Clover Island Section 1135 Ecosystem Restoration

Kennewick, Washington

Clover Island Feasibility Report and Integrated Environmental Assessment

APPENDIX A, HABITAT EVALUATION MODELS

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1. PROJECT BACKGROUND

Clover Island is approximately 36 miles upstream of McNary Dam on the lower Columbia River at approximately river mile 329 (Figure 1). Before the construction of McNary Dam, Clover Island was estimated to be 162 acres in size. However, the original island was inundated by Lake Wallula upon the completion of McNary Dam in 1957. Prior to the completion of McNary Dam, the US Army Corps of Engineers (Corps) permitted the Port of Kennewick to place fill material obtained from the lower areas of Clover Island on a higher part of the original island (east end), thereby creating the current island. The portion of Clover Island completed in the 1960s was comprised of upland material, and in its current form is approximately 16 acres. The island is a commercial area with a hotel and several restaurants onsite, as well as a large marina with boat mooring (Figure 2).

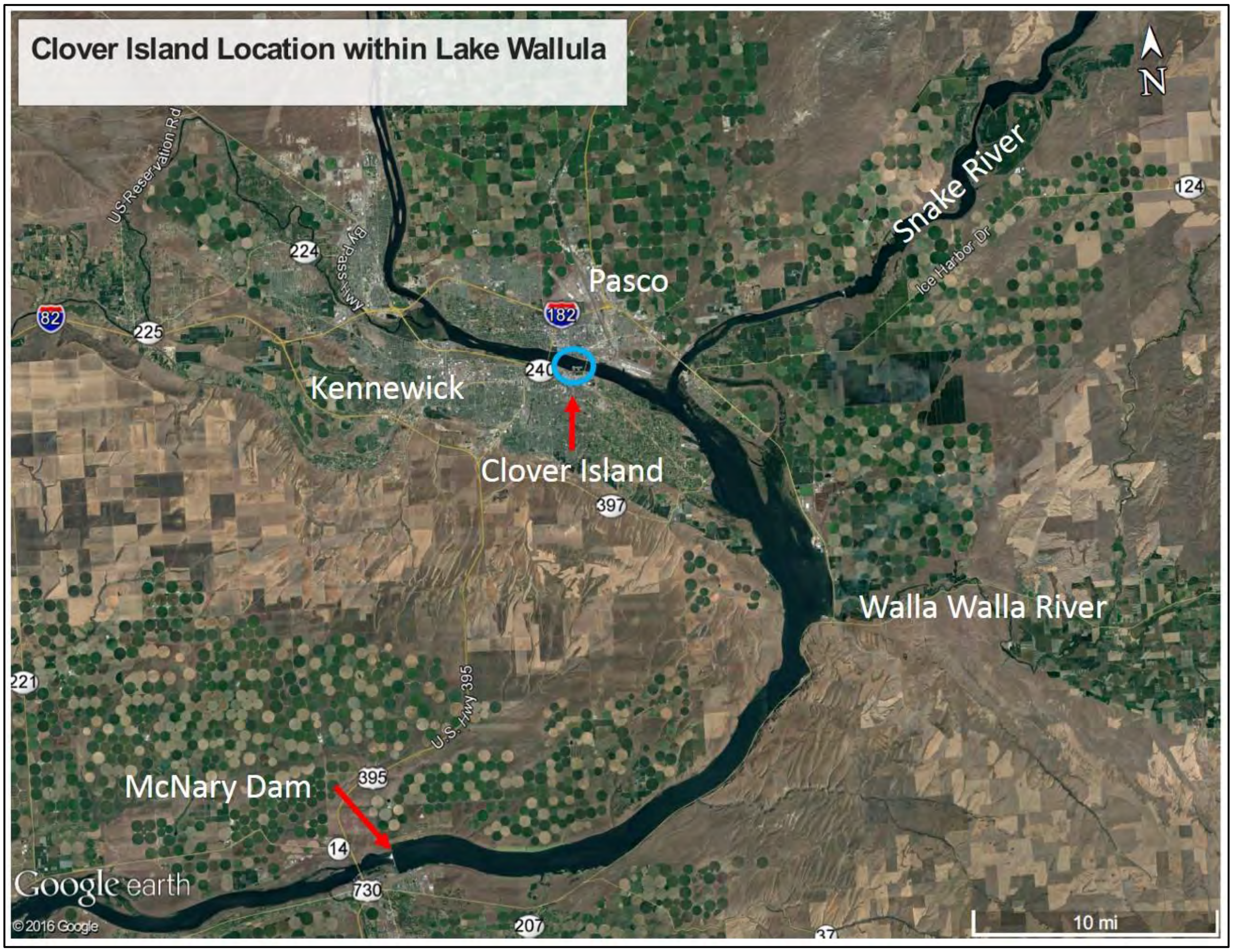

Figure 1. Clover Island is located approximately 36 miles upstream of McNary Dam on the lower Columbia River.

Prior to the construction of McNary Dam, riparian habitat types on Clover Island included a variety of woody vegetation such as black cottonwood (*Populus trichocarpa*), willow species (*Salix spp.*), and seasonally inundated wetlands. The aquatic habitat surrounding the island was ecologically diverse with abundant large woody debris, shallow depths, and off-channel habitat for a variety of salmonid species. Many of these salmonids are now listed as threatened or endangered under the Endangered Species Act (ESA). Today, the lower Columbia River water surface elevations are regulated by the Federal Columbia River Power System (FCRPS). The FCRPS, along with urban development, has adversely impacted the riparian and aquatic habitat of Clover Island. Specific factors adversely affecting natural riverine functions within the project area include:

- *Loss of Habitat Complexity* due to damming, dredging, and bank stabilization.
- *Loss or Degradation of Off-channel Habitats* due to development in the floodplain.
- *Reduction in Nutrients and Woody Material* due to river regulation and floodplain development.

