occupying Reclamation lands and waters at Potholes Reservoir. The SPRC and WDFW are the principle state agencies responsible for managing essentially all Potholes Reservoir land use activities until the MOA terminates in 2002.

Under the MOA, the Reclamation retains primary jurisdiction over developments within the Reclamation Zone for Potholes Reservoir. The Reclamation Zone includes all lands on which O'Sullivan Dam and their appurtenant works are situated, and that portion of the reservoir area generally lying within a strip 200 feet in horizontal width above the reservoir's full pool elevation of 1,046.5 feet. Such jurisdiction is maintained by the Reclamation for the purpose of

insuring proper operation and protection of the reservoir. All developments and actions affecting lands within the Reclamation Zone must be approved by the Reclamation.

As a guide to the administration of the area, the MOA requires the state to prepare development plans within the reservoir area. Such plans are to be submitted to the Reclamation for review and for consultation with the National Park Service (N.S.) and the USFWS. The state may build and maintain any facility or service for recreation purposes and may set aside lands as refuges for wildlife or public shooting grounds. All such actions and developments, however, require prior approval by the Reclamation.

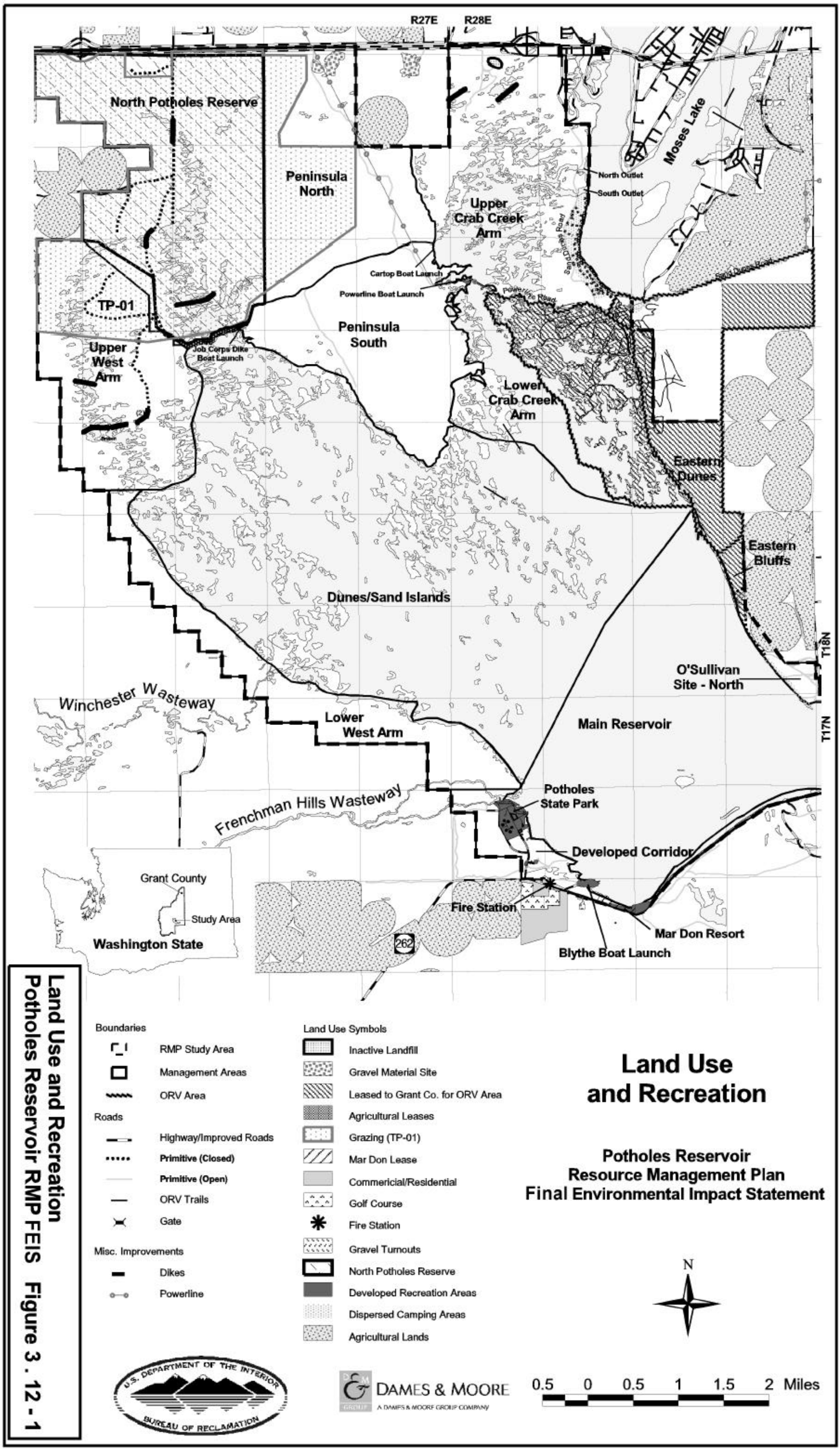
The MOA empowers the state to issue and administer licenses, permits, and concession contracts for the purpose of providing commodities and public services at the reservoir. All licenses, permits and contracts are submitted and approved by the Reclamation before issuance. The MOA also empowers the state, within the limits of its jurisdiction, to make and enforce rules and regulations for the use of the reservoir area as necessary to protect public health and safety; to protect plants, fish and wildlife; and to preserve the scenic, scientific, aesthetic, historic, and archaeological resources of the area.

The state is required to report its revenues from licenses, permits and concession contracts, and its expenditures of such receipts for area administration. Any surpluses of such receipts over expenditures are transferred to the United States.

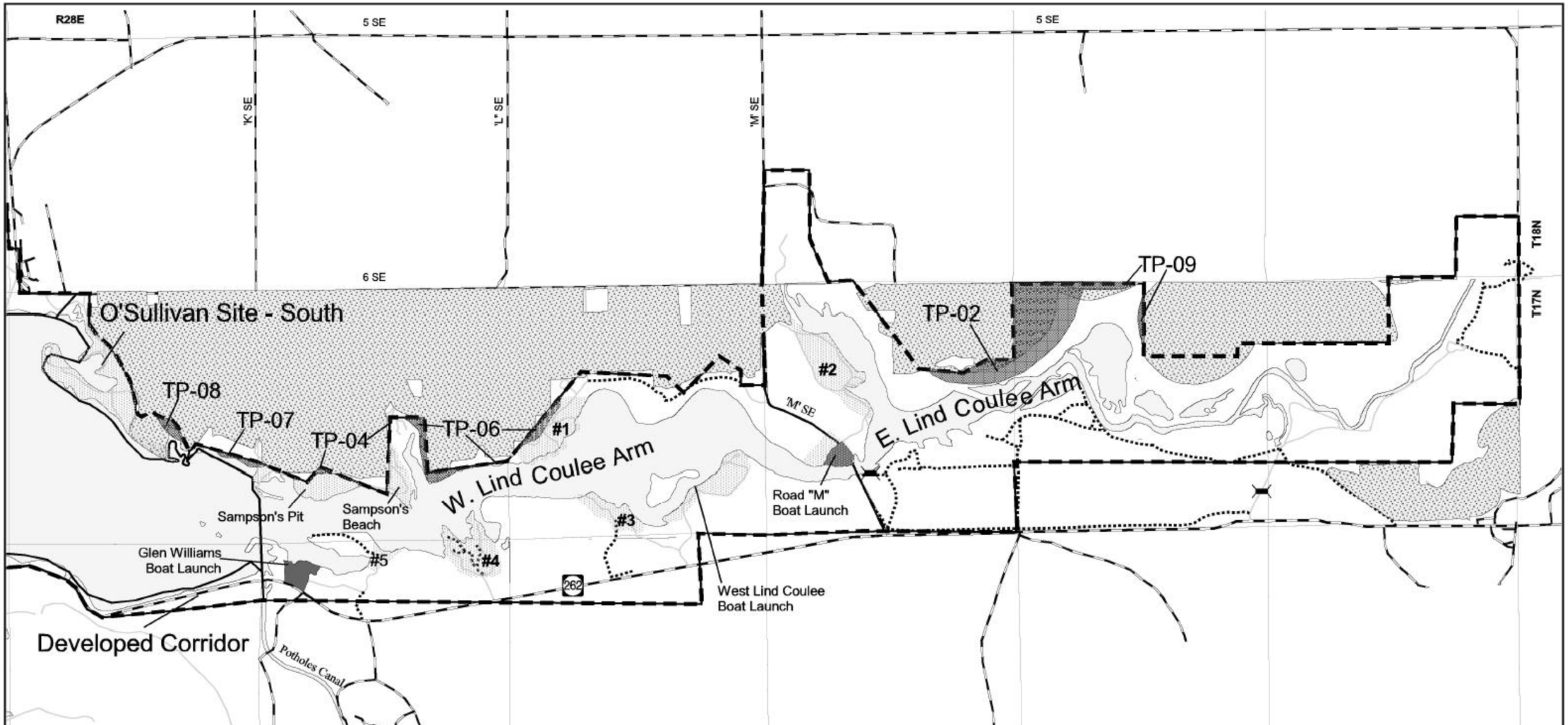
Memorandum of Agreement between State of Washington Department of Game and State of Washington State Parks and Recreation Commission

