Final Environmental Assessment

Howard Hanson Dam
Right Abutment Investigation, Reservoir Refill, Reservoir Drawdown, and Interim Repair

Green River, King County, Washington

June 2009

US Army Corps
of Engineers®
Seattle District

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Responsible Agency: The responsible agency for this work is the U.S. Army Corps of Engineers, Seattle District.

Summary: During a rain storm in January 2009, water was stored at Howard Hanson Dam to elevation 1189 ft to prevent flooding downstream. This was a record flood storage height for the dam. During this time, two small depressions formed on the upstream face of the right abutment of the dam. Turbid water was observed from one of the drains in the right abutment drainage tunnel. These facts create concern that a flow path through the right abutment could potentially be developing that could ultimately lead to dam failure. Several actions are planned to 1) support an investigation of the right abutment to better understand these facts, 2) ensure a safe spring refill of the reservoir, and 3) implement an interim repair of the right abutment. The specific actions include construction of new roads to install monitoring wells on the right abutment, a modified spring reservoir refill, a modified reservoir drawdown, installation of drainage tunnel dewatering wells, and construction of a grout curtain along the right abutment. This document evaluates effects of these actions.

This environmental assessment is intended to meet the Corps' requirements under the National Environmental Policy Act, consistent with Corps implementing regulations (ER 200-2-2).

THE OFFICIAL COMMENT PERIOD FOR THIS ENVIRONMENTAL ASSESSMENT WAS FROM MAY 22, 2009 TO JUNE 8, 2009.

This document is available online under the project name "Howard Hanson Dam Right Abutment" at: http://www.nws.usace.army.mil/ers/doc_table.cfm.

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1. INTRODUCTION

1.1. Background

Howard Hanson Dam (HHD) is located on the Green River 35 miles southeast of Seattle and 25 miles east of Tacoma, Washington (Figure 1). HHD is operated during flood events to reduce the risk of flooding in the lower Green River valley including the cities of Kent, Auburn, Renton, and Tukwila.

During a storm event on 9 January 2009, HHD reached a record high pool elevation of 1188.8 feet[1]. This is approximately six feet higher than the previous high pool record that occurred in February 1996. During and immediately after the record high flood pool, sediment was observed in the water from one of the drainage tunnel wells (well 25) in the right abutment of the dam, and a depression formed on the upstream face of the right abutment of the dam at approximately elevation 1191 ft (Figure 2). A second smaller depression was discovered at approximately elevation 1174 ft on 2 February 2009.

The sediment movement combined with depression formation is an indication of potential piping. Piping is the movement of soil particles by percolating water leading to the development of a channel, and has been identified as a credible failure mode for the right abutment of the dam. Dam failure is not considered an imminent threat at this time. However, in response to these events, the Corps is investigating the integrity of the right abutment. This includes a series of actions that are detailed in this document.

1.2. Purpose and need

The purpose of the right abutment investigation, reservoir refill, and reservoir drawdown activities that are detailed in this document is to evaluate the integrity of the right abutment of the dam in a safe manner. Furthermore, the actions will provide data to determine acceptable flood, conservation, and M&I water storage elevations. Finally, data will be used to design both an interim and ultimately a permanent repair to the right abutment. The purpose of the interim repair project is to address the piping concerns suggested by the depressions and turbidity observed during the January flood.

1.3. Project location

Howard Hanson Dam (HHD) is located in southeast King County on the Green River near Ravensdale, Washington. The dam is located at river mile (RM) 64.5 in Section 28, Township 21 North, Range 8 East, Willamette Meridian. The dam lies within the city of Tacoma municipal watershed and access to much of the over 220 square miles of watershed above HHD is closed to the public. From RM 64.5, the Green River flows west and north from the Cascade Mountains to join with the Black River to form the Duwamish River at RM 12. The Duwamish River then empties into Puget Sound 12 miles downstream at Elliott Bay.

[1] All elevations in this document are referenced to mean sea level.

1.4. Project authority

The authorization for the dam, initially named the Eagle Gorge Dam, came from the Rivers and Harbors Act of 1950 (Public Law 516, 81st Congress, 2nd Session, 17 May 1950). It was constructed by the U.S. Army Corps of Engineers (Corps) and completed in 1962. HHD is a 100 percent Federally funded and operated project. The original authorized and implemented project purposes were flood control and summer low flow augmentation. This includes authority to undertake activities that are necessary for the protection of human health and life downstream, and to protect substantial property interests. The low flow augmentation objective is to discharge sufficient water from the dam to meet 110 cfs with a reliability of 98 percent as measured at the Palmer U.S. Geological Survey (USGS) stream gage about four miles downstream of the dam.

King County was the local sponsor for the original construction and operation of HHD as a flood control structure. The county and several local municipalities maintain a series of levees along the Green River that function in coordination with HHD to regulate floods and protect capital improvements in the lower watershed. HHD provides flood risk management benefits to over $25 billion in infrastructure located in the lower Green River valley, which includes the cities of Kent, Auburn, Renton and Tukwila. The estimated flood damages prevented by the operation of HHD during the January 2009 flood were approximately $3.9 billion.

In April 1997, approval was granted under Section 1135 of the 1986 Water Resources Development Act, as amended, to increase the volume of summer conservation storage. The city of Tacoma was the local sponsor. The Section 1135 project provides for addition of up to 5,000 acre-feet of water storage behind the dam for flow augmentation.

Ecosystem restoration and water supply were added as project authorities with the Additional Water Storage Project (AWSP), a dual purpose project authorized in the Water Resources Development Act of 1999. The city of Tacoma was the local sponsor. Funds were first appropriated for construction in 2002. Phase 1 of the AWSP includes additional water storage behind HHD to elevation 1167 ft for municipal and industrial (M&I) purposes and construction of a suite of habitat restoration and mitigation projects including a fish passage facility at the dam (Corps 1998). The AWSP is currently being implemented. Water was first stored to 1167 ft for M&I purposes in 2007. Because the AWSP has not been fully implemented, and in particular not all mitigation measures have been accomplished, water stored for M&I purposes is considered to be relegated to a subordinate level of priority as compared to requirements imposed by natural resource concerns, in the event that conflict arises between these two considerations.

1.5. Howard Hanson Dam

HHD is an earth-filled structure composed of rolled rock fill, sand and gravel core, drain zones, and rock shell protection (Corps 1998). The embankment is 235 feet high and 500 feet long and has an inclined core of sand and gravel material. The dam is 960 feet thick at the base decreasing to 23 feet thick at the crest. The total length of the dam is 675 feet. The intake structure includes trashrack bars, a deck for debris removal, one tractor-type emergency gate, and gate hoist equipment located in the gate tower. The outlet structure consists of a gate tower and

intake structure with two tainter-type gates, a 900-foot-long concrete horseshoe-shaped 19-foot-diameter outlet tunnel, a gate-controlled bypass pipe, and a stilling basin.

The gate-controlled spillway is anchored in rock on the left abutment and in a concrete monolith adjacent to the embankment. The spillway is a concrete ogee overflow section with two 30-foot-high by 45-foot-wide tainter gates to control major flood flows and prevent overtopping of the dam. The lowest elevation of the gates is 1,176 feet. The downstream chute has a curved alignment and is paved for a distance of 712 feet downstream from the weir. The tainter gates permit storage to elevation 1,206 feet without spillway discharge. The reservoir provides 106,000 acre-feet of flood control storage at elevation 1,206 feet. The maximum spillway discharge is 115,000 cfs at the spillway design flood pool elevation.

The right abutment of the dam is a pre-historic landslide deposit (Figure 2). Subsequent modifications of the dam structure were made after water seepage was discovered during a high water period that occurred in February 1965. The seepage was controlled by a gravel blanket supported by a crib wall. In 1968, a drainage tunnel was constructed within the downstream side of the right abutment at elevation 1,100 feet and extending 640 feet into the right abutment. Twelve relief wells were drilled and extend 20 feet below the tunnel floor. In 2002, a grout curtain was constructed along 300 ft of the right abutment. The top height of the grout curtain is approximately 1207 ft; however, it is somewhat discontinuous along its length.

1.6. Howard Hanson Dam operations

The project is currently operated to provide flood control, summer low-flow augmentation, ecosystem restoration, and water supply. Flood control is the primary operation during the winter generally from late October to March. Usually beginning in late February, the project switches from flood storage to its secondary roles of conservation storage for low-flow augmentation, ecosystem restoration, and water supply.

1.6.1. Winter flood control

HHD provides flood control storage of approximately 106,000 acre-feet from October through March. The project regulates 46 percent of the total drainage area. Therefore, it is not possible to provide total control of all floods in the basin. Flood events that require flood control regulation are expected to have a 50 percent chance of occurrence each year (Corps 1998).

Outflow during a flood is constrained by the Green River channel capacity which is measured to safely carry flows of up to 12,000 cfs as measured at the Auburn USGS stream gage at RM 32. To provide a margin of safety against errors in forecasted local inflow, the project outflow is regulated to an objective flow of 10,000 cfs at Auburn on the rising limb of a flood hydrograph. The objective flow may be increased to 12,000 cfs during a flood recession (once the peak of uncontrolled inflows downstream of HHD have passed) to evacuate storage as rapidly as practicable.

1.6.2. Spring reservoir refill

The spring reservoir filling period continues to evolve over time as more knowledge is gained about hydrologic patterns and natural resource issues. In recent years, spring refill has usually occurred from late February to June. The reservoir is filled by storing a percentage of the inflow to the dam. This is generally referred to as proportional capture. The objective is to refill the reservoir to elevation 1167 ft. The typical target date for a full reservoir is June 1. However, this date varies depending on weather conditions, snow pack, and other factors. At full pool, the water storage includes approximately 25,000 acre-feet for low flow augmentation (1070-1141 ft), 5,000 acre-feet for the Section 1135 restoration project (1141-1147 ft), and 20,000 acre-feet for Tacoma M&I purposes (1147-1167 ft). As indicated previously, the latter component of storage for M&I purposes is subordinated in priority to natural resource concerns in the event of conflict between the two considerations.

1.6.3. Summer conservation flows

After refill is complete in the late spring, the Corps generally passes inflow and maintains the full conservation pool until water is needed from storage. The summer conservation or augmentation period is typically late June to as late as December, dependant on fall hydrologic conditions. Section 1135 water is often used during the early summer (June to July) and early fall (mid-September to October) but is flexible and modified on an annual basis in coordination with natural resource stakeholders and fisheries requirements. M&I water is discharged from the dam at the request of Tacoma. Tacoma collects this water at the Tacoma Headworks Dam at RM 61. The reservoir is evacuated in the late fall as soon as conditions indicate water storage is no longer needed or in order to prepare for flood control operations.

2. ALTERNATIVES

There are four separate categories of actions that are evaluated in this document. The actions include road construction on the right abutment of the dam, a modified reservoir refill plan, a modified reservoir drawdown plan, and interim repair of the right abutment. Each action is independent of the other, except for the reservoir drawdown which assumes a reservoir refill to 1167 ft. Each action, range of alternatives, and effects are addressed and described in the following sections.

2.1. Road construction

In order to more fully understand water movement through the right abutment, groundwater monitoring equipment must be installed along the right abutment. In order to install this equipment, existing roads must be repaired and some new roads must be constructed to provide for the passage of necessary heavy equipment. These roadways would provide direct access to current monitoring locations, and provide access for the installation of new monitoring devices. These devices are used to monitor groundwater elevations to assist in evaluating the structural integrity of the dam's right abutment, and are expected to have both immediate and long-term utility. Establishing access in order to install the necessary instrumentation is highly urgent in

order that all possible evaluation and interim repair efforts can be completed prior to the next flood season.

2.1.1. No action

The National Environmental Policy Act (NEPA) requires that each EA include an analysis of the "no-action" alternative, against which other alternatives including the proposed action can be compared. The no-action alternative would not provide the monitoring equipment necessary to obtain data needed to provide both immediate and long-term evaluation of the right abutment of the dam under different reservoir levels. Under this alternative no work would be done to construct roads or provide equipment access to current and new monitoring locations. This alternative does not meet the project objective of obtaining additional groundwater data for the right abutment. The no-action alternative provides the baseline for evaluating the effects of the action alternatives.

2.1.2. Construct new roads, and repair existing roads

The alternative calls for construction of several new roads, repair, rehabilitation (i.e. minor grading, resurfacing), and widening of existing roadways on the hillside above the right abutment. The purpose is to install monitoring wells and associated equipment along the roadways. This alternative was not carried forward for detailed analysis because it was inconsistent with certain requirements established in the Tacoma Habitat Conservation Plan (HCP) for this location (Tacoma 2001).

2.1.3. Construct limited new roads, repair existing roads, and close roads

The alternative calls for limited construction of new roads, repair, rehabilitation (i.e. minor grading, resurfacing), and widening of existing roadways on the hillside above the right abutment, and abandonment of some existing roads. The purpose is to install monitoring wells and associated equipment along the roadways (Figure 3). This is the preferred alternative because it met all objectives and was consistent with environmental requirements for the site.

2.2. Reservoir refill

As a result of the two depressions and turbidity observed at the dam during the January flood, there is concern about storing water during the normal spring refill period. A modification to the normal spring refill was therefore warranted. The alternatives below consider the various issues associated with this action.

2.2.1. No action – refill to 1167 ft

In the case of HHD refill, the no-action alternative consists of normal spring refill operations at the dam. Since 2007, this has meant storing water by proportional capture from the end of February until June to a reservoir elevation of 1167 ft. The typical target date for a full reservoir is June 1. However, this date varies depending on weather conditions, snow pack, and other factors. The alternative does not provide for a systematic evaluation of reservoir refill. It does provide data useful for future flood management, investigation, and repair of the right abutment.

The alternative does not address water storage concerns and therefore does not meet the purpose and need. The no-action alternative provides the baseline for evaluating the effects of the action alternatives.

2.2.2. No spring refill

This alternative results in no reservoir water storage at HHD during the spring. Under this alternative the reservoir would remain at approximately elevation 1070 ft. This is considered the elevation of an empty reservoir and is typically referred to as the turbidity pool because if the reservoir drops below this elevation, sediment is eroded from the banks of the river creating turbid conditions in the reservoir and in the downstream river. This alternative results in no low flow augmentation of the Green River, no Section 1135 water storage, and no M&I water storage for the city of Tacoma. It provides no data that can be used to guide future flood operations or future repairs. It was therefore not carried forward for detailed analysis.

2.2.3. Refill to 1190 ft to investigate dam with periodic refill stops

This alternative consists of storing water in a gradual and controlled manner from the end of February until June to a peak reservoir elevation of 1190 ft. This includes four temporary stops to maintain a relatively consistent reservoir elevation. Each refill stop would last for approximately four days. The purpose of the stops is to allow wells and instrumentation to equilibrate in order to better evaluate the condition of the right abutment. The refill stops would occur at reservoir elevations of approximately 1147 ft, 1157 ft, 1167 ft, and 1182 ft. This alternative was not carried forward for detailed analysis due to significant environmental effects upstream and potentially downstream of the dam and dam safety concerns related to maintaining high reservoir elevations over the duration required to reach the 1190 ft elevation during the spring.

2.2.4. Refill to 1167 ft with periodic refill stops

This alternative is similar to the no action alternative except that it includes two refill stops for approximately four days each to maintain a relatively consistent reservoir elevation. The purpose of the stops is to allow wells and instrumentation to equilibrate in order to evaluate the condition of the dam. The refill stops would occur at reservoir elevations of approximately 1147 ft and 1157 ft. This alternative was not carried forward for detailed analysis because it provided less data than the preferred alternative.

2.2.5. Refill to 1167 ft, periodic refill stops, with potential short peak above 1167 ft

This alternative consists of storing water to 1167 ft, refill stops at 1147 ft and 1157 ft where a relatively consistent reservoir elevation will be maintained for approximately four days each, and potential for an additional short-term increase in pool elevation above 1167 ft if suitable hydrologic conditions occur. The short-term increase could be between two and 10 feet over 1167 ft. The total duration the reservoir would be higher than 1167 ft is seven days. This includes both the storage and drawdown back to 1167 ft. The drawdown to 1167 ft would replicate the ‘natural’ inflow peak that was captured to raise the reservoir, only it would occur three to four days later. The delayed, managed discharge peak would not be more than ten

percent of the inflow peak. Under this alternative, the reservoir will be held at 1167 ft for approximately two weeks to wait for a storm or snowmelt event to quickly raise the reservoir elevation. The reservoir could be raised above 1167 ft without an inflow peak. Water capture rates would be in the range observed during a typical spring refill. Discharge would be limited to flows below those that might scour steelhead redds. Again, the total time above 1167 ft would be limited to seven days.

The elevations for the refill stops are targets and could occur at an elevation near the target (± 2 feet) depending on hydrologic conditions and forecast. The reservoir will be allowed to increase by about two feet during each four day stop period. This flexibility allows effects of the stops on downstream flow to be minimized. The objective is to minimize abrupt changes in river stage downstream due to the refill stops.

This is the preferred alternative because it maximizes data collected about the dam and minimizes potential adverse effects.

2.3. Reservoir drawdown

A typical reservoir drawdown extends from June until the flood control season typically around November 1. Water has been stored for Tacoma M&I purposes the last two years requiring water to be held above elevation 1147 ft until late September. There is a dam safety concern regarding the storage of water above 1147 ft for this three to four month period. As a consequence of this dam safety concern, alternate drawdown alternatives were considered.

2.3.1. No action - normal drawdown

The normal drawdown would discharge stored water in a manner consistent with all project authorities and stakeholder needs. This is expected to be similar to the drawdown of 2007 and 2008, the first two years water was stored under the AWSP. Normal drawdown therefore consists of gradually drawing down the reservoir in order to provide low flow augmentation of the Green River, Section 1135 flow augmentation, and stored water to the city of Tacoma for M&I uses, as further described in section 1.5.3. The no-action may be the preferred alternative depending on monitoring data collected and dam safety considerations.

2.3.2. Three day drawdown to elevation 1147 ft

The three day drawdown consists of a rapid drawdown from 1167 ft to 1147 ft over about three days. This will result in a flow at the USGS stream gage at Auburn of approximately 12,000 cfs for the three day period. This alternative was not carried forward for detailed analysis due to downstream concerns resulting from discharging this amount of water this time of year. Downstream concerns include safety for unprepared boaters and swimmers, potential for stress to the levee system in the lower Green River valley, and potential adverse effects to natural resources including steelhead that are listed as threatened under the Endangered Species Act.

2.3.3. Ten day drawdown to elevation 1147 ft

The ten day drawdown consists of a relatively rapid drawdown from 1167 ft to 1147 ft over a ten day period. This will result in a flow at the USGS Auburn gage of approximately 6,000 cfs for the entire duration of the drawdown. This alternative was not carried forward for detailed analysis because of downstream concerns including safety for unprepared boaters and swimmers on the river this time of year and potential adverse effects to steelhead.

2.3.4. Three week drawdown to elevation 1147 ft

The three week drawdown consists of a drawdown from 1167 ft down to 1147 ft over three weeks. This will augment flow in the Green River by approximately 500 cfs above the no-action drawdown flows during the three week period. The three week drawdown may be the preferred alternative depending on monitoring data collected and dam safety considerations.