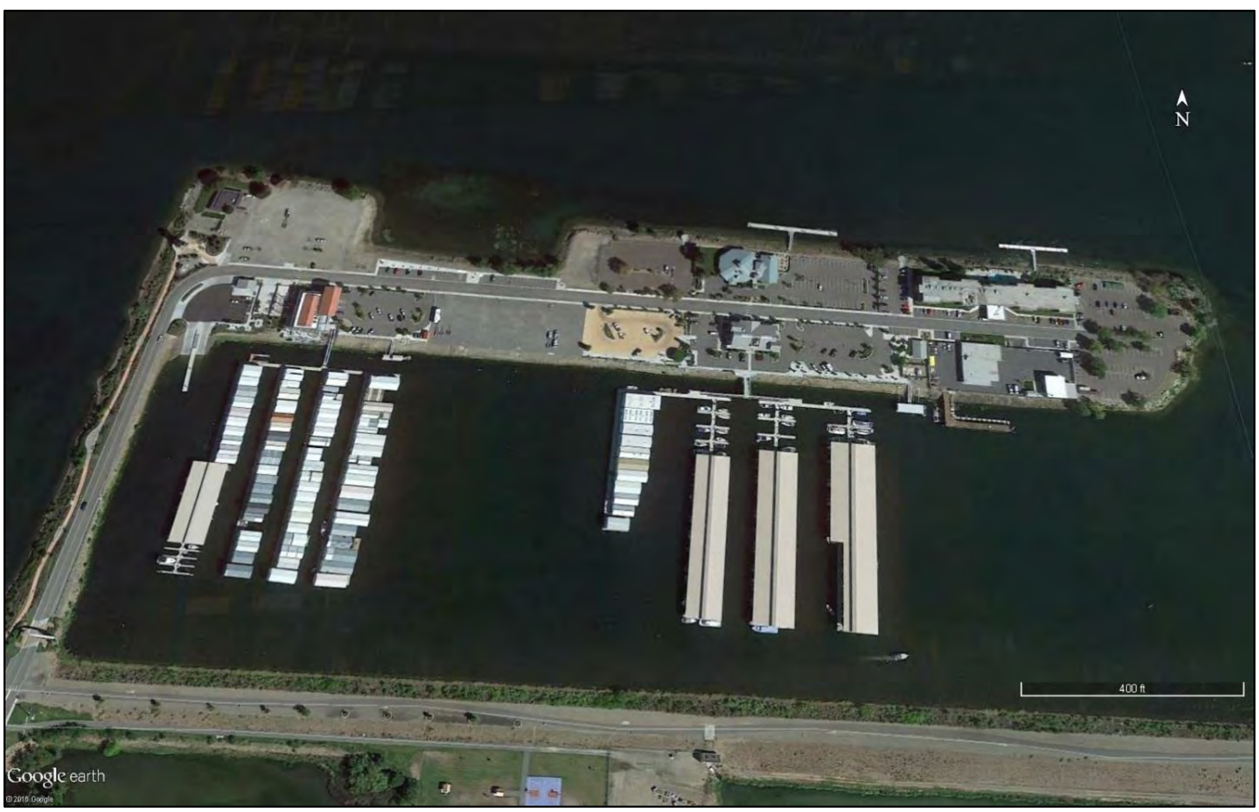

Figure 2. Present day Clover Island.

The purpose of the Clover Island Ecosystem Restoration Project is to restore ecosystem function to riparian and shallow aquatic habitat along the northern shoreline of Clover Island. Specific objectives of the Clover Island Ecosystem Restoration Project are to 1) Restore shallow aquatic habitat for rearing juvenile ESA-listed salmonids; and 2) Restore native riparian habitat and ecosystem function to support aquatic habitat. Due to various levels of development and erosion along the Clover Island shoreline, restoration alternatives were addressed relative to specific areas of the Island (Figure 3).

Figure 3. Clover Island Habitat Restoration Areas

2. HABITAT EVALUATION PROCEEDURE

The Habitat Evaluation Procedure (HEP) method was used to compare the future with-project condition for each of the alternatives to the future without project condition. HEP is a method that was developed by the U.S. Fish and Wildlife Service (USFWS) to evaluate the quality and quantity of available habitat for selected wildlife species (USFWS 1980). The HEP method utilizes Habitat Suitability Index (HSI) models with outputs that range from 0.0 (unsuitable) to 1.0 (optimal) to determine habitat quality. HSI values are multiplied by the area of available habitat to obtain Habitat Units (HUs). To calculate habitat value over a period of time, such as a 50-year period of analysis, HUs are averaged on a yearly basis to provide Average Annual Habitat Units (AAHUs).

Specific HSI models used for this project were modified versions of the yellow warbler (*Setophaga petechia*) and the Chinook salmon (*Oncorhynchus tshawytscha*). The selection of these species was based on the fact that geographic range of these species is within the project area, these species utilize the habitat types that are proposed for restoration, and data could be readily obtained for the model inputs.

Because it may be inaccurate to represent habitat suitability for large guilds or assemblages of species, and the project would affect a small habitat area with limited habitat variety, only yellow warbler and juvenile Chinook salmon models were selected for the HEP portion of this project (and are described later) to represent the habitat requirements for relatively small guilds or individual species of interest that can benefit from the restoration.

2.1 HSI Models

It is desirable to use existing HSI models that have been approved for use for the EcoPCX. Approved riparian and aquatic species models were utilized to capture a broader range of benefits that may be realized by habitat restoration. Model variables were modified to apply to the mainstem Columbia River, and modifications are discussed in the model development sections.

2.1.1 Description of Input and Output Data

The input data required to estimate habitat suitability may vary substantially from one HSI to another (e.g. migratory song bird versus fish). Typical variables that are measured may include percent canopy cover, count and diameter of trees, water depth, water velocity, woody debris counts, vegetation composition, etc. Input data for the current project’s HSI models were collected specifically at the project site (July 2014) and referenced from past data collected in 1995 and 1996 by HDR (1997) in drafting an Environmental Impact Statement for the Port of Kennewick regarding a proposed Clover

Island Redevelopment Plan. The document drafted by HDR included alternatives for island expansion (which did not occur), as well as improvement within the existing footprint of the island. Input variables such as percent canopy cover were measured by the Corps in 2014 at multiple locations on the project site and then averaged or multiplied to yield an overall SI score for each variable.

The output data from a HSI is the HSI score, which is needed to calculate HUs. Acreages for the calculation of HUs were estimated from polygons created in GIS overlaid on aerial photos of the project site. The acreage for with- and without-project conditions is the same to ensure an objective comparison of habitat values before and after implementation of restoration measures, although the aquatic area may increase with the implementation of the proposed project.

2.1.2 Capabilities and Limitations of Models

A major assumption of HEP is that there is a linear relationship between the HSI and either carrying capacity for a species or an observed preference or requirement for a specific habitat feature in some cases; however, there is likely variance in this relationship that is not captured with simplistic HSI models. When developing specific HSI models, it is necessary to define varying qualities of habitat (i.e., optimum, good, fair, poor) based on observed relationships in the literature. For example, if shoreline seining efforts result in the majority of observations consisting of juvenile Chinook salmon rearing over mixed gravel, cobble, and boulder substrates relative to silty substrates, then substrates characterized by a mix of stone sizes are assumed to provide optimal rearing habitat, and thus yield a high index score (in the range of 0.8 to 1.0). Substrates of smaller particle size are assumed to be less suitable and yield lower index scores.

Specific limitations have been observed in the use of HEP and HSIs that include: 1) many of the developed models have not been tested sufficiently to match observed “preferred” habitat components by the various species or to match species experts’ knowledge of optimal habitat; 2) high values generated from the HSIs do not necessarily match observed higher species diversity or abundance compared to sites with lower values; 3) difficulty in collecting sufficient data to use the models (particularly when models have numerous variables); 4) use of one species model to represent suitability for wider guilds or assemblages may not accurately represent those other species; and 5) lack of variables that describe landscape scale effects on species diversity and abundance (O’Neil et al. 1988; Wakeley 1988; Barry et al. 2006). These limitations were recognized in the development of HSI models for this project; specifically, the assumption that the yellow warbler model satisfactorily represents a variety of migratory songbird habitats, and the juvenile Chinook salmon model represents fully functioning habitats utilized by salmon and steelhead within the inland portion of the Lower Columbia

River based on the substrate categorization and the three variables that may be improved by this project.