Under a MOA dated July 15, 1952 between the WDFW (formerly the Department of Game) and the SPRC, all lands transferred from the United States to the state are to be administered by the WDFW with the exception of the following SPRC administered areas: O'Sullivan, Blythe, Peninsula and Lind Coulee Sites, and Potholes State Park. Each agency is responsible for the development, maintenance and management of their respective areas.

Although the existing MOA divided and determined specific responsibilities between the two agencies, the reader should note that the lands administered by the SPRC are currently limited to the O'Sullivan Site (North and South) and Potholes State Park. All other RMP lands are currently administered by the WDFW.



Land Use and Recreation
Potholes Reservoir RMP FEIS Figure 3 . 12 - 1



Land Use and Recreation
Potholes Reservoir Resource Management Plan FEIS

Boundaries
- RMP Study Area
- Management Areas

Roads
- Highway/Improved Roads
- Primitive (Closed)
- Primitive (Open)
- Gate

- Dispersed Camping Areas
- Agricultural Lands
- Agricultural Leases
- Developed Recreation Areas
- Water

N

Scale 1:24,000

0.5 0 0.5 Miles

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

DAMES & MOORE
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Land Use and Recreation
Potholes Reservoir RMP FEIS Figure 3.12 - 2

3.12.3 Land Use Agreements

As described below, most land use activities at Potholes Reservoir are authorized by specific land use agreements with either the SPRC, WDFW, or Reclamation. The SPRC uses a lease agreement as its primary authorization instrument, whereas the WDFW administers a grazing permit and agricultural lease program. Currently there are no second party subleases, concession agreements, or special use permits authorized in the study area.

Interlocal Cooperative Agreement between Washington State Parks and Recreation Commission and the Washington Department of Natural Resources

Dated April 1, 1999, this SPRC administered agreement authorizes the WDNR to provide for the management of recreational resources on 30-acres of Reclamation land currently used for the Mar Don Resort facility. Currently, this Reclamation parcel together with a WDNR parcel are leased under a separate agreement (see Lease No. 62395) for the resort. The term of the interlocal agreement is from April 1, 1999 to July 10, 2002. Renewal or extension of the agreement is subject to the extension or replacement of the 1952 MOA between the United States and Washington State, and to the additional approval of the Reclamation. The annual fee paid to the SPRC is $6000.

State of Washington Department of Natural Resources (Lease No. 62395)

Under a lease dated April 1, 1979 between the WDNR and The New Mar Don Resort, Inc. (lessee), approximately 30 acres of Reclamation land (per above agreement) and 30 acres of WDNR lands are authorized for motel facilities, permanent mobile home space rental; overnight camping for trailers, recreational vehicles (RVs), and tents, picnic facilities, and swimming, boating and beach use. The previous lease with Mar Don expired on March 31, 1999 and was extended to the year 2002 per the interlocal agreement described above.

Land Use Agreement

A land use agreement dated November 16, 1993, between the WDFW and Grant County, allows the county to operate and maintain an ORV Area on approximately 2,144 acres of Reclamation land (based on a reservoir elevation of 1,039 feet). Located just south of Moses Lake, the ORV Area's Yellow Zone (about 1,459 acres) is open seasonally between July 1 and October 1, and the Green Zone is open to ORV use year-round (see Figures 2-2 and 3.12-1, "Land Use and Recreation"). Currently, an estimated 105 acres located in the Eastern Bluffs management area are included in the land use agreement, but situated outside the authorized ORV riding area.

P.E.C. Headworks Powerplant Project Agreement

An agreement dated July 21, 1986 between PUD No. 2 of Grant County and the South Columbia Basin, East Columbia Basin, and Quincy-Columbia Basin irrigation districts (Districts) allows the PUD to construct and operate an electric generating plant at the Potholes East Canal (PEC). The agreement terminates 40 years from the beginning operation date for the project or October 1, 2032, whichever occurs first.

Agreement for Fisheries Mitigation for P.E.C. Headworks Project (FERC No. 2840-003)

An agreement dated September 25, 1987 between the WDFW and the Districts satisfies Article 40 under FERC License No. 2840-003. Article 40 requires the Districts to develop a fishery mitigation plan for losses due to the P.E.C. Headworks Project. The plan calls for trout hatchery production at the Columbia Basin Hatchery and a rearing facility at the Moran Slough at Priest Rapids Dam. The rearing facility has not been developed yet, although the permit for Moran Slough expires in the year 2005. This agreement is effective until the expiration of FERC License No. 2840-003.

Washington Department of Fish and Wildlife Fire Protection Contract

A fire protection contract between Fire Protection District Numbers 4, 5, and 11 and the WDFW stipulates that the districts provide fire protection services to all lands, buildings, and equipment owned, controlled or managed by the WDFW within and/or adjacent to the boundaries of each fire district. The contract term extends for an indefinite period and can be terminated by either party with 90 days written notice before the end of each year. The WDFW is required to pay to the districts a fee based on the assessed land and building valuation calculated at the same rate levied on similar private property. Such fees are paid at the end of each contract year (December 31).

Memorandum of Understanding between Grant County Mosquito Control District No. 1 and the Washington Department of Fish and Wildlife

A 1991 Memorandum of Understanding (MOU) between Grant County Mosquito Control District No. 1 and the WDFW was renewed on April 11, 1997. The 5-year MOU gives the district jurisdiction to apply mosquito control actions on lands owned, controlled, or managed by the WDFW. The WDFW is extremely interested in minimizing the use of chemicals or mosquito control applications that could impact non-target species important to the food chains of local fish and wildlife. The district agrees to use biological pesticides as their primary pesticide, as approved through the State Environmental Protection Act (SEPA) process. The

district is required to comply with the restrictions outlined in the MOU on the application of chemicals on lands and waters managed by the WDFW.

In an effort to assist the district in understanding WDFW's concerns and special requirements, the WDFW is required to provide the district a Master Plan identifying:

- a map of the lands managed by WDFW;
- a map of non-fish waters of special concern to WDFW (i.e., waterfowl and nongame waters);
- plans for increasing habitat by flooding, shoreline work, or any other water projects;
- waterways and wetlands of specific concern for federal/state endangered, threatened and/or species of concern; and
- plans for proposed ponds and wetland developments for wildlife enhancement.

