3. REACH INVENTORY AND ANALYSIS

SHORELINE JURISDICTION REACH BREAKS

Several sources were used to map the shoreline jurisdiction as shown on Figure 3 and synthesis maps in the map portfolio. The City of Moses Lake city and urban growth boundary were received from the City of Moses Lake. Lake boundaries were digitized from Washington Department of Transportation 1:24,000 black and white orthophotos (1996), based on estimating the ordinary high water mark using "greenline" estimation. Associated wetland locations were mapped based on National Wetland Inventory information. For the purposes of this inventory, those wetlands assumed to be associated with shorelines (fall within 200 feet as measured from the ordinary high water mark, or if they are connected to the defined lake shoreline environment) are included in the shoreline area shown on Figure 3. To categorize distinct reaches of the Town's shorelines for characterization, the shoreline jurisdiction was classified into thirty preliminary reaches based on biophysical characteristics, as well as general land uses. Table 1 indicates the location of shoreline segments, as well as the justification for breaks between reaches. Reaches are also shown on Figure 3.

SHORELINE CHARACTERIZATIONS AND ASSESSMENTS

REACH 1

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 1 is predominately flood gravels. Part of a Missoula Flood cut bank, 76% of the area has slopes greater than 15% (U.S. Geological Survey [USGS] 2000). Nearshore sediment sizes are classified as a combination of mixed alluvium (59.8%) and cobble (40.5%). The soils within the SMP jurisdiction are predominately Malaga cobbly sandy loam (50.1%) or Malaga very stony sandy loam (35.6%) (U.S. Department of Agriculture, Natural Resources Conservation Service [NRCS], 2003). As a result, soil permeability is entirely moderately rapid while runoff is primarily classed as moderate (85.7%). The hazard of soil erosion is also predominately moderate (85.7%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the southwest and northwest. Fetch lengths range between 1.00 and 2.78 km and are higher for both the southwest and northwest. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the entire shoreline having nearshore exposure widths less than 10 m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation

Upland

For Reach 1, potential natural vegetation is primarily shrub-steppe (United States Forest Service [USFS], 1995).

Riparian

Overhanging vegetation is present along 64.7% of Reach 1. Principal upland species include willow (*Salix)*, poplar (*Populus*), pine (*Pinus*), and maple (*Acer)*. Emergent vegetation in the littoral zone is restricted to a narrow corridor less than 2 m wide along the shoreline. This corridor extends along less than 1% of Reach 1.

Based on information collected for Washington Department of Fish and Wildlife (WDFW) in 2003, the unprotected mixed alluvium shorelines in this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University [CWU], 2005). On the other hand, the portion of protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*). In addition, the unprotected cobble shorelines tend to have 12 species of aquatic vegetation found in the nearshore, including 6 submergent and 6 emergent species. (Table 9) The submergent species are dominated by sago pondweed and Eurasian water milfoil (*Myriophyllum spicatum*), while the emergent species are dominated by reed canary grass (*Phalaris arundinacea*) and softstem bulrush (*Scirpus validus*). By comparison, protected cobble shorelines tend to have a slightly lower diversity of species, including 5 submergent and 1 emergent species, softstem bulrush (Table 11). The submergent species are dominated by white stem pondweed, sago pondweed, Eurasian water milfoil, and curly leaf pondweed.

Wetlands

No wetlands are found in the SMP jurisdiction (United States Fish and Wildlife Service [USFWS], 2003).

Wildlife

Fish

Based on data collected by WDFW between 2002 and 2003, at least ten fish species may be found along Reach 1, dominated by yellow perch (39%), bluegill (14%), largemouth bass (14%), and black crappie (10%) (Fig. 4) (Gabriel and Jordan, 2004). Other notable species include walleye (8%), black bullhead (8%), and smallmouth bass (5%) (Table16). Portions of the shoreline have also been identified as good bass fishing (Fish-n-Map Co., n.d.).

Avian

Reach 1 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with denser zones of riparian tree cover and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region.

Terrestrial

Reach 1 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, the northern half of the reach is classified as a priority riparian habitat, primarily consisting of willow and Russian olive trees (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)

Of the SMP jurisdiction lands along Reach 1, 57.8% are classified as undeveloped. Of the remaining 42.2% of SMP jurisdiction lands, 30.2% is under single family residential development, 11.7% is mining and 0.3% is commercial. Based on land use, imperviousness of this reach is estimated to be approximately 3.6%. Parcel sizes in the reach have an average width of 60 m and an average depth of approximately 175 m. Based on a survey of 16 shoreline structures, average structure setback from the shoreline along Reach 1 is 34.4 m, ranging from 23.2 to 57.5 m. There is no public land ownership classified within the SMP jurisdiction, though 5.1% is zoned as Urban Public Facilities.

Transportation Infrastructure (Table 6)

Roadways occupy a total of 4 meters of Reach 1 (WDNR, 1996). There are no storm sewer outfalls along this reach (City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)

Approximately 2.7% of the shoreline along Reach 1 is hardened with bulkheads. In addition, 29 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)

Current zoning within the SMP jurisdiction of Reach 1 is predominantly Urban Residential 2 (61.0%) and Urban Residential 3 (28.8%), with smaller areas of Urban Light Industrial (5.1%) and Urban Public Facilities (5.1%). Currently the Grant County SMP environmental designation for Reach 1 is a combination of Rural and Suburban.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites within the SMP jurisdiction of Reach 1 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 1 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 76%	Undeveloped: 57.8% Riparian tree cover: 64.7% Priority habitats: 1 Species of concern: 4 Fish Species: 10	Public land: 5.1%	Principal land use: undeveloped Imperviousness: 3.6% Roads: 4 m Bulkheads: 2.7% Docks: 29

Ecological functions along Reach 1 are impaired by residential development, which covers 30.2% of the jurisdiction, and account for the majority of the estimated 3.6% imperviousness within the reach. Upland vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is extremely limited in extent (less than 1% of the reach), though this might be in part due to the relatively steeper nearshore and greater windward fetch found along this reach. The majority of the reach is presently undeveloped (57.8%) and has overhanging vegetation (64.7%), which helps provide shading of aquatic habitat and bank stability. The northern half of the reach is classified as a priority riparian habitat, primarily consisting of willow and Russian olive trees.
Only a small portion of the reach has shoreline hardening (2.7%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the ten fish species found along this reach. This aquatic habitat is further impaired by the fairly large number of docks (29) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
1A	Shoreline Residential - Resource	Zoned residential; riparian tree cover, steep slopes, largely unplatted and undeveloped
1B	High Intensity	Gravel mining
1C	Shoreline Residential - Resource	Zoned residential; riparian tree cover, steep slopes

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect priority riparian habitat as identified by WDFW.
B. Protect vegetative buffer on residential and agricultural land.
C. Prevent increase in the number of bulkheads on the shoreline

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
B. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.

REACH 2

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 2 is predominately flood gravels. This section is a combination of a glacial outwash point bar system and another Missoula Flood cut bank. Nearshore sediment sizes are classified as being entirely mixed alluvium. The soils within the SMP jurisdiction are predominately comprised of Ephrata Malaga complex (72.1%) (NRCS, 2003). Soil permeability is moderately rapid while runoff and hazard of soil erosion are entirely slow.

Fetch and Near-Shore Exposure
The shoreline is exposed to wind directions ranging from the south to northwest. Fetch lengths range between 0.79 and 2.39 km, and are higher from both the south and northwest. The relatively shallow nearshore tends to be moderately impacted by the fall lake level drawdown of 1.5 m, with 56.7% of the reach having nearshore exposure widths between 10-35 m. However, an additional 17.6% of the reach has a seasonal nearshore exposure between 36-60 m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 44.6% of Reach 2. The principal upland species include Willow (*Salix*) and Elm (*Ulmus*). Emergent vegetation in the littoral zone is fairly extensive, with an average width of 5-10 m extending along 40.3% of the reach. In addition, another 7.9% of the reach has emergent vegetation zones with widths ranging between 2-5 m and less than 2 m. The primary emergent vegetation species of Reach 2 are softstem bulrush (*Scirpus validus*), broad-leaved cattail (*Typha latifolia*), common reed (*Phragmites australis*), and reed canary grass (*Phlaria aruninacea*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Gabriel and Jordan, 2004). On the other hand, the portion of protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*).

Wetlands
Wetland habitat in Reach 2 is fairly extensive, dominated by palustrine, emergent forest wetlands and comprising 11.6% of the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least ten fish species may be found along Reach 2, dominated by yellow perch (69%), bluegill (11%), and walleye (7%) (Fig. 5) (Gabriel and Jordan, 2004). Other notable species include smallmouth bass (5%), largemouth bass (4%), and black crappie (3%) (Table 17).

Avian
Reach 2 provides potential habitat for numerous avian species, such as mallard, Canada Goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation or riparian tree cover, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. In addition, most the reach's nearshore is classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, as well as an important brooding area for geese (WDFW, 2002).

Terrestrial
Reach 2 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 2, 50.6% are classified as residential single-family. Of the remaining 49.4% of SMP jurisdiction lands, 47.8% is undeveloped, 0.3% is unclassified and 1.3% is classified as parks/open land. Based on land use, imperviousness of this reach is estimated to be approximately 11.4%. Parcel sizes in the reach have an average width of 42 m and an average depth of approximately 87 m. Based on a survey of 22 shoreline structures, average structure setback from the shoreline along reach 2 is 33.7 m, ranging from 23.2 to 55.9 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 167 meters of SMP jurisdiction land in Reach 2, though no storm sewer outfalls occur along this reach (WDNR 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 4.6 % of the shoreline along Reach 2 is hardened with bulkheads. In addition, 24 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 2 is entirely Urban Residential 3. Currently the Grant County SMP environmental designation for Reach 2 is Suburban.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 2 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 2 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 0.4%	Wetlands: 11.6% Undeveloped: 47.8% Riparian tree cover: 44.6% Priority habitats: 1 Species of concern: 4 Fish Species: 10		Principal land use: undeveloped Imperviousness: 11.4% Roads: 167 m Bulkheads: 4.6% Docks: 24

Ecological functions along Reach 2 are impaired by residential development, which covers 50.6% of the jurisdiction and accounts for the majority of the estimated 11.4% imperviousness for the reach. Riparian vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. Roadways, which cover 167 m of the jurisdiction, may be another source of nonpoint source pollution. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is fairly extensive, though is only found along less than half the reach. Most of the reach's nearshore is classified as a priority habitat for waterfowl concentrations, while approximately 11.6% of the reach is also classified as wetlands (WDFW, 2002). Much of the reach is presently undeveloped (47.8%) and has

overhanging vegetation (44.6%), which helps provide shading of aquatic habitat and bank stability. Only a small portion of the reach has shoreline hardening (4.6%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the ten fish species found along this reach. This aquatic habitat is further impaired by the fairly large number of docks (24) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
2A	Shoreline Residential - Resource	Residential use; riparian tree cover,
2B	Water-Oriented Park	Public park
2C	Shoreline Residential – Special Resource	Residential use; wetlands; riparian tree cover
2D	Shoreline Residential – Resource	Residential use; docks; riparian tree cover; emergent vegetation

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Prevent increase in the number of bulkheads on the shoreline.
B. Protect emergent vegetation near docks, residential areas, and public access areas.
C. Protect existing wetlands from encroachment by residential development
D. Protect emergent vegetation near docks, residential areas, and public access areas.
E. Protect vegetative buffer on residential and agricultural land.
F. Protect priority habitat for waterfowl identified by WDFW.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
B. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
C. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
D. Develop vegetative buffers around parking areas on public land, as well as direct overland flow away from lake.

REACH 3

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 3 is dominantly flood gravels. This section is a mid island bar that was created by glacial outwash that split into two channels and deposited its sediments in the middle. Approximately 20.3% of the reach has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as being entirely of mixed alluvium. The soils within the SMP jurisdiction are predominately Malaga cobbly sandy loam (36.5%) or Ephrata-Malaga complex (33.2%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff and hazard of erosion is predominantly slow (63.5%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the northwest to the south. Fetch lengths ranging between 0.83 and 1.70 km. and are higher from both the south and west. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the majority of the shoreline having nearshore exposure widths less than 10 m (79.3%). However, an additional 20.7% of the reach has a seasonal nearshore exposure between 36-60 m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 51.7% of Reach 3. The principal upland species is willow (*Salix*). Emergent vegetation in the littoral zone is fairly limited with an average width of less than 2 m extending along 27.5% of the reach. In addition, another 1.3% of the reach has emergent vegetation zones with widths ranging between 2-5 m. The primary emergent vegetation species of Reach 3 is softstem bulrush (*Scirpus validus*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Gabriel and Jordan, 2004). On the other hand, the portion of protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*).

Wetlands
Wetland habitat in Reach 3, composed of palustrine forested and emergent wetlands, is limited, as it comprises only 0.6% of the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least ten fish species may be found along Reach 3, dominated by yellow perch (71%), bluegill (6%), largemouth bass (5%), and black crappie (5%) (Fig. 6) (Gabriel and Jordan, 2004). Other notable species include walleye (3%), smallmouth bass (4%), and bullhead (8%) (Table 18).

Avian
Reach 3 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with denser zones of emergent vegetation or riparian tree cover, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. In addition, a small northern portion the reach's nearshore is classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, as well as an important brooding area for geese (WDFW, 2002).
.

Terrestrial
Reach 3 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf*

Land Use (Table 5)*)*
Of the SMP jurisdiction lands along Reach 3, 64.5% are classified as single family residential. Of the remaining 35.5 % of SMP jurisdiction lands, 28.9% is undeveloped, 4.7% is multi-family residential, 1.1% is unclassified, and 0.6% is classified as open land. Based on land use, imperviousness of this reach is estimated to be approximately 15.9%. Parcel sizes in the reach have an average width of 40 m and an average depth of approximately 101 m. Based on a survey of 18 shoreline structures, average structure setback from the shoreline along Reach 3 is 27.2 m, ranging from 0 to 46.1 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 342 meters of SMP jurisdiction land in Reach 3, though no storm sewer outfalls occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 21.4% of the shoreline along Reach 3 is hardened with bulkheads. In addition, 40 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 3 is entirely Urban Residential 3. Currently the Grant County SMP environmental designation for Reach 3 is Suburban.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 3 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 3 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 20.3%	Wetlands: 0.6% Undeveloped: 28.9% Riparian tree cover: 51.7% Priority habitats: 1 Species of concern: 4 Fish Species: 10		Principal land use: residential. Imperviousness: 15.9% Roads: 342.1 m Bulkheads: 21.4% Docks: 40

Ecological functions along Reach 3 are impaired by residential development, which covers 64.5% of the jurisdiction and accounts for the majority of the estimated 15.9% imperviousness for the reach. Riparian vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. Roadways, which cover 342 m of the jurisdiction, may be another source of nonpoint source pollution. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is fairly limited, found in narrow strips along less than one third of the reach. In addition, wetlands are only found in 0.6% of the reach. A small northern portion the reach's nearshore is also classified as a priority habitat for waterfowl concentrations (WDFW, 2002). While much of the reach is presently

undeveloped (28.9%), most of the reach has overhanging vegetation (51.7%), which helps provide shading of aquatic habitat and bank stability. Despite having only moderate windward fetch and erosion-resistant mixed alluvium shorelines, a relatively large portion of the reach has shoreline hardening (21.4%), which increases wave reflectivity, thereby affecting aquatic vegetation and the ten fish species found along this reach. This aquatic habitat is further impaired by the fairly large number of docks (40) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
3A	Shoreline Residential - Resource	Residential use; priority habitat
3B	Natural	Undeveloped; priority habitat; riparian tree cover
3C	Shoreline Residential – Resource	Residential use; docks; priority habitat; emergent vegetation; riparian tree cover
3D	Shoreline Residential – Special Resource	Undeveloped; unplatted; extensive riparian tree cover
3E	Shoreline Residential – Resource	Residential use; docks; riparian tree cover; emergent vegetation

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect priority riparian habitat as identified by WDFW.
B. Protect emergent vegetation near docks, residential areas, and public access areas.
C. Prevent increase in the number of bulkheads on the shoreline.
D. Prevent increase in the number of bulkheads on the shoreline.
E. Protect emergent vegetation near docks, residential areas, and public access areas.
F. Protect vegetative buffer on residential and agricultural land

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
B. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
C. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.

D. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
E. Use education and incentives to encourage restoration of emergent vegetation on developed parcels and in agricultural areas.

REACH 4

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils

The surface geology of Reach 4 is dominantly flood gravels. There is a mid island bar created by glacial outwash and 4.8% of the area have slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are entirely classified as mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Ephrata-Malaga complex (52.4%) or Ephrata fine sandy loam (34.8%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is classed as slow. The hazard of soil erosion is also entirely classed as slow.

Fetch and Near-Shore Exposure

The shoreline is exposed to wind directions ranging from the north to the south. Fetch lengths range between 0.17and 1.99 km, and are higher from both the south and southeast. The relatively shallow nearshore tends to be moderately impacted by the fall lake level drawdown of 1.5 m, with 40.1% of the reach having nearshore exposure widths less than 10 m. However, an additional 70.8% of the reach has a seasonal nearshore exposure between 10-35 m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation

Upland

The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian

Overhanging vegetation is present along 8.2% of Reach 4. The principal upland species is willow (*Salix*). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is extensive, with an average width of greater than 10 m extending along 36.8% of the reach, and an average width of 5-10 m extending along 21.1% of the reach. In addition, another 11.9% of the reach has emergent vegetation zones with widths ranging between 2-5 m and less than 2 m. The primary emergent vegetation species of Reach 4 include softstem bulrush (*Scirpus validus*) and broad-leaved cattail (*Typha latifolia*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Gabriel and Jordan, 2004). On the other hand, the portion of protected mixed alluvium shorelines tend to

have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*).

Wetlands

Palustrine emergent wetland habitat in Reach 4 is fairly extensive, comprising 16.3% of the SMP jurisdiction (USFWS, 2003). Much of this habitat is classified as priority habitat, consisting of hardstem bulrush, cattail and common reed (WDFW, 1997).

Wildlife

Fish

Based on data collected by WDFW between 2002 and 2003, at least twelve fish species may be found along Reach 4, dominated by yellow perch (52%), bluegill (8%), largemouth bass (12%), and bullhead (8%) (Fig. 7) (Gabriel and Jordan, 2004). Other notable species include black crappie (7%) and walleye (6%) (Table 19). Portions of the shoreline have also been identified as good bass and walleye fishing areas (Fish-n-Map Co., n.d.).

Avian

Reach 4 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation or riparian tree cover, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The middle third of the reach's nearshore is also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, as well as an important brooding area for geese and ducks (WDFW, 2002). A Clark's grebe nesting colony has been identified as a Natural Heritage site on nearby Crest Island, which is also classified as a priority habitat nesting area for ducks, geese and pheasant. Part of the shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves.