Another limitation in the use of ecological models is that other factors beyond the specific parameters evaluated in the models could have greater effects on populations. Examples could be infectious diseases that could wipe out a localized population, climate change effects on temperatures and hydrology, and invasive species. These are important considerations for the success of any habitat restoration project, and while not amenable to analysis in the models, they should be considered by the project team during design development and implementation.

Finally, it should be noted that model variable input values for the future with-project condition are based on professional judgement of the expected outcome of restoration actions. This project is not intended to manage habitat for or specifically increase the population of a single species; however, this project is intended to restore functioning riparian and aquatic habitat at Clover Island in the lower Columbia River to support ecosystem function over time for ESA-listed rearing juvenile anadromous salmonids with an added benefit to migratory songbirds. The project area is small enough to limit the potential variability of habitats, both terrestrial and aquatic, that may be restored; however, multiple aquatic and terrestrial species may benefit from the habitat restoration. At maturity, the restored riparian would provide food sources and cover for migratory songbirds, macroinvertebrate food sources, and juvenile salmonids. The HSI models have been modified to reflect local or regional data, as well as simplified so that only the variables (and habitat types) likely to change as a result of the restoration are included.

2.2 Model Development Process

The HSI models for approval are documented below. These models were developed by the USFWS professional biologists and have been accepted as a whole by the Corps for use in ecosystem restoration projects. The adjustment, inclusion, or exclusion of model parameters to reflect new information or represent local habitat and site conditions appropriately is recommended in the preface of the model documentation (Raleigh et al. 1986; Schroeder 1982); therefore, it should be noted here that some model parameters were modified to represent onsite conditions and habitat preferences as defined for site- or drainage-specific locations.

Testing and validation of the models is more limited, but parameters are based on published literature and professional judgment. A recommendation for future use of these models is that the monitoring plan developed for this project should incorporate the parameters included in the HSI models to test and validate assumptions of habitat suitability. This monitoring data could inform future refinements or changes to the models and improve their predictive capability within the FCRPS.

2.2.1 Availability of Input Data

Input data used for these models were collected from onsite field surveys (July 2014) and from the use of aerial photography and ArcGIS. Riparian and aquatic habitat data were collected at 65 points around Clover Island. ArcGIS was used to assign a series of random points along the shoreline encompassing all potential restoration areas. Points were then semi-randomly selected every approximately 65 feet along the shoreline (Figure 4). At each point, a 3.3-square-foot sample area was selected within approximately 10 feet of the shoreline for aquatic habitat, and at the ordinary high water mark in the riparian zone. Habitat within the vicinity of the docks was not sampled as this habitat was visually determined to be uniform and similar to that characterized at points immediately west of the docks near the notch (Area 2), and immediately east near the downstream end of the island (Figure 3). Data were extrapolated from appropriate sample points for this area.

Riparian data collection was conducted with a densiometer to measure canopy cover. Mature tree canopy height was visually estimated in meters, shrub canopy height was measured with a meter tape, and trees and shrubs were enumerated and identified to species. For aquatic data, depth was measured with a meter tape, percentage of substrate type was visually estimated via wet-wading, and percent canopy cover measured with a densiometer. Bank cover including roots, overhanging vegetation, and woody debris was visually estimated where present. Metric data were subsequently converted to feet for analysis.

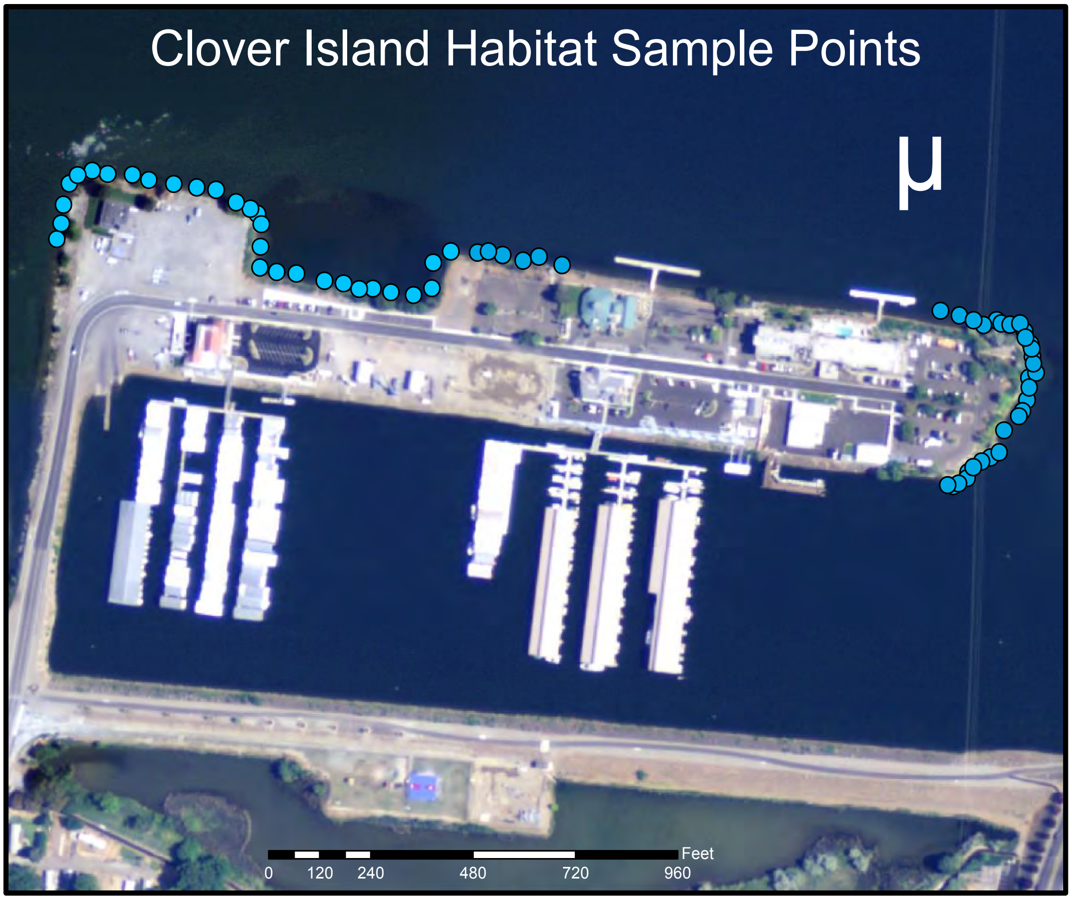

Figure 4. Map of habitat sampling points around Clover Island

65 points were sampled to characterize riparian and aquatic habitat on July, 31, 2014. Habitat within the vicinity of the docs was not sampled as this habitat was visually determined to be uniform and similar to that characterized at points immediately west of the docs near the notch and immediately east near the downstream end of the island.