Washington Department of Fish and Wildlife Grazing Permit

A single, 5-year grazing permit (#TP-01), issued and administered by the WDFW, authorizes livestock grazing in the upper northwest portion of the study area. Table 3.12-1 summarizes the permit and Figure 3.12-1 shows the specific area authorized for livestock grazing under the permit. The following general permit conditions apply:

- WDFW reserves the right to alter and change the provisions of the grazing use plan to include reduction in acres of pasture available and number of AUMs authorized when WDFW determines that such changes are required to benefit fish or wildlife management or public hunting and other recreational uses.
- WDFW reserves the right to cancel the permit in the event the area authorized for grazing in the permit is included in a land use plan determined by WDFW to be a higher and better use. Such cancellation will be in writing, will state the reason for cancellation, and notice will be at least 90 days before cancellation.
- Range improvements such as seeding, water developments, fertilization, etc. may be agreed upon and performed by the permittee only with WDFW written approval.
- Major fence repairs will be the responsibility of WDFW when WDFW's examination reveals that replacement is warranted. Minor fence maintenance is the responsibility of the permittee to assure the fences will contain and control livestock.

- All permit lands will remain open for public hunting, fishing, and other recreational uses.

- Permittees are obligated to pay a 12.84 percent leasehold excise tax on all grazing fees in addition to the annual payment of an Animal-Unit-Month (AUM) fee based on fair market value.

- The terms and conditions of a renewed permit are subject to change in land area, grazing management, AUM allotment, and fees. If it is found that permit renewal is in the best interest of WDFW, the permittee will be provided the option of meeting the highest bid made at public auction.

Washington Department of Fish and Wildlife Agricultural Leases

There are six agricultural leases (encompassing about 52 acres) issued and administered by the WDFW within the study area. All of them involve Reclamation lands in the Lind Coulee Arm (East and West) and authorize the production of food and cover for wildlife. Each lease also provides for continued recreation use while granting exclusive right to the lessee for farming. Table 3.12-1 summarizes the leases and Figure 3.12-2, "Land Use and Recreation" shows the land areas that are included in the agricultural lease program. The following general conditions apply to all the agricultural leases issued within the study area:

- Lessee agrees to provide all labor, water, seed, fertilizer, herbicides, and equipment for establishing crops.

- Use good farm management according to local standards to ensure ecosystem health and protection of soils.

- Weed control should be done using mutually acceptable standards.

- Lands should be prevented from becoming a fire hazard.

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- Land shall be open at all times for hunting, fishing and other recreational uses managed by the WDFW.

Table 3.12-1
Agricultural Leases and Grazing Permits Administered by the Washington Department of Fish and Wildlife at Potholes Reservoir

Lessee	Lease No.	Total Acreage	Term	Rent/Year	Allocation
Ray Dagnon	TP-01 (Grazing Permit)	7400	4 grazing seasons Commence: 1/1/95 Terminate: 12/31/99	Fair market value per AUM	600 AUMs
Lee Williams	TP-02 (Agricultural Lease)	19	5 crop years Commence: 1/1/99 Terminate: 12/31/03	2.1 acres of standing grain over winter	
Cheryl Gunderson	TP-04 (Agricultural Lease)	4.6	5 crop years Commence: 3/31/96 Terminate: 12/31/00	$50/acre	
Lee Walker	TP-06 (Agricultural Lease)	17.5	5 crop years Commence: 3/31/96 Terminate: 12/31/00	17.5 acres of wildlife food and cover	
Leif Ludvigson	TP-07 (Agricultural Lease)	1.17	5 crop years Commence: 3/31/96 Terminate: 12/31/00	$58.50	
Terry Hulbert	TP-08 (Agricultural Lease)	2.7	5 crop years Commence: 3/31/96 Terminate: 12/31/00	$100.00	
Bruce Roylance	TP-09 (Agricultural Lease)	7	5 crop years Commence: 4/1/95 Terminate: 12/31/99	$420.00 plus excise tax or 16-foot strip standing grain around perimeter	

3.12.4 Other Land Uses

Gravel and Landfill Sites

A gravel pit is located in the RMP study area within the northeast 1/4 of Section 35, Township 19 North, Range 28 East, and is accessed by D.5 SE Road just south of Interstate 90. An inactive landfill site is located within the northwest 1/4 of Section 21, Township 19 North Range 28 East and is accessed from South Frontage Road just south of Interstate 90.

North Potholes Reserve

Established in 1979, North Potholes Reserve was established by the State Game Commission. Managed by the WDFW, the reserve encompasses about 3,650 acres as shown on Figure 3.12-1. The amount of water varies in size from approximately 250 acres at low water in September to about 750 acres at high water in March. Within the boundaries of the reserve, it is unlawful to hunt game animals, game birds, or to trap fur-bearing animals.

The primary purpose of the reserve is to provide migrating waterfowl with a protected resting area in the north part of the Columbia Basin. In September 1978, the north-south access road near the west boundary of the preserve was closed to motor vehicle travel. Vehicular access to Jobs Corps Dike which separates the main reservoir from the reserve is still available via the channel access road to the east.

Potholes State Park

Potholes State Park is about 640 acres in size and managed by the SPRC. Located on the southwest shore of the reservoir and north of State Highway 262, the park is a well-maintained facility with a wide variety of overnight and day use facilities. Recreation facilities provided by the SPRC include campsites with or without utility hookups, picnic sites, a swimming area, boat launch lanes, fish cleaning stations, comfort stations, access roads, and other support facilities and amenities. A detailed discussion of recreation resources, use, and access is provided in Section 3.13, "Recreation."

Boat Launch Sites

Within the administration areas established between the SPRC and WDFW, the SPRC is responsible for the operation and maintenance of one boat launch site within Potholes State Park, and the WDFW is responsible for seven boat launch sites at Potholes Reservoir (see Table 3.12-2). Operation and maintenance responsibilities for the other boat launch site located at the Mar Don Resort is the responsibility of the respective lessee.

Table 3.12-2
Boat Launch Sites and Operation and Maintenance Responsibilities
Potholes Reservoir, Washington

Washington Department of Fish and Wildlife
Blythe Boat Launch Glen Williams Boat Launch West Lind Coulee Boat Launch Road "M" Boat Launch Powerline Boat Launch Cartop Boat Launch (informal/unmaintained) Job Corps Dike Boat Launch (informal/unmaintained)
Washington State Parks and Recreation Commission
Potholes State Park
Mar Don Resort Lessee
Mar Don Resort

3.12.5 Existing Management Plans and Zoning

Specific management plans have been developed by federal, state, and local agencies to assist in the management of resources and land use activities within and adjacent to the study area. The following plans are summarized in Chapter 1:

- Columbia Basin Wildlife Area Management Plan
- Grant County Comprehensive Plan
- Grant County Shorelines Management Master Program
- Groundwater Management Area

Zoning

All lands within the RMP study area boundary are zoned by Grant County as "Open Space and Recreation"(OS-R). Lands adjacent to the Potholes Reservoir study area primarily are used for irrigated agriculture to the east and southwest, and are vacant or unimproved to the north, west

and southeast. In the vicinity of Moses Lake, urban/residential and commercial uses are intermixed with open space/recreation and agricultural land designations. Private, unincorporated lands adjacent to the study area are subject to current Grant County zoning ordinances and Comprehensive Plan land use designations.

Essentially all unincorporated properties to the west and north of Potholes Reservoir are zoned as OS-R land. The county's agriculture (A) zone lies to the east and southwest of Potholes Reservoir. The area directly east of Moses Lake and north of the ORV Area is a Planned Unit Development (P-D) zone.