Terrestrial

Reach 4 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 4, 49.9% are single family residential development, 47.3% are undeveloped, 2.5% are mobile home residential development, and 0.3% is unclassified. Based on land use, imperviousness of this reach is estimated to be approximately 7.6%. Parcel sizes in the reach have an average width of 59 m and an average depth of approximately 153 m. Based on a survey of 17 shoreline structures, average structure setback from the shoreline along reach 4 is 28.7 m, ranging from 6.6 to 59.3 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 14 meters of SMP jurisdiction land in Reach 4, though no storm sewer outfalls occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 11.4% of the shoreline along Reach 4 is hardened with bulkheads. In addition, 38 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 4 is predominantly Urban Residential 3 (93.2%) with a smaller area of Urban Commercial (6.8%). Currently the Grant County SMP environmental designation for Reach 4 is Suburban.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 4 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 4 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 4.8%	Wetlands: 16.3% Undeveloped: 47.3% Riparian tree cover: 8.2% Priority habitats: 4 Species of concern: 4 Natural Heritage		Principal land use: residential. Imperviousness: 7.6% Roads: 14 m Bulkheads: 11.4% Docks: 38

	points: 1 Fish Species: 12		

Ecological functions along Reach 4 are impaired by residential development, which covers 52.4% of the jurisdiction and accounts for the majority of the estimated 7.6% imperviousness for the reach. Riparian vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is fairly extensive along most of the reach, notably exceeding 10m in width for over one-third of the reach. Four types of priority habitat are found along this reach. In addition, approximately 16.3% of the reach is classified as wetlands. While much of the reach is presently undeveloped (47.3%), very little of the reach has overhanging vegetation (8.2%), which helps provide shading of aquatic habitat and bank stability, though this vegetation includes Russian olive, a highly invasive exotic species. A relatively small portion of the reach has shoreline hardening (11.4%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the twelve fish species found along this reach. This aquatic habitat is further impaired by the fairly large number of docks (38) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
4A	Shoreline Residential - Resource	Residential use; docks; emergent vegetation; riparian tree cover
4B	Shoreline Residential – Special Resource	Undeveloped; unplatted; wetland habitat; emergent vegetation
4C	Shoreline Residential – Resource	Residential use; docks; emergent vegetation;

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Prevent increase in the number of bulkheads on the shoreline.
B. Protect emergent vegetation near docks, residential areas, and public access areas.
C. Protect existing wetlands from encroachment by residential development
D. Protect priority habitat for waterfowl identified by WDFW.
E. Protect emergent vegetation near docks, residential areas, and public access areas.
F. Protect emergent vegetation near docks, residential areas, and public access areas.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
B. Use education and incentives to encourage restoration of emergent vegetation on developed parcels and in agricultural areas.
C. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
D. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
E. Use education and incentives to encourage restoration of emergent vegetation on developed parcels and in agricultural areas.

REACH 5

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 5 is entirely flood gravels. Erosional processes involved in the splitting of the fluvial channel formed this section of shoreline before the point bar associated with reach 2 was formed. This boggy, marshy area is the product of the fluvial processes that swung the main current of glacial outwash out of the Lewis Horn channel and into the main channel. Slopes greater than 15% equal 14.7% (USGS, 2000). Nearshore sediment sizes are entirely classified as mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Malaga gravelly sandy loam (44.9%) in combination with ponded Aquents (25.8%) (NRCS, 2003). As a result, soil permeability is predominately moderately rapid (74.2%) while runoff is primarily classed as slow (74.2%). The hazard of soil erosion is entirely classified as slow.

Fetch and Near-Shore Exposure
The shoreline is exposed to wind directions ranging from the north to the south, with relatively low fetch lengths ranging from 0.03 to 0.08 km. Fetch lengths are higher from both the northeast and east. The shallow sloped nearshore tends to be highly impacted by the fall lake level drawdown of approximately 1.5 m, where 59.5% of the shoreline has nearshore exposure widths ranging from 36-60 m. An additional 16.9% of the reach has a seasonal nearshore exposure between 61-85 m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 4% of Reach 5. The principal upland species are willow (*Salix*) and elm (*Ulmus*). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is restricted, with 7.4% of the reach has emergent vegetation zones with widths ranging between 2-5 m and less than 2 m. The primary emergent vegetation species of Reach 5 are softstem bulrush (*Scirpus validus*) and broad-leaved cattail (*Typha latifolia*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Gabriel and Jordan,

2004). On the other hand, the portion of protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*).

Wetlands
Palustrine emergent wetland habitat in Reach 5 is extensive, comprising 28.3% of the SMP jurisdiction (USFWS, 2003). Much of this habitat is classified as priority habitat, consisting of hardstem bulrush, cattail and common reed (WDFW, 2002).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least eleven fish species may be found along Reach 5, dominated by yellow perch (46%), largemouth bass (21%), walleye (12%), and bluegill (8%)(Fig. 8) (Gabriel and Jordan, 2004). Other notable species include black crappie (6%) and bullhead (3%)(Table 20).

Avian
Reach 5 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation or riparian tree cover, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The small embayments and wetlands at the end of Lewis Horn are also classified as a priority habitat for waterfowl concentrations, primarily as a duck brooding area (WDFW, 2002).

Terrestrial
Reach 5 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 5, 48.4% are classified as single family residential, 43.5% is undeveloped, 7.5% is unclassified, and 0.6% is commercial.. Based on land use, imperviousness of this reach is estimated to be approximately 5.8%. Parcel sizes in the reach have an average width of 87 m and an average depth of approximately 138 m. Based on a survey of 6 shoreline structures, average structure setback from the shoreline along reach 5 is 24.9 m, ranging from 0.0 to 53.4 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 322 meters of SMP jurisdiction land in Reach 5, though no storm sewer outfalls occur along this reach (WDNR, 1996 ,City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 3.1% of the shoreline along Reach 5 is hardened with bulkheads. There are no docks along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 5 is predominantly Urban Residential 4 (57.3%) and Urban Residential 2 (27.6%), with smaller areas of Urban Commercial (13.7%) and Urban Residential 3 (1.4%). Currently the Grant County SMP environmental designation for Reach 5 is Suburban.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 5 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 5 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 14.7%	Wetlands: 28.3% Undeveloped: 43.5% Riparian tree cover: 4% Priority habitats: 2 Species of concern: 4 Fish Species: 11		Principal land use: residential. Imperviousness: 5.8% Roads: 322 m Bulkheads: 3.1%

Ecological functions along Reach 5 are impaired by residential development, which covers 48.4% of the jurisdiction and accounts for the majority of the estimated 5.8% imperviousness for the reach. Riparian vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. Roadways, which cover 322 m of the jurisdiction, may be another source of nonpoint source pollution. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is extremely restricted, extending less than 7.4% of the reach, which has a predominantly shallow nearshore. However,

approximately 28.3% of the reach is classified as wetlands. The small embayments and wetlands at the end of Lewis Horn are also classified as a priority habitat for waterfowl concentrations. Much of the reach is presently undeveloped (43.5%), while most of the reach has overhanging vegetation (64.7%), which helps provide shading of aquatic habitat and bank stability, though this vegetation includes Russian olive, a highly invasive exotic species. Having limited fetch and a substrate comprised of erosion-resistant mixed alluvium, a very limited portion of the reach has shoreline hardening (3.1%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the eleven fish species found along this reach. This aquatic habitat is further impaired by exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
5A	Shoreline Residential - Resource	Residential use; priority habitat
5B	Shoreline Residential – Special Resource	Undeveloped; wetland and priority habitat
5C	Shoreline Residential - Resource	Residential use; wetland and priority habitat
5D	Shoreline Residential – Special Resource	Largely undeveloped and unplatted; priority habitat
5E	Shoreline Residential – Resource	Residential use

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Prevent increase in the number of bulkheads on the shoreline.
B. Protect existing wetlands from encroachment by residential development
C. Protect priority habitat for waterfowl identified by WDFW.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).

REACH 6

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils

The surface geology of Reach 6 is dominantly flood gravels. This reach contains some fairly steep slopes, with 13.1% greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Malaga stony sandy loam (40.0%) and Ephrata fine sandy loam (57.2%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is primarily classed as slow (67.7%). The hazard of soil erosion is also predominately slow (67.7%).

Fetch and Near-Shore Exposure

The shoreline is primarily exposed to wind directions from the southeast and west. Fetch lengths range between 0.35 and 1.80 km are higher from both the southeast and southwest. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the entire shoreline having nearshore exposure widths less than 10 m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation

Upland

The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian

Overhanging vegetation is present along 7.4% of Reach 6. The principal upland species include willow (*Salix)*, poplar (*Populus*), and elm (*Ulmus*). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is fairly limited, with an average width of 2-5 m extending along 10.7% of the reach. In addition, another 13% of the reach has emergent vegetation zones with widths ranging between 5-10 m and less than 2 m. The primary emergent vegetation species of Reach 6 is softstem bulrush (*Scirpus validus*) and broad-leaved cattail (*Typha latifolia*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Gabriel and Jordan,

2004). On the other hand, the portion of protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*).

Wetlands
Palustrine emergent wetland habitat in Reach 6 is extremely limited, comprising 1.9% of the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least nine fish species may be found along Reach 6, dominated by yellow perch (54%), bluegill (11%), and largemouth bass (19%)(Fig. 9) (Gabriel and Jordan, 2004). Other notable species include black crappie (6%) and smallmouth bass (6%)(Table 21).

Avian
Reach 6 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation or riparian tree cover, and parks/open land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region.

Terrestrial
Reach 6 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and parks/open land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)

Of the SMP jurisdiction lands along Reach 6, 43.0% are classified as parks/open land. Of the remaining 57% of SMP jurisdiction lands, 39.2% is under single family residential development, 11% is agricultural, and 4.8% is unclassified, 1.8% is multi family residential, and 0.3% is transportation and utilities. Based on land use, imperviousness of this reach is estimated to be approximately 5.8%. Parcel sizes in the reach have an average width of 82 m and an average depth of approximately 125 m. Based on a survey of 12 shoreline structures, average structure setback from the shoreline along reach 6 is 34.0 m, ranging from 18.0 to 51.2 m.

The City of Moses Lake public lands cover approximately 42.9% of Reach 6, including Cascade Park. Considered and environmental conservancy area, Cascade Park facilities include two boat launch ramps, day boat moorage, restrooms, playground, and picnic areas (City of Moses Lake, 2001a). The park also includes a campground containing 32 tent sites, 41 RV sites and group camping areas.

Transportation Infrastructure (Table 6)
Roadways occupy 440 meters of SMP jurisdiction land in Reach 6, though no storm sewer outfalls occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 5.2% of the shoreline along Reach 6 is hardened with bulkheads. In addition, 21 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 6 is predominantly Public (42.9%), Urban Residential 3 (28.2%), and Urban Residential 4 (27.8%), with a smaller area of Single Family Residential (1.1%). Currently 44.1% of the reach is designated as Conservancy by the City of Moses Lake SMP, and 55.9% is designated as Suburban by the Grant County SMP.

Cultural Resource Designations (Table 6)

There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 6 on file with the Washington State Office of Archaeology and Historic Preservation. One facility/site has been identified as being of interest to DOE due to pollution/permitting concerns (DOE, 1998b).

ECOLOGICAL FUNCTION SUMMARY

Reach 6 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 13.1%	Wetlands: 1.9% Riparian tree cover: 7.4% Species of concern: 4 Fish Species: 9	Public land: 42.9% Parks: 1 Boat launches: 1	Principal land use: parks/open land Imperviousness: 5.8% Roads: 440 m Bulkheads: 5.2% Docks: 21

			DOE Facility/Site: 1

Ecological functions along Reach 6 are impaired by recreational and residential development, which account for the majority of the estimated 5.8% imperviousness for the reach. Riparian vegetation has been removed and replaced with buildings, lawns and parking lots, which can promote increased runoff and nonpoint source pollution. Roadways, which cover 440 m of the jurisdiction, may be another source of nonpoint source pollution. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is fairly restricted (less than 25% of the reach), though this might be in part due to the relatively steeper nearshore found along this reach. In addition, only 1.9% of the reach is classified as wetlands, while only a small portion of the reach has overhanging vegetation (7.4%), which helps provide shading of aquatic habitat and bank stability. This vegetation includes Russian olive, a highly invasive exotic species. Despite having limited fetch and a substrate comprised of erosion-resistant mixed alluvium, a limited portion of the reach has shoreline hardening (5.2%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the nine fish species found along this reach. This aquatic habitat is further impaired by the fairly large number of docks (21) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
6A	Shoreline Residential – Resource	Residential use; priority habitat; riparian tree cover; emergent vegetation
6B	Water-Oriented Park	Public park

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect existing wetlands WDFW from encroachment by residential development.
B. Protect priority habitat for waterfowl identified by WDFW.
C. Prevent increase in the number of bulkheads on the shoreline.
D. Protect existing wetlands from encroachment by residential development
E. Protect emergent vegetation near docks, residential areas, and public access areas

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).

B. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
C. On public land, move parking areas out of the SMP jurisdiction or set them back from the shoreline.
D. Restore emergent vegetation on publicly owned land, and manage areas of emergent vegetation to support healthy ecological processes and functions.
E. Restore emergent vegetation on publicly owned land, and manage areas of emergent vegetation to support healthy ecological processes and functions

REACH 7

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 7 is dominantly flood gravels. The reach has been formed as the result of the erosion occurring at the confluence of the flood channels of Rocky Ford and Crab Creek. As a result 65.9% of the reach contains slopes that are greater than 15% (USGS, 2000). Nearshore sediment sizes are entirely classified as mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Malaga cobbly sandy loam (83.9%) or Ephrata fine sandy loam (16.1%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid (100%) while runoff is primarily classed as moderate (90.3%). The hazard of soil erosion is also primarily classed as moderate (90.3%).

Fetch and Near-Shore Exposure
The shoreline is exposed to wind directions ranging from the south and northwest. Fetch lengths range between 0.4 and 1.3 km, and are higher from both the northwest and south. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of 1.5 m, with 72.1% of the reach having nearshore exposure widths less than 10 m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 5.4% of Reach 7. The principal upland species are willow (*Salix)* and salt bush (*Atriplex*). Emergent vegetation in the littoral zone is fairly restricted, with an average width of less than 2 m extending along 28.4% of the reach. In addition, another 9.6% of the reach has emergent vegetation zones with widths ranging between 2-5 m. The primary emergent vegetation species of Reach 7 is softstem bulrush (*Scirpus validus*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005). On the other hand, the portion of protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species

(Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*).

Wetlands
No wetlands are found in the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least nine fish species may be found along Reach 7, dominated by yellow perch (52%), bluegill (16%), walleye (16%), and largemouth bass (7%)(Fig. 10) (Gabriel and Jordan, 2004). Other notable species include black crappie (4%) and smallmouth bass (4%)(Table 22). Portions of the shoreline have also been identified as good bass and walleye fishing areas (Fish-n-Map Co., n.d.).

Avian
Reach 7 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with denser zones of emergent vegetation or riparian tree cover, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. A Clark's grebe nesting colony has also been identified on nearby Crest Island as a Natural Heritage site, which is also classified as a priority habitat nesting area for ducks, geese and pheasant (WDFW, 2002). Part of the shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves.

Terrestrial
Reach 7 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS *– see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 7, 89.9% is classified as single family residential development and 10.1% is undeveloped. Based on land use, imperviousness of this reach is estimated to be approximately 19.8%. Parcel sizes in the reach have an average width of 31 m and an average depth of approximately 98 m. Based on a survey of 6 shoreline structures, average structure setback from the shoreline along reach 7 is 52.3 m, ranging from 48.1 to 59.8 m. There are 0.2% public lands within the SMP

jurisdiction. This small portion of public land is Cascade Park and is owned by the City of Moses Lake.

Transportation Infrastructure (Table 6)
There are no roadways on SMP jurisdiction land in Reach 7 and no storm sewer outfalls occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 7.1 % of the shoreline along Reach 7 is hardened with bulkheads. In addition, 18 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 7 is dominantly Single Family Residential (99.8%), with a smaller area of Public land (0.2%). Currently 12.6% of the reach is designated as Urban and 87.4% as Conservancy by the current SMP.

Cultural Resource Designations (Table 6)
There is one Archeological Site Form record of a cultural site within the SMP jurisdiction of Reach 7 on file with the Washington State Office of Archaeology and Historic Preservation. The site is recorded as a habitation site.

ECOLOGICAL FUNCTION SUMMARY

Reach 7 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 65.9%	Undeveloped: 10.1% Riparian tree cover: 5.4% Species of concern: 4 Priority habitats: 2 Natural Heritage points: 1 Fish Species: 9	Public land: 0.2% Parks: 1	Principal land use: residential. Imperviousness: 19.8% Bulkheads: 7.1% Docks: 18

Ecological functions along Reach 7 are impaired by residential development, which covers 89.9% of the jurisdiction and accounts for the estimated 19.8% imperviousness for the reach. Riparian vegetation has been removed and replaced with buildings, lawns and footpaths to the shore, which can promote increased runoff and nonpoint source pollution. While no wetlands are located in the reach, emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, covers

approximately 40% of the reach, though the limits to extent and widths might be in part due to the relatively steep upland slope and nearshore found along this reach. In addition, only a small portion of the reach is presently undeveloped (10.1%) or has overhanging vegetation (5.4%), which helps provide shading of aquatic habitat and bank stability. Two priority habitats and one Natural Heritage site are associated with this reach. Despite having a limited fetch and a substrate comprised of erosion-resistant mixed alluvium, a portion of the reach has shoreline hardening (7.1%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the nine fish species found along this reach. This aquatic habitat is further impaired by a number of docks (18) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
7	Shoreline Residential - Resource	Residential use with docks; emergent vegetation

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect vegetative buffer on residential and agricultural land.
B. Prevent increase in the number of bulkheads on the shoreline.
C. Protect emergent vegetation near docks, residential areas, and public access areas.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
B. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).

REACH 8

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 8 is entirely flood gravels. Due to the fluvial processes associated with Crab Creek, this reach shifts from gentle to steep slopes. Approximately 3.5 % of the shoreline has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are entirely classified as mixed alluvium. The soils within the SMP jurisdiction are a combination of Ephrata fine sandy loam (39.6%), Starbuck very fine sandy loam (33.5%), or Malaga cobbly sandy loam (26.9%) (NRCS, 2003). As a result, soil permeability is predominantly moderately rapid (66.5%) while runoff is classed as primarily moderate (73.3%). The hazard of soil erosion is also primarily classified as moderate (73.3%).

Fetch and Near-Shore Exposure
The shoreline is exposed to wind directions ranging from the east to the northwest. Fetch lengths range between 0.26 and 0.81 km and are higher for both the northwest and east. The relatively shallow nearshore is moderately impacted by the fall lake level drawdown of approximately 1.5 m, where the 30.7% of the shoreline has nearshore exposure widths less than 10 m and the remaining 69.3% experiences exposure widths ranging from 10-35 m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 33.1% of Reach 8. The principal upland species are willow (*Salix*) and salt bush (*Atriplex*). Emergent vegetation in the littoral zone is fairly restricted, with an average width of 2-5 m extending along 7.2% of the reach. In addition, another 7.0% of the reach has emergent vegetation zones with widths of less than 2 m. The primary emergent vegetation species of Reach 8 are softstem bulrush (*Scirpus validus*) and broad-leaved cattail (*Typha latifolia*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington

University, 2005). On the other hand, the portion of protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*).

Wetlands
Palustrine forested wetland habitat in Reach 8 is somewhat limited, comprising 5.0% of the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least six fish species may be found along Reach 8, dominated by yellow perch (51%), smallmouth bass (34%), and bluegill (10%)(Fig. 11; Table 23) (Gabriel and Jordan, 2004).

Avian
Reach 8 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat and denser zones of emergent vegetation or riparian tree cover (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore is also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, as well as an important brooding area for ducks (WDFW, 2002). The shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves.