2.3 HSI Models

Although the focus of the project is to benefit ESA-listed juvenile salmonids, riparian species were included to capture other benefits that may be realized from riparian restoration.

The mainstem Chinook salmon model was borrowed from the Lower Willamette River Ecosystem Restoration Project (approved for one-time use by ECO-PCX 28 July 2015) and utilized to represent this species; although, model variables were modified to be relevant to Columbia River rearing habitats based on literature review, professional judgment, and site conditions. Upper Columbia River spring Chinook salmon are ESA-listed endangered and their rearing habitat overlaps with that of ESA-listed threatened Upper and Middle Columbia River steelhead such that this model can be assumed relevant to both species.

Considering the proposed with-project riparian planting, the HSIs for the yellow warbler and Chinook salmon were used for the habitat evaluation (Table 1). Riparian restoration can reasonably include planting of hydrophytic shrubs suitable for yellow warbler nesting and is assumed to be suitable for many other riparian-nesting passerines [e.g. willow flycatcher (*Empidonax traillii)*, common yellowthroat (*Geothlypis trichas*), and Wilson's warbler (*Cardellina pusilla*)]. The yellow warbler model, calculated as proposed by Schroeder (1982), represents migratory neotropical birds that utilize riparian habitat for nesting with one additional variable.

Table 1. Species Selected for HEP Modeling

Species/Guild	Habitat Types Associated with	Variables/Attributes
Native Salmonids	Mainstem out-migration and rearing (shallow water margins, floodplain side channels and backwaters)	Substrate, depth, and percent bank cover/vegetation
Yellow Warbler	Riparian and floodplain vegetation communities (particularly cottonwood and willow)	% deciduous shrub crown cover, height of shrub canopy, % hydrophytic shrubs, % overall canopy cover

Generally, new and Corps approved HSI models that have been modified must be reviewed by the Corps' Eco-PCX for approval prior to being used. One exception is for Continuing Authority Program (CAP) projects, such as the Clover Island Ecosystem Restoration. Models utilized for CAP projects may be approved through the Agency Technical Review process as described in the Director of Civil Works' Policy Memorandum #1, dated 19 January, 2011.

2.3.1 Native Salmonids Mainstem Model

Existing SIs for ocean-bound juvenile Chinook salmon were utilized in the development of a model to represent this life stage of native salmonids. This model has been modified and is assumed to represent suitable habitat for both juvenile Chinook salmon and steelhead. These data were combined with site specific data to create a model for use in evaluating the effects of restoration on native juvenile salmonids migrating and rearing through the lower Columbia River. Modifications of the original HSIs were based upon localized limiting factors identified in available data and publications, as well as site specific observations.

2.3.1.1 Juvenile Salmonid Life Stage Requirements and Utilization of the Mainstem Columbia River

The habitat conditions required for these species and the rearing life stage are relatively constant within the Columbia River Basin (Everest and Chapman 1972; Hillman et al. 1987; Tiffan and Hattan 2012), but utilized substrate types appear to be varied, particularly for Chinook. Juvenile Chinook and steelhead typically rear in shallow channel margins (≤ 6 feet deep) during outmigration through the lower Snake and Columbia Rivers (Everest and Chapman 1972; Tiffan and Connor 2012; Tiffan and Hattan 2012). In these locations, water velocities are lower [≤ 1.3 feet per second optimal (Everest and Chapman 1972; Garland et al. 2002; Tiffan et al. 2006)], terrestrial cover more abundant [~30 percent optimal (Friesen et al. 2004)], and temperatures slightly warmer than mid-channel (Raleigh et al. 1986; Hillman et al. 1987; Tiffan et al. 2006; Tiffan and Hattan 2012).

Tiffan and Connor (2012) sampled juvenile Chinook in depths approximately 6.5-20 feet, but these fish were considered migrating and not rearing or resting. None of the studies reviewed suggest that juvenile salmonids rear in depths greater than 10 feet. These data, in consideration with substrate preference, suggests that juvenile Chinook are attracted to habitats that are by definition low in velocity. Additionally, numerous studies conclude that younger age classes of juvenile salmonids are highly associated with shallow, nearshore beach habitats (e.g., Lister and Genoe 1970; Dauble et al. 1989).

Substrate preferences in the Columbia River appears to be site specific (i.e., dependent upon available substrate material). Platts et al. (1989) suggested that juvenile Chinook salmon prefer cobble and boulder substrates in the Salmon River, Idaho (Snake River tributary). Hillman et al. (1987), and Tiffan et al. (2006) found cobble to be a preferred substrate over finer particles. Tiffan and Hattan (2012) similarly found higher catch rates over fine or cobble substrates upstream of Lower Granite Dam on the lower Snake River. Subyearling fall Chinook prefer substrates dominated by sand, gravel, and cobble [< 9.8 inch (in) diameter] in Lake Wallula [impounded by McNary Dam and encompassing Clover Island (Garland et al. 2002)] and in the free-flowing Hanford Reach upriver of Tri-Cities (Tiffan et al. 1999; Tiffan et al. 2006). Raleigh et al. (1986) also suggested that cobble and small boulders are preferred and still highly suitable when mixed with gravel. Finally, Everest and Chapman (1972) found that juvenile Chinook and steelhead occupy the same habitats in Salmon River tributaries and is assumed to be true in mainstem rivers with limited rearing habitat. Considering the above literature and the work of Tiffan et al. (1999), Garland et al. (2002), Tiffan et al. (2006), and Tiffan and Hattan (2012) being most relevant to the project location, it appears that gravel and cobble substrates with scattered boulders are preferred over substrates dominated by finer or coarser materials.

Bank cover is another important factor for rearing. While canopy cover, undercut banks, shoreline vegetation, and complex root and wood structures are clearly identified in literature as important for juvenile Chinook rearing (Raleigh et al. 1986; Hillman et al. 1987; Healey 1991), there is little quantification of optimal cover provided. Raleigh et al. (1986) estimated optimal canopy cover to be approximately 50-75 percent in smaller streams. Friesen et al. (2004) sampled significantly more juveniles along shorelines with 21-30 percent bank vegetation than at other sites, particularly when cover was 1-10 percent.