The OS-R zone allows for campgrounds, public parks, grazing, wildlife preserves, non-commercial docks and piers, and single-family/multiple-family dwellings (with 2-acre minimum lot and 30 foot height restrictions). A Conditional Use Permit is required for R.V. parks, bed and breakfasts, and travel trailers for part-time use.

The agriculture (A) zone allows crops and related industries; livestock; building and land uses necessary for government and public utility functions; and accessory buildings. Any owner-occupied residence located in the "A" zone may be segregated under the Short Plat Ordinance so long as the segregation contains no less than one acre and the remainder of the original parcel contains two or more acres. The Short Plat Ordinance allows three additional lots of less than forty (40) acres to be created contiguously and devoted primarily to agricultural commodity production. A Conditional Use Permit is required for cemeteries, R.V. parks/campgrounds, gravel pits and surface mining, storage and sale of agricultural products, commercial feedlots, farm labor camps/housing, animal training and health facilities, and for commercial/industrial agriculturally related uses.

3.12.6 Adjacent Land Uses

Public land uses which occur adjacent to or in close proximity to the RMP boundary are briefly described.

Desert Wildlife Area

The Desert Wildlife Area is located west of Potholes Reservoir and incorporates both Winchester and Frenchman Hills Wasteways. The wildlife area is managed by the Washington Department of Fish and Wildlife.

Columbia National Wildlife Refuge

The Columbia National Wildlife Refuge is located immediately south of Potholes Reservoir and about 8 miles northwest of Othello, WA. The 23,000-acre refuge is managed by the U.S. Fish and Wildlife Service. The refuge office is located in Othello. The Soda Lake Campground is the only area where camping is permitted. ORVs are prohibited throughout the refuge. The refuge attracts a large number of migrating waterfowl during the fall and winter.

Warden Hills Golf Resort

The Warden Hills Golf Resort, a privately owned and operated nine-hole course, is located to the south of Potholes Reservoir, off State Route 262, between Potholes State Park and Mar Don Resort.

Perch Point

A trailer/RV residential community consisting of about 70 units and a small store is situated adjacent to RMP boundary at the intersection of "J" SE, 6 SE, and the access road leading to O'Sullivan Beach/Perch Point. According to the Grant County Planning Department, this small community is a pre-existing, non-conforming use (Hooper, 2000).

Washington Department of Natural Resources School Endowment Lands

School endowment lands administered by the WDNR encompass all or portions of Section 16 and Section 36 lands located in and adjacent to the study area. Except for the lease to Mar Don Resort, Inc., most of these lands are free of any land use agreements or encumbrances.

3.13 RECREATION

3.13.1 Introduction

Visitors are drawn to Potholes Reservoir for its unique geographical characteristics and the recreation opportunities they provide. The reservoir maintains high water through the early summer, making it an appealing place to boat, fish, and ride PWCs. The sand dune areas are popular for camping and ORV use. Hunters and wildlife enthusiasts enjoy the diversity of species supported by the reservoir's many habitats. The landscape surrounding the reservoir is relatively flat and rolling and allows open and scenic views from almost any vantage point on the water. Grant County residents generally use the reservoir and surrounding lands during the

weekdays, while the majority of weekenders come from the Puget Sound area. People also visit from other parts of Washington, Idaho, Oregon, and Canada.

This section describes the existing recreation resources, activities and users at Potholes Reservoir Chapter 4 identifies the direct and indirect, individual and cumulative effects each of the management actions could have on these resources and the public.

3.13.2 Recreation Management

Study area lands are managed under agreements with the State of Washington for recreation, fish, and wildlife. Under current conditions, Potholes State Park and O'Sullivan Beach/Perch Point are managed by the SPRC; the Mar Don Resort is privately operated under a WDNR lease; and the remaining facilities and dispersed recreation areas managed by the WDFW. Both developed recreation areas (Potholes State Park and Mar Don) require fees for use whereas an Access Stewardship Decal is required at most WDFW sites. Decals are $10 or free with a hunting or fishing license.

The State of Washington provides regional recreation overview and guidance through the Statewide Comprehensive Outdoor Recreation Plan (SCORP) process. As part of this process, the *Assessment and Policy Plan 1995-2001* was prepared by the Interagency Committee for Outdoor Recreation (IAC) to guide state government activities in outdoor recreation and habitat preservation into the next century (IAC, 1995). Most of the recreation-related management actions being considered by the Reclamation are consistent with the IAC report.

3.13.3 Recreation Use

Visitor Profile

In 1998 and 1999, a "Potholes Reservoir Visitor Profile and Recreational Use Study" was conducted to gather information about visitor use and satisfaction, crowding, conflicts, recreation needs, as well as demographic and economic data pertinent to the study area. The survey team conducted day surveys during seven different sampling periods: three peak holidays (Labor Day 1998, Memorial Day 1999, and July 4th, 1999), the opening day of waterfowl hunting season (October 10, 1999), two non-peak summer weekday periods (June 9-10, 1999 and July 28-29, 1999), and a non-peak summer weekend (August 13-14, 1999).

During the sampling periods, survey team members hand-distributed numbered packets consisting of a cover letter, survey form, and postage-paid return envelope to visitors at recreation sites and accessible shoreline locations in the study area. A small percentage of the surveys were attached to windshields of vehicles found at various parking and boat launch areas.

The survey team distributed approximately 1,959 surveys over the 1998/1999 peak recreation season. A total of 329 surveys (17 percent) were returned. The returned surveys were compiled and analyzed by date and number.

User counts were conducted by overflights during the peak weekends of Memorial Day, the Fourth of July and Labor Day, and one off-peak weekend (August 13, 1999).

Survey Findings

The recreation survey indicated that most Potholes Reservoir respondents were from the Puget Sound area, with 31 percent from the Seattle area. Fourteen percent of the respondents were locals from Grant County, 13 percent were from the Tacoma area, and 10 percent were from the Everett area.

About 35 percent of the respondents were return visitors, and 59 percent identified Potholes Reservoir as one of their favorite reservoirs to visit. Seventy-six percent of all users came to Potholes to be with friends, and about half of the respondents were satisfied with their trip. About half of the respondents would be willing to pay user fees from $1 to $10 per year; whereas 26 percent indicated they were not willing to pay for facility use.

The average length of stay was five days. Twenty-three percent of respondents decided to stay at Potholes Reservoir one week to one month in advance of their visit. Thirty-three percent of the visitors have been coming to Potholes Reservoir for more than 10 years, 24 percent from 6 to 10 years, and 21 percent from 3 to 5 years. Thirty-four percent stayed in public dispersed camping areas and 26 percent camped at Potholes State Park. Nineteen percent of the respondents stayed at Mar Don Resort.

Overall survey use include camping (72 percent), fishing (63 percent), sunbathing (46 percent), and swimming (45 percent), however thirty-six percent of the survey respondents ranked fishing as the most important activity while 24 percent consider camping the most important recreation activity. Anglers ranked walleye and bass as the preferred catch, followed by trout and perch. Thirty-eight percent of the respondents used powerboats and 21 percent used PWCs.

3.13.4 Recreation Activities

Camping

The survey identified camping as the highest use activity at Potholes Reservoir. Dispersed camping primarily occurs along the shoreline on lands managed by the WDFW. Potholes State Park and Mar Don Resort are the only two developed camping areas on the reservoir.