Terrestrial
Reach 8 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, the reach's nearshore is also classified as a priority habitat for mink, rated as moderate to high density (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 8, single family residential use comprises the entire shoreline. Based on land use, imperviousness of this reach is estimated to be approximately 30%. Parcel sizes in the reach have an average width of 27 m and an average depth of approximately 57 m. Based on a survey of 32 shoreline structures,

average structure setback from the shoreline along reach 8 is 27.4 m, ranging from 11.6 to 46.8 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
There are no roadways within the SMP jurisdiction of Reach 8 (WDNR, 1996). However, there is one storm sewer outfall found along this reach (City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 62.0% of the shoreline along Reach 8 is hardened with bulkheads. In addition, 41 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 8 is entirely Single Family Residential. Currently 100% of the reach is designated as Urban by the City of Moses Lake SMP.

Cultural Resource Designations (Table 6)
There is one Archeological Site Form record of a cultural site within the SMP jurisdiction of Reach 8 on file with the Washington State Office of Archaeology and Historic Preservation. One facility/site has been identified as being of interest to DOE due to pollution/permitting concerns, associated with a gas station (DOE, 1998b).

ECOLOGICAL FUNCTION SUMMARY

Reach 8 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 3.5%	Wetlands: 5% Undeveloped: 5.75 Riparian tree cover: 33.1% Priority habitats: 3 Species of concern: 4 Fish Species: 6		Principal land use: residential-1 family Imperviousness: 30% Bulkheads: 62% Storm drains: 1 Docks: 41 DOE Facility/Site: 1

Ecological functions along Reach 8 are impaired by residential development, which covers the entire jurisdiction and accounts for the estimated 30% imperviousness for the reach. Riparian vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. One storm sewer outfall also is found along this reach. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is extremely restricted,

extending less than 15% of the reach. In addition, only 5% of the reach is classified as wetland habitat. However, approximately one-third of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. In addition, three types of priority habitats are associated with this reach. Despite having limited windward fetch and a substrate comprised of erosion-resistant mixed alluvium, a very high portion of the reach has shoreline hardening (62.0%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the six fish species typically found along this reach. This aquatic habitat is further impaired by exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
8A	Shoreline Residential	Residential use with extensive docks and bulkheads
8B	Shoreline Residential -Resource	Residential use with docks and bulkheads; riparian tree cover

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect emergent vegetation near docks, residential areas, and public access areas.
B. Prevent increase in the number of bulkheads on the shoreline.
C. Prevent increase in the number of bulkheads on the shoreline.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
B. Restore emergent vegetation on publicly owned land, and manage areas of emergent vegetation to support healthy ecological processes and functions.
C. Retrofit storm sewer outfalls to limit pollution loading to the lake.
D. Retrofit storm sewer outfalls to limit pollution loading to the lake.

REACH 9

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 9 is predominately flood gravels with about one fourth of the reach consisting of alluvium. This reach is a continuation of the cut , with 13% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Malaga cobbly sandy loam (42.8%) or Malaga stony sandy loams (38.5%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is predominantly classed as slow (57.2%). The hazard of soil erosion is also predominantly classed as slow (57.2%). Approximately 6.1% of the jurisdiction is in the floodway (DOE, 1998c).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the east and southwest. Fetch lengths range between 0.20 and 0.78 km and are higher for both the southwest and south. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths predominantly less than 10 m (50.9%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 9. The principal upland species are willow (*Salix*) and salt bush (*Atriplex*). The primary emergent vegetation species of Reach 9 are softstem bulrush (*Scirpus validus*) and broad-leaved cattail (*Typha latifolia*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005). On the other hand, the portion of protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*).

Wetlands
Wetland habitat in Reach 9 is fairly extensive, composed primarily of palustrine open water and emergent wetlands comprising 7.5% of the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
This reach within Parker Horn is an important area for spring walleye spawning migrations (Gabriel and Jordan, 2004).

Avian
Reach 9 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western Grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore is also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, as well as an important brooding area for ducks (WDFW, 2002). The shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves.

Terrestrial
Reach 9 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, the reach's nearshore is also classified as a priority habitat for mink, rated as moderate to high density (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 9, 48.7% are classified as commercial. Of the remaining 51.3% of SMP jurisdiction lands, 24.8% are transportation, utilities, 20.6% are residential single family, 5.7% is undeveloped, and 0.2% is recreation. Based on land use, imperviousness of this reach is estimated to be approximately 43.9%. Parcel sizes in the reach have an average width of 177m and an average depth of approximately 72m. Based on a survey of 7 shoreline structures, average structure setback from the shoreline along Reach 9 is 31.5 m, ranging from 23.6 to 43.7 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 1045 meters of SMP jurisdiction land in Reach 9 (WDNR, 1996). Railroads occupy 182.5 meters of SMP jurisdiction and 1 storm sewer outfall occurs along this reach (United States Census Bureau 2000, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 1.8% of the shoreline along Reach 9 is hardened with bulkheads. In addition, 1 dock is located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 9 is predominantly General Commercial and Business (85.0%), with a smaller area of Single Family Residential (3.0%) and 12.0% with no zoning designation. Currently 93.6% of the reach is designated as Urban and 6.4% as Conservancy by the current SMP.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 9 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 9 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 13% Floodway: 6.1%	Wetlands: 7.5% Undeveloped: 5.7% Priority habitats: 3 Species of concern: 4		Principal land use: commercial Imperviousness: 43.9% Roads: 1045 m Bulkheads: 1.8% Storm drains: 1 Docks: 1

Ecological functions along Reach 9 are impaired by commercial and residential development, which accounts for the majority of the estimated 43.9% imperviousness for the reach. Riparian vegetation has been removed and replaced with lawns, which can promote increased runoff and nonpoint source pollution. Roadways and a railroad, which cover 1045 m of the jurisdiction, may be additional sources of nonpoint source pollution. One storm sewer outfall also is found along this reach. While 7.5% of the reach is classified as wetland habitat, there is no overhanging vegetation found along this reach. Three types of priority habitat are found along this reach. Having limited windward fetch

and a substrate comprised of erosion-resistant mixed alluvium, a very small portion of the reach has shoreline hardening (1.8%), which increases wave reflectivity, thereby affecting aquatic vegetation and aquatic habitat. Only one dock is found along this reach. This aquatic habitat is further impaired by exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
9A	High Intensity	Highway
9B	High Intensity -Resource	Commercial and residential use; wetlands

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect existing wetlands from encroachment by residential development

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Retrofit storm sewer outfalls to limit pollution loading to the lake.
B. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.

REACH 10

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 10 is predominately alluvium with about one third of the reach consisting of flood gravels. Part of the original Crab Creek channel and floodplain, there are no slopes greater than 15% (USGS, 2000). The soils within the SMP jurisdiction are predominately Kittitas silt loam (76%) and Malaga stony sandy loams (13.5%) (NRCS, 2003). As a result, soil permeability is predominantly moderately slow (76%), moderately rapid (19.6%). Runoff is primarily classed as ponded (76%). The hazard of soil erosion is predominately none (76%) or slow (19.6%). Approximately 52.5% of the jurisdiction is in the floodway (DOE, 1998c).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the east, south and southwest. Fetch lengths range between 0.16 and 0.25 km and are higher for the southwest, south and east.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 10. The principal upland species are willow (*Salix*) and salt bush (Atriplex). The primary emergent vegetation species are softstem bulrush (*Scirpus validus*) and broad-leaved cattail (*Typha latifolia*).

Wetlands
Wetland habitat in Reach 10 is extensive, comprising 38.3% of the SMP jurisdiction and composed of palustrine emergent and palustrine emergent scrub/shrub wetlands (USFWS, 2003). Much of this habitat is classified as priority habitat, consisting of hardstem bulrush, cattail and juncus mixed with open water areas (WDFW, 2002). This habitat is classified as being high quality habitat for waterfowl, upland gamebirds, nongame birds and furbearers.

Wildlife
Fish
This reach within Parker Horn is an important area for spring walleye spawning migrations (Gabriel and Jordan, 2004).

Avian

Reach 10 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore, wetlands and offshore island are also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, an important migration and wintering area for Canada geese and dabbling ducks, and an important brooding habitat for ducks (WDFW, 2002). The shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves. In addition, the nearshore and wetlands at the Crab Creek inlet at end of the bay are classified as priority habitat for shorebird concentrations of dowitcher, yellow legs, blacknecked stilts, avocet, sandpipers, phalarope, killdeer and other species, primarily in the late summer and fall.

Terrestrial

Reach 10 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, the reach's nearshore is also classified as a habitat for mink, rated as moderate to high density (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)

Of the SMP jurisdiction lands along Reach 10, 70.8% are classified as undeveloped and 29.2% are under commercial development. Based on land use, imperviousness of this reach is estimated to be approximately 24.8%. Parcel sizes in the reach have an average width of 274m and an average depth of approximately 91m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)

There are no roadways or storm sewer outfalls that occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)

None of the shoreline along Reach 10 is hardened with bulkheads and there are no docks located along this reach (Central Washington University 2004a, 2004b).

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 10 is entirely Multi Family Residential (100%). Currently 100% of Reach 10 is designated as Natural.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 10 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 10 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Floodway: 52.5%	Wetlands: 38.3% Undeveloped: 70.8% Priority habitats: 5 Species of concern: 4		Principal land use: undeveloped Imperviousness: 24.8%

Ecological functions along Reach 10 are impaired by commercial development, which accounts for the estimated 24.8% imperviousness for the reach. While the reach is primarily undeveloped and dominated by wetland habitat, which comprises 38.3% of the reach, some riparian vegetation has been removed, which can promote increased runoff and nonpoint source pollution. Besides wetland habitats, four types of priority habitats are found along this reach. There is no overhanging vegetation found along this reach. No shoreline hardening or docks are found along this reach.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
10	Natural	Undeveloped; wetlands; priority habitats

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect existing wetlands from encroachment by residential development.
B. Protect priority habitat for waterfowl and shorebirds identified by WDFW

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*
none

REACH 11

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 11 is predominately basalt flows with about one fourth of the reach consisting of alluvium and about another one fourth of the reach consisting of flood gravels. This reach is also part of the original Crab Creek channel and floodplain, with none of the area having slopes greater than 15% (USGS, 2000). The soils within the SMP jurisdiction are predominately Prosser very fine sandy loams (45.5%) with smaller areas of Ephrata-Malaga complex (30.9%) and Kittitas silt loam (20.3%) (NRCS, 2003). As a result, soil permeability is mostly moderate (48.8%) while runoff is primarily classed as moderate (48.8%). The hazard of soil erosion is also predominately moderate (48.8%). Approximately 13.5% of the jurisdiction is in the floodway (DOE, 1998c).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the southwest and northwest. Fetch lengths range between 0.03 and 0.25 km and are higher for both the north and west.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 11. The principal upland species are willow (*Salix*) and salt bush (Atriplex). The primary emergent vegetation species are softstem bulrush (*Scirpus validus*) and broad-leaved cattail (*Typha latifolia*).

Wetlands
Palustrine emergent wetland habitat in Reach 11 is extensive, comprising 41.4% of the SMP jurisdiction (USFWS, 2003). Much of this habitat is classified as priority habitat, consisting of hardstem bulrush, cattail and juncus mixed with open water areas (WDFW, 2002). This habitat is classified as being high quality habitat for waterfowl, upland gamebirds, nongame birds and furbearers.

Wildlife
Fish
This reach within Parker Horn is an important area for spring walleye spawning migrations (Gabriel and Jordan, 2004). Portions of the shoreline have also been identified as black crappie and bluegill fishing areas (Fish-n-Map Co., n.d.).

Avian

Reach 11 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore, wetlands and offshore island are also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, an important migration and wintering area for Canada geese and dabbling ducks, and an important brooding habitat for ducks (WDFW, 2002). The shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves. In addition, the nearshore and wetlands at the Crab Creek inlet at end of the bay are classified as priority habitat for shorebird concentrations of dowitcher, yellow legs, blacknecked stilts, avocet, sandpipers, phalarope, killdeer and other species, primarily in the late summer and fall.

Terrestrial

Reach 11 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, the reach's nearshore is also classified as a priority habitat for mink, rated as moderate to high density (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)

Of the SMP jurisdiction lands along Reach 11, 90.7% are classified as commercial retail. Of the remaining 9.3% of SMP jurisdiction lands, 6.0% is undeveloped and 3.2% is transportation and utilities. Parcel sizes in the reach have an average width of 564 m and an average depth of approximately 335 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)

There are no roadways and no storm sewer outfalls along this reach.

Bulkheads and Docks (Table 6)

None of the shoreline along Reach 11 is hardened with bulkheads and there are no docks located along this reach (Central Washington University 2004a, 2004b).

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 11 is entirely Heavy Industrial. Currently 100% of Reach 10 is designated as Natural.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 11 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 11 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Floodway: 13.5%	Wetlands: 41.4% Undeveloped: 6% Priority habitats: 5 Species of concern: 4		Principal land use: commercial

Ecological functions along Reach 11 are impaired by commercial development. While the reach is dominated by wetland habitat, which comprises 41.4% of the reach, some riparian vegetation has been removed, which can promote increased runoff and nonpoint source pollution. Besides wetland habitats, four types of priority habitats are associated with this reach. There is no overhanging vegetation found along this reach. No shoreline hardening or docks are found along this reach.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
11	Natural	Undeveloped commercial; wetlands; priority habitats

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect existing wetlands from encroachment by residential development

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

none

REACH 12

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 12 is predominately flood gravels. This relatively flat reach is part of the original flood channel from the Crab Creek sector of the Missoula Floods, with 2.5% of the area having slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Ephrata-Malaga complex (59.1%) and Ephrata fine sandy loams (30.4%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff and hazard of erosion are classed as slow. Approximately 3.6% of the jurisdiction is in the floodway (DOE, 1998c).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the north and northwest. Fetch lengths range between 0.21 and 0.33 km and are higher for both the north and west. The relatively shallow nearshore tends to be moderately impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly greater than 85 m (51.8%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 12. The principal upland species include willow (*Salix*) and elm (*Ulmus*). The primary emergent vegetation species are softstem bulrush (*Scirpus validus*) and broad-leaved cattail (*Typha latifolia*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005).

Wetlands
Wetland habitat in Reach 12 is fairly extensive, comprising 22.2% of the SMP jurisdiction and composed of palustrine emergent and palustrine emergent scrub/shrub wetlands (USFWS, 2003).

Wildlife

Fish

This reach within Parker Horn is an important area for spring walleye spawning migrations (Gabriel and Jordan, 2004).

Avian

Reach 12 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. In addition, the reach's nearshore is classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, as well as an important brooding area for ducks (WDFW, 2002). The shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves.

Terrestrial

Reach 12 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, the reach's nearshore is also classified as a priority habitat for mink, rated as moderate to high density (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)

Of the SMP jurisdiction lands along Reach 12, 25.3% are under transportation and utilities. Of the remaining 74.7% of SMP jurisdiction lands, 21.5% are classified as commercial, 21.0% are multifamily residential, 18.6% are undeveloped, 10.6% are unclassified, and 3.0% are classified as parks/open land. Based on land use, imperviousness of this reach is estimated to be approximately 20.8%. Parcel sizes in the reach have an average width of 60 m and an average depth of approximately 203 m. Based on a survey of 5 shoreline structures, average structure setback from the shoreline along reach 12 is 50.4 m, ranging from 42.6 to 58.2 m.

The small parcel of public land (0.9%) owned by the City of Moses Lake is the Neppel Landing Park. Considered an environmental and historical conservancy area, Neppel Landing is a 2.5 acre park with green space, picnic shelters, a bike and walking path, boat dock, and kayak and canoe racks (City of Moses Lake, 2001a).

Transportation Infrastructure (Table 6
Roadways occupy 1855 meters of SMP jurisdiction land in Reach 12 (WDNR, 1996). Railroads occupy 922 meters of SMP jurisdiction, and one storm sewer outfall is located along this reach (United States Census Bureau 2000, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
None of the shoreline along Reach 12 is hardened with bulkheads. In addition, 1 dock is located along this reach (Central Washington University 2004a, 2004b).

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 12 is predominantly Light Industrial (53.0%), Multi Family Residential (16.0%) and Heavy Industrial (11.2%), with smaller areas of Central Business District (9.2%), Public (0.9%) and 9.7% with no zoning designation. Currently 63.7% of the reach is designated as Urban and 8.2% as Conservancy by the current SMP and 28.0% is Natural.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 12 on file with the Washington State Office of Archaeology and Historic Preservation. One facility/site has been identified as being of interest to DOE due to pollution/permitting concerns, associated with a tire dealership (DOE, 1998b).

ECOLOGICAL FUNCTION SUMMARY

Reach 12 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Floodway: 3.6% Steep slopes: 2.5%	Wetlands: 22.2% Undeveloped: 18.6% Priority habitats: 3 Species of concern: 4	Public land: 1% Parks: 1	Principal land use: transportation-utilities Imperviousness: 20.8% Roads: 1855 m Storm drains: 1 Docks: 1 DOE Facility/Site: 1

Ecological functions along Reach 12 are impaired by a wide variety of development. While three priority habitat are found along this reach and 22.2% is classified as wetland

habitat, riparian vegetation has been removed and replaced with buildings, lawns, and parking lots, which can promote increased runoff and nonpoint source pollution. Imperviousness for the reach is estimated at 20.8%. Roadways and a railroad, which cover 2.77 km of the jurisdiction, may be additional sources of nonpoint source pollution. Water quality may be further impacted by stormwater discharges from the one storm sewer outfall found along this reach. While there are no bulkheads along the reach, artificial fill for the railroad grade has covered littoral habitat with coarse materials, increasing slope and wave reflectivity, thereby affecting aquatic vegetation and habitat for the seven fish species found along this reach. Only one dock is found along this reach. This reach is important for spring walleye spawning migrations.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
12A	Natural	Undeveloped commercial; wetlands; priority habitats
12B	High Intensity - Resource	Developed commercial use; wetlands
12C	High Intensity	Highway

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect existing wetlands from encroachment by light industrial development

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Retrofit storm sewer outfalls to limit pollution loading to the lake.

REACH 13

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 13 is dominantly flood gravels. Part of a mid island bar created by the Missoula Floods, 8.2% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as a combination of mixed alluvium (35.1%) and cobble (66.5%). The soils within the SMP jurisdiction are predominately Malaga stony sandy loams (50.8%) and Ephrata fine sandy loam (48.5%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is classed as slow. The hazard of soil erosion is also slow.

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the north and northwest. Fetch lengths range between 0.29 and 0.86 km and are higher for both the northeast and west. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the entire shoreline having nearshore exposure widths less than 10 m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 13. The principal upland species include willow (*Salix*) and elm (*Ulmus*). Emergent vegetation in the littoral zone is limited, with an average width of less than 2 m extending along only 4.1% of the reach. The primary emergent vegetation species of Reach 13 are softstem bulrush (*Scirpus validus*), broad-leaved cattail (*Typha latifolia*), and common reed (*Phragmites australis*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines found in this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005). In addition, the unprotected cobble shorelines tend to have 12 species of aquatic vegetation found in the nearshore, including 6 submergent and 6 emergent species. (Table 10) The submergent species are dominated by sago pondweed and Eurasian water milfoil (*Myriophyllum spicatum*), while the emergent species are dominated by reed canary grass (*Phalaris arundinacea*) and softstem bulrush (*Scirpus validus*).