2.3.1.2 Chinook Salmon Model Development

Model variables cited from Friesen et al. (2004) and Allen and Hassler (1986) that were used in the Lower Willamette River Ecosystem Restoration Project were referenced relative to the variables provided in Raleigh et al. (1986) for Chinook salmon rearing habitat. There were between twelve and seventeen model variables proposed by Raleigh et al. (1986) to characterize juvenile Chinook rearing habitat, but only three were pertinent to the Clover Island Ecosystem Restoration Project (Table 2). Many variables proposed by Raleigh et al. (1986) were developed for tributary habitat (e.g. riffle and pool metrics), water quality (e.g. temperature and nitrogen concentrations), and flow. These conditions are generally regulated by McNary Dam and varying annual environmental conditions such as precipitation and air temperature in the vicinity of Clover Island [Note that temperature, depth, and velocity measured in 1995 (HDR 1997) were suitable for juvenile salmonids under conditions very similar to the existing conditions]. Furthermore, the inclusion of all model parameters does not guarantee the most accurate predictor of suitable habitat. It was noted by Raleigh et al. (1986) that model prediction accuracy of suitable habitat varied among studies with varying numbers of model parameters. In some cases, models with fewer variables were proven to be better habitat predictors than those with many variables. Note that other biological factors such as flow may be limiting for juvenile salmonids within this reach, but would not be influenced by physical habitat restoration at Clover Island. Factors such as water temperature related to spawning and egg incubation are unlikely applicable to this mainstem habitat according to literature.

Percent bank cover cited in the Lower Willamette River Ecosystem Restoration Project from Friesen et al. (2004) appears to be appropriate for the Clover Island restoration and was utilized as a model parameter. However, considering piscivores to include black basses (*Micropterus spp.*) occupy the Clover Island shoreline, bank cover denser than 30 percent was considered less than optimal as predators may also utilize dense shoreline cover.

Depth categories were prescribed for the Clover Island model to be consistent with the literature as described in Section 2.3.1.1. For substrate, the few substrate categories provided by Raleigh et al. (1986) and those used for the Willamette River project did not fully capture the substrates available and occupied by rearing juveniles in the Lower Columbia River. Cobble and boulders are key materials with gravel and sand being preferred over fines or silt. Gravel, cobble, and boulders were present at many Clover Island sites. These substrates were included in the model parameters and weighted based on literature and professional judgment. Rock classified as "boulders" during data collection included rocks much smaller than what would be typically classified as riprap, but the riprap value from the Lower Willamette River model appears to be reasonable and was used for boulders in the present model. Large concrete chunks were included in the boulder category, but poured slab concrete was assigned a 0 SI value where it precluded natural substrate. There were also many sites where gravel was mixed among cobble or boulders. A mixed substrate category was added for these that roughly occur in equal quantities at a sample point.

Gravel, cobble, and boulder size classes used for onsite substrate classification are defined below along with their relevance to classifications in literature.

- **Gravel: 0.8 – 2 in diameter (dia)** (Everest and Chapman 1972; Platts et al. 1983; classified as fine gravel by Julien 1998)

- **Cobble: 2 – 3.9 in dia** (larger gravel classification Everest and Chapman 1972; gravel to rubble by Platts et al. 1983; small cobble by Julien 1998)

- **Boulder: >3.9 in dia** (classified as rubble by Everest and Chapman 1972; rubble to boulder by Platts et al. 1983; large cobble to boulder by Julien 1998)

Table 2. Juvenile Chinook Salmon HSI Variable Descriptions for the Clover Island Ecosystem Restoration Project

Variable	Description	Rational
V1	Percent shoreline vegetation and structure providing overwater shading and cover	Identified in literature and onsite as compensatory factor that could be measurably improved
V2	Depth < 60 feet from shore	Identified in literature and onsite as compensatory factor that could be measurably improved
V3	Percentage and type of substrate available for forage and cover	Identified in literature and onsite as compensatory factor that could be measurably improved

The following equation and model variables (Table 3) represent the HSI model for rearing Chinook salmon in the Columbia River. Variable classifications and SI value justification are presented in Table 4.

$$HSI = \frac{(V1 + V2 + V3)}{3}$$

Table 3. Juvenile Chinook Salmon HSI Model Variables

Variable	Description	Classification	SI Value
V1	Percent Bank Cover – Bank Vegetation and Structure	0-10	0.1
		11-20	0.3
		21-30	1
		31-40	0.6
		41-80	0.2
		81-100	0.1
V2	Depth [(ft) < 60 ft from the shore]	0.7 – 6.5	1
		6.6 – 9.8	0.6
		>9.8	0
V3	Substrate	Concrete Pour	0
		Bedrock	0.25
		Boulders/ Concrete Chunks	0.35
		Sand	0.6
		Fines/Silt	0.4
		Gravel	0.6
		Cobble	0.75
		Gravel/Cobble/Boulder Mix	1

During the modeling process, where there were two substrate types such as cobble and boulder, the SI value of the highest percentage material was assigned. For example, a point with 80 percent cobble and 20 percent boulder substrate was assigned the cobble SI value. In a case where both were present in equal amounts, the higher SI value between the two materials was assigned to avoid biasing the already poor existing condition low.

Table 4. Juvenile Chinook Salmon HSI Model Variable justification

Variable	Classification	SI Value	Class/SI justification
V1	0-10	0.1	**Classification:** Friesen et al. 2004 **SI value:** Professional judgement based on literature.
	11-20	0.3	**Classification:** Friesen et al. 2004 **SI value:** Professional judgment based on literature.
	21-30	1	**Classification:** Friesen et al. 2004 **SI value:** Optimal based on literature.
	31-40	0.6	**31-100% cover densities** assigned SI values based on professional judgement due to the presence of non-native predatory fishes at Clover Is. While Friesen et al. 2004 found Chinook using habitats with up to 80% cover, I wanted to avoid dense cover at the water's edge to avoid creating predator habitat. Furthermore, Hillman et al. 1987 found Chinook prefer interstitial substrate pockets among cobbles compared to heavy vegetation and undercut banks during winter rearing.
	41-80	0.2	
	81-100	0.1	
V2	0.7 – 6.5	1	**Classification:** Everest and Chapman 1972; Raleigh et al. 1986; Hillman et al. 1987; Tiffan and Connor 2012; Tiffan and Hattan 2012 **SI value:** Literature suggests optimal depth.
	6.6 – 9.8	0.6	**Classification:** Tiffan and Connor 2012 **SI value:** Professional judgment based on literature as migrating juvenile chinook were sampled between 6.5-20 feet, but not rearing.
	>9.8	0	**Classification:** Tiffan and Connor 2012; Tiffan and Hattan 2012 **SI value:** Professional judgment based on rearing only documented in literature < 10 feet in depth. Creating rearing habitat is the purpose of this project.
V3	Bedrock	0.25	**Classification:** Everest and Chapman 1972; Tiffan et al. 1999; Garland et al. 2002; Tiffan et al. 2006 **SI value:** Professional judgment based on literature as migrating juvenile chinook were sampled among all substrates available, but showed no association with bedrock and up to moderate association with scattered boulders. Steelhead are likely to use boulders as well.
	Boulders	0.35	
	Sand	0.6	**Classification:** Everest and Chapman 1972; Raleigh et al. 1986; Tiffan et al. 1999; Garland et al. 2002; Tiffan et al. 2006 **SI value:** Professional judgment based on literature. Everest and Chapman 1972 and Tiffan et al. 1999 found sand to be highly utilized by Chinook, but Garland et al. 2002 and Tiffan et al. 2006 did not find it as important as gravel and cobble in the free-flowing Hanford Reach on the Columbia River. Everest and Chapman 1972 found larger substrates preferred by steelhead.
	Fines/Silt	0.4	**Classification:** All studies cited. **SI value:** Professional judgement as fines are marginally used, neutrally associated with rearing.