2.3.5. Drawdown to elevation compatible with M&I water needs

The objective of this alternative is to draw down the reservoir from 1167 ft to an elevation that provides M&I water storage sufficient to meet water needs for summer and fall 2009. The drawdown from elevation 1167 ft to this intermediate elevation will take place over approximately two to three weeks. The preliminary estimate required for water storage is approximately 8,000 acre-ft (Tacoma 2009). This equates to a reservoir elevation of 1155.6 ft. The precise storage requirements and resultant reservoir elevation will be determined in real time. This is the presumptive alternative. This may change based on monitoring data collected and dam safety considerations.

2.4. Interim repair

The purpose of the interim repair is to address the potential piping concern suggested by the depressions on the right abutment and turbidity observed during the January flood. The objective of the repair is to restore the flood risk reduction function of the dam before the start of the next flood season which generally begins around November 1. A design for a long term permanent repair is expected to be developed over the next couple years and would be subject to a separate NEPA process.

2.4.1. No action

The no action alternative consists of no repair of the project to address the increased seepage issues identified during and immediately following the January 2009 flood. This alternative was not carried forward because it did not meet the project objective. The no-action alternative provides the baseline for evaluating the effects of the action alternatives.

2.4.2. Micropile wall

This alternative consists of constructing a micropile wall along approximately 300 to 500 feet of the right abutment. This includes drilling two rows of 12 inch diameter holes to bedrock, a depth of approximately 80 to 160 feet, and backfilling with concrete. The two rows would be 10 feet apart. Holes would be drilled every 12 inches. Grout is then injected between the row of

concrete piles. This objective was not carried forward after detailed comparison with the preferred alternative. The micropile wall would result in a seven to 10 foot thick seepage barrier wall. The preferred alternative would result in a 20 foot thick seepage barrier wall. Since seepage control and not structural strength was the objective, the micropile wall was considered an unnecessary structural feature that provided less seepage control than the preferred alternative.

2.4.3. Construct secant wall

The secant wall alternative is similar in design to the micropile wall except the hole diameter is two to four feet, there is only one row of drilled holes filled with concrete, and there is no grout. This alternative was not carried forward because the design could not be completed by the 1 November target date and the technology is rather specialized with limited capability currently available to implement.

2.4.4. Geosynthetic clay liner or shotcrete on upstream face of dam

This alternative consists of either a geosynthetic clay liner or shotcrete applied to the upstream face of the right abutment. The 'blanket' would extend from elevation 1206 ft down to approximately 1070 ft and approximately 1000 ft across the upstream face of the right abutment. A barrier wall would be further excavated or installed from 1070 ft down to bedrock which is approximately elevation 975 ft. This alternative was not carried forward because of constructability issues associated with tying the feature into bedrock.

2.4.5. Dewatering wells in the existing drainage tunnel

This alternative consists of drilling new drainage wells into the right abutment. This alternative includes several actions. It replaces well 25, the drainage tunnel well that produced turbidity during the January flood, with two to three vertical drainage wells and approximately 10 horizontal drainage wells drilled in the immediate vicinity of the current well 25 (Figure 4). Well 25 will be pressure grouted and abandoned as part of the alternative. It adds three horizontal drains at the north end of the drainage tunnel. All drainage wells will be between two and six inches depending on location. The drainage wells that serve to replace well 25 are expected to provide a similar amount of drainage control of the right abutment as the existing well 25. The drainage wells installed at the north end of the tunnel will serve to increase drainage capacity at this end of the right abutment.

This alternative was carried forward as part of the preferred plan because it replaces a problem drainage well that is inadequately screened, and it provides additional dewatering capability of the right abutment. This alternative will reduce potential for water to cause piping and internal erosion within the right abutment.

2.4.6. Grout curtain

This alternative includes construction of a continuous grout curtain along approximately 450 ft of the right abutment. The grout curtain would extend from a minimum elevation of 1206 ft down into bedrock and extend laterally from the embankment of the dam to the northeast across

the right abutment (Figure 4). The grout curtain is constructed by drilling two rows of approximately 6 inch diameter grout holes. The rows are spaced approximately 10 feet apart. The holes are drilled from about elevation 1206 ft down into bedrock and a silt aquitard down to an elevation ranging from 1120 ft at the southwest end to 1040 ft at the northeast end. Grout holes will be drilled approximately 15 ft into bedrock and no more than 4 feet into the silt aquitard. For a given row, there will be at least three series of grout holes drilled. The primary holes will be drilled 20 ft apart. Grout is then injected under pressure. This fills voids within the soil/rock mass. Grout is expected to extend about five feet in all directions from the drilled hole. For each drilled hole, the result is a 10 foot diameter column of grout/soil/rock extending from 1206 ft to depth. After all primary holes are drilled, secondary holes are then drilled in between the primary holes also on 20 ft centers. The secondary holes are thus 10 ft from the primary holes. Grout is injected as described above. Assuming the grout travels the expected five feet after injection in both the primary and secondary holes, there should be 10 foot diameter columns of grout/soil/rock that will reduce water seepage through the abutment. A third series of grout holes is then planned in between the primary and secondary holes to increase the integrity of the grout curtain and ensure all of the soil/rock/voids have been filled with grout. The spacing for this third series of grout holes is 10 feet. In this manner a continuous grout curtain would be constructed. The second row will be constructed after the first row is complete or partially complete. The grout hole spacing will be somewhat tighter for the southeast 100 ft due to use of a lower mobility grout in this location. The reduction in formation permeability by grouting will be tested as grouting progresses by water inflow testing of each hole prior to grouting. Additional series of grout holes will be drilled until permeability specifications are reached. The end product is a grout curtain that is approximately 20 feet thick.

A drill pad and staging area is planned to support the drilling operation. The pad will be constructed on the right abutment of the dam at an elevation around 1206 ft and extend from the engineered dam embankment across the right abutment (Figure 4). The exact dimensions and material of the pad will be determined at the time of construction. It is anticipated the pad will be about 20 ft wide and extend at least the length of the grout curtain. It may extend further to serve as a staging area. The drill pad and staging area may be removed at the end of construction.

Small quantities of water will be required for drilling activities. This water will be obtained from the reservoir. All water generated through drilling activities will be collected and treated as necessary. Stormwater will be controlled at the site and treated as necessary before discharge. Water may be re-used for drilling operations, discharged to construction sedimentation ponds that currently exist on site, or discharged by other appropriate method.

This is part of the preferred alternative because it provides a seepage barrier along the short seepage path of the right abutment. It can be feasibly constructed before the start of the next flood season that begins 1 November 2009.

2.5. Preferred alternative

The preferred alternative consists of:

- Construct limited new roads, repair existing roads, and close roads on the right abutment.

- Reservoir refill to 1167 ft with periodic stops at 1147 ft, 1157 ft, and 1167 ft with option for short duration additional storage above 1167 ft.
- Reservoir drawdown compatible with M&I water needs.
- There are two preferred interim repair alternatives both planned for construction:
    - Dewatering wells in the existing drainage tunnel.
    - Grout curtain.

The preferred alternative is predicated on the fact that an emergency drawdown may be necessary at any reservoir elevation depending on the dam safety situation. This emergency drawdown is considered very unlikely for the duration of the refill and drawdown period.

The road construction project was completed in early April. The reservoir refill stops at 1147 ft and 1157 ft occurred in May. The reservoir drawdown from 1167 ft was initiated on June 16. Due to the emergency nature of the project, the Corps evaluated effects of these project elements to address NEPA as part of an expedited process. This is further detailed in section 7.1.

The vertical wells are planned for construction in August 2009. Work will take approximately two weeks. The horizontal wells are planned for construction after the first grout curtain row is installed. This will probably be about mid-September. The concrete pad is planned for construction in July. The grout curtain is planned for construction from August to November 1. All work is planned to be completed by 1 November 2009. All equipment brought into the Green River municipal watershed and planning to work in or near the water will be disinfected according to Tacoma decontamination procedures.

3. EXISTING CONDITIONS

3.1. Land use and basin characteristics

Most of the land (99 percent) in the upper Green River basin upstream of HHD is managed as a water supply area for Tacoma and for commercial timber production. Ownership in the upper basin is divided among private timber companies, U.S. Forest Service, Burlington Northern Sante Fe Railroad, the Muckleshoot Indian Tribe, city of Seattle, Washington State Department of Transportation, Washington State Department of Natural Resources, and city of Tacoma (Tacoma 1998). Tacoma has intentionally concentrated its holdings in lands adjacent to the Green River and the HHD reservoir. Tacoma manages these lands according to Tacoma's HCP and Green River Watershed Forest Land Management Plan to protect water quality and, where consistent, conduct commercial timber harvest. Private and state timber lands are managed according to the Washington State Forest Practices Rules and Regulations (Title 222 WAC) and other management directives such as Habitat Conservation Plans developed to comply with the Federal Endangered Species Act.

Below HHD, almost 80 percent of the land use is rural, forest production, and urban/residential. The middle Green River basin between HHD and Soos Creek has one of the largest remaining agricultural communities in King County and is of increasing importance as an affordable area for suburban and rural residences and hobby farms. The majority of the lower Green River basin

downstream of the Soos Creek confluence is urban residential, but there is also a substantial amount of rural and agricultural land use. Land use in the lower 11 miles of the basin is predominantly urban-residential, with heavy industrial use along the river. However, even in this urban/industrial setting, over 20 percent of the land is classified as rural.

Prior to settlement by Euroamericans, the floodplain of what was once the lower White River probably covered most of the floor of what is now the Green River Valley north of Auburn, which averages about two miles in width. Due to the construction of levees, dredging of channels, and flood control by HHD, this floodplain is now essentially inactive.

3.2. Geology and soils

Soils in the upper Green River basin upstream of HHD are largely derived from volcanic parent material and occur on mountainous slopes that become quite steep toward the crest of the Cascade Mountains. The upper basin also includes terraces in the underlying lava and bedrock created by glacial scouring and by wave action in large Pleistocene lakes that developed between the glacial lobe and the Cascade Mountains. Many locations of bedrock outcrop also exist. The upper Green River and its tributaries have relatively narrow to nonexistent floodplains that are confined by the steep valley sides.

The lower Green River is defined as the reach below HHD extending downstream to the Puget Sound. In the lower Green River basin, soils are largely derived from unconsolidated glacial material and occur on more gradual slopes characterizing the rolling topography in this area (SCS 1973). Soils in the Everett association, which are gravelly sandy loams formed in glacial outwash deposits, dominate the uplands surrounding the Green River floodplain. Floodplain soils in the middle basin are in the Oridia-Seattle-Woodinville association, which consists of somewhat poorly drained to very poorly drained silt loams, mucks, and peats. There are also strips of gravel and sand deposited along channels, which are typically quite narrow but average nearly 1,000 feet in width (nearly one-third of the floodplain) near the confluence of Newaukum Creek (Mullineaux 1970).

The floodplain of the lower Green River varies considerably in width. The Green River Gorge has virtually no floodplain, due to the rapid downcutting through relatively weak sandstones and mudstones. Downstream of the Gorge, the river has developed a broad floodplain in a valley that is typically about 0.5 mile in width. In the lower Green River basin below the confluence of Soos Creek, soils are also in the Oridia-Seattle-Woodinville association developed from fine-textured alluvial material deposited by the Green, White, and Cedar rivers, with organic soils in depressional areas.

3.3. Climate

The climate of the Green River basin is dominated by maritime influences of the Pacific Ocean and topographic effects of the Cascade Mountains. Regional climate is characterized by cool, wet winters and mild, dry summers. Precipitation is mostly derived from cyclonic storms generated in the Pacific Ocean and Gulf of Alaska that move inland in a southwest to northeast direction across western Washington. Over 80 percent of precipitation falls between the months of October and April. During summer months a regional high pressure system generally resides

over most of the Pacific Northwest, which diverts storms and associated precipitation to the north.

This regional climatic pattern is modified by the presence of the Cascade Mountains, which rise to an elevation of approximately 5,000 feet at the eastern margin of the Green River basin. Moist, maritime air cools and condenses as it moves up in elevation from west to east through the basin, resulting in decreasing temperatures and increasing precipitation up this elevation gradient. Consequently, there is a considerable difference in both temperatures and precipitation from the lower to the higher elevations of the basin. In addition, there is more snow in the upper portion of the basin. Melting of snow and the resulting surface runoff in spring is a major source of water to streams.

3.4. Hydrology

The Green River originates in the high Cascades in central Washington state, and flows northwest for approximately 93 miles before emptying into Puget Sound at Elliot Bay. The basin is about 460 square miles. Forty-eight tributaries enter the system above HHD, feeding both the mainstem and reservoir. Large headwater tributaries include the North Fork of the Green River, and Sunday, Smay, Charley, Gale, Twin Camp, Sawmill and Friday creeks. These tributaries lie within the snow zone and exhibit two distinct discharge peaks associated with fall rainstorms and spring snowmelt.

Below HHD, major tributaries include Newaukum and Soos creeks, which enter the middle Green River near RM 41 and RM 34, respectively. A number of flow-related problems have been associated with the increasing urban development in lower basin tributaries such as Soos Creek (King County 1989). With increasing impervious surface area, water runs off more quickly and less is captured and stored by wetlands or alluvial aquifers, reducing groundwater contributions that maintain summer low flows. Increased impervious area and ground water withdrawals were cited as the primary cause of recent declines in summer low flows in Soos and Newaukum Creeks (Culhane 1995).

Large flood events are most likely to occur from November to March. Highest flows generally occur in December or January, declining through March with a subsequent snowmelt peak in April or May (Corps 1997). As a consequence of HHD construction, flood events that inundated the adjacent floodplain no longer occur. Large, channel-altering flows have an extremely low probability of occurrence (Corps 1997). However, localized flooding does still occur.

Low summer flows are most often associated with reduced upper basin runoff after a low snow year. Minimum stream flows in the river occur between July and November and are most frequent in August and September. Prior to construction of HHD, flows at the Tacoma Diversion Dam (RM 61) fell below 150 cfs every other year on average and below 100 cfs every 9 years on average. The HHD low flow augmentation regime has reduced the frequency of low flows less than 150 cfs to approximately one in every six years, on average, and flows less than 100 cfs to less than once in 50 years (Corps 1997).

Downstream of the confluence with Soos Creek, the river has been channeled and straightened, increasing the velocity of flows through the lower basin due to reduced overbank storage. Overbank storage was historically provided by wetlands and floodplains associated with the river and helped regulate flows, minimizing peak flows and maximizing low flows. There is a high percent of impermeable surfaces that reduces the rate and quantity of infiltration and increases the rate and quantity of surface runoff during storms. This can cause the river to reach a peak flow more quickly, and the peak to be higher in a basin which has undergone urbanization and industrialization (Corps 1997).

3.5. Water quality

The Washington State Department of Ecology (Ecology) is responsible for setting water quality standards based on water use and water quality criteria. For aquatic life uses, the Green River is classified as core summer habitat from the headwaters to about RM 24.5, spawning and rearing downstream to RM 11, and rearing/migration only downstream to the mouth. For recreational uses, the Green River as classified as extraordinary primary contact from the headwaters to Flaming Geyser State Park (RM 43), primary contact downstream to RM 11, and secondary contact downstream to the mouth. For water supply uses, it is classified as domestic water upstream of RM 11. The entire river is classified as suitable for miscellaneous uses (WAC 173-201A-602). In general, water quality in the upper Green River upstream of HHD is better than at the downstream stations. While the Green River maintains a relatively high water quality rating, it appears on Ecology's 303d list of impaired waters for various contaminants and temperature.

3.6. Vegetation and habitat

The upper Green River basin upstream of HHD is within the Western Hemlock Forest Zone (Franklin and Dyrness 1988). The Western Hemlock Forest Zone is characterized by climax western hemlock (*Tsuga heterophylla*) and western red cedar (*Thuja plicata*) forests and sub-climax Douglas-fir (*Pseudotsuga menziesii*) forests. Although western hemlock is the potential climax species in this zone, Douglas-fir forests cover large areas of the landscape. Hardwood forests are commonly restricted to moist, early successional sites, where red alder (*Alnus rubra*) often dominates and big-leaf maple (*Acer macrophyllum*) is common. Common understory species include sword fern (*Polystichum munitum*) in moist sites, salal (*Gaultheria shallon*) in dry sites, and Oregon grape (*Berberis nervosa*) in sites with intermediate moisture status. Vine maple (*Acer circinatum*) is a common shrub in the middle understory.

Disturbance has had a major impact on forest patterns in the upper Green River basin due primarily to extensive timber harvest and past wild fires. Timber harvest activities have resulted in the predominance of second-growth, even-aged coniferous stands. There is a large area of hardwood dominated by red alder with an understory of western hemlock and western red cedar present. The majority of the stands are 30 to 90 years old and, until about 30 years ago, regenerated naturally. More recent harvested areas have been planted with Douglas-fir. Deciduous forests comprised of red alder, big-leaf maple, and black cottonwood (*Populus balsamifera*) occur on wetter slopes.

The lower watershed downstream of HHD is dominated by second-growth Douglas fir on the forested slopes near the river. The forested habitats of the lower watershed are similar in

composition to the forested habitats in the upper watershed. Virtually no late successional forest exists in the lower watershed. Pasture and cropland are the dominant cover types in the agricultural areas further downstream. Because the topography is flatter in the lower watershed, riparian and wetland habitats are more common than in the upper watershed. Riparian deciduous forest is common immediately adjacent to the river. Wetland habitat is most prevalent in the lower segments where the river is flanked by floodplain.

The lower Green River basin is characterized by rapid development and urbanization. In general, human activity and land use intensity increase in the downstream direction. Much of the forest land has been cleared through logging or for agriculture and development. With the construction of HHD and levee system, much of the remaining riparian vegetation has been removed. The vegetation that now exists in the riparian zone is patchy and narrow, and is often dominated by non-native, invasive species. This reduction in riparian vegetation has reduced the corridor function of the riparian zone for wildlife and plants, and has reduced connectivity to upland seed sources. The reduction in the riparian zone has limited the amount of large wood available in the riparian system (Fuerstenberg et al. 1996).

3.7. Fishery resources

Over 30 fish species have been documented in the Green/Duwamish River. The salmonid species include both resident and anadromous stocks. Resident fish are present in the lower river and the upper river including the reservoir area. Anadromous stocks are limited to the river system below the Tacoma Diversion Dam, except where they are stocked or released in the upper basin.

Five major anadromous salmonid runs use the lower and middle basin to complete their life cycles: Chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), chum (*Oncorhynchus keta*), and pink (*Oncorhynchus gorbuscha*) salmon, and steelhead (*Oncorhynchus mykiss*). A few sockeye salmon (*Oncorhynchus nerka*) are observed annually as well. The majority of salmonid spawning occurs upstream of RM 29.6. Limited spawning does occur downstream of this point, however, spawning gravels are limited. Small numbers of sea-run cutthroat trout (*Oncorhynchus clarki*) may also use the middle Green River. Additionally there are three hatcheries operating in the middle Green River, two run by the Washington Department of Fish and Wildlife and one by the Muckleshoot Tribe, which supplement Chinook, coho, chum and steelhead runs. Resident fish populations may include rainbow trout, cutthroat trout and mountain whitefish. Other native fish species are present including lamprey, minnows, sculpins, and suckers.