Wetlands
Palustrine emergent wetland habitat is extremely limited along Reach 13, comprising only 0.3% of the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least seven fish species may be found along Reach 13, dominated by yellow perch (43%), black crappie (15%), and smallmouth bass (14%)(Fig. 12) (Gabriel and Jordan, 2004). Other notable species include walleye (13%) and bluegill (13%) (Table 24). Portions of the shoreline have also been identified as walleye fishing areas (Fish-n-Map Co., n.d.).

Avian
Reach 13 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation, and parks/open land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore and shoreline is classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, as well as an important brooding area for ducks (WDFW, 2002). The shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves.

Terrestrial
Reach 13 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and parks/open land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, the reach's nearshore is also classified as a priority habitat for mink (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 13, 38.1% are classified as commercial retail. Of the remaining 61.9% of SMP jurisdiction lands, 36.3% is under parks/open land, 17.5% is transportation/utilities, 3.3% is residential single family, 1.7% is unclassified, 2.3% is lodging and 0.7% is multi family residential. Based on land use, imperviousness of this reach is estimated to be approximately 32.8%. Parcel sizes in the reach have an average width of 400 m and an average depth of approximately 36 m. Based on a survey of 19 shoreline structures, average structure setback from the shoreline along reach 13 is

40.8 m, ranging from 26.0 to 58.0 m. Within the SMP jurisdiction, 26.7% of Reach 13 contains public lands owned by the City of Moses Lake (Neppel Landing).

Transportation Infrastructure (Table 6)
Roadways occupy 2512 meters of SMP jurisdiction land in Reach 13 (WDNR, 1996). Railroads occupy 1502 meters of SMP jurisdiction and 2 storm sewer outfalls occur along this reach (United States Census Bureau 2000, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
None of the shoreline along Reach 13 is hardened with bulkheads. In addition, 1 dock is located along this reach (Central Washington University 2004a, 2004b).

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 13 is predominantly General Commercial and Business (35.6%), Public (26.6%), and Light Industrial (24.4%), with a smaller area of Central Business District (13.4%). Currently 49.5% of the reach is designated as Urban and 50.5% as Conservancy by the current SMP.

Cultural Resource Designations (Table 6)
There is one Archeological Site Form record of cultural sites with in the SMP jurisdiction of Reach 13 on file with the Washington State Office of Archaeology and Historic Preservation. Seven facilities/sites has been identified as being of interest to DOE due to pollution/permitting concerns, primarily related to automotive businesses, gas stations and underground storage tanks (DOE, 1998b).

ECOLOGICAL FUNCTION SUMMARY

Reach 13 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 8.2%	Wetlands: 0.3% Priority habitats: 3 Species of concern: 4 Fish Species: 7	Public land: 26.7% Parks:1	Principal land use: commercial-retail Imperviousness: 32.8% Roads: 2512 m Storm drains: 2 Docks: 1 DOE Facilities/Sites: 7

Ecological functions along Reach 13 are impaired by the Columbia Basin Railroad and recreational and commercial development found along the reach, which account for the majority of the estimated 32.8% imperviousness for the reach. While 3 priority habitats

are found along this reach, wetland habitat comprises only 0.3% of the reach, while riparian vegetation has been removed and replaced with buildings, lawns, and parking lots, which can promote increased runoff and nonpoint source pollution. Roadways and a railroad, which cover 4.0 km of the jurisdiction, may be additional sources of nonpoint source pollution. Water quality may be further impacted by stormwater discharges from the two storm sewer outfalls found along this reach. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is extremely restricted, extending 4.1% of the reach, though the limits to extent and widths might be in part due to the relatively steep nearshore found along this reach. While there are no bulkheads along the reach, artificial fill for the railroad grade has covered littoral habitat with coarse materials, increasing slope and wave reflectivity, thereby affecting aquatic vegetation and habitat for the seven fish species found along this reach. Only one dock is found along this reach. This aquatic habitat is further impaired by exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
13A	Water-Oriented Park	Public park
13B	High Intensity	Developed downtown commercial use

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect existing wetlands from encroachment by light industrial development.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Retrofit storm sewer outfalls to limit pollution loading to the lake.
B. Retrofit storm sewer outfalls to limit pollution loading to the lake.
C. Provide public access at railroad grade in Neppel Park and restore emergent vegetation and vegetative buffer.

REACH 14

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 14 is dominantly flood gravels. This reach was probably caused by the alleviation of velocity of the water when the lake was dammed, with no areas having slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Ephrata-Malaga complex (89.9%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is classed as slow. The hazard of soil erosion is also slow.

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the north and northwest. Fetch lengths range between 0.07 and 2.32 km and are higher for both the southwest and west. The relatively gentle nearshore tends to be moderately impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths primarily between 36 and 60m (43.7%) and 10-35m (36.4%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 14. The principal upland species is salt bush (Atriplex). Emergent vegetation in the littoral zone is extensive, with an average width of 5-10 m extending along 94.8% of the reach. The primary emergent vegetation species of Reach 14 are softstem bulrush (*Scirpus validus*), broad-leaved cattail (*Typha latifolia*), and common reed (*Phragmites australis*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines in this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005). In addition, wetland shorelines tend to have11 species of aquatic vegetation species found in the nearshore, including 5 submergent species, dominated by sago pondweed and Eurasian water milfoil, and 6 emergent species, dominated by softstem bulrush (Table 16).

Wetlands
Palustrine emergent wetland habitat is extremely extensive along Reach 14, comprising 52.8% of the SMP jurisdiction (USFWS, 2003). Much of this habitat is classified as priority habitat, consisting of hardstem bulrush, cattail and common reed (WDFW, 2002).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least three fish species may be found along Reach 14, including walleye (53%), bullhead (43%), and bluegill (14%) (Fig. 13; Table 25) (Gabriel and Jordan, 2004). Portions of the shoreline have also been identified as good bass and walleye fishing areas (Fish-n-Map Co., n.d.).

Avian
Reach 14 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. Small islands offshore are classified as a priority nesting habitat area for ducks (WDFW, 2002).

Terrestrial
Reach 14 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 14, 76.0% are undeveloped. Of the remaining 24.0% of SMP jurisdiction lands, 18.8% are under single family residential development, 3.9% are unclassified, and 1.3% are classified as commercial. Based on land use, imperviousness of this reach is estimated to be approximately 5.3%. Parcel sizes in the reach have an average width of 46 m and an average depth of approximately 67 m. Based on a survey of 3 shoreline structures, average structure setback from the shoreline along reach 14 is 36.6 m, ranging from 13.7 to 50.0 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 206 meters of SMP jurisdiction land in Reach 14 (WDNR, 1996). Railroads occupy 50 meters of SMP jurisdiction, though no storm sewer outfalls occur along this reach (United States Census Bureau 2000,City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
None of the shoreline along Reach 14 is hardened with bulkheads or docks.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 14 is predominantly Multi Family Residential (93.6%), with a smaller area of Light Industrial (6.4%). Currently 18.2% of the reach is designated as Urban and 81.8% as Conservancy by the current SMP.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 14 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 14 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
	Wetlands: 52.8% Undeveloped: 76% Species of concern: 4 Priority habitat: 2 Fish Species: 14		Principal land use: undeveloped Imperviousness: 5.3% Roads: 206 m

Ecological functions on Reach 14 are relatively intact. The shoreline within this reach is predominantly made up of wetlands identified by the National Wetland Inventory, providing priority habitat for a wide variety of wildlife and fish species. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is extensive, with an average width between 5-10 m extending along 94.8% of the reach. The shoreline is an important spawning and rearing area for walleye, as well as bullhead and bluegill. While the reach is principally undeveloped (76.0%), residential development in the upland is encroaching on the wetland environment and is a potential source of stormwater runoff and nonpoint pollution such as sediment, fertilizers and pesticides. Imperviousness is estimated to be 5.3% along this reach. Roadways and a railroad, which cover 256 m of the jurisdiction, may be additional sources of nonpoint source pollution. Currently there are no shoreline protection structures along this reach.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
14A	Natural	Undeveloped; wetlands; emergent vegetation
14B	Shoreline Residential - Resource	Residential use; emergent vegetation

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect existing wetlands from encroachment by residential development.
B. Protect spawning and rearing habitat for important fish species.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Provide incentives for landowners to develop vegetative buffers around parking areas, as well as direct overland flow away from lake, on sites already developed.

REACH 15

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 15 is predominately flood gravels. A mid channel bar, 33.1% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are entirely classified as cobble. The soils within the SMP jurisdiction are predominately Malaga stony sandy loams (41.0%) and Malaga cobbly sandy loam (38.5%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is primarily classed as slow (61.5%) and moderate (38.5%). The hazard of soil erosion is also slow (61.5%) and moderate (38.5%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the north and northwest. Fetch lengths range between 0.25 and 2.51 km and are higher for both the north and west. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly less than 10 m (89.8%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 9.6% of Reach 15. The principal upland species are sagebrush (Artemesia) and giant rye (Elymus condensatus). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is relatively limited, with an average width of less than 2 m extending along 12.2% of the reach. The primary emergent vegetation species of Reach 15 is softstem bulrush (Scirpus validus).

Based on information collected for WDFW in 2003, the unprotected cobble shorelines tend to have 12 species of aquatic vegetation found in the nearshore, including 6 submergent and 6 emergent species (Central Washington University, 2005). (Table 9) The submergent species are dominated by sago pondweed and Eurasian water milfoil (*Myriophyllum spicatum*), while the emergent species are dominated by reed canary grass (*Phalaris arundinacea*) and softstem bulrush (*Scirpus validus*). By comparison, protected cobble shorelines tend to have a slightly lower diversity of species, including 5

submergent and 1 emergent species, softstem bulrush (Table 10). The submergent species are dominated by white stem pondweed, sago pondweed, Eurasian water milfoil, and curly leaf pondweed.

Wetlands
No wetlands are found in the SMP jurisdiction (USFWS, 2003), though a small island largely comprised of emergent vegetation is located offshore.

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least ten fish species may be found along Reach 15, dominated by yellow perch (23%), black crappie (19%), and largemouth bass (16%)(Fig. 14) (Gabriel and Jordan, 2004). Other notable species include bluegill (12%), walleye (11%), and bullhead (10%)(Table 26). Portions of the shoreline have also been identified as good bass and walleye fishing areas (Fish-n-Map Co., n.d.).

Avian
Reach 15 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with denser zones of emergent vegetation or riparian tree cover, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore and a small offshore island largely comprised of emergent vegetation are also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, as well as an important nesting area for geese and ducks (WDFW, 2002).

Terrestrial
Reach 15 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 15, 42.8% are classified as residential single family. Of the remaining 57.2 % of SMP jurisdiction lands, 18.3% is lodging, 11.3% is under residential multi-family, 7.9% is undeveloped, 8.0% is residential mobile home, 2.3% is commercial and 9.5 is unclassified. Based on land use, imperviousness of this reach is estimated to be approximately 25.2%. Parcel sizes in the reach have an average

width of 30 m and an average depth of approximately 70 m. Based on a survey of 37 shoreline structures, average structure setback from the shoreline along reach 15 is 30.8 m, ranging from 9.0 to 48.8 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 950 meters of SMP jurisdiction land in Reach 15, and one storm sewer outfall occurs along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 42% of the shoreline along Reach 15 is hardened with bulkheads. In addition, 29 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 15 is predominantly Multi-Family Residential (82.1%) and Single and Two Family Residential (17.9%). Currently 92% of the reach is designated as Urban and 8% as Conservancy by the current SMP.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 15 on file with the Washington State Office of Archaeology and Historic Preservation. One facility/site has been identified as being of interest to DOE due to pollution/permitting concerns, related to the metal industry (DOE, 1998b).

ECOLOGICAL FUNCTION SUMMARY

Reach 15 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 33.1%	Undeveloped: 7.9% Riparian tree cover: 9.6% Priority habitats: 1 Species of concern: 4 Fish Species: 10		Principal land use: residential Imperviousness: 25.25 Roads: 950 m Bulkheads: 42% Storm drains: 1 Docks: 29 DOE Facility/Site: 1

Ecological functions along Reach 15 are impaired by residential and commercial development, which covers most of the jurisdiction and accounts for the majority of the estimated 25.2% imperviousness for the reach. Only 7.9% of the land is still undeveloped along the reach. Riparian vegetation has been removed and replaced with buildings,

lawns, and parking lots, which can promote increased runoff and nonpoint source pollution. Roadways, which cover 950 m of the jurisdiction, may be an additional source of nonpoint source pollution. One storm sewer outfall also is found along this reach. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is extremely limited, with an average width of less than 2 m and extending only 12.2% of the reach, though this might be in part due to the relatively steeper nearshore and greater windward fetch found along this reach. There are no wetlands located in this reach, though it is associated with 1 priority habitat. In addition, only 9.6% of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. This vegetation includes Russian olive, a highly invasive exotic species. Despite a substrate comprised of erosion-resistant cobble, a very high portion of the reach has shoreline hardening (42.0%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the ten fish species typically found along this reach. This aquatic habitat is further impaired by the fairly large number of docks (29) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
15A	Shoreline-Residential	Residential with extensive docks and bulkheads; minimal riparian tree cover and emergent vegetation
15B	High Intensity	Developed commercial use

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Prevent increase in the number of bulkheads on the shoreline.
B. Protect emergent vegetation near docks, residential areas, and public access areas.
C. Prevent increase in the number of bulkheads on the shoreline.
D. Prevent increase in the number of bulkheads on the shoreline.
E. Prevent increase in the number of bulkheads on the shoreline.
F. Protect vegetative buffer on residential and agricultural land.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
B. Provide incentives for landowners to develop vegetative buffers around parking areas, as well as direct overland flow away from lake, on sites already developed.

C. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
D. Use education and incentives to encourage restoration of emergent vegetation on developed parcels and in agricultural areas.
E. Retrofit storm sewer outfalls to limit pollution loading to the lake.
F. Provide incentives for landowners to develop vegetative buffers around parking areas, as well as direct overland flow away from lake, on sites already developed.

REACH 16

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 16 is predominately flood gravels with some small areas of conglomerate. This reach is a mid channel bar, with none of the area having slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are entirely classified as cobble. The soils within the SMP jurisdiction are predominately Malaga cobbly sandy loam (71.8%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is primarily classed as moderate (71.9%). The hazard of soil erosion is also predominately moderate (71.9%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the south and northwest. Fetch lengths range between 0.08 and 1.32 km and are higher for both the southwest and northwest. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly less than 10 m (99.1%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 1.7% of Reach 16. The principal upland species are sagebrush (Artemesia) and giant rye (Elymus condensatus). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone has an average width of less than 2 m extending along 31.1% of the reach. In addition, another 4.1% of the reach has emergent vegetation zones with widths ranging between 2-5 m. The primary emergent vegetation species of Reach 16 are softstem bulrush (*Scirpus validus*) and common reed (*Phragmites australis*).

Based on information collected for WDFW in 2003, the unprotected cobble shorelines tend to have 12 species of aquatic vegetation found in the nearshore, including 6 submergent and 6 emergent species (Central Washington University, 2005). (Table 9) The submergent species are dominated by sago pondweed and Eurasian water milfoil (*Myriophyllum spicatum*), while the emergent species are dominated by reed canary grass (*Phalaris arundinacea*) and softstem bulrush (*Scirpus validus*). By comparison, protected cobble shorelines tend to have a slightly lower diversity of species, including 5

submergent and 1 emergent species, softstem bulrush (Table 10). The submergent species are dominated by white stem pondweed, sago pondweed, Eurasian water milfoil, and curly leaf pondweed.

Wetlands
No wetlands are found in the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least twelve fish species may be found along Reach 16, dominated by yellow perch (29%), walleye (22%), and bluegill (21%)(Fig. 15) (Gabriel and Jordan, 2004). Other notable species include largemouth bass (15%) and black crappie (11%)(Table 27). Portions of the shoreline have also been identified as good bass and walleye fishing areas (Fish-n-Map Co., n.d.).

Avian
Reach 16 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with denser zones of emergent vegetation or riparian tree cover, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore in the leeward portion of the peninsula is also classified as a priority wintering habitat for Tundra Swan and priority breeding habitat for the Clark's and Western grebe (WDFW, 2002).

Terrestrial
Reach 16 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, a small portion of the east end of the reach is classified as a priority riparian habitat, including willow, Russian olive, greasewood, Chinese elm, and saltgrass (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 16, 81.7% are classified as residential single family. Of the remaining 18.3% of SMP jurisdiction lands, 9.3% are unclassified, 3.6% are residential mobile home, 3.6% are undeveloped, and 1.9% are classified as lodging. Based on land use, imperviousness of this reach is estimated to be approximately 24.8%. Parcel sizes in the reach have an average width of 32 m and an average depth of approximately 69 m. Based on a survey of 48 shoreline structures, average structure

setback from the shoreline along reach 16 is 21.0 m, ranging from 0.0 to 42.3 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 1455 meters of SMP jurisdiction land in Reach 16, and 2 storm water outfalls occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 28.6% of the shoreline along Reach 16 is hardened with bulkheads. In addition, 46 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 16 is predominantly Single Family Residential (86.6%) and Multi Family Residential (4.3%) , with no zoning designation for 9.1% of the reach. Currently 92.0% of the reach is designated as Urban by the current City of Moses Lake SMP and 8.0% contains no environment designation.

Cultural Resource Designations (Table 6)
There is one Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 16 on file with the Washington State Office of Archaeology and Historic Preservation. This site is recorded as a habitation site.

ECOLOGICAL FUNCTION SUMMARY

Reach 16 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
	Undeveloped: 3.6% Riparian tree cover: 1.7% Priority habitats: 3 Species of concern: 4 Fish Species: 8		Principal land use: residential-1 family Imperviousness: 24.8% Roads: 1455 m Bulkheads: 28.6% Storm drains: 2 Docks: 46

Ecological functions along Reach 16 are impaired by residential development, which predominantly covers the jurisdiction and accounts for the majority of the estimated 24.8% imperviousness for the reach. Only 3.6% of the land is still undeveloped along the reach. While 3 priority habitats are found along this reach, riparian vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. Roadways, which cover 1455 m of the jurisdiction, may be an

additional source of nonpoint source pollution. Two storm sewer outfalls are also found along this reach. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution is limited, primarily comprised of an average width of less than 2 m extending along approximately one third of the reach (though this might be in part due to the relatively steeper nearshore and greater windward fetch found along this reach). There are no wetlands located along this reach. In addition, only 1.7% of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. This vegetation includes Russian olive, a highly invasive exotic species. Despite a substrate comprised of erosion-resistant cobble, a substantial portion of the reach has shoreline hardening (28.6%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the twelve fish species typically found along this reach. This aquatic habitat is further impaired by the extremely high number of docks (46) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
16A	High Intensity	Highway and commercial use (lodging)
16B	Shoreline Residential - Resource	Residential use with docks and bulkheads; emergent vegetation

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect emergent vegetation near docks, residential areas, and public access areas.
B. Prevent increase in the number of bulkheads on the shoreline.
C. Protect emergent vegetation near docks, residential areas, and public access areas.
D. Prevent increase in the number of bulkheads on the shoreline.
E. Protect emergent vegetation near docks, residential areas, and public access areas.
F. Protect priority riparian habitat as identified by WDFW.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
B. Use education and incentives to encourage restoration of emergent vegetation on developed parcels and in agricultural areas.
C. Retrofit storm sewer outfalls to limit pollution loading to the lake.
D. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).