Table 4 Continued.

Variable	Classification	SI Value	Class/SI justification
	Gravel	0.6	**Classification:** Raleigh et al. 1986; Tiffan et al. 1999; Garland et al. 2002; Tiffan et al. 2006 **SI value:** Professional judgment based on literature finding gravel to be at least equally important as sand. Steelhead use gravel, but not as readily as cobble.
V3 cont'd	Cobble	0.75	**Classification:** Everest and Chapman 1972; Hillman et al. 1987; Tiffan et al. 1999; Garland et al. 2002; Tiffan et al. 2006 **SI value:** Professional judgment based on literature. Garland et al. 2002 and Tiffan et al. 2006 found cobble important for Chinook in the free-flowing Hanford Reach on the Columbia River. Everest and Chapman 1972 found larger substrates preferred by steelhead.
	Gravel/Cobble/ Boulder Mix	1	**Classification:** Everest and Chapman 1972; Hillman et al. 1987; Tiffan et al. 1999; Garland et al. 2002; Tiffan et al. 2006 **SI value:** Professional judgment based on literature. Mixed substrates are present in Hanford Reach upstream of Clover Is. Juvenile Chinook have been shown to utilize gravel and cobble over finer substrates, and are more likely to use interstitial refugia among large cobbles and boulders than shoreline cover during winter rearing. Steelhead also prefer larger substrates and readily utilize boulders.

One significant limitation of the Native Salmonids Mainstem Model is that it does not represent predation issues or habitat connectivity, which are two important limiting factors in Lake Wallula. These are qualitative benefits that cannot be measured for the purpose of this model, but can certainly be improved by restoring habitat at Clover Island. Presently, avian predation is a problem, particularly near the mouth of the Snake and Walla Walla Rivers, where large rookeries of double-crested cormorants (*Phalacrocorax auritus*) and Caspian terns (*Hydroprogne caspia*) have imposed a measurable impact on juvenile salmonid survival (Lyon's et al. 2011). Non-native fishes such as smallmouth bass (*Micropterus dolomieu*) and walleye (*Sander vitreus*) are found in the vicinity of Clover Island and prey upon juvenile salmonids.

Suitable shallow water rearing habitat in Lake Wallula is fragmented making juvenile ESA-listed salmonids more vulnerable to predation as they migrate to the ocean. Restoring riparian and aquatic habitat at Clover Island would reduce avian and piscivore predation and aid in closing the gap in suitable rearing habitat between the Yakima River delta and the McNary National Wildlife Refuge.

2.3.2 Yellow Warbler Model

2.3.2.1 Yellow Warbler Life History and Habitat Requirements

Yellow warblers are a breeding bird throughout the U.S. The existing model and habitat requirements are described in Schroeder (1982) and Knopf and Sedgwick (1992). The yellow warbler prefers riparian habitats composed of abundant, moderately tall, deciduous shrubs ranging in height from 4.9 to 13.1 feet. Shrub densities between 60 and 80 percent are considered optimal, while areas dominated by conifers are avoided. Greater than 90 percent of forage is insects, and foraging takes place primarily on small limbs in deciduous foliage. Nests are generally located 3.0 to 7.8 feet above the ground in willows, alders (*Alnus spp.*), and other hydrophytic shrubs and trees, including box elder (*Acer negundo*) and cottonwood [*Populus spp.* (Schroeder 1982; Knopf and Sedgwick 1992)].

2.3.2.2 Yellow Warbler HSI Model Development

The variables used in the yellow warbler HSI include the three variables in the approved model (Schroeder 1982), plus one additional variable (percent overall canopy cover) to represent habitat factors that may be measurably improved at Clover Island. Model variables V1-V3 (Table 5) represent habitat requirements for nesting as described by Schroeder (1982). Suitable habitat requirements for forage, cover, and water are met by nesting habitat requirements that are considered limiting factors. The additional variable V4 was added as a factor that would provide compensatory benefit as discussed by Schroeder (1982) and is assumed to provide benefit to other migratory bird species as a result of this restoration project. The inclusion of a compensatory factor in a limiting factor model may appear unintuitive; however, the final HSI scores for the model including this variable are appropriately conservative for the with-project condition and representative of the expected restoration outcome. Conservative model results for the restored habitat condition are expected to be realistic and reduce subjectivity in modeling future conditions. The V4 variable is appropriate to evaluate as a measurable model parameter as yellow warblers do inhabit deciduous hardwoods for foraging and choose this cover when less suitable habitat such as conifers are present; however, yellow warblers generally do not inhabit areas with a fully closed forest canopy (Schroeder 1982).

Our calculation of the HSI comports with that proposed by the USFWS (Schroeder 1982) as a limiting factor model. The model calculation proposed by Schroeder (1982) results in a score of the product of the variables raised to a power of 0.5 that falls between 0 and 1 (1 being optimal), as with other HSI models. Therefore, a value of zero for any variable would result in a HSI score of zero.

Table 5. Yellow Warbler HSI Model Variable Descriptions for the Clover Island Ecosystem Restoration Project

Variable[1]	Description	Rational
V1	Percent deciduous shrub crown cover	Identified in literature as limiting factor and onsite as factor that could be measurably improved
V2	Average height of shrub canopy	Identified in literature as limiting factor and onsite as factor that could be measurably improved
V3	Percent shrub canopy comprised of hydrophytic shrubs	Identified in literature as limiting factor and onsite as factor that could be measurably improved
V4[2]	Percent overall canopy cover	Identified in literature as potential compensatory factor (although included as limiting factor in model*) and onsite as factor that could be measurably improved

Notes:
1. These variables were adopted for the Clover Island Ecosystem Restoration Project as they are directly applicable with identical rational.
2. Potential compensatory factor applicable to other migratory bird species and ensures conservative "with-project" scores.