3.8. Wildlife resources

Wildlife present in the vicinity of the upper watershed upstream of HHD includes common species associated with lowland coniferous and deciduous forests of western Washington. Because the upland forests in the project area consist primarily of younger stands, wildlife primarily associated with late successional forests are expected to be uncommon or absent from the area. A variety of forest dwelling mammals, including herbivores, carnivores, rodents, lagomorphs (rabbits and hares), and insectivores occur. The most visible mammals include Rocky Mountain elk (*Cervus elaphus nelsoni*) and black-tailed deer (*Odocoileus hemionus*).

Cougar (*Felis concolor*) are numerous. Common amphibians and reptiles associated with forests, wetlands, and riparian areas of western Washington live in the upper watershed.

Passerines (perching birds), raptors (birds of prey), waterfowl, upland gamebirds, and shorebirds occupy the various habitats of the upper watershed. Raptors occurring in the basin include bald eagle (*Haliaeetus leucocephalus*), red-tailed hawk (*Buteo jamaicensis*), Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipiter striatus*), osprey (*Pandion haliaetus*) and several species of owls. Waterfowl species that may nest near the reservoir include great blue heron (*Ardea herodias*), Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), green-winged teal (*Anas crecca*), wood duck (*Aix sponsa*), harlequin duck (*Histrionicus histrionicus*), hooded merganser (*Lophodytes cucullatus*) and common merganser (*Mergus merganser*). Common loons (*Gavia immer*) have been observed nested on the reservoir since the early 1990's. The reservoir is utilized during the winter by common goldeneye (*Bucephala clangula*), ring-necked duck (*Aythya collaris*), and bufflehead (*Bucephala albeola*).

Because of the migratory tendencies of many birds, their populations typically fluctuate throughout the year in any given location. The upper watershed is no exception. Passerines are typically more common during the nesting season in spring and early summer. Waterfowl populations are highest in winter when up to 200 ducks have been observed on the reservoir at a time.

Wildlife occurrence in the upstream portion of the lower watershed is similar to that of the upper watershed. However, because of an increase in human activity below the public restricted portion of the watershed, populations of wildlife most sensitive to human disturbance, such as elk and cougar, are generally lower. Further downstream where forest habitat decreases and agricultural land dominates, wildlife composition shifts to a predominance of species associated with agricultural and edge habitat. Because of the increase in human activity and predominance of disturbed habitats in the downstream areas, wildlife inhabiting these areas are typically adaptable to a variety of habitats and have more tolerance to disturbance.

Bird diversity remains high in the middle basin roughly between HHD and Soos Creek, but diminishes somewhat downstream where urban density is higher. Many small mammals (e.g., foxes, skunks, weasels, and squirrels) use the dense understories of some of the forested stands. Small streams and sloughs meander through the pasture and upland habitats, providing habitat for many species of insects and for amphibians including red-legged frogs (*Rana aurora*), Pacific tree frogs (*Pseudacris regilla*), salamanders, and toads. Reptilian fauna is not diverse, but several species of snakes and lizards occur here as well (Corps 1997).

3.9. Threatened and endangered species

Eight endangered or threatened species of animals and fish may occur in the Green River Basin: Northern spotted owl (*Strix occidentalis caurina*), grizzly bear (*Ursus arctos horribilis*), marbled murrelet (*Brachyramphus marmoratus*), gray wolf (*Canis lupus*), Canada lynx (*Lynx canadensis*), Coastal/Puget Sound distinct population segment (DPS) of bull trout (*Salvelinus confluentus*), Puget Sound distinct population segment (DPS) of steelhead(*Oncorhynchus*

mykiss) and Puget Sound Evolutionary Significant Unit (ESU) of Chinook salmon (*Oncorhynchus tshawytscha*).

Northern Spotted Owl

The upper Green River watershed upstream of HHD supports 20 known spotted owl activity centers; none of these, are located within 1.8 miles of HHD. Three years of Washington Department of Natural Resources surveys (1992 to 1994) resulted in no detections of spotted owls, but did result in numerous detections of the barred owl (*Strix varia*). Barred owls are known to compete successfully with spotted owls in young and mid-aged forest, so the abundance of barred owls suggests that the forest in this area is not high quality spotted owl habitat.

Marbled Murrelet

A 1994 survey team identified three stands in the reservoir area as marginally suitable habitat; however, no murrelets were detected in the upper Green River watershed during that survey, making these stands unlikely to be occupied (Corps 2000). One of these stands is about ¾ mile from the project area. In other surveys, two stands with murrelet occupancy were detected more than seven miles east of the reservoir.

Grizzly Bear

The grizzly bear population in the North Cascades ecosystem is estimated at 10 to 20 bears (Johnson and Cassidy 1997); however, the Washington Priority Habitats and Species database contains no records of grizzly bears in the Green River basin (WDFW as cited in Corps 2000). Grizzly bears will avoid areas of human use, including areas containing roads and signs of timber cutting (USFWS 1997).

Gray Wolf

The gray wolf is listed as endangered at both the federal and state levels in Washington. While a small number of sightings have been reported in the North Cascades, the occurrence of the gray wolf in Washington remains questionable (Johnson and Cassidy 1997).

Canada Lynx

Canada lynx require a matrix of two important habitat types, which are boreal forest with a high density of large logs and stumps for denning, and early successional forest with high densities of snowshoe hare (*Lepus americanus*). In Washington, lynx are known to occur above 4,000 feet in elevation (McKelvey et al. 1999). The current projected range of the lynx in Washington does not extend west of the Cascade crest, so lynx presence in the action area is highly unlikely.

Puget Sound Chinook Salmon ESU

Chinook salmon present in the Green River are classified as summer/fall run stocks (WDFW and Western Washington Treaty Indian Tribes 1994). As of 2002 the stock status of Green/Duwamish Chinook is healthy (WDFW 2002). Adult Chinook salmon migrate upstream into the Green River from the Puget Sound from late June through November (Grette and Salo 1986). Most juvenile Chinook salmon in the Green River have an ocean-type life history, meaning that they migrate to the ocean during the year they emerge from spawning gravels (Lister and Genoe 1970; Healey 1991). Chinook salmon outmigration timing is generally

depicted in Figure 5 extending from January until July. Preferred spawning areas for Chinook salmon in the Green River include the main river channel and large side channels upstream of RM 30.0 to the Tacoma Headworks diversion (RM 61.0). The Green River both upstream and downstream of Howard Hanson Dam has been designated as Chinook salmon critical habitat.

Puget Sound Steelhead DPS

Steelhead are known to be present in the Green/Duwamish River year-round. Steelhead are anadromous and can spend several years in freshwater prior to smoltification and migration to salt water. The majority of steelhead found in the Green River remain in the river for two years and in the ocean for two years (Pautzke and Meigs, 1940). The Green River system supports both winter and summer stocks. As of 2002 the winter stock status was healthy, and the summer stock status was depressed (WDFW 2002). The winter return adult wild steelhead in the Green/Duwamish begins in February but occurs predominately in March and April. Critical habitat for Puget Sound steelhead has not yet been proposed.

Coastal-Puget Sound Bull Trout DPS

Bull trout have historically been recorded in the Green River (Suckley 1859) and a bull trout was captured near the mouth of Newaukum Creek in 2000. There is ample evidence from captures that anadromous bull trout regularly use the lower Duwamish River downstream of RM 5.8, especially in the spring. These fish are believed to be migratory visitors from other watersheds that entered the Duwamish perhaps to forage on emigrating smolts. No bull trout have been found in recent surveys of the upper basin upstream of HHD and no bull trout stock is presently recognized as existing in the Green River by WDFW (1998). The Green River downstream of the Tacoma Headworks has been designated as bull trout critical habitat.

3.10. Historic properties and cultural resources

Past researchers have placed the Howard Hanson Dam within the territory of the Green River people or Skopamish (Benson and Moura 1985:13; Lewarch, Forsman, and Larson 1996). During the historic period these and related people came to be known as the Muckleshoot Indians. The Muckleshoot Indian Reservation was established in 1857 and 1874. The geographical position of the Skopamish required greater dependence on hunting and overland travel and the influence of the Sahaptin-speaking Yakama and Klickitat differentiated them from the neighboring Puget Sound groups (Lewarch, Forsman, and Larson 1996:15-16). In reference to Yakama and Klickitat influence in the HHD area, Lewarch, Forsman, and Larson (1996:15) stated that:

The degree of Sahaptin cultural influence upon the Green River groups intensified proportionately to a village's upriver position. In other words, the farther upstream or east a Green River group lived, the more of a Sahaptin and less of a Duwamish cultural influence was present in the village. Therefore, the groups that exploited resources within the project area or traveling through the drainage might be expected to possess cultural adaptations comparable to their Sahaptin neighbors.

National Historic Preservation Act (NHPA) compliance for construction and operation activities at the Howard Hanson Dam Reservoir and associated restoration and mitigation projects was

addressed in a 2003 memorandum of agreement (MOA) signed by the Corps, Tacoma, and the Washington Department of Archaeology and Historic Preservation (DAHP). The Muckleshoot Tribe was consulted during development of the MOA in several staff-to-staff meetings between Corps archaeologists and the Muckleshoot Tribe's Cultural Resource Committee. The tribe chose to not sign the MOA as a concurring party for tribal policy reasons, rather than disagreement with the provisions of the MOA. The Muckleshoot Tribe did provide a letter to the Corps expressing their general support for the provisions of the MOA. The Corps will continue to work closely with the Muckleshoot Tribe on this and other HHD related projects.

In 1995 and 1996 the Corps contracted Larson Anthropological and Archaeological Services (LAAS) to conduct a survey for the AWSP pool raise that included study of the approximately 900 acre impact zone between 1,141 ft and 1,206 ft (Lewarch, Forsman, and Larson 1996). The LAAS survey was hampered by thick vegetation with little native ground surface visibility and did not locate any new prehistoric archaeological sites. The survey did record four historic sites, including several sites that had been previously recorded by Benson and Moura (1986) and Hedlund et al (1978). The sites, consisting of the remnants of a lumber mill, logging camps and homesteads, were assessed as not eligible for the National Register because of extensive damage due to river erosion and historic and recent razing and demolition activities (Lewarch, Forsman, and Larson 1996).

3.11. Recreation and aesthetics

HHD is within the Tacoma municipal watershed boundary. Public access is restricted by Tacoma for the purposes of water quality. As a result there is no recreation around HHD. Downstream of HHD and the municipal watershed boundary, the Green River is a popular boating river. Kayaks and rafts frequent the middle Green River in particular the Green River Gorge (Oasis 2008). Downstream of the Green River Gorge, small boats are common during fishing seasons. Fishing is also common from the river banks throughout the river downstream of HHD.

The visual quality of the lower Green River basin varies with its diverse land use and development. Visual quality decreases downstream as development increases.

3.12. Air quality and noise

The Puget Sound airshed is currently in attainment for carbon monoxide, ozone, PM_{10}, and has maintenance plans in place for these pollutants. Air quality in the lower Green River basin is quite variable and dependant on several factors: season, topography, and nature of pollution sources. In the lower basin, a high concentration of industrial sources and vehicles has caused air quality problems. Motor vehicles are the largest source of air pollutants in King County. General periods of drought in the mid-summer can result in localized problems with dust and particulates from vehicles on unpaved roads or slash burning contributing to high particulate levels. In the winter months, temperature inversions can occur as a result of low solar heating. During these occasions, high concentrations of pollutants associated with wood burning (stoves and fireplaces) and transportation sources can occur. This condition is intensified by the topography of the valley walls.

Sound levels throughout the lower basin are variable depending on location, ranging from relatively loud noises associated with urban and industrial activities on the Duwamish River to very quiet rural environments upstream of Soos Creek. In portions of the lower basin, especially near industrial areas, sound levels could occasionally exceed noise standards under certain conditions.

3.13. Socioeconomic

HHD provides flood risk management benefits to over $25 billion in infrastructure located in the lower Green River valley, which includes the cities of Kent, Auburn, Renton and Tukwila. Industrial, commercial, and residential development is located throughout the Green River valley, as well as significant infrastructure of highways, roads, utilities, and water treatment and sewer treatment facilities. Over 300,000 people live and work in and transit through the Green River valley. The Green River Valley is the third largest contiguous warehousing district in the United States. The estimated flood damages prevented by the operation of HHD during the January 2009 flood were approximately $3.9 billion.

Since 2007, the city of Tacoma has stored 20,000 acre-feet of M&I water behind HHD during the spring for use in the summer and early fall. This is the result of the Additional Water Storage Project currently being implemented by Tacoma and the Corps.

4. ENVIRONMENTAL EFFECTS

This section analyzes the environmental effects of each component of the preferred alternative in comparison to the no-action alternative.

4.1. Road construction

4.1.1. Water quality

Impacts include short-term and temporary increases in construction run-off adjacent to the worksite, periodic elevation of dust and noise levels, and loss of second-growth forest habitat. Waters of the U.S. were not impacted as a result of construction activities as the proposed action did not involve any work in the HHD reservoir, the Green River, or in wetlands. Work followed guidance on best management practices for minimizing impacts to water quality and erosion.

4.1.2. Vegetation and habitat

The area affected by the road construction does not appear to provide habitat for any threatened or endangered species. However, the area is located within the natural zone as defined in Tacoma Water's Green River HCP pursuant to Section 10 of the ESA. Lands affected include the Forest Management Zone and Natural Zone. The Forest Management Zones are lands managed to provide maintenance of water quality, protection of fish and wildlife habitat, and timber and other forest products. The Natural Zone is an area managed without timber harvest for preservation of healthy vegetative cover to reduce erosion and provide fish and wildlife habitat.

This HCP covers 32 species of fish and wildlife that are known to either use, or have the potential to use, the Green River watershed. The proposed work impacts three HCP requirements – Habitat Conservation Measure (HCM) 3-01A, Forest Management Zone; HCM 3-01B, Natural Zone; and HCM 3-03C, Road Construction.

In coordination with the Tacoma Water Department, the Corps developed a list of Best Management Practices for road construction. These were implemented during road rehabilitation and new road construction. The HCP has provision for a variety of measures to provide habitat conservation of listed and unlisted species; many of these measures were suggested by the Muckleshoot Tribe. Measures that can be used to meet these requirements include: stockpiling of trees cleared during the road construction for instream or upland wildlife habitat consistent with HCM 2-03 and 2-10 habitat rehabilitation and 2-08 woody debris management, and follow the Washington Forest Practices Act standards or higher protection measures for road related actions and avoidance of mass-wasting zones. Selected roadways will be abandoned and will follow guidance provided in HCM 3-03I on road abandonment, HCM-03B on road sediment reduction, and HCM 3-03E on new road construction. With the foregoing measures in place, the effect of road construction on the right abutment slope is not expected to result in significant environmental effects.

The work was completed in early April 2009. A total of 1,650 ft of new road was constructed in the Tacoma Natural Zone while 150 ft of old road was abandoned. The Corps is assuming a 1 to 1 replacement for the amount of old road to be abandoned to equal the new road constructed. There has been a net gain of 1,500 ft of new road from the project. The Corps will work with Tacoma to find an appropriate area for 1,500 ft of road abandonment to meet the requirement of offsetting new road construction.

4.1.3. Fish and wildlife resources

There are no fish species found within the proposed work area but impacts to upland vegetation areas may affect fish habitat. A number of wildlife species utilize the proposed work area. Work followed best management practices and guidance from the HCP to minimize impacts and provide habitat conservation.

Bald Eagle (*Haliaeetus leucocephalus*)
Although bald eagle was delisted in 2007, bald eagles are still protected under the Bald and Golden Eagle Protection Act, and Federal agencies must still assure that their actions do not adversely affect nesting bald eagles. Bald eagles are frequently sighted near HHD and are considered a year-round resident in the area. The nearest nest site to the project area is located in Eagle Gorge, more than one mile northeast of HHD (USFS 1996). Bald eagles seen in the area are assumed to be acclimated to regular operations and maintenance activities at HHD, and to the large construction project that began in early 2004, which involves heavy machinery, cranes, blasting, and excavation noises. The short-term presence of humans and excavators on the right abutment during daylight hours only did not likely affect bald eagles as the activity is located along the right abutment far away from the nearest nest and feeding area, and thus would not

disrupt feeding behavior. Therefore, road construction activities were not expected to affect bald eagles.

4.1.4. Threatened and endangered species

Northern Spotted Owl
Owls occupying the activity centers in the upper Green River watershed are unlikely to utilize habitat near the right abutment. The temporary and localized noise and presence of humans at the right abutment did not likely affect northern spotted owls. Therefore, the project likely had "no effect" on northern spotted owls.

Marbled Murrelet
Marbled murrelets are not expected to occur adjacent to HHD or the reservoir, due to the absence of suitable habitat; therefore, the drill road project on the right abutment likely had "no effect" on marbled murrelets.

Grizzly Bear
Because of the low probability of grizzly bear presence in the Green River watershed, the drill road project on the right abutment likely had "no effect" on grizzly bears.

Gray Wolf
Gray wolves typically avoid human activity and roads so the likelihood of their occurrence in the vicinity of HHD is low. The drill road project on the right abutment likely had "no effect" on gray wolves.

Canada Lynx
Canada lynx presence in the action area is highly unlikely. The action area for the drill road project on the right abutment is at an elevation of approximately 1,200 feet and does not include the prerequisite abundance of snowshoe hares for lynx to be present, so this project likely had "no effect" on Canada lynx.

Puget Sound Chinook Salmon ESU
There was likely "no effect" to Chinook salmon or critical habitat as natural reared Chinook do not have access to nor do they occupy waters of the upper Green River. There are indirect effects to downstream areas due to loss of vegetation and riparian habitat in areas of road construction.

Puget Sound Steelhead DPS
There was likely "no effect" on steelhead as natural reared steelhead do not have access to nor do they occupy waters of the upper Green River. There are indirect effects to downstream areas due to loss of vegetation and riparian habitat in areas of road construction. Critical habitat for Steelhead has not yet been designated.

Coastal-Puget Sound Bull Trout DPS

There was likely "no effect" to bull trout or critical habitat as this species is not found in the upper Green River. There are indirect effects to downstream areas due to loss of vegetation and riparian habitat in areas of road construction.

4.1.5. Historic properties and cultural resources

No prehistoric archaeological or historic-period cultural resources are known to exist within the work areas. Recently, the Seattle District completed a professional in-house archaeological survey of the road area, also with negative results. The hillside where the roads were repaired and new roads constructed was found to have been previously disturbed by logging activity, road construction, and previous well installations. The Corps has determined that no historic properties were affected by the road project.

4.1.6. Land use

The work area includes existing roads, test wells, and forest lands. These land uses will not change and therefore the proposed work will not affect land use.

4.1.7. Recreation and aesthetics

There are no existing recreation activities or public access as the Green River watershed near the dam is closed to the public.