Dispersed Camping

Dispersed camping areas are usually shoreline sites with easy access to the water. RV and camper use is typical in these areas, however, the use of tents is also common. While most of the study area is open to dispersed camping, only a handful of sites receive consistent use. The most popular areas for dispersed camping are identified and highlighted on the "Land Use and Recreation" map (see Figures 3.12-1 and 3.12-2). The most heavily used areas include the West Lind Coulee Arm, O'Sullivan Beach/Perch Point, North Outlet, South Outlet, and the west shore of Moses Lake. These areas are typically accessed by the primitive road network or by boat. The Dunes/Sand Islands management area is a popular boat-in camping area. The islands receive heavy use during peak use periods (i.e., holiday weekends) and in late spring/early summer when high reservoir levels provide excellent boating and access opportunities.

Developed Camping

Potholes State Park, the largest developed public recreation area within the study area, provides a wide variety of camping opportunities including full RV hook-up, tent, and boat-in campsites. Campsite user fees are $16 for a utility hook-up, and $7 (based on 1999 fee schedules) for a primitive campsite (no hook-up). The park also provides excellent opportunities for boating, picnicking, fishing, swimming, and other day use activities. The trailer dumping fee is $3. The boat launch fee is $4, but is included in the camping fee. Extra vehicles are charged $5 per night unless towed by a RV. Park day-use hours are from 8 a.m. until dusk.

Mar Don Resort, a privately-operated recreation area, offers monthly RV/trailer lease sites, campsites, motel rooms, boat moorage, and a general store. During the peak recreation season, user fees are $20 for a RV hook-up and $17 for a tent site. Extra vehicles are charged $5 per night. Boat launch and fishing fees are waived for paying guests.

Potholes State Park and Mar Don Resort offer the only developed camping opportunities within the study area. Both of these developed recreation areas are located in the Developed Corridor off State Highway 262. Dispersed camping is not allowed at either area. The survey indicated that when the state park becomes full during peak weekends, campers are often forced to camp in dispersed areas.

Fishing

According to the survey, fishing is the area's second most used recreation activity. The reservoir supports a warm-water fishery with a variety of species, including smallmouth bass, largemouth

bass, rainbow trout, bluegill, walleye, crappie, yellow perch, burbot, carp, and channel catfish. Rainbow trout are stocked annually.

Large- and smallmouth bass are the most common game fish in the reservoir, although yellow perch, walleye, rainbow trout, bluegill, and crappie are also frequently harvested. Non-game fish include carp, burbot, and channel catfish. Most reservoir anglers fish from boats although several areas are very popular for bank fishing (e.g., O'Sullivan Beach/Perch Point, North Outlet, South Outlet, and West Lind Coulee Arm).

Fishing tournaments are held annually at the reservoir under the jurisdiction of WDFW. Compared with other Washington waters, Potholes Reservoir hosts a relatively high number of bass fishing tournaments each year. Between 14 and 19 tournaments were held each year during the 1991 and 1995 period. Only one walleye tournament was held during this period in 1995.

Boating

The survey showed boating to be the third most used activity at Potholes. Most people use power boats or PWCs in combination with waterskiing, swimming, or other recreational activities. Sailboats, kayaks, canoes, and other non-motorized boats are uncommon, although these water craft can be used to access many reservoir areas otherwise unaccessible when reservoir water levels are low (e.g., late summer). Effects on wildlife habitat from boating-related activities were previously discussed under vegetation and wildlife (see Sections 3.4 and 3.5, respectively).

Boating activities tend to be concentrated in different areas of the reservoir depending on water levels, the location of boat launches, and fishing opportunities. There are no specific seasonal counts of boating use available for the study area. Conflicts between boaters appear to be infrequent due to the ability of boaters to disperse widely on the reservoir. When conflicts do occur, they are primarily at the south end of the reservoir near the popular Blythe and Glen Williams boat launch sites. These conflicts generally arise on peak-use days due to boat launch and parking/dispersed camping congestion at these sites.

Hunting

The Potholes study area is part of WDFW's Game Management Unit (GM) #290 and includes big game, upland birds and waterfowl. The islands and pockets of isolated water within the study area provide excellent waterfowl habitat and hunting opportunities. Decoy hunting is most popular in the Dunes/Sand Islands management area.

Pheasants are hunted on the southeastern side of the reservoir in the Lind Coulee Arm, and to the north in the Upper Crab Creek Arm. Most mule deer are hunted west of Potholes State Park. Fur trapping is popular in the Dunes/Sand Islands and Crab Creek Arm management areas.

Nature Study

Nature study (e.g., hiking and wildlife watching) occurs as a recreational activity and in combination with day use, hunting, or camping. Currently, there are no designated walking trails within the study area.

Off-Road Vehicle Use

The Grant County ORV Area is located in the sand dune area northeast of Potholes Reservoir. This area is managed under a joint agreement by the Grant County Sheriff's Department and the Off-Road Vehicle Advisory Committee (ORVAC). The ORV Area currently is divided into three management zones totally 3,787 acres to protect sensitive habitat areas (see Figure 2-2). The Green Zone (approximately 1,875 acres) is open year-round for ORV use. Approximately 650 acres are located on Reclamation lands within the RMP study area. Of the remaining 1,225 acres, about 320 acres are Reclamation lands, about 475 acres are WDNR lands, and about 430 acres are Grant County lands.

The Yellow and Red zones are located entirely within the RMP study area boundary. Currently, the Yellow Zone (about 1,460 acres) is open seasonally from July 1 to October 1, and the Red Zone (about 430 acres) is closed year-round to ORV use.

The ORV Area is reached via Sand Dunes Road. During peak weekends, travel often becomes congested due to the high number of ORV riders and group camps that congregate at the parking pull-out areas located adjacent to the road on county lands. The most congested area on peak-use days is near Competition Hill just south of Moses Lake on the RMP study area boundary. Although dispersed camping is allowed throughout the ORV Area, this area is consistently the most popular and heavily used ORV riding and dispersed camping area used by the ORV community.

Four vault toilets are located in the ORV Area. Two toilets exist on Reclamation lands, but one is inoperable due to vandalism. Portable toilets are also provided by the county at the parking pull-out areas along Sand Dunes Road to help meet the area's sanitation needs. Trash collection is provided by a large dumpster located at the base of Competition Hill. Because there are no other trash receptacles in the ORV Area, dispersed and roadside campsites frequently become heavily littered and unsightly following peak-use periods and ORV gatherings. The Sand Commandos, a local ORV club, provides the Grant County Sheriff's Department clean-up

assistance following such events. Although these types of problems occur in the area, the vast majority of users abide by the rules and strive to keep the area clean and safe.

Using aerial overflights, the survey team observed the heaviest use of the ORV Area over Memorial Day weekend, with approximately 725 cars and campers parked in the Green Zone, and 50 cars parked along Sand Dunes Road and along the shoreline of Moses Lake in the closed Red Zone. Several riders also were observed trespassing in the seasonally-closed Yellow Zone over this holiday weekend.

Use of the ORV Area was less during all other sampling periods (see Table 3.13-1). During the Fourth of July weekend, 49 groups were observed in the Green Zone, one ORV group was using the Red Zone, and 4 groups were observed in the Yellow Zone. During the Labor Day weekend, 110 groups were observed in the Green Zone, two groups were in the Red Zone, and no riders were observed in the Yellow Zone.

Although the data gathered from the aerial overflights and from ground visiting the ORV area during the sampling periods selected are not exhaustive, the photographs and ground observations consistently showed several ORV trends and findings. These include: (1) the greatest ORV use occurs on county lands within the Green Zone and is typically concentrated in the vicinity of Competition Hill and the south shore of Moses Lake; (2) use of the Yellow Zone is light even during peak holiday weekends when the area is open to ORV riding (i.e., July 4th and Labor Day), and (3) illegal ORV riding occurs in the Red Zone even though it's posted closed to motorized travel, (4) local residents use the ORV area throughout the year, after work and on weekends. While the most activity occurs on the Green Zones characteristic sand dunes, some unauthorized ORV use occurs in the closed Red and seasonally closed Yellow zones through vandalized gates at the entrance to Powerline Road, and by indiscriminate entry on roads and trails posted closed to motorized travel.