The following equation and model variables (Table 6) represent the HSI model and associated SI values for yellow warbler. Variable classifications and SI value justification are presented in Table 7.

$$HSI = (V_1 * V_2 * V_3 * V_4)^{0.5}$$

Table 6. Yellow Warbler HSI Model Variables

Variable	Description	Classification	SI Value
V1	Percent Deciduous Shrub Cover	0	0
		25	0.4
		50	0.75
		60	1
		80	1
		90	0.8
		100	0.6
V2	Average Height of Deciduous Shrub Canopy (ft)	< 3	0
		3-6.5	0.5
		> 6.5	1
V3	Percent Canopy Comprised of Hydrophytic Shrubs	0	0.1
		25	0.3
		50	0.55
		75	0.8
		100	1
V4	Percent Overall Canopy Cover (additional variable)	0-20	0
		20-40	0.1
		40-60	0.2
		60-70	0.8
		70-80	1
		80-100	0.1

Table 7. Yellow Warbler HSI Model Variable Justification

Variable	Classification	SI Value	Class/SI justification
V1	0	0	**Classification and SI Values** taken from Schroeder (1982) as presented.
	25	0.4	
	50	0.75	
	60	1	
	80	1	
	90	0.8	
	100	0.6	
V2	< 3	0	**Classification and SI Values** taken from Schroeder (1982) as presented. I pulled three categories and associated SI values from the V2 figure on page 5. While it may be assumed that a shrub height less than 3 feet may still provide some habitat benefit, based on Knopf and Sedgewick (1992) and professional judgement it is assumed that there is a low likelihood of a shrub of this size providing quality nesting habitat or refugia.
	3-6.5	0.5	
	> 6.5	1	
V3	0	0.1	**Classification and SI Values** taken from Schroeder (1982) as presented.
	25	0.3	
	50	0.55	
	75	0.8	
	100	1	
V4	0-20	0	**Classification and SI Values** adopted as presented in the approved Lower Willamette River Ecosystem Restoration yellow warbler model. Inclusion of this variable represents a broader range of bird species that may benefit from the project based on professional judgement. It has been documented that yellow warbler prefer edge habitats and forage, but rarely nest in mixed-forest type habitats, particularly under a fully closed canopy (Schroeder 1982).
	20-40	0.1	
	40-60	0.2	
	60-70	0.8	
	70-80	1	
	80-100	0.1	

3.0 HEP RESULTS

The HSIs for each species and area were calculated for the proposed project, both for existing and future conditions and for each measure, but were not calculated for future without-project conditions as these conditions are expected to remain very similar to the existing condition. The HSIs were calculated for conditions at year 0, 5, 10, 25, and 50 with-project (project life span) and then used to calculate HUs for each species and area. The HUs were then summed as follows to produce an overall net benefit to compare future with- and without-project conditions suitable for use in a Cost Effectiveness/Incremental Cost Analysis (CE/ICA).

$$\begin{array}{l} Data_{Aq} \rightarrow HSI_{Aq} \rightarrow HSI * Area = HU_{Aq} \\ Data_{Rip} \rightarrow HSI_{Rip} \rightarrow HSI * Area = HU_{Rip} \end{array} \Rightarrow HU_{Aq} + HU_{Rip} = HU_{Total} \Rightarrow HU_{project} - HU_{existing} = HU_{net}$$

The CE/ICA evaluated the HU benefits for the full range of project measures and alternatives. The following assumptions were made when scoring each variable for with- and without-project conditions.

3.1 Without-Project Condition Assumptions

- *Vegetation:* The composition of the riparian community would remain similar to existing conditions. Although riparian zones are dynamic ecosystems, most areas surveyed displayed little to no riparian cover, much of which was dominated by invasive and non-woody species. Unstable earth conditions are prevalent as the island has been eroding slowly over time. Therefore, it is assumed that the riparian area would not change significantly within 50 years, and stable, mature ecosystems are unlikely to occur due to erosion.

- *Water Quality:* The Columbia River currently has high water quality ratings. Global atmospheric temperature change is expected between 0.3 – 0.7° Fahrenheit by 2035 (IPCC 2014). When coupled with continued changes in land use, water temperature in the mainstem Columbia River may increase over time, as well. Other water quality parameters including turbidity and pollution from stormwater and industrial outputs affect aquatic habitat at Clover Island. There are currently nine stormwater outfalls located along the south shore of the Columbia River upriver of Clover Island, five within the City of Richland (Aldrich 2015) and four within the City of Kennewick (Meilleur et al. 2007). A tenth outfall draining the City of Kennewick is located on the south shore at Clover Island, downstream of the causeway (Meilleur et al. 2007). Based on these reports, water quality parameters are expected to improve over time due to improvements in the management and treatment of stormwater in the Cities of Richland and Kennewick.

- *Large Woody Debris (LWD):* LWD accumulation is expected to remain similar to existing conditions. Narrow riparian zones segregated from the river channel by levees in most areas do not promote woody debris recruitment in this area of the Columbia River. Although some woody debris may accumulate over the projected time period, a measurable net gain of LWD is not expected.

- *Percent Ground Cover at Water's Edge:* The percentage of ground cover composed of materials such as logs and brush at the water's edge is not expected to have increased significantly as little exists currently with few inputs.

- *In-River Substrate and Depth:* Although present substrate and depth is marginally acceptable, no improvements are expected to occur. Any changes in substrate are likely to result from erosion of the Clover Island shoreline, which is not expected to have a positive or negative impact on substrate or depth.

3.2 With-Project Condition Assumptions

It was assumed that incremental increases in riparian and aquatic habitat would occur over time as most plant species (e.g. coyote willow, red osier dogwood, etc.) would mature between 5 and 10 years (Woods et al. 1996; Moore 2016), but the full benefits of the project would not be measurable until maturity. Black cottonwood may provide near maximum benefit within 25 years based on timber production estimates in plantations (Murray and Harrington 1983), but full maturity, and thus maximum benefit is expected to occur within 60 years (Roe 1958; Nesom 2002).

- *Re-vegetation:* Planting native riparian species would ensure that a sufficient number of species and individual plants are provided to establish riparian area stability and restore habitat. It is assumed that at least 50 percent of shrubs planted would be hydrophytic shrubs in most areas of the island with two exceptions. In Area 4 (if planted), planting behind a retaining wall would reduce the amount of hydrophytic shrubs that may be planted as filling behind the retaining wall is expected to raise near-shore plantings higher above the water table. In Area 2, the wetland concept would increase the percentage of hydrophytic shrubs to 100 percent in this area.

o Year 1: Minimal benefit would be realized from riparian restoration (<25 percent expected for shrub categories). Slightly higher benefits for wetland measure in year 1 for aquatic bank cover due to non-woody emergent plants.

o Year 5: A rapid growth of hydrophytic shrubs and small diameter trees, canopy cover and density, and understory shrub height over current conditions is expected. Riparian restoration would provide minor benefits with the maturity of plants like red osier dogwood and the moderate growth of coyote willow providing some yellow warbler nesting habitat (approximately 60 percent for shrub categories expected based on maturity rates) and some aquatic bank cover through complex root structures (10-15 percent expected bank cover). Wetland plants expected to be mature. Black cottonwood still small, not providing much deciduous canopy cover (up to 25 percent expected). This increase is expected to continue for approximately 10 years, after which the growth rate of these parameters is expected to decrease, particularly for the shrub species.

o Year 10: Riparian restoration provides moderate to high benefits as plants like red osier dogwood and coyote willow are fully mature providing nesting, foraging, and resting habitat for yellow warbler (100 percent for shrub categories), and fully developed complex root structures and overwater cover for salmonids (up to 20 percent bank cover expected). Expecting 40-50 percent overall canopy cover from black cottonwood growth.

o Year 25: Riparian restoration provides near maximum benefit as all plants and associated benefits are expected to have reached maturity (100 percent for shrub categories) with the exception of black cottonwood canopy cover (60-70 percent expected).

o Year 50: Maximum riparian and aquatic benefits realized as mature black cottonwoods provide full canopy benefits for riparian wildlife and woody debris inputs that may provide cover for salmonids. Shrub canopy cover is not expected to decrease as a result of overall canopy cover at project maturity. Planting would consider an appropriate mix of upper canopy trees to allow for maximum establishment of hydrophytic shrubs. Maximum cover over the river and along the water's edge would be expected by this time.