4.1.8. Air quality and noise

The activities were conducted in an area that has attainment for all priority pollutants. Emissions generated by the construction activity are expected to be minor, short-term, and well below the de minimis threshold. There are no existing noise thresholds required for the proposed work area as it lies in a closed watershed; however, there were short term periods of increased road noise. Vehicle activities fall within the capacity of existing road use in and near the dam with no expected impact to existing activities.

4.2. Reservoir refill

The refill plan consisted of water storage to 1167 ft, periodic refill stops, and a short duration peak above 1167 ft. The time above 1167 ft was limited to one week. The storage target of 1167 ft was evaluated previously in the AWSP EIS (Corps 1998). Refill to the 1167 ft elevation while features of the AWSP are being implemented is consistent with existing project authorities, as water stored for M&I purposes is subordinated in priority to natural resources considerations in the event of conflict between the two during the period that implementation is being completed. The refill stops at elevation 1147 ft and 1157 ft and the short duration peak above 1167 ft are departures from normal operations since 2007 and are evaluated below.

4.2.1. Hydrology and water quality

The table and analysis below describes the anticipated effects of the refill stops in the draft EA prior to their occurrence. Since the refill stops occurred during the draft EA public review period, the refill stops have already occurred. Actual effects are discussed at the end of this

section. The draft EA analysis was retained in this document for comparison purposes to what actually occurred.

Anticipated effects described in the draft EA

The table below represents historical flow data at the Palmer and Auburn stream gages. Assuming an average water capture rate of 20 percent (the average flow capture rate required to meet all project authorities including the AWSP), the table below lists the total volume of water that theoretically would be stored during a four day period on the dates listed. During the refill stops, this water theoretically would not be stored but passed downstream resulting in an increase in flow by the amount indicated in the row titled cfs x 20 percent. For median (50%) flow on May 1 this represents a change in flow of 244 cfs. This represents a stage change of approximately 0.40 ft at the Palmer stream gage. The higher the inflow, the more water is stored assuming a constant 20 percent capture rate and the greater the stage change resulting from the refill stop. The 90th percentile flow (10% chance that the flow will be at or exceed that listed) results in a 458 cfs increase in flow during the refill stops. This is an approximately 0.4 ft increase in stage downstream. At the end of the four day refill stop, a corresponding decrease in flow might occur.

Table 1.

Date	May 1				May 15				June 1			
Percentile of mean daily values	90%	75%	50%	25%	90%	75%	50%	25%	90%	75%	50%	25%
cfs (at Palmer)	2290	1670	1220	742	2830	1840	1130	606	2120	1520	866	448
cfs x 20%	458	334	244	148	566	368	226	121	424	304	173	90
acre-feet (4 days)	3634	2650	1936	1177	4491	2920	1793	962	3364	2412	1374	711
Palmer stage change (ft)	0.47	0.41	0.40	0.38	0.50	0.41	0.43	0.35	0.44	0.38	0.41	0.30
Auburn cfs	2620	2090	1610	1230	3220	2270	1470	947	2460	1880	1190	722
Auburn stage change (ft)	0.49	0.39	0.31	0.20	0.55	0.40	0.30	0.19	0.46	0.36	0.25	0.16

The above analysis should be considered worst case scenarios, which would be applicable only if there were no real time management to moderate abrupt changes in flow during the refill stops. There is a certain degree of flexibility that is inherent to the refill stops under the preferred alternative. This includes allowing the reservoir to vary by as much as two feet during the stop period. At the 1147 ft reservoir elevation, two feet represents about 1700 acre-ft. This two foot flexibility would absorb nearly the entire volume of water during the four day stop period if the 50th percentile (median) flow occurred during the stop. In practical terms, this means there would be no discernible refill stop because normal operation (i.e., 20% capture rate) does not cause more than a two foot rise in the reservoir. If the 90th percentile flow occurred during the stop, about half the total volume would be absorbed by a two-foot rise in the reservoir. This would result in an increase in discharge by 300 cfs over the four-day stop period and corresponding decrease in flow at the conclusion of the stop. This translates to a 0.3-ft stage change at the Palmer stream gage for this flow. If unusually high flow is occurring at the time of the refill stop, it is likely that the capture rate under normal management conditions would be much less than 20 percent because there is no need to store that quantity of water. The average capture rate of 20 percent assumes a median flow. If flow is higher, then less percent capture is required to achieve the same storage targets. Likewise if flow is lower than median (i.e., a dry spring), a higher than average capture rate is required to achieve water storage targets.

Actual effects of the modified refill
The Corps was able to moderate the stage changes during the refill stop periods by continuing to store water and by lengthening the transition period at the conclusion of the refill stops. The reservoir increased by about 1.5 ft during the 1147 ft stop period and by about 1.2 feet during the 1157 ft stop period.

The 1147 ft refill stop occurred May 5 to May 8. The maximum hourly stage change on May 5 was 0.21 ft at Palmer and 0.13 ft at Auburn. The mean daily stage change from May 4 to May 5 was 0.36 ft at Palmer and 0.33 ft at Auburn. The maximum hourly stage change on May 8 was -0.31 ft at Palmer and -0.21 ft at Auburn. The total stage change was about -0.95 ft over a six hour period at Palmer and -0.95 ft at Auburn over a similar time period. The mean daily stage change from May 8 to May 9 was -0.39 ft at Palmer and -0.74 ft at Auburn.

The 1157 ft refill stop occurred May 19 to May 22. The maximum hourly stage change on May 19 was 0.24 ft at Palmer and 0.17 at Auburn. Total stage change was 0.53 ft and occurred over 6 hours at Palmer. Total stage change at Auburn was 0.46 ft over a similar timeframe. On May 21/22 the maximum hourly stage change was -0.14 ft at Palmer and -0.15 ft at Auburn. The mean daily change was -0.56 ft on May 21 and -0.21 ft on May 22 at Palmer, and -0.60 ft on May 21 and -0.22 ft on May 22 at Auburn.

In general these stage changes are within the ranges anticipated in the draft EA except for the ramp down on May 8. While the hourly stage changes were relatively moderate on this date, a stage of nearly a foot over a six hour period was not a desired management goal. While the ramp down was partly the result of some internal miscommunication, the operation was largely driven by an observed receding inflow hydrograph and a forecast for a steeply receding inflow hydrograph through the subsequent weekend. Thus the stage change resulted from a combination of the refill stop superimposed on a naturally declining inflow hydrograph.

The short duration storage and drawdown above elevation 1167 ft was conducted June 9 to June 16. Water was captured at a rate similar to that throughout the spring refill period. A high pool of elevation 1169.2 ft was achieved on June 12. Storage occurred for about three and a half days. The drawdown from 1169.2 ft to 1167 ft occurred over a similar timeframe.

4.2.2. Vegetation and habitat

Spring refill up to 1167 ft including the refill stops likely resulted in no effects to vegetation or habitat beyond those previously addressed in the AWSP EIS. Since there have been three years (2002 test pool, 2007, and 2008) of water storage up to approximately elevation 1167 ft, long-term vegetation and habitat effects from water storage at that elevation have already begun. The short duration storage above 1167 ft was limited to no more than one week to minimize adverse effects to vegetation. The maximum reservoir elevation achieved was 1169.2 ft. This likely had minimal, if any, effect on vegetation around the reservoir. In general, hardwoods survive inundation without much difficulty. Conifers are more vulnerable and die if branches become inundated after just a few days (Iles 1993). The majority of vegetation between elevation 1167 ft

and 1177 ft are hardwood species, primarily alder. There are conifers within this zone, the majority residing closer to the 1177 ft elevation.

4.2.3. Fishery resources

The refill up to 1167 ft including the refill stops likely had minimal, if any, effect on fishery resources both within the reservoir and in the downstream river. The refill timing and volume of water captured followed the normal refill pattern for the project. As a result of the generally cool spring and large snowpack, the total time for the spring refill was greater than a typical spring refill. As a result, the anticipated compression of the spring refill period caused by the eight days of refill stop did not materialize. This resulted in typical spring refill capture rates.

The refill stops resulted in slight changes in downstream river stage as described above. Real time management limited substantial stage variations. All ramping rate guidelines were followed. Accordingly, effects on downstream fisheries were minimized.

The May 8 ramp down described above likely had minimal effects on fish due to the relatively high flows (about 2,400 cfs) at the time. Ramping rate guidelines only apply to flows less than 1,500 cfs, and most side channel habitat remains connected to the river at these flows. While the hourly down ramping was relatively moderate, on the order of two inches per hour or less, it is possible that some habitat became isolated during the course of this action temporarily stranding fish. These stranded fish may have been subject to higher predation rates as a result. The fact that the river regained this stage about one week later reconnecting any habitat that may have been isolated during the ramp down should have limited this effect, if it occurred at all.

The short duration storage above 1167 ft likely resulted in negligible effects on fish within the reservoir due to the relatively small increase in reservoir elevation. Downstream flows requested by the resource agencies for protection of steelhead redds were met throughout this one week period.

4.2.4. Wildlife resources

No effect to any wildlife species likely occurred from the refill to 1167 ft or the refill stops that has not already been addressed in the AWSP EIS. It is unlikely that the short duration storage above 1167 ft affected wildlife species around the reservoir. It is possible that some low nesting bird species were flooded off their nests resulting in some loss of eggs. This would be limited to ground nesting birds such as ducks and geese, and birds nesting in understory vegetation.

<u>Bald eagle</u>
Refill activities did not likely affect bald eagle habitat or their ability to find prey. Existing nests are all well above 1177 ft. There may have been some incremental effect to reservoir bird species as mentioned above that bald eagle might prey upon. However, the loss of waterfowl nests should not affect bald eagles, as it is the adults that eagles typically prey upon. Since prey were still likely available, foraging should not have been affected. It is unlikely that the project had any effect on bald eagles.

4.2.5. Threatened and endangered species

Northern Spotted Owl
It is unlikely that refill activities affected habitat or prey of the spotted owl. Therefore, the project likely had "no effect" on northern spotted owls.

Marbled Murrelet
Marbled murrelets are not expected to occur adjacent to HHD or the reservoir, due to the absence of suitable habitat nor are they expected to use the reservoir. Therefore, the project likely had "no effect" on marbled murrelets.

Grizzly Bear
Because of the low probability of grizzly bear presence in the Green River watershed, the project likely had "no effect" on grizzly bears.

Gray Wolf
Gray wolves typically avoid human activity and roads so the likelihood of their occurrence in the vicinity of HHD is low. Therefore, the project likely had "no effect" on gray wolves.

Canada Lynx
As stated above, Canada lynx are unlikely to be present around the reservoir. Therefore, the project likely had "no effect" on Canada lynx.

Puget Sound Chinook Salmon ESU
The refill and stops occurred during the juvenile Chinook salmon outmigration (Figure 5). As stated above, real time management of the refill and the stop periods minimized any effect on fishery resources including juvenile Chinook salmon. All ramping guidelines were followed. The May 8 ramp down described above likely had minimal effects on Chinook salmon due to the relatively high flows (about 2,400 cfs) at the time (ramping rate guidelines only apply to flows less than 1,500 cfs), and the fact the river regained this stage about one week later reconnecting any habitat that may have been isolated during the ramp down as described above.

The short duration storage above 1167 ft likely had no effect on juvenile Chinook salmon due to the relatively small amounts of water stored and the fact no real changes in river stage resulted from the action.

Due to the real time management of these actions, the determination for Chinook salmon is "may affect, but not likely to adversely affect" Chinook salmon or Chinook salmon critical habitat.

Puget Sound Steelhead DPS
Based on data collected from the screwtrap installed at RM 33 of the Green River, the juvenile steelhead outmigration period is generally from mid-April to late May (WDFW 2008). The refill stops therefore occurred during the outmigration of this species. Overwintering steelhead and adults were also in the river. However, as is the case for Chinook, any effect was likely minimal due to the real time management of discharge and the adherence to ramping guidelines to avoid stranding any fish. Steelhead eggs were present in the gravel at the time of the refill stops and the short duration storage above 1167 ft. The actions did not affect agency requested steelhead

redd protection flows. Due to the real time management of these actions as described above, the ESA determination for steelhead is "may affect, but not likely to adversely affect". Steelhead critical habitat has not yet been designated.

Coastal-Puget Sound Bull Trout DPS

Only limited numbers of bull trout occur in the Green River. Due to the real time management of the refill activities and the limited bull trout in the system, the ESA determination for bull trout and bull trout critical habitat is "no effect".

4.2.6. Historic properties and cultural resources

It is unlikely that the 2009 reservoir refill affected vegetation which could lead to increased erosion that might expose unrecorded archaeological material in previously surveyed areas. The potential erosion effects of the refill and drawdown are no different than the periodic on-going winter flood pools. The Corps has determined that no historic properties were affected by the reservoir refill, but will field-check selected areas during its annual archaeological monitoring of the reservoir to ensure that no new archaeological sites have been exposed.

4.2.7. Land use

The refill to 1167 ft and the refill stops did not affect land use above or below the dam. The range of flows were within the range of typical flows in the river for this time of year. The short duration storage event above 1167 ft was limited to a two foot increase in reservoir elevation. The land surrounding the reservoir is predominantly owned by the city of Tacoma. There is a small amount of land near the dam that is owned by the Federal Government. The effects of storage above 1167 ft on activities around the dam were minor. This may have included some minor road flooding that would cause certain dam operations routes or activities to be slightly altered or delayed for a week. The Tacoma land is all designated either 'Natural Zone' or 'Conservation Zone' (Tacoma 2001). The natural zone is managed as a natural area for fish and wildlife species. There is no timber harvesting in the natural zone. The conservation zone is similarly managed for fish and wildlife with only limited timber harvesting. Based on correspondence with Tacoma staff, no timber harvest or other activities were planned in these areas in the vicinity of the inundation zone (Volkhardt 2009). The project will have no long-term effect on these areas.

4.2.8. Recreation and aesthetics

The refill plan likely had minimal effects on recreation activities downstream of the dam. The refill stops and the short duration storage above 1167 ft resulted in slight increases in flow for the duration of the stop. The increase was on the order of 200 cfs. As indicated above, real time management minimized these increase to some degree. The water storage above 1167 ft resulted in a decrease in flow by about 200 to 300 cfs during the three days of refill and a corresponding increase in flow by about 200 to 300 cfs during the three day drawdown.

4.2.9. Air quality and noise

The refill actions involved no construction equipment or activities beyond normal dam operations activities. Therefore no change in air quality or noise occurred.

4.2.10. Socioeconomic

Since 2007, 20,000 acre-ft of water has been stored at HHD for the city of Tacoma and its partners that include the Cities of Kent, Covington, and Lake Haven. The reservoir storage from 1147 ft to 1167 ft is the additional reservoir elevation required to store this water. The spring refill included storage of the additional water for Tacoma.

4.3. Reservoir drawdown

The preferred reservoir drawdown alternative was selected on June 12. It was initiated on June 16. The drawdown alternative selected was that consistent with Tacoma M&I water storage requirements and dam safety concerns. The drawdown will be down to an elevation of 1155 ft and occur over a period of approximately two weeks. The drawdown alternative was selected after a careful evaluation of right abutment monitoring data, Tacoma water needs, and environmental effects.

4.3.1. Hydrology and water quality

The reservoir drawdown from 1167 ft to 1155 ft over two weeks will result in higher flows in the Green River downstream of the dam than would otherwise occur. The alternative will augment flow in the Green River by about 470 cfs over this time period. Median flow at the Auburn stream gage on June 15 is about 750 cfs. Adding 500 cfs to this results in flow of 1250 cfs. This is a stage change of 0.78 ft. Median flow on July 1 is approximately 580 cfs. Adding 500 cfs to this results in flow of 1080 cfs. This is a stage change of 0.84 ft. These would be expected flows during this drawdown scenario assuming median inflow to the dam. If natural inflow is higher or lower than median, the resulting augmented flow would also be higher or lower. The 90th percentile flow on July 1 is 1300 cfs. The resultant augmented flow would therefore be about 1800 cfs.

4.3.2. Vegetation and habitat

Vegetation and upland habitat around the reservoir should be minimally impacted by a two week drawdown from 1167 ft to 1155 ft. Grasses and sedges exist around the rim of the reservoir below elevation 1167 ft. These species may experience additional growth this year compared to a typical AWSP drawdown from 1167 ft that would keep these areas flooded until later in the summer.

4.3.3. Fishery resources

The expedited drawdown scenario would increase flow in the downstream river during this period resulting in incrementally more aquatic habitat in the river. This should incrementally benefit some juvenile salmon species that are at the tail end of their spring outmigration to Puget Sound. Overwintering coho, steelhead, and resident fish species may benefit. Under the no

action scenario, the total volume of M&I water (20,000 acre-ft) would be roughly split between Tacoma municipal use and flow augmentation for fisheries according to an agreement between Tacoma and the Muckleshoot Tribe. In this case, the fisheries water could be used at any time determined by fisheries agencies to provide the greatest benefit. In a normal year, at least part of this water would likely be used in the fall to augment flow for spawning Chinook salmon resulting in some incremental benefit in the form of more spawning habitat. Water storage below 1147 ft is typically used to augment flow in the river throughout the summer and particularly in the fall when adult salmon return to the Green River.

4.3.4. Wildlife resources

Minimal effect to wildlife species is expected from the expedited drawdown scenario. As described above, grasses and sedges may experience a longer growing season and be available for a longer period of time around the rim of the reservoir. This may provide some additional forage for elk and deer that would typically not be available.

Bald Eagle
The reservoir drawdown should not affect prey resources or feeding habits of the bald eagle. The drawdown will not affect nesting areas or disturb bald eagles. The shrinking reservoir might concentrate waterfowl slightly, resulting in easier foraging opportunities for eagles. The project is not expected to affect bald eagles.

4.3.5. Threatened and endangered species

Northern Spotted Owl
The drawdown scenarios will not affect habitat or prey of the spotted owl. Therefore, the project is expected to have "no effect" on northern spotted owls.

Marbled Murrelet
Marbled murrelets are not expected to occur adjacent to HHD or the reservoir, due to the absence of suitable habitat nor are they expected to use the reservoir. Therefore, the drawdown scenarios are expected to have "no effect" on marbled murrelets.

Grizzly Bear
Because of the low probability of grizzly bear presence in the Green River watershed, the project is expected to have "no effect" on grizzly bears.

Gray Wolf
Gray wolves typically avoid human activity and roads so the likelihood of their occurrence in the vicinity of HHD is low. The project is expected to have "no effect" on gray wolves.

Canada Lynx
As stated above, Canada lynx are unlikely to be present around the reservoir. Therefore, the project is expected to have "no effect" on Canada lynx.

Puget Sound Chinook Salmon ESU

The tail end of the juvenile Chinook salmon migration to Puget Sound will likely be occurring at the time of the two week drawdown. The expedited drawdown scenario will result in somewhat higher flow in the Green River during the early summer. This is within the range of flows typical for the Green River this time of year.