The IAC provides funding for the ORV Area. The Sand Commandos, a well-organized local ORV club, donates approximately $10,000 annually to underwrite law enforcement costs in the ORV Area.

Table 3.13-1
ORV User Counts on Sample Weekends

	Memorial Day	**July 4th**	**Labor Day**	**Off-Peak Weekend**
Green Zone	207 groups	49 groups	110 groups	33 groups
Yellow Zone 1/	0 groups	4 groups	0 groups	2 groups
Red Zone	15 groups	1 group	2 groups	1 group

1/ Seasonally open from July 1 - October 1.

Day Use

Popular day use activities in the study area include fishing, boating, swimming, water-skiing, sunbathing, walking/hiking, ORV riding, bicycling, sight-seeing, windsurfing, PWC riding, wildlife watching, and hunting. Potholes State Park and Mar Don Resort provide picnic sites and playground areas. Golfing is available at the Warden Hills Golf Course just south of State Highway 262 between Mar Don Resort and the state park. Wildlife watching can be enjoyed in nearly all parts of the reservoir although no developed watchable wildlife or interpretive facilities currently exist. North Potholes Reserve, a state designated wildlife reserve, is particularly notable for bird-watching.

Visitor Information

Currently, visitor information is available only at Potholes State Park. For the study area as a whole, there is no general system of visitor information materials such as brochures or maps. Additionally, there is no centralized point for visitor information about the study area or its recreational opportunities. There is a limited system of informational and directional signs to assist public access and inform visitors of area boating hazards and regulations. Interpretive signs are essentially non-existent.

Access

Land-based access to the study area is provided primarily by State Highway 262, a two-lane asphalt road that crosses O'Sullivan Dam at the south end of the study area. Sand Dunes Road and Powerline Road provide access to the northwest corner of the study area including the Grant County ORV Area. The D 5 SE Road provides access to the Peninsula North, Peninsula South and North Potholes Reserve (Job Corps Dike) areas, and Road "M" SE provides access off of State Highway 262 and other local county roads to many popular dispersed camping areas located in the West Lind Coulee Arm.

The existing network of graveled county and WDFW maintained primitive roads provides motorized access to most shoreline areas popular for dispersed camping throughout the reservoir area. Of the 60.3 miles of primitive road that exist within the study area, approximately 3.2 miles are seasonally closed in the East Lind Coulee Arm and Lower Crab Creek Arm (Powerline Road); 17.7 miles are permanently closed (the greatest concentration of these closed roads occurs in the North Potholes Reserve and East Lind Coulee Arm areas); and 39.4 miles are open year round to public motorized travel.

Boat launching opportunities are available at nine launch sites (see Table 3.12-2). Of these launch sites, two are informal/unmaintained launch areas (Job Corps Dike and Cartop Boat

Launch). Of the seven launch sites that are maintained for public boat access, the Blythe Boat Launch is unuseable at low reservoir elevations. As the summer season ends, low water-levels limit boat launching opportunities in many reservoir areas. Recreation sites and amenities are listed and summarized in Table 3.13-2.

Crowding, Conflicts and User Satisfaction

Sixty-five percent of the survey respondents indicated they did not feel crowded at Potholes, and 53 percent reported they encountered about as many other recreationists as they had expected. Seventy-five percent of the respondents said they had no major conflicts with another group or person. However, of those boaters who encountered PWC users, 59 percent had a problem with this group. Personal water craft, by design, are highly maneuverable, fast and loud. Their use often intrudes on more passive recreation activities such as fishing and wildlife observation.

Most recreation users view Potholes as one of their favorite reservoirs and are generally satisfied with their visit. While most visitors are satisfied with the number of facilities in place, the survey indicated that additional facilities would be welcome. In order of preference visitors would like to see more trash receptacles, courtesy docks at public boat launch sites; developed campsites and swimming areas; restrooms at campsites and boat launches; and improved boat ramps in the northern half of the reservoir. About half of the respondents support development of O' Sullivan Site-North (O'Sullivan Beach/Perch Point) as a unit of Potholes State Park, and, consistently, the biggest problem identified was trash dumping due to the lack of trash receptacles in the study area.

Recreation Sites and Facilities

Most of the developed public recreation areas and popular dispersed camping areas are located at the south end of Potholes Reservoir (see Figures 3.12-1 and 3.12-2) in the Developed Corridor and West Lind Coulee Arm management areas. State Highway 262 provides access to the developed and undeveloped sites concentrated in this area. Table 3.13-2 provides an overview of the most popular public recreation sites and facilities currently available at the reservoir. These sites include developed, semi-developed, and unimproved dispersed recreation areas. No regularly used dispersed recreation/camping areas, developed recreation sites, or facilities occur in the Eastern Bluffs, Main Reservoir, Upper West Arm, and Lower West Arm management areas. Specific to the Dunes/Sand Islands management area, although this area has no improvements, it is extremely popular for boat-in dispersed camping and day use activities during the late spring and early summer. During this time, reservoir water levels are high enough to provide good to excellent boat access opportunities throughout this popular potholed area. Group camping is a very popular activity on the sand islands.

Table 3.13-2
Recreation Sites and Facilities
Potholes Reservoir, Washington

Recreation Sites by Management Area	Managing Agency	Facilities and Resources
North Potholes Reserve		
Job Corps Dike	WDFW	• dispersed campsites with fire rings • 2 non-surfaced boat launches • no WDFW Access Stewardship Decal required
Peninsula North		
"Cartop" Boat Launch	WDFW	• no improvements • informal boat launching • gravel parking lot • dispersed camping/informal fire rings • no WDFW Access Stewardship Decal required
Peninsula South		
Dispersed Recreation Area	WDFW	• gravel parking lot • dispersed camping/informal fire rings • no WDFW Access Stewardship Decal required
Powerline Boat Launch	WDFW	• single-lane concrete boat launch • gravel turnouts and parking area • dispersed camping/informal fire rings • picnic table • WDFW Access Stewardship Decal required
Upper Crab Creek Arm		
"Red Zone"	GCSD WDFW	• walk-in/boat in only • dispersed camping/informal fire rings • closed to motorized travel/ORV riding year-round
South Outlet	WDFW	• dispersed camping/informal fire rings • 3-day camping limit • 1 single-vault toilet • gravel parking area • fishing access • WDFW Access Stewardship Decal required
North Outlet	WDFW	• dispersed camping/informal fire rings • 3-day camping limit • 1 single-vault toilet • handicapped-accessible trail and fishing pier • gravel and paved parking areas • WDFW Access Stewardship Decal required

Table 3.13-2
Recreation Sites and Facilities
Potholes Reservoir, Washington

Recreation Sites by Management Area	Managing Agency	Facilities and Resources
Lower Crab Creek Arm		
Grant County ORV Area "Yellow Zone"	GCSD WDFW	• dispersed camping • on- and off-trail riding • open July 1 - October 1 to ORV riding/motorized travel
Eastern Dunes		
Grant County ORV Area "Green Zone"	GCSD WDFW	• 2 vault toilets (one closed) • dumpster • dispersed camping/informal fire rings • on- and off-trail riding • open year-round to ORV riding/motorized travel
Developed Corridor		
Potholes State Park	SPRC	• developed overnight and day-use facilities • 60 campsites w/utility hook-ups; 66 campsites each with fire ring/grill and picnic table • shower and bathroom facilities • 33 picnic sites (19 w/pedestal grills) • 2 playgrounds • 1 gravel and 2 concrete boat launches • courtesy dock • fish cleaning stations • public swimming area • trailer dump station • gravel parking area for 225 vehicles • trash collection and shade trees • SPRC fee area
Blythe Boat Launch	WDFW	• graveled parking area • camping allowed in parking area • 1 gravel boat launch (low water accessible) • 1 two-lane concrete boat launch (inoperable at low water) • 2 single-vault toilets • WDFW Access Stewardship Decal required