E. Retrofit storm sewer outfalls to limit pollution loading to the lake.
F. Retrofit storm sewer outfalls to limit pollution loading to the lake.
G. Retrofit storm sewer outfalls to limit pollution loading to the lake.

REACH 17

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 17 is dominantly conglomerate. This reach is a mid channel bar, with none of the area having slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as cobble (100%). The soils within the SMP jurisdiction are predominately Ephrata- Malaga complex (97.8%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is primarily classed as slow (97.8%). The hazard of soil erosion is also predominately slow (97.8%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the northeast and south. Fetch lengths range between 0.92 and 1.87 km and are higher for both the south and east. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly less than 10 m (80.4%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 17. The principal upland species are sagebrush (Artemesia) and giant rye (Elymus condensatus). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is extensive, with an average width of 2-5 m extending along 98.4% of the reach. The primary emergent vegetation species of Reach 17 is softstem bulrush (*Scirpus validus*).

Based on information collected for WDFW in 2003, the unprotected cobble shorelines found along this reach tend to have 12 species of aquatic vegetation found in the nearshore, including 6 submergent and 6 emergent species (Central Washington University, 2005). (Table 9) The submergent species are dominated by sago pondweed and Eurasian water milfoil (*Myriophyllum spicatum*), while the emergent species are dominated by reed canary grass (*Phalaris arundinacea*) and softstem bulrush (*Scirpus validus*). By comparison, protected cobble shorelines tend to have a slightly lower diversity of species, including 5 submergent and 1 emergent species, softstem bulrush

(Table 10). The submergent species are dominated by white stem pondweed, sago pondweed, Eurasian water milfoil, and curly leaf pondweed.

Wetlands
No wetlands are found in the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least seven fish species may be found along Reach 17, dominated by yellow perch (25%), walleye (20%), bluegill (16%), and smallmouth bass (16%)(Fig. 16) (Gabriel and Jordan, 2004). Other notable species include black crappie (9%), largemouth bass (9%), and rainbow trout (5%)(Table 28).

Avian
Reach 17 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with denser zones of emergent vegetation, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore and nearby Goat Island are also classified as a priority wintering habitat for tundra swan and breeding habitat for the Clark's and Western grebe, while a Clark's grebe nesting colony has been identified as a Natural Heritage site on nearby Goat Island (WDFW, 2002). The reach's nearshore and offshore island are also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, and an important nesting habitat for ducks and geese.

Terrestrial
Reach 17 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, the reach is classified as a priority riparian habitat, including willow, Russian olive, greasewood, Chinese elm, and saltgrass (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf*

Land Use (Table 5)*)*
Of the SMP jurisdiction lands along Reach 17, 51.5% are classified as recreation. Of the remaining 48.5% of SMP jurisdiction lands, 28.7% is agricultural development, 15.9% is undeveloped, 0.4% is residential single family, and 3.6% is unclassified. Based on land use, imperviousness of this reach is estimated to be approximately 0.05%. Parcel sizes in the reach have an average width of 113 m and an average depth of approximately 234 m.

Within the SMP jurisdiction, 50.8% of Reach 17 contains public lands, including the 22 acre Lower Peninsula Park. Considered an environmental conservancy area, the park contains restroom facilities, a picnic area, two boat launch ramps, and day boat moorage (City of Moses Lake, 2001a).

Transportation Infrastructure (Table 6)
There are no roadways and no storm sewer outfalls that occur along this reach.

Bulkheads and Docks (Table 6)
Approximately 0.7% of the shoreline along Reach 17 is hardened with bulkheads. In addition, 1 dock is located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 17 is predominantly Public (50.8%) and Single Family Residential (49.2%). Currently 45.7% of the reach is designated as Rural and 54.3% as Conservancy by the current SMP.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 17 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 17 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
	Undeveloped: 15.9% Priority habitats: 4 Species of concern: 4 Natural Heritage points: 1 Fish Species: 7	Public land: 50.8% Parks: 1 Boat launches: 1	Principal land use: recreation Imperviousness: 0.05% Docks: 1

Ecological functions along Reach 17 are impaired by recreational development. Riparian vegetation has been removed and replaced with parking lots, which can promote increased runoff and nonpoint source pollution. While there are no wetlands located along this reach, emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is extensive, with an average width between 2-5 m extending along 98.4% of the reach. One Natural Heritage location, four priority habitats, and at least seven fish species are found along this reach. Only 0.7% of the

reach has shoreline hardening, and only one dock is found along the reach, associated with Lower Peninsula Park. The riparian habitat is further impaired by Russian olive, a highly invasive exotic species, as well as the exotic submergent species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
17A	Water-Oriented Park	Public park
17B	Shoreline Residential-Resource	Residential and agriculture use; unplatted; emergent vegetation

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect emergent vegetation near docks, residential areas, and public access areas.
B. Protect priority riparian habitat as identified by WDFW.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. On public land, move parking areas out of the SMP jurisdiction or set them back from the shoreline.

REACH 18

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 18 is predominately flood gravels with only about one fourth of the reach consisting of conglomerate. This reach is a mid channel bar, with no areas having slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as cobble (100%). The soils within the SMP jurisdiction are entirely Ephrata-Malaga complex (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is classed as slow (100%). The hazard of soil erosion is also slow (100%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the east and south. Fetch lengths range between 0.95 and 1.54 km and are higher for both the south and southeast. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly less than 10 m (93.2%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 18. The principal upland species are sagebrush (Artemesia) and giant rye (*Elymus condensatus*). This riparian zone also supports Russian olive (Elaeagnus) and yellow flag (*Iris pseudacorus L.)*, which are invasive species. Emergent vegetation in the littoral zone has an average width of less than 2 m extending along 40.8% of the reach. In addition, another 10.5% of the reach has emergent vegetation zones with widths ranging between 2-5 m. The primary emergent vegetation species of Reach 18 are softstem bulrush (*Scirpus validus*) and yellow flag (*Iris pseudacorus L.*).

Based on information collected for WDFW in 2003, the unprotected cobble shorelines found in this reach tend to have 12 species of aquatic vegetation found in the nearshore, including 6 submergent and 6 emergent species (Central Washington University, 2005). (Table 9) The submergent species are dominated by sago pondweed and Eurasian water milfoil (*Myriophyllum spicatum*), while the emergent species are dominated by reed canary grass (*Phalaris arundinacea*) and softstem bulrush (*Scirpus validus*). By

comparison, protected cobble shorelines tend to have a slightly lower diversity of species, including 5 submergent and 1 emergent species, softstem bulrush (Table 10). The submergent species are dominated by white stem pondweed, sago pondweed, Eurasian water milfoil, and curly leaf pondweed.

Wetlands
No wetlands are found in the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least eight fish species may be found along Reach 18, dominated by yellow perch (58%), bluegill (10%), largemouth bass (11%), and common carp (10%)(Fig. 17) (Gabriel and Jordan, 2004). Other notable species include black crappie (7%) and smallmouth bass (4%)(Table 29).

Avian
Reach 18 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with denser zones of emergent vegetation, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore is also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, as well as an important wintering area for tundra swans (WDFW, 2002).

Terrestrial
Reach 18 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, a small portion of the south end of the reach is classified as a priority riparian habitat, including willow, Russian olive, greasewood, Chinese elm, and saltgrass (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 18, 48.8% are classified as residential single-family. Of the remaining 51.2% of SMP jurisdiction lands, 24.8 is transportation and utilities, 15.4% is unclassified, and 9.7% is undeveloped and 1.3% is multi-family residential. Based on land use, imperviousness of this reach is estimated to be approximately 13.0%. Parcel sizes in the reach have an average width of 38 m and an average depth of approximately 53 m. Based on a survey of 10 shoreline structures,

average structure setback from the shoreline along reach 18 is 24.8 m, ranging from 19.9 to 33.0 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways 592 meters of SMP jurisdiction land in Reach 18, though no storm sewer outfalls occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 34% of the shoreline along Reach 18 is hardened with bulkheads. In addition, 9 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 18 is predominantly Single Family Residential (52.8%) and Multi Family Residential (24.7%) , with no zoning designation for 22.5%. Currently 77.0% of the reach is designated as Urban by the current SMP and 23.0% contains no environment designation.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 18 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 18 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
	Undeveloped: 9.7% Priority habitats: 3 Species of concern: 4 Fish Species: 8		Principal land use: residential-1 family Imperviousness: 13% Roads: 592 m Bulkheads: 34% Docks: 9

Ecological functions along Reach 18 are impaired by residential development, which covers the majority of the jurisdiction and accounts for most of the estimated 13% imperviousness for the reach. Only 9.7% of the land is still undeveloped along the reach. Riparian vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. Roadways, which cover 592 m of the jurisdiction, may be an additional source of nonpoint source pollution. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint

pollution is limited, primarily comprised of an average width of less than 2 m extending along approximately half of the reach (though this might be in part due to the relatively steeper nearshore found along this reach). While there are no wetlands found along this reach, it is associated with three types of priority habitat. In addition, none of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. The riparian vegetation includes Russian olive and Yellow flag iris, both highly invasive exotic species. Despite a limited windward fetch and a substrate comprised of erosion-resistant cobble, a substantial portion of the reach has shoreline hardening (34.0%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the eight fish species typically found along this reach. This aquatic habitat is further impaired by the relatively small number of docks (9) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
18A	Shoreline Residential-Resource	Residential use; emergent vegetation
18B	High Intensity	Highway

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Prevent increase in the number of bulkheads on the shoreline.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
B. Use education and incentives to encourage restoration of emergent vegetation on developed parcels and in agricultural areas.

REACH 19

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 19 is dominantly flood gravels. This reach is a mid channel bar, with no areas having slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as cobble (100%). The soils within the SMP jurisdiction are predominately Ephrata-Malaga complex (73.2%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is classed as slow (100%). The hazard of soil erosion is also slow (100%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the northeast and southwest. Fetch lengths range between 0.21 and 0.78 km and are higher for both the southeast and east. The nearshore tends to be moderately impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly between 36 and 60 m (51.0%) and less than 10m (39.8%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 19. The principal upland species are sagebrush (Artemesia) and giant rye (Elymus condensatus). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is fairly extensive, with an average width of 2-5 m extending along 49.4% of the reach. In addition, another 8.2% of the reach has emergent vegetation zones with widths averaging less than 2 m. The primary emergent vegetation species of Reach 19 are softstem bulrush (*Scirpus validus*) and Yellow flag (*Iris pseudacorus L.*).

Based on information collected for WDFW in 2003, the unprotected cobble shorelines found in this reach tend to have 12 species of aquatic vegetation found in the nearshore, including 6 submergent and 6 emergent species (Central Washington University, 2005). (Table 9) The submergent species are dominated by sago pondweed and Eurasian water milfoil (*Myriophyllum spicatum*), while the emergent species are dominated by reed canary grass (*Phalaris arundinacea*) and softstem bulrush (*Scirpus validus*). By comparison, protected cobble shorelines tend to have a slightly lower diversity of species, including 5 submergent and 1 emergent species, softstem bulrush (Table 10). The

submergent species are dominated by white stem pondweed, sago pondweed, Eurasian water milfoil, and curly leaf pondweed.

Wetlands
Palustrine emergent wetland habitat in Reach 19 is fairly extensive, comprising 6.8% of the SMP jurisdiction (USFWS, 2003). Much of this habitat is classified as priority habitat, consisting of hardstem bulrush, cattail and common reed (WDFW, 2002).

Wildlife
Fish

Based on data collected by WDFW between 2002 and 2003, at least seven fish species may be found along Reach 19, dominated by bluegill (46%), yellow perch (20%), largemouth bass (15%), and smallmouth bass (11%)(Fig. 18) (Gabriel and Jordan, 2004). Other notable species include walleye (3%), black crappie (3%), and rainbow trout (3%) (Table 30). Portions of the shoreline have also been identified as good common carp fishing areas (Fish-n-Map Co., n.d.).

Avian
Reach 19 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's shoreline and nearshore are classified as a priority habitat for tundra swan wintering, Clark's and Western grebe breeding, and waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring (WDFW, 2002). The shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves.

Terrestrial
Reach 19 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 19, 80.1% are classified as residential single family. Of the remaining 19.9% of SMP jurisdiction lands, 10.0% is under unclassified, 3.1% is commercial, 2.8% is lodging, 2.5% is undeveloped, 0.8% is multi-family

residential and 0.7% is transportation, utilities. Based on land use, imperviousness of this reach is estimated to be approximately 24.2%. Parcel sizes in the reach have an average width of 26 m and an average depth of approximately 65 m. Based on a survey of 28 shoreline structures, average structure setback from the shoreline along reach 19 is 23.7 m, ranging from 0.0 to 49.4 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 562 meters of SMP jurisdiction land in Reach 19 (WDNR, 1996). Railroads occupy 65 meters of SMP jurisdiction and 3 storm sewer outfalls occur along this reach (United States Census Bureau 2000,City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 42.7% of the shoreline along Reach 19 is hardened with bulkheads. In addition, 32 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 19 is predominantly Single Family Residential (87.6%), with smaller areas of Multi Family Residential (5.9%) and Single and Two Family Residential (5.3%) with no zoning designation for 1.2%. The remaining lands (1.2%) have no zoning designation. Currently 100% of the reach is designated as Urban by the current SMP.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 19 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 19 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
	Wetlands: 6.8% Undeveloped: 2.5% Priority habitats: 5 Species of concern: 4 Fish Species: 7		Principal land use: residential-1 family Imperviousness: 24.2% Roads: 562 m Bulkheads: 42.7% Storm drains: 3 Docks: 32

Ecological functions along Reach 19 are impaired by residential development, which covers the majority of the jurisdiction and accounts for most of the estimated 24.2% imperviousness for the reach. Only 2.5% of the land is still undeveloped along the reach. Riparian vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. Roadways and railroads, which cover 627 m of the jurisdiction, may be an additional source of nonpoint source pollution. Three storm sewer outfalls are also found along this reach. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution is fairly extensive, primarily comprised of an average width between 2-5 m extending along 58% of the reach. Five types of priority habitat are associated with this reach. In addition, 6.8% of the reach is classified as wetland habitat. However, none of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. The riparian vegetation includes Russian olive and Yellow flag iris, both highly invasive exotic species. Despite a limited windward fetch and a substrate comprised of erosion-resistant cobble, a substantial portion of the reach has shoreline hardening (42.7%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the seven fish species typically found along this reach. This aquatic habitat is further impaired by the relatively high number of docks (32) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
19A	Shoreline Residential	Residential use with extensive docks and bulkheads
19B	Shoreline Residential - Resource	Residential use; wetlands and emergent vegetation

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Prevent increase in the number of bulkheads on the shoreline.
B. Protect emergent vegetation near docks, residential areas, and public access areas.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Retrofit storm sewer outfalls to limit pollution loading to the lake.
B. Retrofit storm sewer outfalls to limit pollution loading to the lake.
C. Use education and incentives to encourage restoration of emergent vegetation on developed parcels and in agricultural areas.

D. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
E. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
F. Retrofit storm sewer outfalls to limit pollution loading to the lake.
G. Retrofit storm sewer outfalls to limit pollution loading to the lake.
H. Retrofit storm sewer outfalls to limit pollution loading to the lake.

REACH 20

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 20 is dominantly flood gravels. This reach is a mid island bar, with 5.8% of the area having slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are entirely classified as cobble. The soils within the SMP jurisdiction are predominately Ephrata fine sandy loam (64.3%) (NRCS, 2003). As a result, soil permeability is entirely moderately rapid while runoff is classed as slow (100%). The hazard of soil erosion is also predominately slow (100%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the east and south. Fetch lengths range between 0.42 and 0.72 km and are higher for the south. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly less than 10 m (93.7%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 20. Emergent vegetation in the littoral zone is limited, with an average width of 2-5 m extending along 6.1% of the reach. The primary emergent vegetation species of Reach 20 are softstem bulrush (*Scirpus validus*) and broad-leaved cattail (*Typha latifolia*).

Based on information collected for WDFW in 2003, the unprotected cobble shorelines found along this reach tend to have 12 species of aquatic vegetation found in the nearshore, including 6 submergent and 6 emergent species (Central Washington University, 2005). (Table 9) The submergent species are dominated by sago pondweed and Eurasian water milfoil (*Myriophyllum spicatum*), while the emergent species are dominated by reed canary grass (*Phalaris arundinacea*) and softstem bulrush (*Scirpus validus*).

Wetlands
No wetlands are found in the SMP jurisdiction (USFWS, 2003).

Wildlife

Fish

Based on data collected by WDFW between 2002 and 2003, at least eight fish species may be found along Reach 20, dominated by yellow perch (56%), bluegill (24%), smallmouth bass (9%), and black crappie (6%)(Fig. 19; Table 31) (Gabriel and Jordan, 2004). Portions of the shoreline have also been identified as good black crappie fishing areas (Fish-n-Map Co., n.d.).

Avian

Reach 20 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with denser zones of emergent vegetation, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's shoreline and nearshore are classified as a priority habitat for tundra swan wintering, Clark's and Western grebe breeding, and waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring (WDFW, 2002). The shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves.

Terrestrial

Reach 20 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with parks/open land and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)

Of the SMP jurisdiction lands along Reach 20, 27.5% are classified as single-family residential. Of the remaining 72.5% of SMP jurisdiction lands, 21.0% is under parks/open land, 15.2% is undeveloped, 12.6% is residential multi-family, and 10.4% is governmental services, 9.0% is unclassified, 4.4% is transportation and utilities. Based on land use, imperviousness of this reach is estimated to be approximately 15.1%. Parcel sizes in the reach have an average width of 39 m and an average depth of approximately 54 m. Based on a survey of 26 shoreline structures, average structure setback from the shoreline along reach 20 is 25.7 m, ranging from 16.1 to 38.1 m.

Within the SMP jurisdiction, 27.2% of Reach 20 contains public lands owned by the City of Moses Lake, including McCosh Park. Considered and environmental conservancy area, McCosh Park is a 20 acre facility that includes 6 lighted tennis courts, playground

and picnic areas, basketball courts, and restrooms (City of Moses Lake, 2001a). Within the park there is also a family aquatic center and an amphitheater for summer concerts.