The expedited drawdown scenario results in the loss of water that would likely have been used to augment flow in the fall when adult Chinook return to spawn. This may have some incremental effect on Chinook salmon by reducing spawning habitat that might otherwise be available without the early drawdown. This could result in more spawning near the center of the channel than would otherwise occur. In general, flood scouring flows are greatest in the center of the channel so any redds in this location are more vulnerable to scour. However, the HHD low flow augmentation and Section 1135 water volumes are retained in either drawdown scenario. This water will be used to augment flows beyond the natural inflow to the reservoir. Since the Tacoma M&I water that is lost during the drawdown provides potential fall augmentation well in excess of what naturally occurs, its loss can not be considered an adverse effect. This water is more appropriately described as 'bonus' water that improves upon the natural conditions. For this reason, the expedited drawdown alternatives "may effect, but are not likely to adversely effect" Chinook salmon or Chinook salmon critical habitat.

Puget Sound Steelhead DPS

By the time of the drawdown, few adult winter steelhead are present in the Green River. Juveniles have largely completed their outmigration to Puget Sound. Overwintering steelhead will be present in the river. The expedited drawdown scenarios will result in somewhat higher flow in the Green River during the early summer. This is within the range of flows typical for the Green River this time of year. This may provide additional water to protect steelhead eggs that will be in the gravel this time of year. This will benefit steelhead. The water evacuated from the reservoir could be used more beneficially to augment steelhead redds by increasing the time period of the drawdown to a period greater than two weeks. It was determined that the incremental benefit was outweighed by the dam safety concerns to achieve 1155 ft quickly. Since this evacuated water is Tacoma M&I water, it should be considered 'bonus' water as described above for Chinook salmon. Therefore the expedited drawdown alternatives "may effect, but are not likely to adversely effect" steelhead. Steelhead critical habitat has not yet been designated.

Coastal-Puget Sound Bull Trout DPS

Only limited numbers of bull trout occur in the Green River. The expedited drawdown will result in somewhat higher flow in the Green River during the early summer. This is within the range of flows typical for the Green River this time of year. The project is expected to have "no effect" on bull trout or bull trout critical habitat.

4.3.6. Historic properties and cultural resources

The Corps has determined that no historic properties will be affected by the proposed reservoir drawdown, but will field-check selected areas during its annual archaeological monitoring of the reservoir to ensure that no new archaeological sites have been exposed.

4.3.7. Land use

Reservoir elevations and river flows will be within ranges typical of this time of year. The drawdown will therefore not affect land use around the reservoir or downstream.

4.3.8. Recreation and aesthetics

The expedited drawdown alternatives will result in downstream flow higher than would be expected during the period of the drawdown. As stated above, flow could be augmented by nearly 500 cfs. This will likely improve recreational boating opportunities downstream during the period of the drawdown.

4.3.9. Air quality and noise

The refill actions involve no construction equipment or activities beyond normal dam operations activities. Therefore no change in air quality or noise is expected.

4.3.10. Socioeconomic

In 2007, approximately 2,500 acre-ft of the M&I water storage was used by Tacoma and partners. In 2008, approximately 3,500 acre-ft was used. Tacoma and partners indicated a need of about 4,000 acre-ft of AWS M&I water for 2009. Tacoma has since 2007 agreed to use half of the stored water for fisheries purposes. This is until the HHD fish passage facility is completed. This need results in a total of 8,000 acre-ft of water storage requested by Tacoma and their partners (Tacoma 2009). At the conclusion of the two week drawdown period, it is estimated that approximately 8,500 acre-feet of Tacoma M&I water will remain in the reservoir. This drawdown therefore provides the requested water volume for Tacoma and its partners.

4.4. Interim repair

The interim repair consists of two separate projects. This includes installation of several dewatering wells in the existing dam drainage tunnel, and a grout curtain along approximately 450 ft of the right abutment.

4.4.1. Hydrology and water quality

The purpose of the new dewatering wells is to replace existing dewatering well number 25 and increase the drainage of the right abutment. The construction itself will have no effect on hydrology of the river. The drainage wells typically flow year round responding both to rain and reservoir elevation. As the reservoir increases during floods or spring refill, there is generally a corresponding increase in discharge from the drainage tunnel. The quantity of water flowing from the drainage tunnel is not expected to substantially change as a result of the new drainage wells. This is in part due to the grout curtain. The vertical and horizontal wells installed in the vicinity of well 25 are expected to simply replace the function that well performed. With the addition of the grout curtain, seepage through this part of the right abutment is expected to decrease resulting in a corresponding decrease in water captured by these wells. The grout curtain is designed to decrease seepage through the right abutment by increasing the length of the flow path water from the reservoir must travel. This may result in more seepage around the

northeast end of the grout curtain. The new wells installed at the northeast end of the drainage tunnel are designed to drain this additional water. The additional water at the end of the tunnel is expected to roughly offset the reduced water collected in the vicinity of the former well 25. This would result in roughly no change in flow in the culvert exiting the drainage tunnel and entering the river at the stilling basin.

Water quality during well construction will be controlled by isolating the drill construction site. All drill cuttings and water will be controlled on site and disposed at appropriate disposal sites. No water quality effects in the Green River are expected.

The drill pad will not affect hydrology. As stated above, the grout curtain is designed to decrease seepage through the right abutment by increasing the length of the flow path water from the reservoir must travel. This long seepage path reduces the probability of a piping failure from occurring, thus increasing the safety of the dam. No effects to river hydrology are expected from the grout curtain.

Together the new wells and grout curtain are expected to reduce seepage in the short path seepage area, increase seepage at the northeast end of the right abutment, and increase drainage of the northeast end of the right abutment.

4.4.2. Vegetation and habitat

The vertical dewatering wells will be constructed from the surface along an existing road. Therefore no new road construction or access is required.

The drill pad, staging area, and grout curtain would be constructed on the face of the right abutment itself. The existing habitat in this location is generally riprap and gravel road. Several conifers do exist at the northeast end of the staging area. Access is expected to be along an existing road alignment in this location so no trees should be removed. No effect on vegetation and habitat is therefore expected.

4.4.3. Fishery resources

All work will be conducted out of water. No change in river habitat, flow, or water quality is expected as a result of the well project as described above. No effect to fisheries resources is therefore expected.

4.4.4. Wildlife resources

All work will be conducted in the immediate vicinity of the dam where similar types of construction activity and dam operations occur on a regular basis. This should not alter any wildlife patterns in the area. No new vegetation is expected to be removed during construction. There are not expected to be any long term effects to wildlife. There will be no long term habitat effects and no long term operations as a result of this project that have potential to affect wildlife including bald eagle.

4.4.5. Threatened and endangered species

Northern Spotted Owl
The interim repair projects will not affect habitat or prey of the spotted owl. Therefore, the projects are expected to have "no effect" on northern spotted owls.

Marbled Murrelet
Marbled murrelets are not expected to occur adjacent to HHD or the reservoir, due to the absence of suitable habitat nor are they expected to use the reservoir. Therefore, the projects are expected to have "no effect" on marbled murrelets.

Grizzly Bear
Because of the low probability of grizzly bear presence in the Green River watershed, the projects are expected to have "no effect" on grizzly bears.

Gray Wolf
Gray wolves typically avoid human activity and roads so the likelihood of their occurrence in the vicinity of HHD is low. The projects are expected to have "no effect" on gray wolves.

Canada Lynx
As stated above, Canada lynx are unlikely to be present around the reservoir. Therefore, the projects are expected to have "no effect" on Canada lynx.

Puget Sound Chinook Salmon ESU
The projects are all upland and not expected to affect aquatic habitat. Water quality and erosion control measures instituted as part of construction should prevent any potential water quality effects. Therefore, the projects are expected to have "no effect" on Chinook salmon.

Puget Sound Steelhead DPS
The projects are all upland and not expected to affect aquatic habitat. Water quality and erosion control measures instituted as part of construction should prevent any potential water quality effects. Therefore, the projects are expected to have "no effect" on steelhead.

Coastal-Puget Sound Bull Trout DPS
The projects are all upland and not expected to affect aquatic habitat. Water quality and erosion control measures instituted as part of construction should prevent any potential water quality effects. Therefore, the projects are expected to have "no effect" on bull trout.

4.4.6. Historic properties and cultural resources

No prehistoric archaeological or historic-period cultural resources are known to exist within the proposed work areas. The two drainage wells that will be drilled through the road next to the dam headquarters are in an area of fill over what was originally a steep slope prior to dam construction. The grout curtain will cross a previously surveyed, steep, eroded hillside to the highly disturbed dam area. An archeological survey of the grout curtain area was completed in 1995 and 1996 for the Corps with negative results (Lewarch, Forsman, and Larson 1996). The

Corps has determined that no historic properties will be affected by the proposed grout curtain or drilling of the drainage wells.

4.4.7. Land use

The interim repair projects all occur on the Federal reservation of Howard Hanson Dam. The existing land use is to support activities associated with operation and maintenance of the dam. The project will not result in any change in land use.

4.4.8. Recreation and aesthetics

The project area is within the Tacoma Municipal Watershed that is closed to the public. No recreation therefore occurs at the dam. This will not change. The upstream face of the right abutment will be slightly altered from the drill pad, associated riprap, and staging area. This part of the right abutment currently consists primarily of riprap, rock outcrops, and gravel road. The general character of the site will therefore not change substantially.

4.4.9. Air quality and noise

The interim repair will result in no long term changes in air quality or noise. During the construction period which is expected to occur from 1 July to 1 November 2009, there will be increases in noise and minor effects to air quality as a result of heavy equipment operation.

4.4.10. Socioeconomic

In the near term (next few years), the interim repair is expected to improve flood storage capabilities at the dam. It is also expected to improve water storage capabilities during the spring refill so that all water storage projects including M&I storage can be successfully implemented.

5. CUMULATIVE IMPACTS

NEPA defines cumulative impacts as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR §1508.7).

Future and current activities in and around HHD include several large construction projects including construction of a fish passage facility. Multiple habitat restoration type activities associated with the AWSP and Tacoma HCP are ongoing or planned. Timber harvesting in the upper Green River watershed will continue. In the lower Green River, several levee rehabilitation projects were constructed in 2008. Several additional levee repair projects are planned for 2009. These activities are likely to continue as local municipalities manage flood risks.

The activities described in this document evaluate and maintain the existing authorized functions of HHD. This includes flood control and the various water storage activities. The proposed activities, combined with future planned activities are not expected to result in significant cumulative impacts to the environment.

6. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The irreversible and irretrievable commitment of resources is the use of materials, resources, or land during implementation of an alternative that makes these resources unavailable for other uses, given known technology and reasonable economics. No federal resources would be irreversibly and irretrievably committed to the proposed action until this Environmental Assessment is finalized and a "Finding of No Significant Impact" has been signed.

7. ENVIRONMENTAL COMPLIANCE

7.1. National Environmental Policy Act

This document satisfies NEPA requirements for the Howard Hanson Dam right abutment, refill, and drawdown activities described. A Finding of No Significant Impact (FONSI) is included in Appendix B. Comments received during the public review period are addressed in Appendix C.

The following elements of the project activities evaluated in this EA have been completed: road construction and reservoir refill to elevation 1167 feet. The reservoir drawdown has been initiated. As the road construction was an essential prerequisite to the subsequent monitoring and analysis measures to be undertaken during the reservoir refill process; because the reservoir refill had to take place at a point in the season when the inflow conditions permitted capture so as to manage the refill with periodic stops and a potential short peak above 1167 feet, all in such a way as to minimize the upstream and downstream effects of the refill process on natural resources; and because the reservoir drawdown had to be initiated promptly thereafter to reduce unnecessarily prolonged stress on the HHD structure as investigation of the condition of the right abutment proceeds, and in order to meet downstream flow needs of both natural resources and water supply, as applicable, the Corps determined that it was not possible to complete the NEPA process prior to initiation. These elements of the project were initiated following full consideration that NEPA had previously been complied with to the maximum extent possible, as reflected in Environmental Compliance Status Memoranda promulgated on 2 April 2009 and 4 May 2009, respectively. In each case, the Corps has acknowledged the need to evaluate the implementation of these project elements, based on the fuller analysis conducted in this EA, and in light of public comment received in response to circulation of this EA, to determine if adjustment during the course of implementation is necessary.

This EA assesses a proposed course of pool refill and drawdown activities. The timing and maximum elevations reflected in these measures have been selected so as to generate minimal risk to the structural integrity of HHD while necessary engineering investigations and monitoring are carried out. It is possible, although highly unlikely, that structural integrity concerns arising in the course of carrying out the drawdown will require abandoning the proposed action. If

abandoned, it is possible that an emergency rate of drawdown may be required. Such a drawdown would be managed in real time to conserve natural resources, upstream and downstream of HHD, to the maximum practicable extent. In such a case, this EA and FONSI would be reevaluated to address any adverse effects of a deviation from the proposed course of action.

7.2. Endangered Species Act

In accordance with Section 7(a)(2) of the Endangered Species Act of 1973 (ESA), as amended, Federally funded, constructed, permitted, or licensed projects must take into consideration impacts to Federally listed or proposed threatened or endangered species. This document evaluates the effects of the proposed action on threatened and endangered species.

Coordination of the proposed actions has occurred with the National Marine Fisheries Service (NMFS) and U.S. Fish & Wildlife Service to address potential effects to species listed under the ESA. Due to the urgent nature of completing this project prior to the oncoming flood season, the Corps implemented certain elements of the action, notably the road construction, modified reservoir refill, and drawdown, prior to completing consultation with the Services.

Due to the urgent nature of completing proposed activities prior to the oncoming flood season, the Corps may proceed with implementation prior to completion of the consultation with the Services pursuant to the "emergency circumstances" provisions of the ESA consultation regulation, and may complete ESA consultation after the fact rather than delaying the urgent work in order to complete ESA consultation before implementation begins. The applicable regulation is set out at 50 CFR Section 402.05 (a) and (b) and provides as follows:

(a) Where emergency circumstances mandate the need to consult in an expedited manner, consultation may be conducted informally through alternative procedures that the Director determines to be consistent with the requirements of section 7(a)-(d) of the Act. This provision applies to situations involving acts of God, disasters, casualties, national defense or security emergencies, etc.

(b) Formal consultation shall be initiated as soon as practicable after the emergency is under control. The Federal agency shall submit information on the nature of the emergency actions(s), the justification for expedited consultation, and the impacts to endangered or threatened species and their habitats. The Service will evaluate such information and issue a biological opinion including the information and recommendations given during emergency consultation.

Due to the management flexibility built into the refill and drawdown scenarios, these activities are expected to have minimal effect on threatened and endangered species. The refill and drawdown therefore "may affect, but are not likely to adversely affect" Chinook salmon and steelhead. The remaining project elements including the interim repair are expected to have "no effect" on listed species.

NMFS concluded their evaluation of the project on 16 June 2009, concurring with the Corps determination of "not likely to adversely affect" for steelhead, Chinook salmon, and Chinook salmon critical habitat (see Appendix B).

7.3. Magnuson-Stevens Fishery Conservation and Management Act

The Act requires Federal agencies to consult with National Marine Fisheries Service regarding actions that may affect Essential Fish Habitat (EFH) for Pacific coast ground fish, coastal pelagic species, and Pacific salmon. The Act defined EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". Descriptions of EFH are provided in Fishery Management Plans produced by the Pacific Fisheries Management Council. This document evaluates the effects of the proposed action on essential fish habitat. No effects to EFH are expected from the proposed activities.

7.4. Clean Water Act

Under Section 404 of the Clean Water Act (CWA), a Department of the Army permit is required for the discharge of dredged or fill material into waters of the United States including wetlands. Under Section 401 of the CWA, State Water Quality Certification is required for discharges that may impact water quality. The certification ensures that the discharge will comply with the applicable provisions of Sections 301, 302, 303, 306 and 307 of the CWA. The proposed actions will not result in a discharge of fill material into waters of the United States and therefore does not require a Section 404 permit or Section 401 water quality certification.

Section 402(p) of the Clean Water Act (CWA) provides that stormwater discharges associated with industrial activity that discharge to waters of the United States must be authorized by an National Pollutant Discharge Elimination System (NPDES) permit when construction footprints exceed one acre. The term "discharge" when used in the context of the NPDES program means the discharge of pollutants (40 CFR §122.2). The proposed grout curtain may require a NPDES permit depending on the final design of the project.

7.5. Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act of 1899 prohibits the unauthorized obstruction or alteration of any navigable water of the United States. Activities that involve the construction of dams, bridges, dikes etc. across any navigable water, or placing obstructions to navigation outside established Federal lines and excavating from or depositing material in such waters, require permits from the Corps. The proposed activities will not obstruct navigation in the Green River. Anticipated water discharges are within the range expected to occur naturally.

7.6. Coastal Zone Management Act

The Coastal Zone Management Act of 1972, as amended, requires Federal agencies to carry out their activities in a manner that is consistent to the maximum extent practicable with the enforceable policies of a state's approved Coastal Zone Management (CZM) Program. The Shoreline Management Act of 1972 (RCW 90.58) is the core of authority of Washington's CZM Program. Primary responsibility for the implementation of the SMA is assigned to local government. Planning, construction, modification, or removal of public works, facilities, or other structures require a consistency determination from the Department of Ecology.

The King County Shoreline Management Plan (SMP) designates area around the dam as conservancy, excluding federal lands. Conservancy areas are intended to maintain their existing character. This designation is designed to protect, conserve, and manage existing natural resources and valuable historic and cultural areas. The preferred uses are those nonconsumptive of the physical and biological resources of the area. The proposed activities occur primarily on Federal lands so are therefore specifically excluded from the SMP. The road construction work does extend off the Federal reservation. Since the road project was designed to be consistent with the Tacoma HCP natural and conservancy area designations, they are also considered to be consistent with the County SMP which has a similar purpose for these lands. The suite of preferred alternatives is consistent to the maximum extent practicable with the enforceable policies of the Washington CZM Program. Based on coordination with the Washington Department of Ecology, a Federal Consistency determination is not required.

7.7. National Historic Preservation Act

Section 106 of the NHPA requires that Federal agencies identify, evaluate and assess the effects of undertakings on sites, buildings, structures, or objects listed in or eligible for listing in the National Register of Historic Places (NRHP). Eligible properties must generally be at least 50 years old, possess integrity of physical characteristics, and meet at least one of four criteria for significance. Regulations implementing Section 106 (36 CFR Part 800) encourage maximum coordination with the environmental review process required by NEPA and with other statutes. Recently-amended Washington State laws also apply on non-Federal lands, including the Archaeological Sites and Resources Act (RCW 27.53), Indian Graves and Records Act (27.44 RCW) and the Abandoned and Historic Cemeteries and Historic Graves Act (68.60 RCW).

NHPA compliance for construction and operation activities at the Howard Hanson Dam Reservoir and associated restoration and mitigation projects was addressed in a 2003 MOA signed by the Corps, Tacoma, and the DAHP. The Muckleshoot Tribe was consulted during development of the MOA and did not sign, but supports its provisions. In order to comply with Section 106 the Corps has reviewed previous contracted studies, conducted a professional cultural resources survey of the well areas with negative results, and consulted with the Muckleshoot Tribe. The Corps has reached a determination of no historic properties affected for the proposed road construction, reservoir refill, reservoir drawdown, drainage wells, and grout curtain. Required reporting for this project will be included in an in-progress report that compiles all of the recent studies that have been completed for HHD and the AWSP.