Table 3.13-2
Recreation Sites and Facilities
Potholes Reservoir, Washington

Recreation Sites by Management Area	Managing Agency	Facilities and Resources
Mar Don Resort	Private Operator under WDNR lease	• overnight camping high water: 50 tent sites, 142 RV hook-ups low water: 82 tent sites, 146 RV hook-ups • 21 motel rooms • long-term leasing for mobile homes • restaurant/general store/boat rental • courtesy dock • fish cleaning stations • public swimming area • boat moorage • trash collection and shade trees • fee area
West Lind Coulee Arm		
Glen Williams Boat Launch	WDFW	• graveled parking area • camping allowed in parking area • 2-lane concrete boat launch (low-water accessible) • 2 single-vault toilets • WDFW Access Stewardship Decal required
O'Sullivan Site		
O'Sullivan Site-North (O'Sullivan Beach/Perch Point)	SPRC	• 2 portable toilets • informal boat launch at Perch Point • dispersed camping/informal fire rings • popular bank fishing area • 10-day limit • no SPRC fees required
O'Sullivan Site-South	WDFW	• no improvements • dispersed camping/informal fire rings • WDFW Access Stewardship Decal required
West Lind Coulee Arm		
Dispersed Area #1	WDFW	• no improvements • dispersed camping/informal fire rings (some boat-in camping occurs) • WDFW Access Stewardship Decal required
Dispersed Areas #3 and #4	WDFW	• no improvements • dispersed camping/informal fire rings • popular bank fishing area • WDFW Access Stewardship Decal required

Table 3.13-2
Recreation Sites and Facilities
Potholes Reservoir, Washington

Recreation Sites by Management Area	Managing Agency	Facilities and Resources
Dispersed Area #5	WDFW	• no improvements • informal parking area • day-use only • WDFW Access Stewardship Decal required
West Lind Coulee Boat Launch	WDFW	• gravel boat launch (low-water accessible) • 1 single-vault toilet • dispersed camping/informal fire rings • WDFW Access Stewardship Decal required
Road "M" Boat Launch	WDFW	• single-lane gravel boat launch • 1 single-vault toilet • gravel parking area • camping allowed in parking area • WDFW Access Stewardship Decal required
Sampson's Pit	WDFW	• no improvements • dispersed camping/informal fire rings • popular boat-in camping and fishing area • WDFW Access Stewardship Decal required
Sampson's Beach	WDFW	• no improvements • dispersed camping/informal fire rings • some boat-in camping occurs • WDFW Access Stewardship Decal required
East Lind Coulee Arm		
Dispersed Area #2	WDFW	• no improvements • dispersed camping/informal fire rings • no WDFW stewardship decal required

3.13.5 Existing Recreation Opportunities Spectrum

The Recreation Opportunities Spectrum (ROS) is a planning tool used to describe the general nature of the recreational experience available in a particular area. The ROS classes span the spectrum from "primitive" to "urban." Any given area may contain elements of more than one class. When this occurs, the predominant character of the area is used in assigning a ROS classification. As shown in Table 3.13-3, the management areas at Potholes range in the spectrum from "semi-primitive, non-motorized" to "rural."

Table 3.13-3
ROS Classification for Each Management Unit

MANAGEMENT UNIT	ROS CLASSIFICATION
North Potholes Reserve	**Semi-Primitive, Non-Motorized** natural-appearing landscape; high probability of experiencing solitude; few site controls; non-motorized access on primitive roads and trails; vegetative controls are not evident; "Difficult" disability access; rustic facilities for site protection only.
Upper West Arm Lower West Arm	**Semi-Primitive, Motorized** Predominately natural appearing landscape; little evidence of others; subtle on-site restrictions; motorized use is restricted to primitive roads; vegetative alterations visually subordinate; "Difficult" disability access; no site modifications for facilities.
Peninsula North Peninsula South Upper Crab Creek Arm Lower Crab Creek Arm Dunes/Sand Islands Eastern Bluffs	**Roaded Natural** Natural appearing from sensitive sites; Opportunities for interaction with others and for privacy; little on-site control, except for gated roads; areas primarily are related to road corridors that have moderate-to-heavy use; natural looking vegetative alterations; "Difficult" disability access; site modification by users only.
Eastern Dunes O'Sullivan Site (North and South) East Lind Coulee Arm West Lind Coulee Arm	**Roaded Modified** Substantially modified environment; easy access with opportunities to get away from others; some obvious on-site controls, "Moderate" disability access; moderate site modification for facilities.
Developed Corridor	**Rural** Attractive cultural modification of natural environment is evident; convenient access; high evidence of other users and vegetative alterations to maintain visual recreational characteristics; obvious and prevalent on-site controls; access for individual, intensive motorized use; disability access is "easy" and meets ADAAG standards; some facilities designed for user comfort and convenience; moderate-to-heavy site modification.

3.14 SOCIAL AND ECONOMIC RESOURCES

3.14.1 Introduction

With the exception of drought, windstorm, and lightning-caused fires, changes to the landscape of the interior Northwest during the last century have been human-induced for human needs and consumption. The interesting feature of this change is that it occurred over a short time frame. The web of ecological and economic history is complex. The Grant County area is only one example of ecological change to meet social and economic needs.

3.14.2 Demographics

Population

Grant County is an example of this late, fast paced growth in the Pacific Northwest. From 1930 to 1962, the county experienced rapid growth from 6,000 people to over 54,000. This increase was due mainly to the military installations and major construction projects dealing with the allocation and manipulation of the water resources. Since 1970, Grant County has had a relatively constant population showing only a slight overall increase. From 1989 to 1996, however, Office of Financial Management figures show an increase to 66,400 ranking it 17th in the State for population size.

Some population increases can be attributed to the migration of people from cities to rural communities. This commuting culture has created its own economic and ecological changes. For the Potholes area this mobility and desire for solitude has contributed to the influx of the recreating public. However, the majority of increase in population and changes to the Potholes and Grant County area is due to the introduction of water to several new irrigation blocks. This creates a "ripple" affect for the growth of small industry to accommodate the increased need for homes and home services. This was the case for these two Counties leading up to the 1980's.

Table 3.14-1
Population of Grant County, 1910-1998

	Total County		Unincorporated County		Combined Cities	
Year	Population	Average Annual Rate of Growth	Population	Average Annual Rate of Growth	Population	Average Annual Rate of Growth
1910	8,698		7,193		1,505	
1920	7,771	-1.1%	5,173	-3.2%	2,598	5.6%
1930	5,666	-3.1%	3,595	-3.6%	2,071	-2.2%
1940	14,668	10.0%	7,458	7.6%	7,210	13.3%
1950	24,346	5.2%	9,503	2.5%	14,843	7.5%
1960	46,477	6.7%	19,754	7.6%	26,723	6.1%
1970	41,881	-1.0%	16,895	-1.6%	24,986	-0.7%
1980	48,522	1.5%	22,007	2.7%	26,515	0.6%
1990	54,798	1.2%	26,409	1.8%	28,389	0.7%
1997	68,300	2.9%	34,458	4.3%	33,842	5.4%
1998	69,400	1.6%	34,740	5.1%	34,660	3.9%
Average		**2.4%**		**2.3%**		**4.0%**

Source: 1997 Data Book, Washington State Office of Financial Management

Gender, Race, and Ethnicity

Adams and Grant County have a nearly equal number of males and females. Similar to the rest of the state, the median age in Adams County since the 1980 Census has risen 3.1 years to 30.9 years and the median in Grant County has risen 3.0 years to 32.0.