Transportation Infrastructure (Table 6)
Roadways occupy 768 meters of SMP jurisdiction land in Reach 20 (WDNR, 1996). Railroads occupy 125 meters of SMP jurisdiction, and one storm sewer outfall occurs along this reach (United States Census Bureau 2000, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
None of the shoreline along Reach 20 is hardened with bulkheads. Eleven docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 20 is predominantly Single and Two Family Residential (53.7%), followed by Public lands (27.0%) and Multi Family Residential (15.3%) with no zoning designation for 4.0%. Currently 78.6% of the reach is designated as Urban and 21.4% as Conservancy by the current SMP.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 20 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 20 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 5.8%	Undeveloped: 15.2% Priority habitats: 4 Species of concern: 4 Fish Species: 7	Public land: 27.2% Parks: 1	Principal land use: residential. Imperviousness: 15.1% Roads: 768 m Storm drains: 1 Docks: 11

Ecological functions along Reach 20 are impaired by residential and recreational development, which cover the majority of the jurisdiction, though 15.2% of the land is still undeveloped along the reach. Riparian vegetation has been removed and replaced with buildings, lawns, and parking lots, which can promote increased runoff and nonpoint source pollution. Based on land use, imperviousness of this reach is estimated to be approximately 15.1%. Roadways and railroads, which cover 893 m of the jurisdiction, may be additional sources of nonpoint source pollution. One storm sewer outfall also is

found along this reach. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution is extremely limited, primarily comprised of an average width between 2-5 m extending along 6.1% of the reach (though this might be in part due to the relatively steeper nearshore found along this reach). In addition, there are no wetlands found along this reach. The reach provides four types of priority habitat as well as habitat for eight species of fish. The aquatic habitat is impaired by the relatively small number of docks (11) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
20A	Shoreline Residential-Resource	Primarily residential use; priority habitats
20B	Water-Oriented Park	Public park

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect priority habitat for waterfowl, Tundra Swan, Clark's Grebe, and Bald Eagle identified by WDFW.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Retrofit storm sewer outfalls to limit pollution loading to the lake.
B. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
C. Retrofit storm sewer outfalls to limit pollution loading to the lake.
D. Retrofit storm sewer outfalls to limit pollution loading to the lake.

REACH 21

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 21 is predominately conglomerate with about one fourth of the reach consisting of basalt flows and another one fourth consisting of flood gravels. This reach is a relict cut bank, which has been eroded by the Missoula Floods in the sandstone portion of the lake. There are no areas with slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as a combination of mixed alluvium (97.3%) and cobble (2.7%). The soils within the SMP jurisdiction are predominately Aquents (42.9%) (NRCS, 2003). As a result, soil permeability is mostly moderately slow (42.9%) while runoff is primarily classed as ponded (55.4%). The hazard of soil erosion is predominately slow (79.7%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the southwest and northwest. Fetch lengths range between 0.37 and 2.56 km and are higher for both the southwest and northwest. The nearshore tends to be moderately impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly less than 10 m (43.4%) and greater than 85m (30.4%). The shoreline also has nearshore exposure widths 10-35m (26.2%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 21. The principal upland species is Salt bush (*Atriplex*). This riparian zone also supports Russian olive (*Elaeagnus*), an invasive species.

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines in this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005). In addition, the unprotected cobble shorelines tend to have 12 species of aquatic vegetation found in the nearshore, including 6 submergent and 6 emergent species. (Table 9) The submergent species are dominated by sago pondweed and Eurasian water milfoil

(*Myriophyllum spicatum*), while the emergent species are dominated by reed canary grass (*Phalaris arundinacea*) and softstem bulrush (*Scirpus validus*).

Wetlands

Wetland habitat, dominated by palustrine emergent wetlands, is extremely extensive along Reach 21, comprising 77.2% of the SMP jurisdiction (USFWS, 2003). Much of this habitat is classified as priority habitat, consisting of hardstem bulrush, cattail and common reed (WDFW, 2002).

Wildlife

Fish

Based on data collected by WDFW between 2002 and 2003, at least four fish species may be found along Reach 21, including bluegill (76%), yellow perch (14%), largemouth bass (10%), and black crappie (3%)(Fig. 20; Table 32) (Gabriel and Jordan, 2004). Portions of the shoreline have also been identified as good black crappie fishing areas (Fish-n-Map Co., n.d.).

Avian

Reach 21 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's wetlands and nearshore are also classified as a priority habitat for tundra swan wintering, Clark's and Western grebe breeding, and waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring (WDFW, 2002). The shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves.

Terrestrial

Reach 21 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)

Of the SMP jurisdiction lands along Reach 21, 45.6% are classified as single family residential. Of the remaining 54.4% of SMP jurisdiction lands, 22.7% is undeveloped, 16.7% is parks/open land, 3.5% is residential mobile home, 5.9% is unclassified, 2.5% is

commercial, 0.7% is governmental services and 2.4% is residential multi-family. Based on land use, imperviousness of this reach is estimated to be approximately 12.9%. Parcel sizes in the reach have an average width of 53 m and an average depth of approximately 92 m. Based on a survey of 9 shoreline structures, average structure setback from the shoreline along reach 21 is 34.6 m, ranging from 20.5 to 47.9 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways 698 meters of SMP jurisdiction land in Reach 21, and 3 storm sewer outfalls occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
None of the shoreline along Reach 21 is hardened with bulkheads. In addition, 5 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 21 is predominantly Multi Family Residential (71.5%) and Single Family Residential (28.5%). Currently 15.7% of the reach is designated as Conservancy and 68.7% Urban by the current SMP and 15.6% is not designated by the current City of Moses Lake SMP.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 21 on file with the Washington State Office of Archaeology and Historic Preservation. Two facilities/sites have been identified as being of interest to DOE due to pollution/permitting concerns, related to underground storage tanks (DOE, 1998b).

ECOLOGICAL FUNCTION SUMMARY

Reach 21 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
	Wetlands: 77.2% Undeveloped: 22.7% Priority habitats: 5 Species of concern: 4 Fish Species:3		Principal land use: residential Imperviousness: 12.9% Roads: 698 m Storm drains: 3 Docks: 5 DOE Facilities/Sites: 2

While the shoreline within Reach 21 is predominantly made up of priority habitat wetlands also identified by the National Wetland Inventory, ecological functions are impaired by residential and recreational development, which cover the majority of the jurisdiction, though 22.7% of the land is still undeveloped along the reach. Riparian vegetation has been removed and replaced with buildings, lawns, and parking lots, which can promote increased runoff and nonpoint source pollution. Based on land use, imperviousness of this reach is estimated to be approximately 12.9%. Roadways, which cover 698 m of the jurisdiction, may be additional sources of nonpoint source pollution. Three storm sewer outfalls are also found along this reach. Besides wetlands, the reach provides four other types of priority habitat, as well as habitat for four species of fish. The aquatic habitat is impaired by the relatively small number of docks (5) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
21A	Natural	Undeveloped; wetlands; priority habitats
21B	Shoreline Residential-Special Resource	Relatively undeveloped; wetlands; priority habitats
21C	Shoreline Residential- Resource	Residential use; priority habitats

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect priority habitat for waterfowl, Tundra Swan, Clark's Grebe, and Bald Eagle identified by WDFW.
B. Protect existing wetlands from encroachment by residential development.
C. Protect vegetative buffer on residential and agricultural land.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Retrofit storm sewer outfalls to limit pollution loading to the lake.
B. Retrofit storm sewer outfalls to limit pollution loading to the lake.
C. Retrofit storm sewer outfalls to limit pollution loading to the lake.
D. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.

REACH 22

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 22 is predominately conglomerate with a small area of basalt flows and the part of the reach that extends over the lake is classified as alluvium. This reach is a relict cut bank, which has been eroded by the Missoula Floods in the sandstone portion of the lake. Approximately1% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as a mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Umapine silt loam (67.9%) and aquents (23.7%) (NRCS, 2003). As a result, soil permeability is predominantly moderate (76.3%) while runoff is primarily classed as ponded (91.6%). The hazard of soil erosion is primarily none (67.9%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the north and northwest. Fetch lengths range between 0.28 and 1.36 km and are higher for both the north and northwest. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly less than 10 m (41.8%), 10-35m (32.3%) and 36-60m (25.3%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 22. The principal upland species is salt bush (*Atriplex*). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is fairly extensive, with an average width of less than 2 m extending along 37.6% of the reach. In addition, another 29.8% of the reach has emergent vegetation zones with widths averaging 5-10 m. The primary emergent vegetation species of Reach 22 are softstem bulrush (*Scirpus validus*), broad-leaved cattail (*Typha latifolia*), common reed (*Phragmites australis*), and reed canary grass (*Phalaris arundinacea*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines in this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005).

Wetlands
Wetland habitat in Reach 22, dominated by palustrine emergent wetlands, is extensive, comprising 45.8% of the SMP jurisdiction (USFWS, 2003). Much of this habitat is classified as priority habitat, consisting of hardstem bulrush, cattail and common reed (WDFW, 2002).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least ten fish species may be found along Reach 22, dominated by yellow perch (36%), bluegill (25%), smallmouth bass (24%), and largemouth bass (10%)(Fig. 21); Table 33) (Gabriel and Jordan, 2004). Portions of the shoreline have also been identified as good common carp fishing areas (Fish-n-Map Co., n.d.).

Avian
Reach 22 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation, and parks/open land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's shoreline and nearshore are classified as a priority habitat for tundra swan wintering, Clark's and Western grebe breeding, and waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring (WDFW, 2002). The shoreline is also classified as a priority habitat for wintering bald eagles, which tend to congregate in small groups on shoreline trees, offshore islands, and ice shelves. A Clark's grebe nesting colony has been identified as a Natural Heritage site on the connected Marsh Island, which is also classified as a priority habitat for Marsh hawks and a nesting area for duck and geese.

Terrestrial
Reach 22 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and parks/open land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 22, 63.9% are undeveloped. Of the remaining 36.2% of SMP jurisdiction lands, 20.9% is transportation and utilities, 11.0% is parks/open land, 2.5% is unclassified, and 1.7% is single family residential. Based on

land use, imperviousness of this reach is estimated to be approximately 0.2%. Parcel sizes in the reach have an average width of 221 m and an average depth of approximately 176 m. Based on a survey of 1 shoreline structure, average structure setback from the shoreline along reach 22 is 18.5 m.

There are 12.8 % of public lands within the SMP jurisdiction that are owned by the City of Moses Lake, including Montlake. Considered an environmental conservancy area, Montlake Park is a 9 acre public facility with playground and picnic areas, boat launch, day boat moorage, restrooms and an unsupervised swim area (City of Moses Lake, 2001a).

Transportation Infrastructure (Table 6)
Roadways occupy 2650 meters of SMP jurisdiction land in Reach 22 (WDNR, 1996). Railroads occupy 296 meters of SMP jurisdiction, though no storm sewer outfalls occur along this reach (United States Census Bureau 2000, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
None of the shoreline along Reach 22 is hardened with bulkheads. In addition, there are 2 docks located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 22 is predominantly Single Family Residential (43.5%) and Public (10.9%), with a smaller area of Urban Residential 2 (1.6%) and 44% has no zoning designation. Currently 38.1% of the reach is designated as Conservancy and 35.8% as Urban by the current SMP and 26.1% contains no environment designation.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 22 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 22 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 1% High erosion soils: 6.7% High soil runoff:	Wetlands: 45.8% Undeveloped: 63.9% Priority habitats: 7 Natural Heritage	Public land: 12.8% Parks: 1 Boat launches:	Principal land use: undeveloped Imperviousness: 0.2% Roads: 2650 m

6.7%	sites: 1 Species of concern: 4 Fish Species: 10	1	Docks: 2

Ecological functions on Reach 22 are relatively intact. The shoreline within this reach is predominantly made up of priority habitat wetlands also identified by the National Wetland Inventory, providing potential habitat for a wide variety of wildlife and fish species. While the reach is largely undeveloped (63.9%), residential development in the upland is encroaching on the wetland environment and is a potential source of stormwater runoff and nonpoint pollution such as sediment, fertilizers and pesticides. Roadways and railroads, which cover 2.9 km of the jurisdiction, may be an additional source of nonpoint source pollution. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution is fairly extensive, extending over two-thirds of the reach, with approximately half having emergent vegetation zones with widths averaging 5-10 m. Besides wetlands and one Natural Heritage site, the reach provides six other types of priority habitat, as well as habitat for ten species of fish, including common carp, which may affect the health of the emergent vegetation along this shoreline. The aquatic habitat is impaired by two docks found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
22A	Natural	Undeveloped; park use; wetlands; emergent vegetation
22B	Natural	Relatively undeveloped; wetlands; emergent vegetation
22C	High Density	Highway
22D	Natural	Undeveloped island; wetlands; emergent vegetation; priority habitats

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect priority habitat for waterfowl, Tundra Swan, Clark's Grebe, and Bald Eagle identified by WDFW.
B. Protect existing wetlands from encroachment by residential development.
C. Protect emergent vegetation near docks, residential areas, and public access areas.
D. Develop construction runoff controls for new construction, especially in high soil erosion areas with limited riparian vegetation.
E. Protect priority wetland habitat identified by WDFW.
F. Protect priority island habitat supporting important wildlife nesting areas identified by WDFW.

G. Protect priority habitat for waterfowl identified by WDFW.
H. Protect priority habitat for Clark's Grebe identified by WDFW

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Use education and incentives to encourage restoration of emergent vegetation on developed parcels and in agricultural areas.

REACH 23

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 23 is predominately conglomerate with a small area of basalt flows. This reach is a relict cut bank, which has been eroded by the Missoula Floods in the sandstone portion of the lake. Approximately 32.5% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Wiehl fine sandy loams (48.1%) or Umapine silt loam (38.1%) (NRCS, 2003). As a result, soil permeability is primarily moderate (86.2%) while runoff is primarily classed as very rapid (48.1%) or ponded (38.1%). The hazard of soil erosion is also predominately very high (48.1%) with some areas of no hazard of soil erosion (38.1%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the north and northwest. Fetch lengths range between 0.26 and 1.13 km and are higher for both the west and northwest. The nearshore tends to be moderately impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly between 10 and 35m (53.7%) and less than 10m (31.7%). The remainder of the nearshore exposure widths is 36-60m (14.6%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 14.1% of Reach 23. The principal upland species is salt bush (*Atriplex*). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is fairly extensive, with an average width of 2-5 m extending along 36.7% of the reach. In addition, another 37.3% of the reach has emergent vegetation zones with widths of less than 2 m. The primary emergent vegetation species of Reach 23 are softstem bulrush (*Scirpus validus*) and common reed (*Phragmites australis*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines in this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005).

Wetlands
Palustrine emergent wetland habitat in Reach 23 is fairly extensive, comprising 36.1% of the SMP jurisdiction (USFWS, 2003). Much of this habitat is classified as priority habitat, consisting of hardstem bulrush, cattail and common reed (WDFW, 2002).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least seven fish species may be found along Reach 23, dominated by yellow perch (48%), bluegill (27%), and smallmouth bass (13%)(Fig. 22) (Gabriel and Jordan, 2004). Other notable species include largemouth bass (5%) and black crappie (4%)(Table 34).

Avian
Reach 23 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat and denser zones of emergent vegetation or riparian tree cover (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore and nearby Goat Island are also classified as a priority habitat for tundra swan wintering and Clark's and Western grebe breeding, while a Clark's grebe nesting colony has been identified as a Natural Heritage site on Goat Island (WDFW, 2002). The island is also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring, as well as a nesting area for duck and geese.

Terrestrial
Reach 23 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 23, 99.9% are classified as residential single family and 0.1% is unclassified. Based on land use, imperviousness of this reach is estimated to be approximately 14.0%. Parcel sizes in the reach have an average width of 37 m and an average depth of approximately 175 m. Based on a survey of 5 shoreline structures, average structure setback from the shoreline along reach 23 is 41.6 m, ranging from 23.8 to 56.6 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
There are no roadways and no storm sewer outfalls along Reach 23.

Bulkheads and Docks (Table 6)
None of the shoreline along Reach 23 is hardened with bulkheads. There are 20 docks along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 23 is entirely Urban Residential 2. Currently the Grant County SMP environmental designation for Reach 32 is Suburban.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 23 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 23 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 32.5% High erosion soils: 48% High soil runoff: 48%	Wetlands: 36.1% Riparian tree cover: 14.1% Priority habitats: 5 Species of concern: 5 Natural Heritage points: 1 Fish Species: 7		Principal land use: residential-1 family Imperviousness: 14% Docks: 20

While over one-third of Reach 23 is comprised of priority habitat wetlands identified by the National Wetland Inventory, ecological functions along Reach 23 are impaired by residential development, which covers the majority of the jurisdiction and accounts for all the estimated 14% imperviousness found in this reach. Riparian vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is fairly extensive, extending along approximately three-quarters of the reach. In addition, 14.1% of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. The riparian vegetation includes Russian olive, a highly invasive exotic species. Besides wetlands and one Natural heritage location, the reach provides four other types of

priority habitat as well as habitat for seven species of fish. This aquatic habitat is impaired by a relatively high number of docks (20) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
23	Shoreline Residential - Resource	Residential use with docks; emergent vegetation

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect emergent vegetation near docks, residential areas, and public access areas.
B. Protect vegetative cover on areas prone to high soil erosion.
C. Protect emergent vegetation near docks, residential areas, and public access areas.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Use education and incentives to encourage restoration of emergent vegetation on developed parcels and in agricultural areas.
B. Restore vegetative cover and riparian buffer on areas prone to high soil erosion.
C. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.

REACH 24

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 24 is predominantly basalt flows with about one fourth of the reach consisting of flood gravels and another one fourth consisting of conglomerate. This reach is a depositional feature that postdates the floods. Approximately 2.7% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Ephrata-Malaga complex (91.8%) (NRCS, 2003). As a result, soil permeability is primarily moderately rapid (95.3%) while runoff is primarily classed as slow (91.8%). The hazard of soil erosion is also predominately slow (91.8%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the north and northwest. Fetch lengths range between 0.94 and 1.63 km and are higher for both the north and northeast. The relatively shallow nearshore tends to be moderately impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly between 10 and 35m (46.0%) and 36-60m (29.0%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 4.5% of Reach 24. Emergent vegetation in the littoral zone is fairly extensive, with an average width of less than 2 m extending along 31.1% of the reach. In addition, another 16.5% of the reach has emergent vegetation zones with widths ranging between 2-5 m and 5-10 m. The primary emergent vegetation species of Reach 24 is softstem bulrush (*Scirpus validus*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines in this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005).

Wetlands
Wetland habitat in Reach 24, dominated by palustrine emergent wetlands, is extremely extensive, comprising 72.8% of the SMP jurisdiction (USFWS, 2003).

Wildlife

Fish

Based on data collected by WDFW between 2002 and 2003, at least eight fish species may be found along Reach 24, dominated by yellow perch (51%), bluegill (14%), largemouth bass (13%), and walleye (13%)(Fig. 23) (Gabriel and Jordan, 2004). Other notable species include smallmouth bass (6%), and black crappie (2%)(Table 35). Portions of the shoreline have also been identified as good bass and walleye fishing areas (Fish-n-Map Co., n.d.).

Avian

Reach 24 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation or riparian tree cover, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore is also classified as a priority habitat for tundra swan wintering and Clark's and Western grebe breeding (WDFW, 2002).