If, during construction activities, the Contractor observes items that might have historical or archeological value, such observations shall be reported immediately to the Contracting Officer, or, if present, the Corps' Construction Supervisor so that the appropriate authorities may be notified and a determination can be made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in the destruction of these resources and shall prevent his employees from trespassing on, removing, or otherwise damaging such resources.

7.8. Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. 3001) addresses processes and requirements for federal agencies regarding the discovery, identification, treatment, and repatriation of Native American and Native Hawaiian human remains and cultural items (associated funerary objects, unassociated funerary objects, sacred objects, and objects of cultural patrimony). Consistent with procedures set forth in applicable Federal laws, regulations, and policies, the Corps will proactively work to preserve and protect natural and cultural resources, and establish NAGPRA protocols and procedures.

7.9. Clean Air Act

The Clean Air Act required states to develop plans, called State Implementation Plans (SIP), for eliminating or reducing the severity and number of violations of National Ambient Air Quality Standards (NAAQS) while achieving expeditious attainment of the NAAQS. The Act requires Federal actions to conform to the appropriate SIP. An action that conforms with a SIP is defined as an action that will not: (1) cause or contribute to any new violation of any standard in any area; (2) increase the frequency or severity of any existing violation of any standard in any area; or (3) delay timely attainment of any standard or any required interim emission reductions or other milestones in any area. The proposed actions will not result in changes to air quality. The project is exempted from the conformity requirements of the Clean Air Act because actions taken to repair and maintain existing facilities are specifically excluded from the CAA conformity requirements where the action, as here, would result in an increase in emissions that is clearly de minimis (40 CFR § 93.153(c)(2)(iv)).

7.10. Executive Order 12898: Environmental Justice

Executive Order 12898 directs every Federal agency to identify and address disproportionately high and adverse human health or environmental effects of agency programs and activities on minority and low-income populations. HHD is in area that is closed to the public, and the downstream flow effects are not expected to have more than negligible effects on the human population. Therefore no effects on minority or low income populations will occur.

7.11. Executive Order 11990: Protection of Wetlands

This executive order encourages federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands when undertaking federal activities and programs. No wetlands will be affected by the proposed actions.

7.12. Executive Order 11988: Floodplain Management Guidelines

This executive order requires federal agencies to evaluate the potential effects of actions on floodplains and to avoid undertaking actions that directly or indirectly induce growth in the floodplain or adversely effect natural floodplain values. The proposed actions include an evaluation and repair of HHD, the purpose of which is to restore the dam to its original functionality. This will not result in further development of the Green River floodplain beyond that which had existed prior to the January 2009 flood.

7.13. Tribal Treaty Rights

In the mid-1850's, the United States entered into treaties with a number of Native American tribes in Washington. These treaties guaranteed the signatory tribes the right to "take fish at usual and accustomed grounds and stations . . . in common with all citizens of the territory" [U.S. v. Washington, 384 F. Supp. 312 at 332 (WDWA 1974)]. In U.S. v. Washington, 384 F. Supp. 312 at 343 - 344, the court also found that the Treaty tribes had the right to take up to 50 percent of the harvestable anadromous fish runs passing through those grounds, as needed to provide them with a moderate standard of living (Fair Share). Over the years, the courts have held that this right comprehends certain subsidiary rights, such as access to their "usual and accustomed" fishing grounds. More than de minimis impacts to access to usual and accustomed fishing area violates this treaty right [Northwest Sea Farms v. Wynn, 931 F. Supp. 1515 at 1522 (W.D. WA 1996)].

Project activities will occur within the usual and accustomed fishing grounds of the Muckleshoot Tribe. The tribe has been consulted about the project. No effects to tribal treaty rights are expected.

8. CONCLUSION

Based on this assessment, the proposed action is not expected to result in significant adverse environmental impacts. The proposed action is not considered a major Federal action having a significant impact on the quality of the human environment and does not require preparation of an environmental impact statement.

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Appendix A. Figures

State Map and Project Location

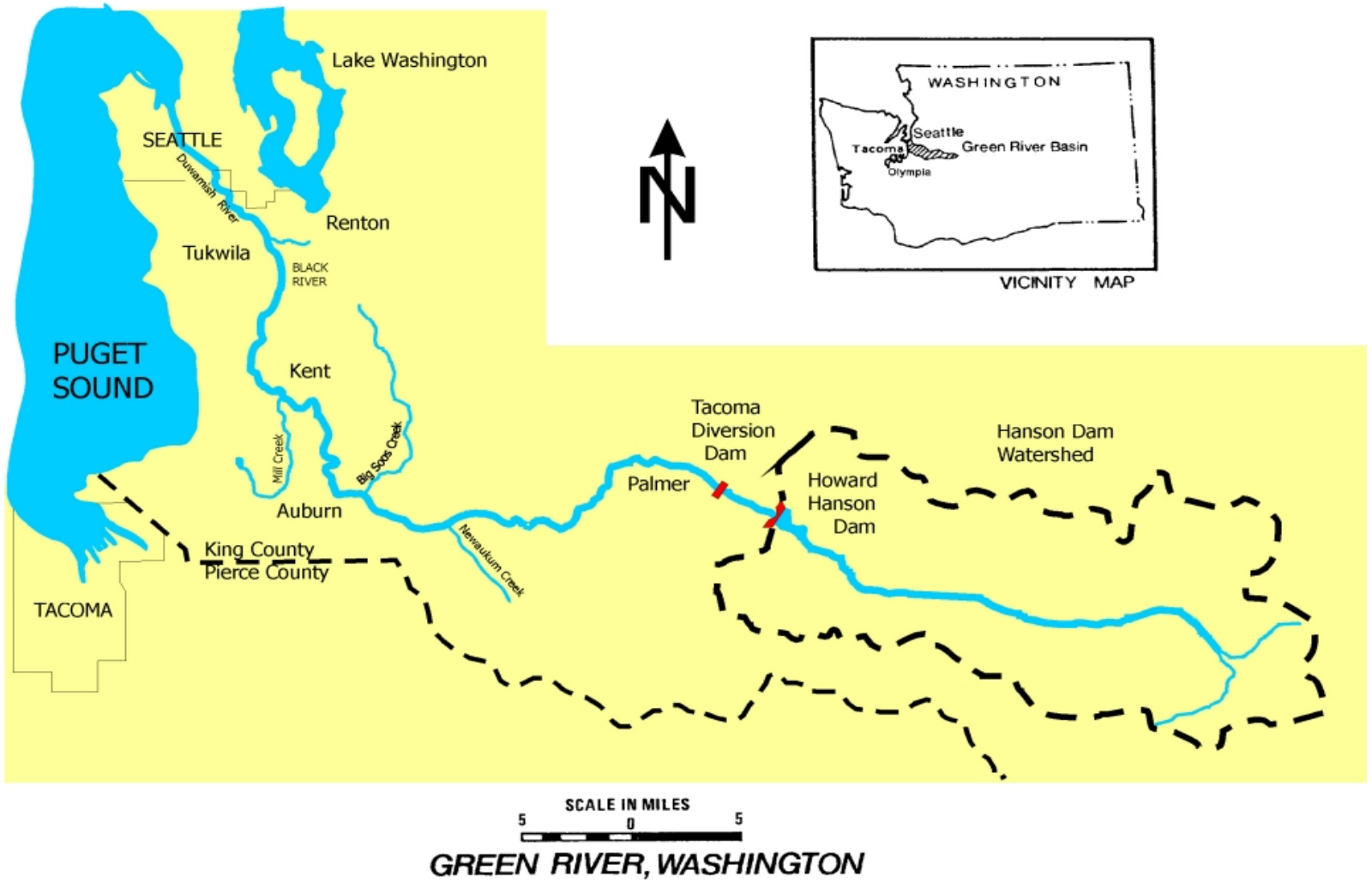

Figure 1. Project location

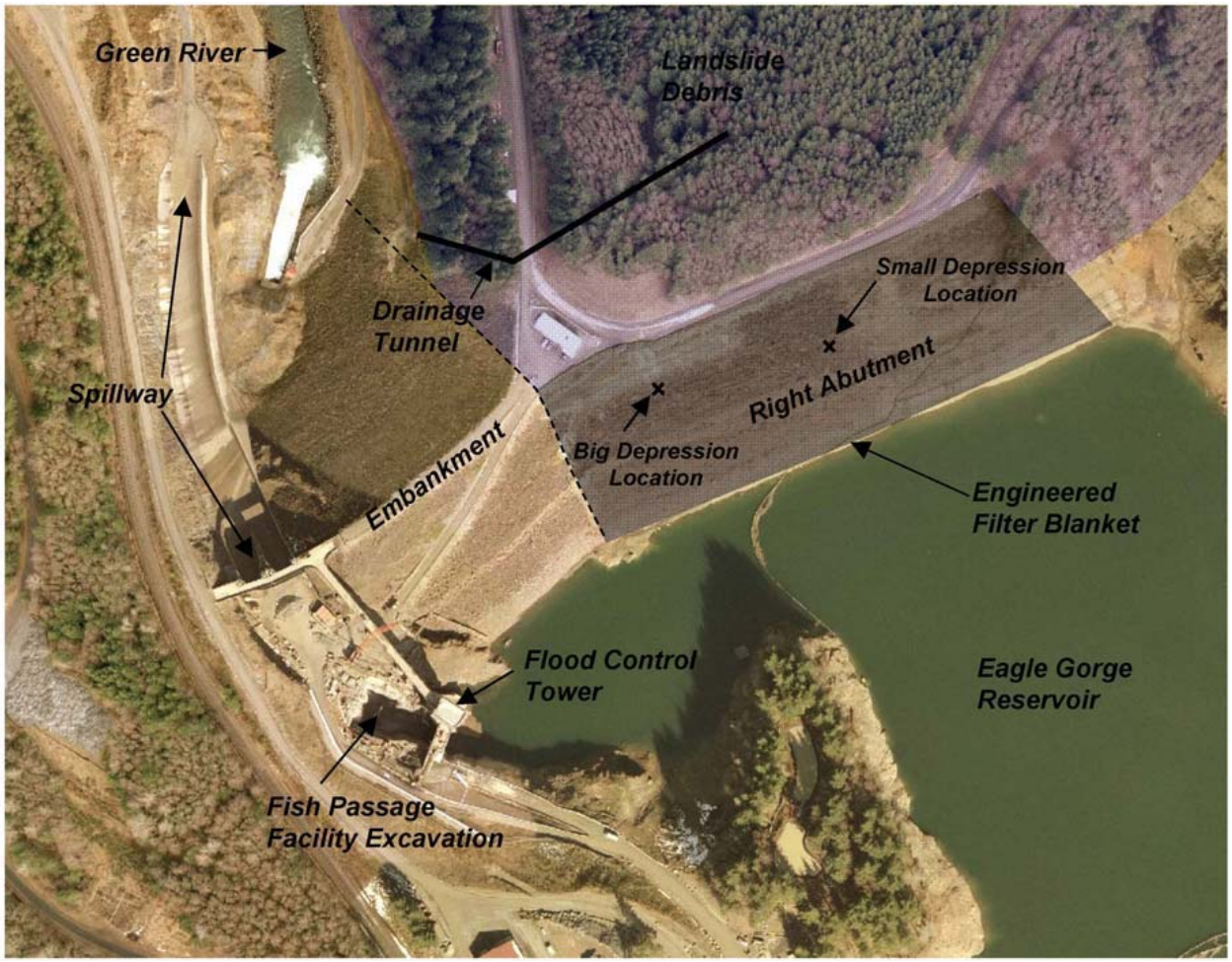

Figure 2. Howard Hanson Dam and features of the right abutment

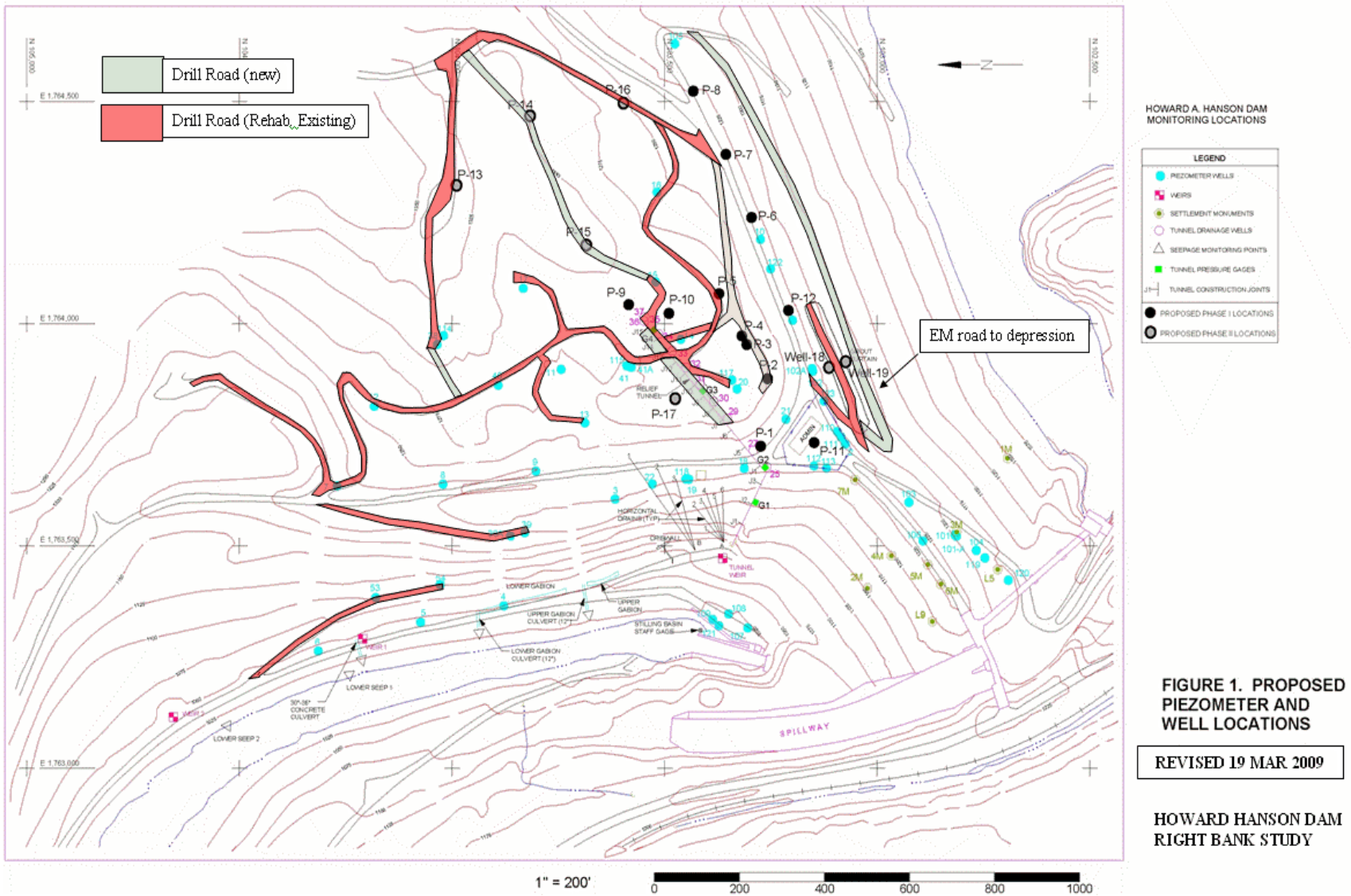

Figure 3. Proposed road alignments and monitoring device locations

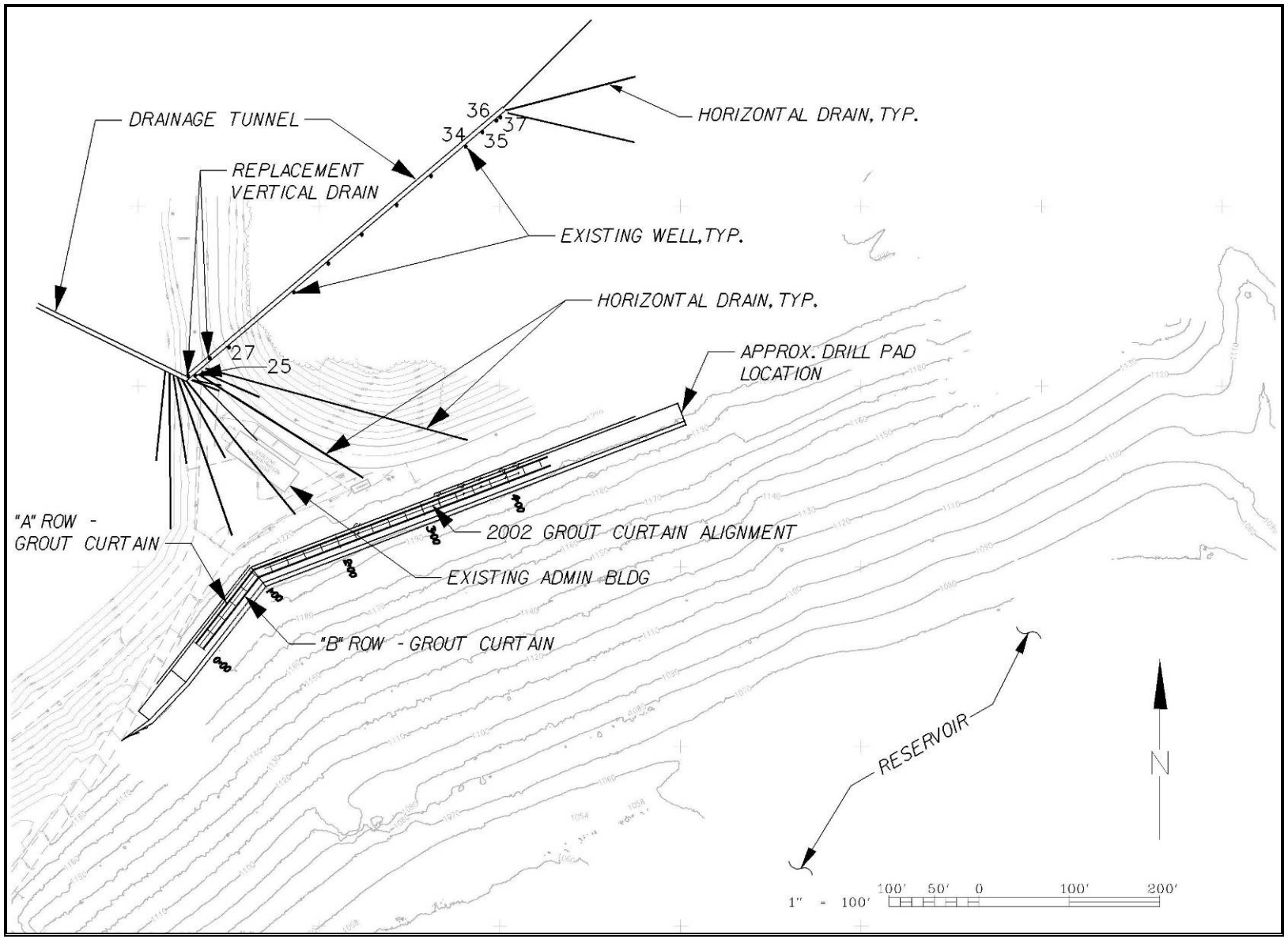

Figure 4. Interim repair of the right abutment including grout curtain and drainage wells.