Racial and origin characteristics continue to change in the two counties. In Adams County, the Caucasian population has declined an estimated 23 percent in the period from 1980 through 1984 to 63.2 percent, with actual numbers declining by nearly 30 percent in the same period. The Caucasian population in Grant County has declined from 90.2 percent in 1980 to 81.2 percent in 1994. Both counties have seen growth in the number of ethnic groups and cultures. Persons of Hispanic origin make up the second-largest group in each county.

3.14.3 Economic Setting

Industries and Employment

Farming is the major industry in the two counties. The region produced 42 percent of the potatoes, 20 percent of the wheat, 54 percent of the sweet corn, 32 percent of the hay, and 43 percent of the peppermint in the state.

In 1993, one out of every four employees in the region was a farm worker. Statewide, less than 4 percent of all workers are farm workers. In Adams County there were over 1,600 farm workers, and in Grant County 5,700. Employment rates vary greatly throughout the year, directly related to the seasonality of farm work.

Construction employment in Adams County accounted for only about 2 percent of the county total. Grant County construction employment closely matches the state average of 5 percent. Manufacturing employment for Adams, Grant, and the state in 1993 were 20 percent, 17 percent, and 15 percent, respectively (Figure 3.14-1). Ninety-seven percent of Adams County manufacturing, and 73 percent of Grant County manufacturing, is in food processing.

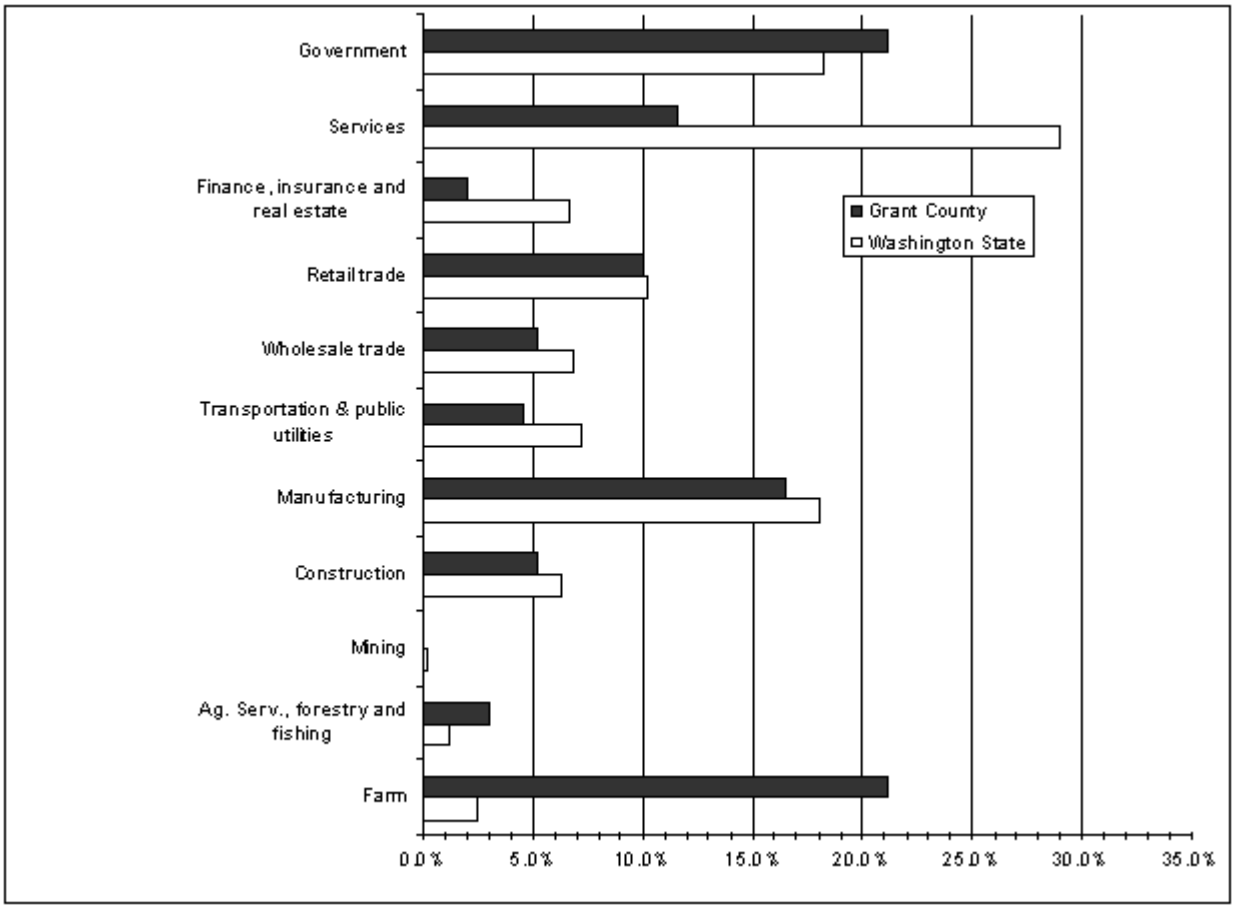
Personal Income

Per capita income in Adams County exceeded the state and national average until 1977 and generally fluctuated up and down through the mid-1980's. Since 1986, per capita income has been below the state and national averages. In 1992, Adams County ranked 14th among the 39 counties with per capita income of $18,693 or 88 percent of the state average of $21,289. The national average was $20,105 for this period. Grant County per capita income has remained relatively flat and below the state and national averages since the mid-1970's. In 1992, per capita

income in Grant County was $16,289, 77 percent of the statewide average, and ranked 31st in the state.

Farm income is the primary factor in the per capita average and reflects the relative volatility of farm income. Twenty-three percent of Adams County and 15 percent of Grant County income is farm related, compared with one percent statewide. Income distribution, measured by median household income, was $29,029 in Adams County, $26,288 in Grant County, compared to a state median household income of $36,648 for 1992.

Figure 3.14-1
Percent of 1996 Total Industry Earnings by Major Industry Group:
Grant County and Washington State



3.14.4 Scope of the Analysis

This analysis will discuss the social and economic implications of the actions on the present values and the institutional structures that groups develop for dealing with common human problems. This forming of groups or communities, either formal or informal, is the basis for establishing culture.

Cultures have values, beliefs, norms, rationalizations, symbols, ideologies, behavior, and material artifacts. However, these attributes can vary between groups and between individuals of the same group or different groups within the same culture. These attributes can also change and take on entirely different meanings to the groups and individuals in the process of being contested. In this way group identities are created, defined, and modified during this process of contesting meaning. (Schmink and Wood 1992).

Humans, individual or group interaction with the environment and the meanings attributed to these interactions are filtered through values, social structure, technology, and the economy, which in turn interact with each other. A value orientation includes beliefs of what exists and what is desirable. If values consist of a relationship between the worth of objects, concepts, or states of being, it is obviously important to the understanding of what is acceptable to the individual or groups and how these values change when being contested. Mutual relationships exist between values and the institutional structures which groups develop. The scope of the analysis of the social implications for the Potholes RMP will focus on how values interact with each other in confronting a specific situation in order for individuals and groups to decide what is acceptable and what people know or believe about the object, concept, or situation.

The economic assessment will determine the impacts of this RMP on, personal income growth and potential income loss. The reference and background for this analysis will be the Grant County Comprehensive Plan FEIS (1999) which provides the economic planning mechanism for the future of the Potholes and Grant County area.