Terrestrial

Reach 24 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)

Of the SMP jurisdiction lands along Reach 24, 48.3% are classified as residential single-family. Of the remaining 51.7% of SMP jurisdiction lands, 33.1% is undeveloped, 7.6% is agriculture, 5.8% is parks/open land, and 5.3% is unclassified. Based on land use, imperviousness of this reach is estimated to be approximately 12.1%. Parcel sizes in the reach have an average width of 30 m and an average depth of approximately 77 m. Based on a survey of 7 shoreline structures, average structure setback from the shoreline along reach 24 is 37.0 m, ranging from 14.2 to 60.1 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 247.7 meters of SMP jurisdiction land in Reach 24, and there are no storm sewer outfalls occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
None of the shoreline along Reach 24 is hardened with bulkheads. In addition, 7 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 24 is entirely Urban Residential 2. Currently the Grant County SMP environmental designation for Reach 24 is Suburban.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 24 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 24 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 2.7%	Wetlands: 72.8% Undeveloped: 33.1% Riparian tree cover: 4.5% Priority habitats: 2 Species of concern: 5 Fish Species: 8		Principal land use: residential-1 family Imperviousness: 12.1% Roads: 247 m Docks: 7

While the shoreline within Reach 24 is predominantly made up of wetlands identified by the National Wetland Inventory, ecological functions are impaired by residential development, which predominantly covers the jurisdiction, though 33.1% of the land is still undeveloped along the reach. Based on land use, imperviousness of this reach is estimated to be approximately 12.1%. Riparian vegetation has been removed and replaced with buildings and lawns, which can promote increased runoff and nonpoint source pollution. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is fairly extensive, extending along approximately 47% of the reach. In addition, 4.5% of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. Besides two types of priority habitat, the reach provides habitat for eight species of fish. This

aquatic habitat is impaired by a relatively small number of docks (7) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
24A	Water-Oriented Park	Public park
24B	Shoreline Residential – Special Resource	Residential uses and undeveloped land; wetlands; emergent vegetation

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect emergent vegetation near docks, residential areas, and public access areas.
B. Protect existing wetlands from encroachment by residential development

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Provide incentives for landowners to develop vegetative buffers around parking areas, as well as direct overland flow away from lake, on sites already developed.

REACH 25

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 25 is dominantly flood gravels. This reach is a sand dune area, with dunes seeming to overlay a point bar type landform. Approximately 18.1% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as sand (100%). The soils within the SMP jurisdiction are predominantly Quincy fine sands (74.5%) (NRCS, 2003). As a result, soil permeability is entirely rapid while runoff is classed as slow (100%). The hazard of soil erosion is also classed as slow (100%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the east and south. Fetch lengths range between 0.59 and 2.65 km and are higher for both the south and southeast. The nearshore tends to be moderately impacted by the fall lake level drawdown of approximately 1.5 m, with the entire shoreline having nearshore exposure widths between 10 and 35m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is not present along Reach 25. The principal upland species are salt bush (*Atriplex*) and wild rose (*Rosa canina*). This riparian zone also supports Russian olive (Elaeagnus) and Yellow flag (*Iris pseudacorus L.)*, which are invasive species. Emergent vegetation in the littoral zone is somewhat limited, with an average width of 2-5 m extending along 22.6% of the reach. The primary emergent vegetation species of Reach 25 are softstem bulrush (*Scirpus validus*) and yellow flag (*Iris pseudacorus L.).*

Based on information collected for WDFW in 2003, dune shorelines tend to have 8 species of aquatic vegetation in the nearshore, including 5 submergent species, dominated by sago pondweed and white stem pondweed, and 3 emergent species, dominated by softstem bulrush (Table 13) (Central Washington University, 2005).

Wetlands
Wetland habitat in Reach 25, comprised of palustrine open water, emergent, and forested wetlands, is fairly extensive, comprising 14.8% of the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least thirteen fish species may be found along Reach 25, dominated by yellow perch (56%), largemouth bass (12%), bluegill (11%), and walleye (7%)(Fig. 24) (Gabriel and Jordan, 2004). Other notable species include black crappie (5%), smallmouth bass (4%), and bullhead (3%)(Table 36).

Avian
Reach 25 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region.

Terrestrial
Reach 25 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 25, 100% are classified as undeveloped. Based on land use, imperviousness of this reach is estimated to be 0%. Parcel sizes in the reach have an average width of 732 m and an average depth of approximately 213 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
There are no roadways that occupy SMP jurisdiction land in Reach 25, and no storm sewer outfalls occur along this reach.

Bulkheads and Docks (Table 6)
None of the shoreline along Reach 25 is hardened with bulkheads. In addition, there are no docks located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 25 is entirely Urban Residential 3. Currently the Grant County SMP environmental designation for Reach 25 is Conservancy.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 25 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 25 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep Slopes: 18.1% Rapid permeability: 100%	Wetlands: 14.8% Undeveloped: 100% Species of concern: 4 Fish Species: 13		Principal land use: undeveloped

Ecological functions on Reach 25 are relatively intact. The shoreline within this reach is entirely made up of undeveloped sand dunes, providing potential habitat for a wide variety of wildlife and fish species, including wetland habitat, which comprises 14.8% of the reach. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution is relatively limited, primarily comprised of an average width between 2-5 m extending along 22.6% of the reach (though this might be in part due to the relatively steeper nearshore found along this reach). The reach provides habitat for thirteen species of fish, the greatest diversity of any of the reaches. The riparian and aquatic habitat is impaired by exotic weed species such as Russian olive, Yellow flag iris, Eurasian water milfoil and curly-leaf pondweed.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
25	Natural	Undeveloped dunes; emergent vegetation; wetlands

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect existing wetlands from encroachment by residential development
B. Protect vegetation and habitat in dune areas.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

none

REACH 26

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 26 is dominantly flood gravels. This reach is a sand dune area, with dunes seeming to overlay a point bar type landform. Approximately 3.1% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are entirely classified as sand. The soils within the SMP jurisdiction are predominately Quincy fine sand (57.2%) (NRCS, 2003). As a result, soil permeability is entirely rapid while runoff is classed as slow (100%). The hazard of soil erosion is also classed as slow (100%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the west. The fetch length is equal to 0.13 km. The nearshore tends to be moderately impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly between 10 and 35m (70.4%) and less than 10 m (29.1%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 33.9% of Reach 26. The principal upland species are salt bush (*Atriplex*) and wild rose (*Rosa canina*). This riparian zone also supports Russian olive (Elaeagnus) and yellow flag (*Iris pseudacorus L.)*, which are invasive species. Emergent vegetation in the littoral zone is fairly limited, with an average width of less than 2 m extending along 7.6% of the reach. In addition, another 8.8% of the reach has emergent vegetation zones with widths ranging between 2-5 m and 5-10 m. The primary emergent vegetation species of Reach 26 are softstem bulrush (*Scirpus validus*), broad-leaved cattail (*Typha latifolia*), common reed (*Phragmites australis*), and yellow flag (*Iris pseudacorus*).

Based on information collected for WDFW in 2003, unprotected residential sand shorelines found in this reach tend to have 13 species of aquatic vegetation found in the nearshore, including 6 submergent and 7 emergent species (Table 11) (Central Washington University, 2005). The submergent species are dominated by sago pondweed while the emergent species are dominated by reed canary grass, softstem bulrush, and yellow flag iris (*Iris pseudacorus*). Protected residential sand shorelines

tend to have a lower diversity of species than along unprotected sand shorelines, including 6 submergent species, dominated by sago pondweed, and only 1 emergent species, softstem bulrush (Table 12).

Wetlands
Wetland habitat in Reach 26, comprised of palustrine open water, aquatic bed, emergent, and forested wetlands, is fairly extensive, comprising 7.1% of the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least thirteen fish species may be found along Reach 26, dominated by yellow perch (57%), largemouth bass (13%), bluegill (12%), and black crappie (5%)(Fig. 25) (Gabriel and Jordan, 2004). Other notable species include walleye (4%), smallmouth bass (4%), and bullhead (3%)(Table 37).

Avian
Reach 26 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation or riparian tree cover, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore is also classified as a priority habitat for Clark's and Western grebe breeding (WDFW, 2002).

Terrestrial
Reach 26 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, the reach is classified as a priority riparian habitat consisting of Russian olive and willow trees on the residential shoreline areas, as well as a priority habitat for mule deer, though this has likely been impaired by extensive shoreline development (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 26, 65.6% are classified as residential single-family. Of the remaining 34.4% of SMP jurisdiction lands, 20.3% is undeveloped, 6.1% is transportation and utilities, 4.3% is lodging, 1.8% is parks/open land, and 1.6% is unclassified. Based on land use, imperviousness of this reach is estimated to be

approximately 16.4%. Parcel sizes in the reach have an average width of 35 m and an average depth of approximately 59 m. Based on a survey of 59 shoreline structures, average structure setback from the shoreline along reach 26 is 17.6 m, ranging from 0.0 to 47.4 m. Approximately 3.7% of the area within the SMP jurisdiction is in public ownership.

Transportation Infrastructure (Table 6)
Roadways occupy 1710 meters of SMP jurisdiction land in Reach 26, and 10 storm sewer outfalls occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 21.7% of the shoreline along Reach 26 is hardened with bulkheads. In addition, 83 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf* **)**

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 26 is predominantly Single Family Residential (73.7%), with smaller areas of Urban Residential 3 (8.4%), General Commercial and Business (5.2%), Public (3.7%), Multi Family Residential (4.5%), and Single and Two Family Residential (3.7%) , with no zoning designation for 0.8%. Currently 6.2% of the reach is designated as Conservancy and 66.8% as Urban by the City of Moses Lake SMP and 27.0% is designated as Conservancy by the Grant County SMP.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 26 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 26 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 3.1% Rapid permeability: 100%	Wetlands: 7.1% Undeveloped: 20.3% Riparian tree cover: 33.9% Priority habitats: 3 Species of concern: 4 Fish Species: 13	Public land: 3.7%	Principal land use: residential-1 family Imperviousness: 16.4% Roads: 1710 m Bulkheads: 21.7% Storm drains: 10 Dock: 83

Ecological functions along Reach 26 are impaired by residential development, which covers the majority of the jurisdiction (65.9%), though 20.3% of the land is still undeveloped along the reach. Riparian vegetation has been removed and replaced with buildings and lawns, both of which can promote increased runoff and nonpoint source pollution. Roadways, which cover 1710 m of the jurisdiction, may be an additional source of nonpoint source pollution. Ten storm sewer outfalls are also found along this reach. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is fairly limited, extending along 16% of the reach. In addition, 7.1% of the reach is classified as wetland habitat, while over one-third of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. The riparian vegetation includes Russian olive, a highly invasive exotic species. The reach is associated with three types of priority habitat. Despite a limited windward fetch, a substantial portion of the reach has shoreline hardening (21.7%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the thirteen fish species typically found along this reach (the high diversity of any reach). This aquatic habitat is further impaired by the extremely high number of docks (83) found in this reach, as well as exotic weed species such as Eurasian water milfoil, curly-leaf pondweed, and yellow flag iris typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
26A	Natural	Undeveloped dunes; wetlands; riparian tree cover
26B	Shoreline Residential – Resource	Residential uses; riparian tree cover; emergent vegetation; priority habitats
26C	High Intensity-Resource	Commercial use (water-oriented, lodging); emergent vegetation
26D	High Intensity	Highway

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect existing wetlands from encroachment by residential development
B. Protect vegetative buffer on residential and agricultural land.
C. Protect emergent vegetation near docks, residential areas, and public access areas.
D. Prevent increase in the number of bulkheads on the shoreline.
E. Protect priority habitat for Western Grebe and shorebirds identified by WDFW.
F. Protect emergent vegetation near docks, residential areas, and public access areas.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Retrofit storm sewer outfalls to limit pollution loading to the lake.
B. Retrofit storm sewer outfalls to limit pollution loading to the lake.
C. Retrofit storm sewer outfalls to limit pollution loading to the lake.
D. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
E. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
F. Retrofit storm sewer outfalls to limit pollution loading to the lake.
G. Retrofit storm sewer outfalls to limit pollution loading to the lake.
H. Retrofit storm sewer outfalls to limit pollution loading to the lake.

REACH 27

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 27 is dominantly flood gravels. This reach is a sand dune area, with dunes seeming to overlay a point bar type landform. Approximately 19.8% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are entirely classified as fine sand. The soils within the SMP jurisdiction are entirely Quincy fine sands (NRCS, 2003). As a result, soil permeability is entirely rapid while runoff is classed as slow (100%). The hazard of soil erosion is also slow (100%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the north and east. Fetch lengths range between 0.77 and 1.73 km and are higher for both the north and east. The nearshore tends to be moderately impacted by the fall lake level drawdown of approximately 1.5 m, with the entire shoreline having nearshore exposure widths between 10 and 35 m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 33.9% of Reach 27. The principal upland species is willow (*Salix)*. This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is fairly extensive, with an average width of 2-5 m extending along 21.9% of the reach. In addition, another 30.7% of the reach has emergent vegetation zones with widths of less than 2 m. The primary emergent vegetation species of Reach 27 is softstem bulrush (*Scirpus validus*).

Based on information collected for WDFW in 2003, unprotected residential sand shorelines found in this reach tend to have 13 species of aquatic vegetation found in the nearshore, including 6 submergent and 7 emergent species (Table 11) (Central Washington University, 2005). The submergent species are dominated by sago pondweed while the emergent species are dominated by reed canary grass, softstem bulrush, and yellow flag iris (*Iris pseudacorus*).

Wetlands
Wetland habitat in Reach 27, comprised of palustrine forested and emergent wetlands, is limited, comprising 2.1% of the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least twelve fish species may be found along Reach 27, dominated by yellow perch (55%), bluegill (12%), largemouth bass (11%), and walleye (6%)(Fig. 26) (Gabriel and Jordan, 2004). Other notable species include black crappie (5%), smallmouth bass (5%), and bullhead (4%)(Table 38).

Avian
Reach 27 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation or riparian tree cover, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore is also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring (WDFW, 2002). In addition, the northern half of the reach is classified as a priority riparian habitat, consisting mainly of willow and elm trees, which provide habitat for pheasants, quail, and nongame birds.

Terrestrial
Reach 27 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 27, 60.9% are classified as undeveloped and 39.1% is parks/open land. Based on land use, imperviousness of this reach is estimated to be 0%. Parcel sizes in the reach have an average width of 343 m and an average depth of approximately 334 m. Based on a survey of 1 shoreline structure, average structure setback from the shoreline along reach 27 is 33.4 m. Approximately 79.5% of the area within the SMP contains Moses Lake public lands. The Moses Lake Community Park is also found along this reach. Considered an environmental conservancy area, the park is a 78-acre facility with 3 restrooms, a playground area, picnic shelters, two boat launch

ramps, and an unsupervised swimming area (City of Moses Lake, 2001a). It also adjoins a fishing bridge located on the I-90 right of way.

Transportation Infrastructure (Table 6)
There are no roadways that occupy jurisdiction land in Reach 27, and no storm sewer outfalls that occur along this reach (WDNR, 1996 ,City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
None of the shoreline along Reach 27 is hardened with bulkheads. However, there is one dock located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 27 is predominantly Public (87.9%), with a smaller area of Single Family Residential (12.1%). Currently 87.0% of the reach is designated as Natural and 13.0% is designated as Urban by the SMP.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 27 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 27 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep Slopes: 19.8% Rapid permeability: 100%	Wetlands: 2.1% Undeveloped: 60.9% Riparian tree cover: 33.9% Priority habitats: 2 Species of concern: 4 Fish Species: 13	Public land: 87.9% Parks: 1 Boat launches: 1	Principal land use: undeveloped Docks: 1

Ecological functions along Reach 27 are impaired by recreational development within a park, which covers 39.1% of the jurisdiction, while the majority of the jurisdiction is still undeveloped along the reach (60.9%). Riparian vegetation has been removed and replaced with lawns, and parking lots, which can promote increased runoff and nonpoint source pollution. While only 2.1% of the reach is classified as wetland habitat, emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is fairly extensive, extending along over half of the reach, though primarily at

widths less than 2 m. The reach is associated with two types of priority habitat. In addition, 33.9% of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. The riparian vegetation includes Russian olive, a highly invasive exotic species. The reach provides habitat for twelve species of fish. This aquatic habitat is impaired by one dock found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type. Moses Lake Community Park, found along this reach, is a 78-acre park with 3 restrooms, a playground area, picnic shelters, boat launch, and an unsupervised swimming area.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
27	Water-Oriented Park	Public park; riparian tree cover; emergent vegetation

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect emergent vegetation near docks, residential areas, and public access areas.
B. Protect existing wetlands from encroachment by residential development.
C. Protect priority riparian habitat as identified by WDFW.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

none

REACH 28

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 28 is dominantly flood gravels. This reach is a sand dune area, with dunes seeming to overlay a point bar type landform. Approximately 26.9% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as a combination of mixed alluvium (94.6%) and sand (5.4%). The soils within the SMP jurisdiction are predominately Quincy fine sand (92.6%) (NRCS, 2003). As a result, soil permeability is primarily rapid (92.6%) while runoff is classed as slow (100%). The hazard of soil erosion is also slow (100%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the north and east. Fetch lengths range between 1.10 and 1.84 km and are higher for both the north and northeast. The nearshore tends to be moderately impacted by the fall lake level drawdown of approximately 1.5 m, with the entire shoreline having nearshore exposure widths between 10 and 35m.

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 45.5% of Reach 28. The principal upland species is willow (*Salix*). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is relatively limited, with an average width of 5-10 m extending along 8.5% of the reach. The primary emergent vegetation species of Reach 28 is softstem bulrush (*Scirpus validus*).

Based on information collected for WDFW in 2003, the unprotected mixed alluvium shorelines in this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005). On the other hand, the portion of protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*). In addition, unprotected residential sand shorelines found in this reach tend to have 13 species of aquatic vegetation found in the nearshore, including 6 submergent and 7 emergent

species (Table 11). The submergent species are dominated by sago pondweed while the emergent species are dominated by reed canary grass, softstem bulrush, and yellow flag iris (*Iris pseudacorus*). Protected sand shorelines tend to have a lower diversity of species than along unprotected sand shorelines, including 6 submergent species, dominated by sago pondweed, and only 1 emergent species, softstem bulrush (Table 12).

Wetlands
Wetland habitat in Reach 28, comprised of palustrine forested and open water wetlands, is fairly extensive, comprising 7.3% of the SMP jurisdiction (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least twelve fish species may be found along Reach 28, dominated by yellow perch (55%), bluegill (13%), largemouth bass (11%), and walleye (6%)(Fig. 27) (Gabriel and Jordan, 2004). Other notable species include black crappie (5%), smallmouth bass (5%), and bullhead (4%)(Table 39).

Avian
Reach 28 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation or riparian tree cover, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore is also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring (WDFW, 2002). In addition, the reach is classified as a priority riparian habitat, consisting mainly of willow and elm trees, which provide habitat for pheasants, quail, and nongame birds.

Terrestrial
Reach 28 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat, parks/open land, and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf*

Land Use (Table 5)*)*
Of the SMP jurisdiction lands along Reach 28, 63.2% are classified as residential single-family. Of the remaining 36.8% of SMP jurisdiction lands, 18.5% is under multi-family residential development, 6.5% is undeveloped, 9.2% is unclassified, and 2.6% is

parks/open land. Based on land use, imperviousness of this reach is estimated to be approximately 27.8%. Parcel sizes in the reach have an average width of 41 m and an average depth of approximately 52 m. Based on a survey of 19 shoreline structures, average structure setback from the shoreline along reach 28 is 17.8 m, ranging from 5.0 to 55.8 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
There are no roadways that occupy SMP jurisdiction land in Reach 28, but there is one storm sewer outfall occurs along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 61.3% of the shoreline along Reach 28 is hardened with bulkheads. In addition, 25 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 28 is entirely Single Family Residential. Currently 100% of the reach is designated as Urban by the SMP.

Cultural Resource Designations (Table 6)
There are no Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 28 on file with the Washington State Office of Archaeology and Historic Preservation.