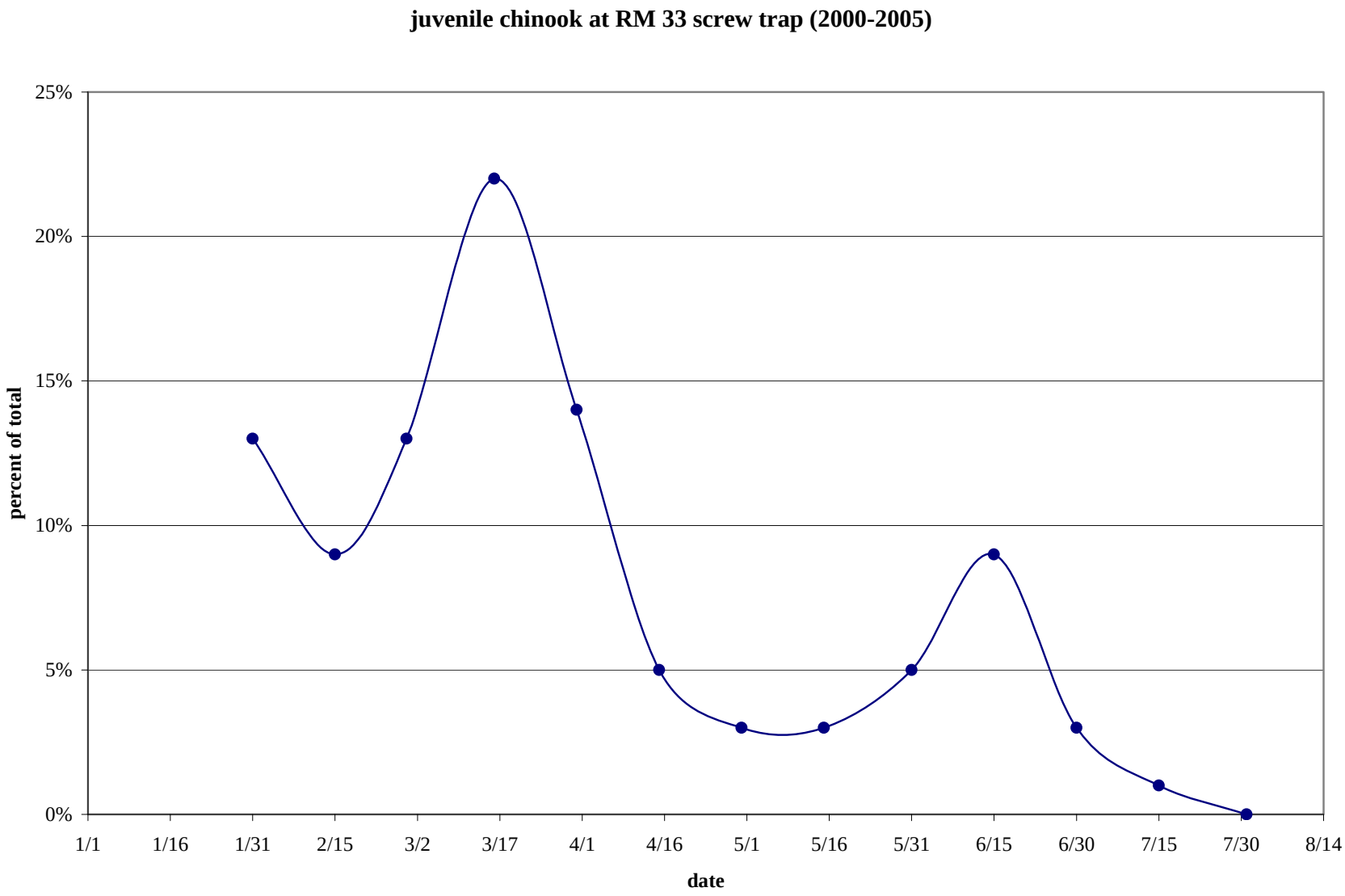

Figure 5. Juvenile Chinook salmon outmigration timing; from WDFW screw trap data

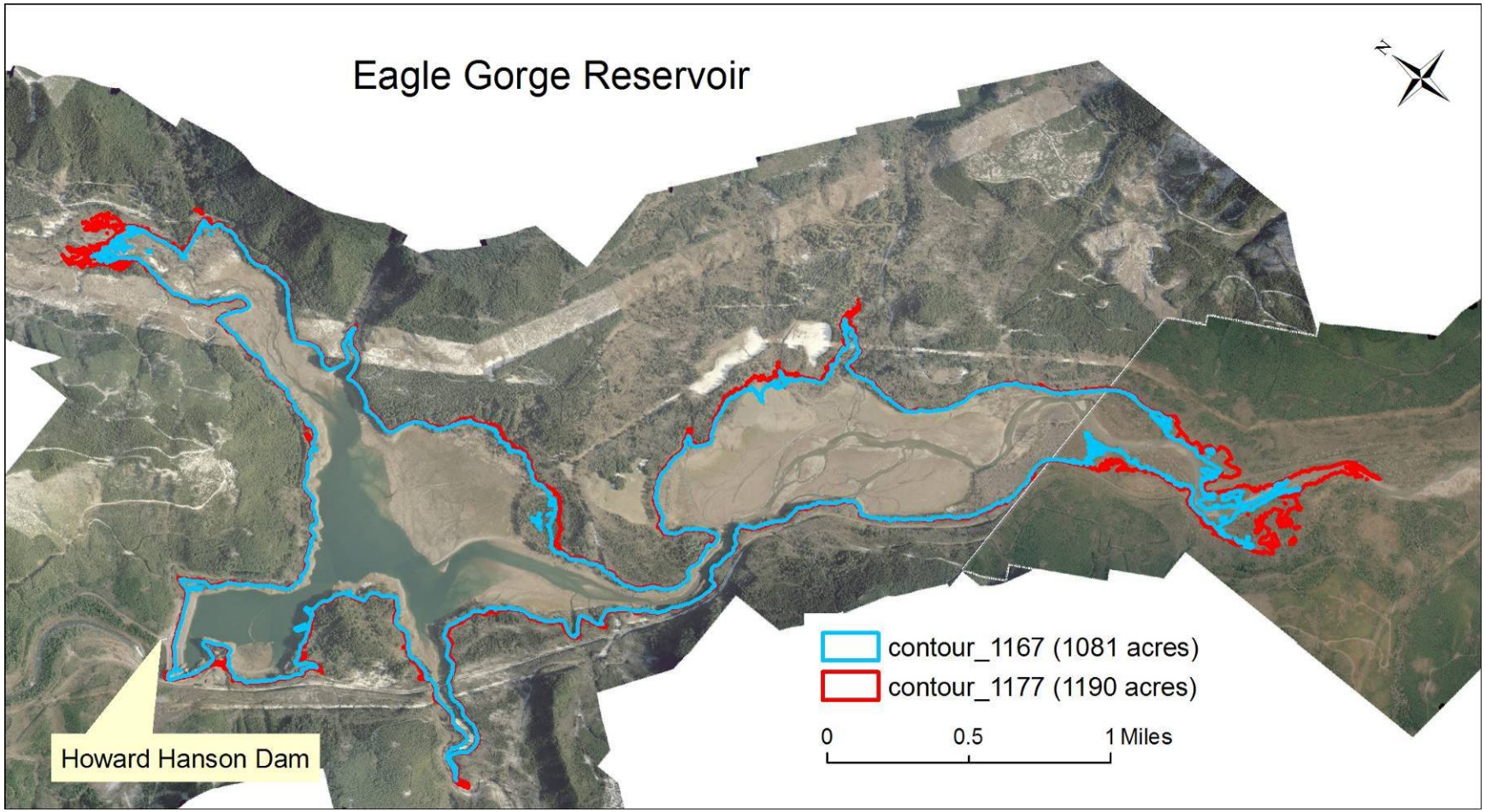

Figure 6. Potential flooded area during short duration water storage to 1177 ft.

Appendix B.

ESA Concurrence Letter

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, Washington 98115

NMFS Tracking No.:
2009/02836

June 16, 2009

Deborah J. Johnston
Chief, Environmental Resources Section
U.S. Army Corps of Engineers
P.O. Box 3755
Seattle, WA 98124-3755

RE: Endangered Species Act Section 7 Informal Consultation for the Howard Hansen Dam Repair, Green River. (King County, Washington) Green River HUC 17110013.

Dear Ms. Johnston:

This correspondence is in response to your request for consultation under the Endangered Species Act (ESA).

Endangered Species Act

The National Marine Fisheries Service (NMFS) has reviewed your May 27 request for consultation for Puget Sound (PS) Chinook (*Oncorhynchus tshawytscha*) and for PS steelhead (*O. mykiss*) which are ESA listed as threatened and for PS Chinook critical habitat. This consultation with NMFS is conducted under section 7(a)(2) of the ESA, and its implementing regulations, 50 CFR Part 402.

According to the Biological Assessment (BA), the Corps of Engineers (COE) is conducting a suite of activities aimed at repair of the Howard Hansen Dam, located on the upper Green River, King County, Washington. In order to address the potential for dam failure, the COE has already taken steps to investigate the site, ensure a safe spring refill of the reservoir, design a grout-curtain to block seepage at the dam abutment, and plan an unseasonal drawdown of the reservoir. The COE has proceeded according to emergency consultation 50 CFR Part 402.5. According to the BA, none of the work already done by the COE for this repair has resulted in adverse effects on ESA-listed salmonids or designated critical habitat. The remaining work that may affect ESA-listed salmonids involves the indirect effects of the proposed drawdown.

A reservoir drawdown of about 20 ft over two weeks will result in slightly higher flows in the Green River downstream of the dam than would otherwise occur in June. The proposed drawdown will augment flow in the Green River by approximately 470 cfs over the 2 week period. Current inflows to the reservoir are about 850 cfs.

Adding 470 cfs to this results in flows of 1320 cfs, which are slightly above median flows but well within the natural range for this season. Most snow has melted above the reservoir by June and flows below the reservoir during the drawdown would continue to drop depending on short storms that add to inflows. Therefore, the drawdown would increase flow in the downstream river period resulting in incrementally more aquatic habitat in the river. This should incrementally benefit some juvenile salmon species that are at the tail end of their spring emigration to Puget Sound. And juvenile coho salmon and steelhead may benefit from greater amounts of rearing habitats for two weeks.

The drawdown will likely result in a slight amount of reservoir capacity not available to augment flow in early autumn when adult Chinook salmon return to spawn. While this change in the flow schedule may have some incremental effect on Chinook salmon by reducing spawning habitat that might otherwise be available without the drawdown, it is not expected to result in adverse effects on Chinook salmon.

The action area for this consultation is the entire Green/Duwamish River for the 77 miles below the Howard Hansen Dam.

Species Determination

Puget Sound Chinook
Puget Sound Steelhead

In the Green/Duwamish River basin, Chinook salmon fry emerge from the streambeds from January to early spring. Juvenile Chinook salmon emigrate starting in mid-January until early July. Returning adult Chinook salmon immigrate in August and September, and spawn in September and October. Steelhead spawn in late spring and many juveniles reside in the river for a year or more. The steelhead smolts that emigrate predominately do so in March through June of each year, are less dependent on nearshore areas for feeding and rearing, and would likely avoid areas of construction.

The proposed project has the potential to alter water quantity and velocities by changing the usual schedule of reservoir operations of refill and drawdown. However, the amount and timing of changed flows do not rise to the level of adverse effects on Chinook salmon or Puget Sound steelhead.

Therefore, NMFS concurs with the effects determination of "may affect, but not likely to adversely affect," for PS Chinook salmon and steelhead.

Critical Habitat Determination

NMFS designated critical habitat for the PS Chinook salmon Evolutionary Significant Unit (ESU) on September 2, 2005 (70 FR 52630). The three primary constituent elements (PCEs) for the PS Chinook salmon ESU critical habitat in this action area are freshwater migration, spawning, and rearing habitats.

Designated critical habitat boundaries within the action area include a lateral extent as defined by the ordinary high-water line of the Green River. NMFS analyzed the potential impacts of the project on these PCEs and determined that the potential effects will be insignificant because:

1. The actions will not result in a barrier to migration: effects on migratory habitat are expected to be insignificant.

2. Potential effects on spawning habitats, while measurable, are likely insignificant in light of the normal snowpack and expected reservoir operations that will enable flows that support typical spawning conditions.

Therefore, NMFS concurs with your "may affect, not likely to adversely affect" determination for critical habitat for PS Chinook salmon.

This concludes informal conference pursuant to the regulations implementing the ESA, 50 CFR 402.10. This project should be reanalyzed by the COE if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation. The project should also be reanalyzed if the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this consultation, and/or if a new species is listed or critical habitat for another species is designated that may be affected by this project.

The efforts by COE to design this project to minimize environmental effects are appreciated. If you have any questions, please contact Matt Longenbaugh, of my staff, at (360) 753-7761 or matthew.longenbaugh@noaa.gov.

Sincerely,

Barry A. Thom
Acting Regional Administrator

cc: Holly Coccoli, Muckleshoot Indian Tribe

Appendix C.

Comments on Draft EA and Corps Responses

Comments from John Kirner, Water Superintendent, Tacoma Water, received by letter dated June 9, 2009.

1. Section 2.1.3 Construct limited new roads, repair existing roads, and close roads

   The last sentence in this section indicates this is the preferred alternative because it met all of the objectives and is consistent with environmental requirements for the site.

   While this alternative reduces permanent road miles compared to the alternative described in 2.1.2, it still increases permanent road miles within the Natural Zone as described in the Green River Habitat Conservation Plan. These will need to be mitigated for by abandoning other roads within this zone.

Corps Response: See response to comment 7 below.

2. Section 3 Existing Conditions

   The document breaks the watershed into the lower, middle and upper Green River basins and the lower and upper Green River. There needs to be some better clarification on how these terms are used and what they represent. Definitions would be helpful.

Corps Response: The final EA clarifies these terms in the sections where they may have previously been ambiguous. In general, the upper Green River basin is that portion of the basin upstream of Howard Hanson Dam. The middle Green River is from Howard Hanson Dam to Soos Creek, and the lower Green River is from Soos Creek to the river mouth at Elliott Bay.

3. Section 3.1 Land use and basin characteristics

   The second sentence lists the landowners in the basin. Landowners not mentioned include Burlington Northern Sante Fe Railroad, the Muckleshoot Indian Tribe, the city of Seattle, and Washington State Department of Transportation.

Corps Response: These landowners were added to section 3.1 in the final EA.

4. Section 3.6 Vegetation and habitat

   In the third paragraph, fifth sentence, remove the phrase “and the river fluctuations are not as severe”. Riparian stands and wetland habitats form in valley bottom floodplains in unregulated river systems where river fluctuations are severe. For example, avulsion often results in the formation of disconnected channels and oxbows that form very productive wetland habitats.

Corps Response: Agree. This phrase was deleted in the final EA.

5. Section 3.7 Fishery resources

   Other native fish species also include sockeye salmon, which are regularly found in the Green River.

Corps Response: Small numbers of sockeye salmon are observed in the Green River annually. Reference has therefore been added to the discussion in section 3.7. However, these fish may simply be strays from Lake Washington and not a stock native to the Green River. The Washington Department of Fish and Wildlife lists no Green River sockeye stock in its database.

6. Section 4.1.2 Vegetation and habitat

   This section discusses requirements under the Green River HCP. The fourth sentence in the first paragraph should also mention that the Forest Management Zone provides timber and other forest products.

   The first sentence in the third paragraph includes the phrase "provide measures to utilize impaired watershed lands". What does this mean?

Corps Response: Language was added to section 4.1.2 indicating that the Forest Management Zone provides timber and other forest products. In regard to the second comment, our interpretation of the HCP was not clear on this item. The phrase was therefore removed from the final EA.

7. The fifth sentence in the third paragraph states that selected roadways will "likely" be abandoned…. A key requirement under HCM 3-03C is that there will not be an increase in permanent road miles within the natural zone over the life of the HCP. The language in this section of the EA/BA should show a strong commitment by the Corps to work with Tacoma Water to identify and fund abandonment of existing roads to off-set new roads built by the Corps over the right abutment. Selection of roads to abandon needs to be based on prioritization determined by Tacoma Water in order to best meet their operational needs and to protect sensitive habitats.

Corps Response: A total of 1,650 ft of new road was constructed in the Tacoma Natural Zone while 150 ft of old road was abandoned. The Corps is assuming a 1 to 1 replacement for the amount of old road to be abandoned to equal the new road constructed. There has been a net gain of 1,500 ft of new road from the project. The Corps will work with Tacoma to find an appropriate area for 1,500 ft of road abandonment, following the guidance of HCM 3-03I, to meet the requirement of offsetting new road construction.

8. Section 4.3.3 Fishery resources

   The second sentence mentions that expedited drawdown scenarios should benefit salmon. However, expedited drawdown would likely cause the downstream displacement of newly emerged fry and has the potential to harm sac fry working through the interstitial spaces prior to swim-up if any part of the bed is mobilized by the increase in flows. These flows come at a time when Green River fish resources would typically experience a declining hydrograph.

Corps Response: The expedited drawdown results in flow increases of approximately 500 cfs. Hydraulic modeling of the middle Green River indicates a flow increase from 900 to 1400 cfs results in an average velocity increase of 13% in the center of the channel (3.29 ft/s to 3.72 ft/s) between river mile 44 and 30. The maximum velocities are 6.83 ft/s and 7.17 ft/s respectively. The minimum velocities are 1.47 ft/s and 1.90 ft/s respectively. While there is certainly an incremental increase in velocity and possibly an incremental effect on juvenile steelhead, it is highly unlikely that any real effect on sac fry displacement can be measured from such a flow change. These flows are far below any threshold to mobilize gravel. In excess of 3,000 cfs is required to mobilize gravel based on studies the Corps has conducted with its gravel nourishment project in the Green River. Finally, the additional flow will offer greater protection to steelhead redds that were created at the channel margins and are therefore susceptible to dewatering. Flows are typically augmented this time of year, although not necessarily to the same degree, to protect these redds.

9. Section 4.3.5 Threatened and endangered species

   Puget Sound Chinook Salmon ESU

   A main reason of increasing flows during chinook spawning is to move the preferred spawning habitat laterally in the channel. The probability of redd scour is highest when redds are forced to be located near the thalweg of the low-flow channel. Flow augmentation during chinook spawning increases the amount of available spawning habitat and reduces the proportion of chinook redds that are constructed in high risk areas.

Corps Response: Agree. Language was added to the final EA to clarify and expand on this point. Note that the HHD low flow augmentation and section 1135 water volumes are retained in either drawdown scenario. This water will be used to augment flows beyond the natural inflow to the reservoir. Since the Tacoma M&I water that is lost during the drawdown provides potential fall augmentation well in excess of what naturally occurs, its loss can not be considered an adverse effect. This water is more appropriately described as 'bonus' water that improves upon the natural conditions.

10. Section 4.3.5 Threatened and endangered species

Puget Sound Steelhead DPS

The "swim-up" of steelhead fry out of the gravel occurs during the June to early July period in the Green River. These fish are very small and poor swimmers during this period in their development. Expedited drawdown is likely to either 1) cause the displacement of newly emerged fry downstream thus decreasing the amount of early rearing habitat available to them and increasing the probability of predation, or 2) cause surficial bed mobilization as sac-fry are migrating to the surface prior to swim-up.

Even though certain flow events may fall within the range of flows that are typical of the Green River, does not mean they are beneficial. The impacts of expedited drawdown may be particularly damaging to the steelhead population in the Green River this year since the 2009 escapement appears to be one of the lowest on record (unpublished Muckleshoot spawning ground survey data).

Corps Response: See response to comment 8.

11. Figure 5. Juvenile Chinook salmon outmigration timing; from WDFW screw trap data

The left side of this graph shows a "low point" in the chinook outmigration at around the second week in February. This is not accurate. The chinook outmigration across Puget Sound is characterized by two peaks, not three. WDFW reports describe chinook outmigration as bi-modal (e.g., Volkhardt et al. 2006. 2005 juvenile salmonids production evaluation report: Green River, Dungeness River, and Cedar Creek. Wash Dept Fish & Wildlife. FPA 06-10). Also, chinook emigration begins earlier than mid-January as depicted in the figure. Outmigration timing varies from year to year in response to spawn timing, water temperatures, and habitat availability. The following report describes earlier outmigration timing than Figure 5 of the BA depicts (Topping et al. 2008. Juvenile salmonids production evaluation report Green River and Dungeness River chinook monitoring evaluations in 2007. Wash Dept Fish & Wildlife, FPA 08-09).

Corps Response: The figure is a summary of data collected from 2000-2005. This limited data snapshot should not be used to conclude there are three outmigration peaks. It should not be used to conclude that the timing is necessarily limited to the period of the data collection, particularly in the early part of the year where the curve does not go to zero. No such conclusions were expressed in the draft EA nor were they implied. The figure simply serves to illustrate a generalized timing of this species outmigration based on data available.

12. The EA should mention that all equipment brought into the watershed that will be working in or near water should be disinfected using city of Tacoma decontamination procedures.

Corps Response: A statement to this effect was added to section 2.5 in the final EA.

Comments from Hilary Lorenz, Green River Facility Manager, Tacoma Water, received by email on June 1 and June 8, 2009.

1. I would like to request that you install continuous pH monitoring instrumentation, with alarm capability, at the USGS gauge just downstream from HHD. I understand from Bryan King that the site is wired for online instrumentation. The Washington State Department of Health dictates that we maintain a target level of pH in the water leaving our facility. Continuous pH monitoring during and after concrete work will give us the ability to respond to any increases in pH and prevent Health Department violations.

   I am basing my request on two previous high pH excursions during late 2004 and early 2005 which were resultant from concrete work at the dam. I have attached a copy of an email from Chris McMeen of Tacoma Water to Mike Padilla of the USACE, dated January 07, 2005, for your review.

2. The risk of another pH excursion may be low; however, given that it has happened before with similar work and that the potential consequences are severe, caution and preparation are appropriate. Continuous online monitoring is the safest way to ensure we have time to shut down before contaminated water enters our intake. We do have online pH monitoring and alarms at the intake, but the contaminated water will already have entered our system when the alarm setpoint is triggered.

   You are correct; the alarm would pop up on the operations terminal at the HHD. Hopefully, it will also be routed to the operator's pager in case they are away from the operations room when an alarm is activated.

   Currently, our pH analyzer at the Headworks intake reads 7.36. This varies a bit seasonally and especially during summer algae blooms. An alarm setpoint of 8.5 should give us an early enough warning to evaluate and respond. That being said, the earlier an alarm is sounded, the more time we have to close our intake. I do know the USGS gauging station is wired for instrumentation, but pH monitoring at the dam outfall would allow more response time. Is there instrumentation capability at the outfall?

Corps Response: The Corps plans to install a real time pH probe at the USGS stream gage approximately 0.7 miles downstream of Howard Hanson Dam. Details with respect to alarms, notification, and thresholds will be addressed as plans are finalized. Monitoring at the dam outfall (stilling basin) is more difficult as there is no power at the site. Furthermore, this site would not integrate the number of seeps that exit the hillside that could potentially contribute to a pH increase. The USGS gage is about three miles upstream of the Headworks intake so should provide some time for Tacoma to respond to a potential increase in pH.

Comments from Holly Coccoli, Fisheries Biologist, Muckleshoot Tribe, received by email on June 8, 2009.

1. Written comments were provided earlier by the MIT Fisheries Division to the Corps with recommendations for the road construction aspect of this project.

Corps Response: These comments were addressed in the draft EA and the 2 April Environmental Compliance Status memorandum discussed in the EA.

2. Preferred alternative "Refill to 1167 ft, periodic refill stops, with potential short peak above 1167 ft". While we do not object to this alternative from a fisheries standpoint, any refill to above 1167 feet depends on the availability of hydrologic conditions that allow higher storage without reducing flows below the protection flows needed for steelhead incubation. Spawning and incubation surveys are being conducted by our staff --as flow and visibility conditions allow --so that we can very soon estimate the protection flows.

Corps Response: The short duration storage and drawdown above elevation 1167 ft was conducted June 9 to June 16. Water was captured at a rate similar to that throughout the spring refill period. A high pool of elevation 1169.2 ft was achieved on June 12. Steelhead redd protection flows requested by the resource agencies were maintained throughout.

3. Given that two refill stops have already occurred, documentation should be made of the actual river stage changes at Palmer and Auburn stream gages during the 1147 and 1157 foot elevation refill stops, and during the 1167 foot test, if available. With this information, and perhaps other information such as available side channel connection flows, the Corps should assess how well its objective was met to avoid downstream impacts to steelhead spawning and incubation during the conduct of the refill stop tests. Our concern included that the stops would result in changes in downstream river stage and velocities that might cause steelhead to spawn at higher streambed/more lateral sites, e.g. in side channels, making them more vulnerable to subsequent redd dewatering or trapping/stranding of fish.

Corps Response: The Corps was able to moderate the stage changes during the stop periods by continuing to store water and by lengthening the transition period at the conclusion of the refill stops. The reservoir increased by about 1.5 ft during the 1147 stop period and by about 1.2 feet during the 1157 stop period.

The 1147 ft refill stop occurred May 5 to May 8. The maximum hourly stage change on May 5 was 0.21 ft at Palmer and 0.13 ft at Auburn. The mean daily stage change from May 4 to May 5 was 0.36 ft at Palmer and 0.33 ft at Auburn. The maximum hourly stage change on May 8 was -0.31 ft at Palmer and -0.21 ft at Auburn. The total stage change was about -0.95 ft over a six hour period at Palmer and -0.95 ft at Auburn over a similar time period. The mean daily stage change from May 8 to May 9 was -0.39 ft at Palmer and -0.74 ft at Auburn.

The 1157 ft refill stop occurred May 19 to May 22. The maximum hourly stage change on May 19 was 0.24 ft at Palmer and 0.17 at Auburn. Total stage change was 0.53 ft and

occurred over 6 hours at Palmer. Total stage change at Auburn was 0.46 ft over a similar timeframe. On May 21/22 the maximum hourly stage change was -0.14 ft at Palmer and -0.15 ft at Auburn. The mean daily change was -0.56 ft on May 21 and -0.21 ft on May 22 at Palmer, and -0.60 ft on May 21 and -0.22 ft on May 22 at Auburn.

In general these stage changes are within the ranges anticipated in the draft EA except for the ramp down on May 8. While the hourly stage changes were relatively moderate on this date, a stage of nearly a foot over a six hour period was not a desired management goal. While the ramp down was partly the result of some internal miscommunication, the operation was largely driven by an observed receding inflow hydrograph and a forecast for a steeply receding inflow hydrograph through the subsequent weekend. This ramp down likely had minimal effects on fish due to the relatively high flows (about 2,400 cfs) at the time. Ramping rate guidelines only apply to flows less than 1,500 cfs, and most side channel habitat remains connected to the river at these flows. While the hourly down ramping was relatively moderate, on the order of two inches per hour or less, it is possible that some habitat became isolated during the course of this action temporarily stranding fish. These stranded fish may have been subject to higher predation rates as a result. The fact that the river regained this stage about one week later reconnecting any habitat that may have been isolated during the ramp down should have limited this effect, if it occurred at all.

4. While it is understood that a normal drawdown depends on monitoring data and dam safety considerations, we strongly urge the Corps to implement the "No action- Normal drawdown" alternative. In this alternative, drawdown is gradual instead of expedited, and storage above 1147 feet is maintained until approximately mid- or late September when releases are especially needed for fisheries flow augmentation for Chinook migration and spawning. While it is possible that the fisheries managers may request some storage above 1147 to be released in early summer to protect incubating steelhead redds, a normal drawdown will enable the Corps and the fisheries resource managers to provide instream flow conditions to help protect anadromous fish including ESA-listed species against adverse impacts.

Corps Response: The Corps has determined that an approximately two week drawdown period from elevation 1167 ft to 1155 ft appropriately balances the dam safety risks and the various stakeholder concerns. The paramount concern is dam safety. The Corps has determined based on extensive monitoring and review that the reservoir should be lowered to 1155 ft within the reasonably short timeframe of about two weeks, that takes into account a balance of structural and water use considerations. Reservoir elevations greater than 1155 ft increase the risk of active internal erosion of the right abutment. This risk is much reduced at reservoir elevations below elevation 1155 ft. This drawdown approach enables use of the drawdown water for the end of the juvenile Chinook salmon outmigration and for protection of steelhead redds. Approximately 9,000 acre-feet of flexible augmentation water will remain in the reservoir after the two week period has concluded on July 1. This water can be used to further augment flows to protect incubating steelhead eggs and to increase flow for Chinook salmon spawning in the fall.

5. Storage above 1147 in the last two years has provided a substantial improvement in instream habitat conditions for migrating and spawning Chinook salmon and increased protection for steelhead redds. Higher flows above base minimum levels not only increase spawning area for Chinook, but increase depth cover and escape opportunity in the face of harassment along the densely populated/heavily used Green River corridor, much of which is lacking in deep pools, riparian forest, and woody cover features. These higher flows (up to 15,000 acre feet or more) have been provided by a combination of Section 1135 storage and a half share of M&I water stored under the AWSP, as well as additional unused M&I water donated by TPU. The half share and donated M&I water has provided interim mitigation for those AWSP mitigation measures that await completion. While temporary these releases serve a vital purpose to improve instream habitat conditions in the middle river and to partially ameliorate the badly degraded riparian and instream habitat conditions for Chinook and steelhead imposed by the current HHD-associated levees the lower river. If, in a worst case scenario, the summer and fall are especially hot and dry, and this project results in failure to provide significant fall flow augmentation, clearly Chinook in that case would be adversely affected.

   Additionally, this fall the odd-year spawning migration of perhaps over two million pink salmon is expected in the Green River coincident with the return of approximately five to ten thousand Chinook salmon spawners. Should low flow conditions occur, large numbers of pink salmon and carcasses may reduce water quality, increase stress, and otherwise impair habitat conditions for the far fewer Chinook

Corps Response: The Corps agrees that the additional Tacoma water that has been used to augment fall flows has improved spawning opportunities for Chinook salmon the last couple years. As stated above in the response to comment 4, approximately 9,000 acre-feet of fisheries augmentation water will be available after the two week drawdown scenario is completed. If especially dry conditions occur in the fall, this may result in more difficult spawning conditions for Chinook salmon. However, this scenario would predominantly occur as a result of natural conditions and not as a direct result of the two week drawdown timeframe to elevation 1155 ft. As explained in section 1 of the EA, the Corps stores water for such a drought under two authorities, 1) 5,000 acre-ft under a Section 1135 Ecosystem Restoration project, and 2) 25,000 acre-ft under the original Howard Hanson Dam authorization. These two volumes of water are not affected by this drawdown scenario and can be used to buffer such a dry period.

In response to stakeholder concerns, the Corps will look for opportunities to conserve and capture additional water during the early summer for use during the fall. This will be coordinated with stakeholders and may include more limited use of the 25,000 acre-ft low flow augmentation water during the early summer, and opportunistically storing water during any storm events that occur over the summer.

6. If dam safety test data indicates that drawdown to an intermediate level (e.g., 1156 feet) is necessary, then we recommend and anticipate that the Corps will convene the HHD water

management group as soon as possible to discuss water management options for flow augmentation for the remainder of the conservation season.

Corps Response: As stated in response to comment 4, the Corps determined that a two week drawdown from elevation 1167 ft to 1155 ft is the appropriate course of action. This decision was reached on June 12. It was discussed with stakeholders at the June 17 Green River flow management conference call.

Appendix D.

Finding of No Significant Impact

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

Environmental Resources Section

Howard Hanson Dam Right Abutment Investigation, Reservoir Refill, Reservoir Drawdown, and Interim Repair King County, Washington

FINDING OF NO SIGNIFICANT IMPACT

1. Background. During a rain storm in January 2009, water was stored at Howard Hanson Dam (HHD) to elevation 1189 ft to prevent flooding downstream. This was a record flood storage height for the dam. During this time, two small depressions formed on the upstream face of the right abutment of the dam. Turbid water was observed from one of the drains in the right abutment drainage tunnel. The sediment movement combined with depression formation is an indication of potential piping. Piping is the movement of soil particles by percolating water leading to the development of a channel, and has been identified as a credible failure mode for the right abutment of the dam. Dam failure is not considered an imminent threat at this time.

2. Purpose and Need. The purpose of the proposed activities is to investigate the integrity of the right abutment of the dam, ensure a safe spring reservoir refill, and address the right abutment integrity concerns suggested by events during the January flood. Furthermore, the actions will provide data to determine acceptable flood, conservation, and municipal and industrial water storage elevations. The purpose of the interim repair project is to address the piping concerns suggested by the depressions and turbidity observed during the January flood.

3. Proposed Action. The specific actions include construction of new roads to install monitoring wells on the right abutment, a modified spring reservoir refill, a modified reservoir drawdown, installation of drainage tunnel dewatering wells, and construction of a grout curtain along the right abutment. Each action is considered to have independent utility except for the reservoir drawdown which is dependent on the reservoir refill. The drawdown alternative was selected in real time after review of right abutment monitoring data during the refill, dam safety considerations, and other factors. The selected drawdown alternative is an approximately two week drawdown from elevation 1167 ft to 1155 ft. Construction timing is constrained by the need to complete construction by the following flood season, which is generally considered to begin November 1.

4. Summary of Impacts. Pursuant to the National Environmental Policy Act, the attached Environmental Assessment (EA) has been prepared. The EA provides an evaluation of the potential environmental impact of the proposed work which is briefly summarized below.

Impacts from the road construction activities include loss of some second growth forest habitat, and short term increases in dust, noise, and construction run-off adjacent to the worksite. The work takes place on land designated as 'Natural Zone' and 'Forest Management Zone' by the Tacoma Water Habitat Conservation Plan (HCP) written to meet requirements of the Endangered Species Act. The HCP allows for road construction but requires a series of measures to meet the various land management requirements. A total of 1,650 ft of new road was constructed in the Tacoma Natural Zone while 150 ft of old road was abandoned. The Corps will work with Tacoma to find an appropriate area for 1,500 ft of road abandonment to meet the requirement of offsetting new road construction.

The reservoir refill and drawdown could potentially affect in stream fisheries including steelhead and Chinook salmon that are listed under the Endangered Species Act (ESA). These actions include sufficient real time management flexibility to minimize these potential effects. The selected drawdown alternative includes full storage of project low flow augmentation water, full storage of Section 1135 Ecosystem Restoration water, and approximately 8,500 acre-feet of water storage for Tacoma as part of the Additional Water Storage Project. Approximately 11,500 acre-feet of water storage for Tacoma will be released as part of the drawdown. This reduces the volume of water available to Tacoma and its water partners. It reduces the volume of water available to augment flows for fisheries due to an arrangement between Tacoma and the Muckleshoot Tribe to use 50 percent of Tacoma water for fisheries purposes until the downstream fish passage facility is completed at HHD. Since the Tacoma water that is lost during the drawdown provides potential fall augmentation well in excess of what naturally occurs, its loss can not be considered an adverse effect. This water is more appropriately described as 'bonus' water that improves upon the natural conditions.

The new dewatering wells are expected to result in negligible environmental impacts. Most work will occur inside the existing right abutment drainage tunnel and will be controlled to prevent drill tailings or contaminated wastewater from exiting the site. Two wells will be drilled from a road into the drainage tunnel. Tailings and waste water will be similarly controlled at this site. The proposed grout curtain is expected to result in negligible environmental impacts. Work would be confined to the upstream face of the right abutment of the dam. All stormwater and waste water would be managed on site and treated before any discharge. Erosion control measures would be employed to minimize erosion at the site. These activities would be managed thru performance specifications and Corps construction oversight that will be outlined in the construction contract.

The project will result in no discharge of fill to waters of the United States. Therefore a Clean Water Act Section 404 evaluation is not required. The final construction footprint for the grout curtain will determine the need for coverage under the Section 402 National Pollutant Discharge Elimination System construction general permit administered by the U.S. Environmental Protection Agency.

The work has been analyzed pursuant to the Coastal Zone Management Act. The suite of preferred alternatives is consistent to the maximum extent practicable with the enforceable policies of the Washington Coastal Zone Management Program. The Washington Department of Ecology has reviewed the proposed actions and determined that a Federal Consistency determination is not required.

Coordination of the proposed actions has occurred with the National Marine Fisheries Service (NMFS) and U.S. Fish & Wildlife Service to address potential effects to species listed under the ESA. Due to the urgent nature of completing this project prior to the oncoming flood season, the Corps implemented certain elements of the action, notably the road construction and modified reservoir refill, prior to completing consultation with the Services pursuant to the "emergency circumstances" provisions of the ESA consultation regulation. Consultation was completed on 16 June 2009. NMFS concurred with the Corps determination of *not likely to adversely affect* for steelhead, Chinook salmon, and Chinook salmon critical habitat. The determination for all other ESA listed species is *no effect*.

National Historic Preservation Act compliance for construction and operation activities at the Howard Hanson Dam Reservoir and associated projects was addressed in a 2003 Memorandum of Agreement (MOA) signed by the Corps, Tacoma, and the Washington Department of Archaeology and Historic Preservation. The Muckleshoot Tribe was consulted during development of the MOA and did not sign, but supports its provisions. The Corps has reached a determination of no historic properties affected for the proposed road construction, reservoir refill, reservoir drawdown, drainage wells, and grout curtain. Required reporting for this project will be included in an in-progress report that compiles all of the recent studies that have been completed for HHD and the Additional Water Storage Project.

5. Finding. For the reasons described above, I have determined that the proposed actions will not result in significant adverse environmental impacts. The project will not constitute a major Federal action with significant impacts on the environment and, therefore, does not require an environmental impact statement.

29JUNE2009
Date

Anthony O. Wright
Colonel, Corps of Engineers
District Commander