ECOLOGICAL FUNCTION SUMMARY

Reach 28 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 26.9% Rapid permeability: 92.6%	Wetlands: 7.3% Undeveloped: 6.5% Riparian tree cover: 45.5% Priority habitats: 2 Species of concern: 4 Fish Species: 12		Principal land use: residential-1 family Imperviousness: 27.8% Bulkheads: 61.3% Storm drains: 1 Docks: 25

Ecological functions along Reach 28 are impaired by residential development, which covers the majority of the jurisdiction (81.7%), though 6.5% of the land is still undeveloped along the reach. Riparian vegetation has been removed and replaced with buildings and lawns, both of which can promote increased runoff and nonpoint source pollution. One storm sewer outfall is also found along this reach. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is

relatively limited, extending along 8.5% of the reach. On the other hand, over 45% of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. The riparian vegetation includes Russian olive, a highly invasive exotic species. In addition, 7.3% of the reach is classified as wetland habitat, while two types of priority habitat are also associated with this reach. Despite limited windward fetch and an erosion-resistant substrate of mixed alluvium, the majority of the reach has shoreline hardening (61.3%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the twelve fish species typically found along this reach (the second highest diversity of any reach). This aquatic habitat is further impaired by the relatively high number of docks (25) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
28	Shoreline Residential	Residential uses with extensive docks and bulkheads

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Prevent increase in the number of bulkheads on the shoreline.
B. Protect existing wetlands from encroachment by residential development.
C. Protect priority riparian habitat as identified by WDFW.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
B. Use education and incentives to encourage restoration of emergent vegetation on developed parcels and in agricultural areas.
C. Retrofit storm sewer outfalls to limit pollution loading to the lake.
D. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.

REACH 29

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 29 is dominantly flood gravels. This reach is a prominent cut bank, and was an area of erosive energy when the Missoula Floods were racing through the area. Approximately 42.8% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are classified as mixed alluvium (100%). The soils within the SMP jurisdiction are predominately Malaga stony sandy loam (75.8%) (NRCS, 2003). As a result, soil permeability is primarily moderately rapid (98.8%) while runoff is primarily classed as slow (100%). The hazard of soil erosion is also predominately slow (100%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the northeast and southeast. Fetch lengths range between 0.87 and 3.99 km and are higher for both the southeast and northeast. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline having nearshore exposure widths mostly less than 10 m (99.1%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 62.5% of Reach 29. The principal upland species include willow (*Salix),* poplar (*Populus*), and elm (*Ulmus*). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is relatively extensive, with an average width of less than 2 m extending along 75.3% of the reach. The primary emergent vegetation species of Reach 29 are softstem bulrush (*Scirpus validus*) and common reed (*Phragmites australis*).

Based on information collected for WDFW in 2003, unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005). On the other hand, protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*).

Wetlands
No wetlands are found in the SMP jurisdiction along Reach 29 (USFWS, 2003).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least twelve fish species may be found along Reach 29, dominated by yellow perch (55%), bluegill (13%), largemouth bass (11%), and walleye (7%)(Fig. 28) (Gabriel and Jordan, 2004). Other notable species include black crappie (5%), bullhead (4%), and smallmouth bass (4%)(Table 40). Portions of the shoreline have also been identified as good bass fishing areas (Fish-n-Map Co., n.d.).

Avian
Reach 29 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with denser zones of emergent vegetation or riparian tree cover, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore is also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the late fall and early spring (WDFW, 2002). In addition, the reach is classified as a priority riparian habitat, consisting mainly of willow and elm, which provide habitat for pheasants, quail, and nongame birds.

Terrestrial
Reach 29 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern.

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 29, 54.2% are classified as single-family residential, 20.4% is agriculture, 8.8% is unclassified, 7.7% is classified as mining, 7.1% is undeveloped, 0.9% is recreation, and 0.9% is transportation and utilities. Based on land use, imperviousness of this reach is estimated to be approximately 11.9%. Parcel sizes in the reach have an average width of 48 m and an average depth of approximately 69 m. Based on a survey of 50 shoreline structures, average structure setback from the shoreline along reach 29 is 22.1 m, ranging from 3.1 to 49.3 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 3987 meters of SMP jurisdiction land in Reach 29, though no storm sewer outfalls occur along this reach (WDNR, 1996 ,City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 17.9% of the shoreline along Reach 29 is hardened with bulkheads. In addition, 49 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 29 is predominantly Urban Residential 3 (93.7%), with a smaller area of Single Family Residential (6.3%). Currently the Grant County SMP environmental designation for Reach 29 is a combination of Suburban and Rural

Cultural Resource Designations (Table 6)
There is one Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 29 on file with the Washington State Office of Archaeology and Historic Preservation. This site is a habitation site.

ECOLOGICAL FUNCTION SUMMARY

Reach 29 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 42.8% Rapid permeability: 1.2%	Undeveloped: 7.1% Riparian tree cover: 62.5% Priority habitats: 2 Species of concern: 5 Fish Species: 12		Principal land use: residential-1 family Imperviousness: 11.9% Roads: 3987 m Bulkheads: 17.9% Docks: 49

Ecological functions along Reach 29 are impaired by residential development, which covers the majority of the jurisdiction (54.2%), though 7.1% of the land is still undeveloped along the reach. Riparian vegetation has been removed and replaced with buildings and lawns, both of which can promote increased runoff and nonpoint source pollution. Based on land use, imperviousness of this reach is estimated to be approximately 11.9%. Roadways occupy 3987 meters of SMP jurisdiction land in Reach 29, may be an additional source of nonpoint pollutants. While no wetlands are located in this reach, emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is relatively extensive, extending along approximately three-quarters of the reach, though at average widths of less than 2 m (this might be in

part due to the relatively steeper nearshore found along this reach). In addition, over 62.5% of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. The riparian vegetation includes Russian olive, a highly invasive exotic species. Two types of priority habitat are found along this reach. Despite limited windward fetch and an erosion-resistant substrate of mixed alluvium, a substantial portion of the reach has shoreline hardening (17.9%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the twelve fish species typically found along this reach (the second highest diversity of any reach). This aquatic habitat is further impaired by the extremely high number of docks (49) found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
29	Shoreline Residential – Resource	Primarily residential use; riparian tree cover

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Prevent increase in the number of bulkheads on the shoreline.
B. Protect emergent vegetation near docks, residential areas, and public access areas.
C. Protect vegetative buffer on residential and agricultural land.
D. Protect emergent vegetation near docks, residential areas, and public access areas.
E. Protect vegetative buffer on residential and agricultural land.
F. Protect priority riparian habitat as identified by WDFW.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).
B. Use education and incentives to encourage restoration of vegetative buffers on developed parcels and in agricultural areas.
C. Develop vegetative buffers around parking areas on public land, as well as direct overland flow away from lake.

REACH 30

ABIOTIC (TABLES 2 AND 3) – *see Physical Synthesis Map in the Map Portfolio DVD (physical.pmf)*

Geology and Soils
The surface geology of Reach 30 is dominantly flood gravels. This reach is a product of glacial outwash of the ice sheet working in conjunction with the existing topography. Approximately 12% of the area has slopes greater than 15% (USGS, 2000). Nearshore sediment sizes are entirely classified as mixed alluvium. The soils within the SMP jurisdiction are predominately Ephrata gravelly sandy loam (31.5%) and Ephrata-Malaga complex (30.1%) (NRCS, 2003). As a result, soil permeability is moderately rapid (100%), while runoff is classed as slow (100%). The hazard of soil erosion is also slow (100%).

Fetch and Near-Shore Exposure
The shoreline is primarily exposed to wind directions from the northeast and south. Fetch lengths range between 1.12 and 2.71 km and are higher for both the south and northeast. The relatively steep nearshore tends to be minimally impacted by the fall lake level drawdown of approximately 1.5 m, with the shoreline primarily having nearshore exposure widths less than 10 m (99.2%).

BIOTIC (TABLE 4) – *see Biological Synthesis Map in the Map Portfolio DVD (biological.pmf)*

Natural Vegetation
Upland
The potential natural vegetation is primarily shrub-steppe (USFS, 1995).

Riparian
Overhanging vegetation is present along 57.4% of Reach 30. The principal upland species is willow (*Salix*). This riparian zone also supports Russian olive (Elaeagnus), an invasive species. Emergent vegetation in the littoral zone is relatively extensive, with an average width less than 2 m extending along 77.8% of the reach. The primary emergent vegetation species of Reach 30 are softstem bulrush (*Scirpus validus*), common reed (*Phragmites australis*), and broad-leaved cattail (*Typha latifolia*).

Based on information collected for WDFW in 2003, unprotected mixed alluvium shorelines found along this reach tend to have approximately 11 species of aquatic vegetation found in the nearshore, including 6 submergent and 5 emergent species, dominated by sago pondweed (*Potamogeton pectinatus*) (Table 7) (Central Washington University, 2005). On the other hand, protected mixed alluvium shorelines tend to have lower diversity of species, including 4 submergent and 4 emergent species (Table 8), dominated by sago pondweed and white stem pondweed (*Potamogeton praelongus*).

Wetlands
Palustrine emergent wetland habitat in Reach 30 is fairly extensive, comprising 8.1% of the SMP jurisdiction (USFWS, 2003). Much of this habitat is classified as priority habitat, consisting of hardstem bulrush, cattail and common reed (WDFW, 2002).

Wildlife
Fish
Based on data collected by WDFW between 2002 and 2003, at least eight fish species may be found along Reach 30, dominated by bluegill (36%), walleye (30%), and largemouth bass (15%)(Fig. 29) (Gabriel and Jordan, 2004). Other notable species include black crappie (8%) and bullhead (6%)(Table 41). Portions of the shoreline have also been identified as good bass fishing areas (Fish-n-Map Co., n.d.).

Avian
Reach 30 provides potential habitat for numerous avian species, such as mallard, Canada goose, and red-winged blackbird, most likely associated with wetland habitat, denser zones of emergent vegetation or riparian tree cover, and undeveloped land (WDFW, 1997). Refer to Table 42 for a complete list of species. Among these species is the Western grebe, a species of current concern. In addition, Table 43 lists the avian species that have been observed in the Moses Lake area from 1998–2003 and may potentially be found in the region. The reach's nearshore is also classified as a priority habitat for waterfowl concentrations of several species of ducks and Canada geese in the later fall and early spring (WDFW, 2002). In addition, the reach is classified as a priority riparian habitat, consisting mainly of willow and elm, which provide habitat for pheasants, quail, and nongame birds.

Terrestrial
Reach 30 provides potential habitat for numerous terrestrial species, such as the painted turtle, raccoon, and striped skunk, most likely associated with wetland habitat and undeveloped land (WDFW, 1997). Refer to Table 44 for a complete list of species. Among these species, the Northern leopard frog, Townsend's big-eared bat, and yuma myotis are species of current concern. In addition, the reach is classified as a priority riparian habitat (WDFW, 2002).

CULTURAL MODIFICATIONS – *see Cultural Modifications Synthesis Map in the Map Portfolio DVD (cultural_modifications.pmf)*

Land Use (Table 5)
Of the SMP jurisdiction lands along Reach 30, 47.7% are classified as undeveloped, 17.9% as recreation, 17.7% are under single-family residential, and 16.7% are classified as commercial. Based on land use, imperviousness of this reach is estimated to be approximately 2.1%. Parcel sizes in the reach have an average width of 268 m and an average depth of approximately 319 m. Based on a survey of 3 shoreline structures,

average structure setback from the shoreline along reach 30 is 38.0 m, ranging from 36.3 to 39.5 m. There are no public lands within the SMP jurisdiction.

Transportation Infrastructure (Table 6)
Roadways occupy 67.0 meters of SMP jurisdiction land in Reach 30, though no storm sewer outfalls occur along this reach (WDNR, 1996, City of Moses Lake, n.d. b).

Bulkheads and Docks (Table 6)
Approximately 8.5% of the shoreline along Reach 30 is hardened with bulkheads. In addition, 4 docks are located along this reach.

CULTURAL JURISDICTIONS – *see Cultural Jurisdictional Synthesis Map in the Map Portfolio DVD (cultural_jurisdiction.pmf)*

Zoning (Table 5)
Current zoning within the SMP jurisdiction of Reach 30 is entirely Urban Residential 2. Currently the Grant County SMP environmental designation for Reach 30 is Rural.

Cultural Resource Designations (Table 6)
There are two Archeological Site Form records of cultural sites with in the SMP jurisdiction of Reach 30 on file with the Washington State Office of Archaeology and Historic Preservation. One Campsite and one lithic scatter. One site is recorded as a lithic scatter and the other site is recorded as a campsite.

ECOLOGICAL FUNCTION SUMMARY

Reach 30 Shoreline Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 12%	Wetlands: 8.1% Undeveloped: 47.7% Riparian tree cover: 57.4% Priority habitats: 3 Species of concern: 4 Fish Species: 8		Principal land use: undeveloped Imperviousness: 2.1% Roads: 67 m Bulkheads: 8.5% Docks: 4

Ecological functions along Reach 30 are impaired by residential and recreational development, though much of the land is still undeveloped along the reach (47.7%). Riparian vegetation has been removed and replaced with buildings, lawns and a golf course, all of which can promote increased runoff and nonpoint source pollution. Based on land use, imperviousness of this reach is estimated to be approximately 2.1%. Emergent vegetation in the littoral zone, which is both an important habitat and buffer for nonpoint pollution, is relatively extensive, extending along approximately three-quarters

of the reach, though at average widths of less than 2 m (this might be in part due to the relatively steeper nearshore found along this reach). In addition, 8.1% of the reach is classified as wetland habitat, while over 62.5% of the reach has overhanging vegetation, which helps provide shading of aquatic habitat and bank stability. The riparian vegetation includes Russian olive, a highly invasive exotic species. Besides wetland habitat, the reach is also associated with two other types of priority habitat and 5 Natural heritage locations. Despite limited windward fetch and an erosion-resistant substrate of mixed alluvium, a relatively small portion of the reach has shoreline hardening (8.5%), which increases wave reflectivity, thereby affecting aquatic vegetation and the habitat for the eight fish species typically found along this reach. This aquatic habitat is further impaired by the four docks found in this reach, as well as exotic weed species such as Eurasian water milfoil and curly-leaf pondweed typically found along this shoreline type.

Draft Environmental Designations – *see Environmental Designations Map in the Map Portfolio DVD (env_designations.pmf)*

Reach	Designation	Rationale
30	Shoreline Residential – Resource	Residential uses; riparian tree cover; wetlands; emergent vegetation; priority habitats

Opportunities for Protection – *see Opportunities Map in the Map Portfolio DVD (opp_protection.pmf)*

A. Protect existing wetlands from encroachment by residential and recreational development.
B. Develop construction runoff controls for new construction, especially in high soil erosion areas with limited riparian vegetation.
C. Protect vegetative buffer on residential and agricultural land.
D. Prevent increase in the number of bulkheads on the shoreline.

Opportunities for Restoration – *see Opportunities Map in the Map Portfolio DVD (opp_restoration.pmf)*

A. Reduce number of bulkheads by replacing with bioengineering approaches or upland retaining walls and emergent vegetation (perhaps develop pilot demonstration project on public lands).

REFERENCES

Bain Jr., Richard C. 1998. Moses Lake Area: Water Quality Monitoring Report (1997). Moses Lake Irrigation and Rehabilitation District.

Bain Jr., Richard C. 1987. Moses Lake Clean Lake Project. Irrigation Water Management Final Stage 3 Report. Moses Lake Irrigation and Rehabilitation District.

Bain Jr., Richard C. 1990. Moses Lake Clean Lake Project. Irrigation Water Management Final Report. Moses Lake Irrigation and Rehabilitation District.

Carroll, James V. 2002. Moses Lake Total Maximum Daily Load Phosphorous Study (Draft). Washington Department of Ecology, Publication No.03-03-02.

CH2MHill. 1994. Sewer System Plan, City of Moses Lake, Washington.

City of Moses Lake. n.d.a. City Parcels and Land Use. Data received June 2004.

City of Moses Lake. 1997. Comprehensive Plan. City of Moses Lake, Washington.

City of Moses Lake. 2001a. Park, Recreation, & Open Space Plan, Moses Lake, Washington.

City of Moses Lake. 1988. Shoreline Management Master Plan.

City of Moses Lake. 2003. Storm Sewer Lines and Outlets. AutoCad map format. Data received June 2004.

City of Moses Lake. 2001b. Water System Plan for the Year 2000. Prepared by the City of Moses Lake Municipal Services Department Engineering Division.

Fish-n-Map Co. n.d. Potholes Lake, Moses Lake, Lake Sammamish.

Gabriel, A.O., and L. Jordan. 2004. Shoreline Habitat Characterization and Analysis for the Moses lake Project. WDFW Contract Report. Contract #33030533. Geo-Ecology Research Group, Central Washington University, Ellensburg, WA.

Grant County. 2004. Grant County Zoning. Data received December 2004.

Pitz, Charles F., L.G, L.HG. 2003. Moses Lake Total Maximum Daily Load Groundwater Study. Washington Department of Ecology, Publication No. 03-03-005.

United States Census Bureau. (2000). Census TIGER® 2000/ Line Data; Railroads. Data retrieved 2004 from www.geographynetwork.com.

United States Department of Agriculture, Natural Resources Conservation Services. (2003). Soil Survey Geographic (SSURGO) Database. Data acquired January 2004. **http://www.ncgc.nrcs.usda.gov/products/datasets/ssurgo/**

United States Department of Agriculture, Natural Resources Conservation Services. (1986). Urban Hydrology for Small Watersheds. Technical Release 55.

United States Fish and Wildlife Service. 2003. National Wetlands Inventory Data. Data retrieved 2004. **http://www.nwi.fws.gov/**

United States Geological Survey. 2000. 10-m Digital Elevation Model. Data retrieved 2004.

Washington State Department of Ecology. 1998a. 303(d) Listings. Data retrieved 2003. http://www.ecy.wa.gov/services/gis/data/watqual/ai_read_me.htm#license.

Washington State Department of Ecology. (1998b). DOE Facilities/Sites. Data retrieved 2004. **http://www.ecy.wa.gov/services/gis/data/agreement.asp?name=facility**

Washington State Department of Ecology. (1998c). FEMA Q3 Flood Data. Data retrieved 2004. **http://www.ecy.wa.gov/services/gis/data/flood/agreement.asp?name=c53065**

Washington State Department of Ecology. 1995. Lake Bathymetry of Washington. Data retrieved 2004. **http://www.ecy.wa.gov/services/gis/data/data.htm**

Washington State Department of Ecology. 2004. Leaking Storage Tanks. Data retrieved 2004.
http://www.ecy.wa.gov/programs/tcp/ust-lust/ust-lst2.html

Washington State Department of Ecology. 2004. Shoreline Master Program Development. http://www.ecy.wa.gov/programs/sea/sma/st_guide/SMP/index.html.

Washington State Department of Fish and Wildlife. 1997. GAP Analysis. Data retrieved 2004.
http://www.wdfw.wa.gov/wlm/gap/vdm.htm.

Washington Department of Fish and Wildlife. 2002. Priority Habitats and Species and Natural Heritage Site databases. Received December 2004.

Washington State Department of Natural Resources. 2000. Geology of Washington (1:100,000-scale). Data retrieved 2004.
http://www3.wadnr.gov/dnrapp6/dataweb/dmmatrix.html#Geology.

Washington State Department of Natural Resources. (1996). Transportation (Roads and Railroads) of Washington (1:24,000-scale). Data retrieved 2004.
http://www3.wadnr.gov/dnrapp6/dataweb/transd.html