- *Water Quality:* Water quality benefits are not expected to occur on the mainstem Columbia River as a result of this project, due to its limited size. The increase in cover over the river would produce a minimal, possibly immeasurable change in the localized water temperature. Other water quality parameters, such as level of dissolved oxygen, may be slightly improved on a site-specific scale by the proposed restoration measures, but these improvements are not expected to be measureable.

- *Large Woody Debris:* No immediate increase in LWD or instream cover and complexity is expected upon implementation of this project as there is no plan to install LWD; however, bank cover would develop as the mature riparian ecosystem (25-50 years) would provide LWD inputs and complex root structures are established.

- *Percentage of Ground Cover at Water's Edge:* The percentage of ground cover would increase significantly in some areas within 5-10 years of project implementation due to willow planting along the water's edge. Ground cover is expected to be maintained over time as restored vegetation matures and establishes in available spaces.

- *In-River Substrate and Depth:* Re-contouring and re-sloping the bank and creating a submerged aquatic bench (if implemented) would add appropriate substrate restoring shallow water habitat that would be utilized by resting and rearing ESA-listed juvenile salmonids. Benefits provided by the submerged aquatic bench are expected to be maximum, immediate, and static across years. In Area 4, if a retaining wall is required, planting is not expected to provide bank cover as root structures and vegetation overhang is expected to be restricted from the ordinary high water mark.

3.3 Existing and Future Without-Project Habitat Conditions

Existing riparian habitat features include steep, crumbling, cobble banks with sparse vegetation along the length of the shoreline. The west end of the island was restored in 2010 similar to the alternatives of this project; however, the restoration area terminates at the extreme northwest end of the island. Layers of concrete cover the shoreline and extend into the water beginning in this location, continuing along the north shore throughout to an inlet referred to in this project as the “notch” (Figure 3). The north shore contains (Area 2). The notch contains some mature trees, as does the northeast corner of the island (Area 5). Otherwise, there are few trees or shrubs present.

Substrate in areas without concrete slabs provides marginally acceptable aquatic habitat with a mix of gravel, cobble, and boulder substrate. Concrete boulders are present at many locations around the island, but create unsuitable conditions at only a few locations; the northwest and east shorelines in particular. Water velocity and temperature are generally acceptable based on past data.

Figure 5 represents the range of HSI scores under the existing condition. The highest possible index score of 1 indicates the best possible conditions for each species. Scores ≥ 0.7 indicate good to excellent quality habitat while scorings ≤ 0.3 indicate unsuitable conditions. Mean HSI scores among the 65 sample sites were 0.02 for riparian and 0.52 for aquatic habitats under existing conditions.

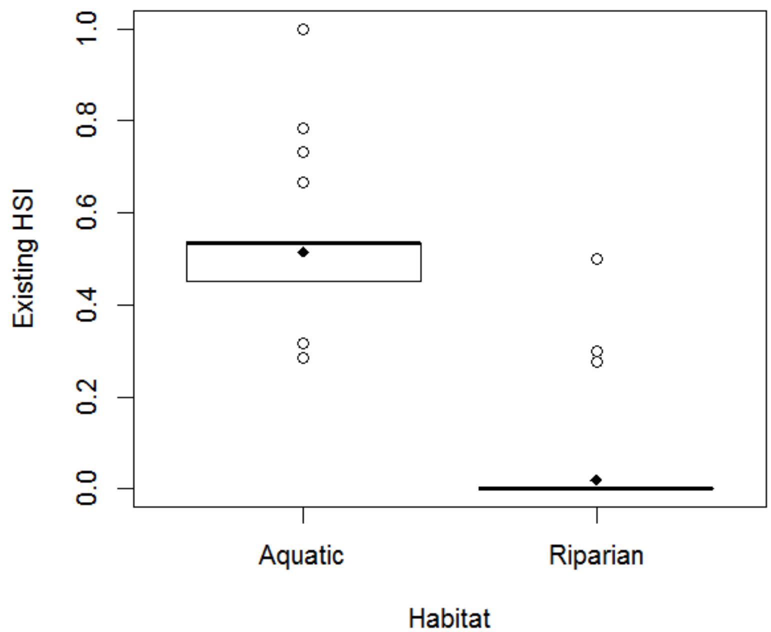

Figure 5. Range of Riparian and Aquatic HSI Scores among 65 Sample Sites on Clover Island under the Existing Condition

Note: Open dots represent the 5th and 95th percentiles (outliers); solid black lines represent the median and 50th percentile, and black dots represent the mean.

4.0 HEP RESULTS AND IWR PLAN MODEL-BASED PROJECT SELECTION

Aquatic and riparian HUs for the future with-project condition estimated for each measure and Area of Clover Island were input into the Corps Institute for Water Resources Planning Suit software (IWR Plan). Six alternatives (including No Action) were identified as "cost effective" or "best buy". The four best buy alternatives included No Action and Alternatives 1, 5, and 7. Alternatives 1, 5, and 7 were then examined for feasibility (Tables 10 – 13; Figure 6). Alternatives 1 and 5 represent two of the four best buy alternatives, propose full riparian restoration in all areas, and provide the highest cost/benefit ratios.

Alternative 1 is the Tentatively Selected Plan. This alternative provides a full shallow water habitat restoration around the island in addition to the full riparian restoration, and provides the maximum benefit to ESA-listed juvenile salmonids.

Table 10. "Best Buy" and "Cost Effective" Alternatives and Associated Costs and HU Benefits Identified by Cost Effectiveness/Incremental Cost Analysis

Alternative[1]	Investment (FY17 $)	Annual Cost (Cost/50 yrs)	Total Benefits (Net HU)	Annual Net[2] Benefits (HU)
Alternative 1 Submerged aquatic bench, wetland in Area 2, and full multi-storied riparian planting	$3,958,840	$177,835	2.11	1.21
Alternative 5 Wetland in Area 2, and full multi-storied riparian planting	$2,430,736	$104,398	1.94	1.04
Alternative 7 Wetland in Area 2 and multi-storied riparian planting except in Area 4	$1,626,043	$72,658	1.55	0.75
Alternative 9 Submerged aquatic bench and full multi-storied riparian planting	$267,967	$176,216	1.85	1.09
Alternative 11 Wetland in Area 2	$266,936	$10,429	0.81	0.10

Notes:
1. Alternatives 1, 5, and 7 are "best buy" alternatives, while Alternative 9 and 11 are "cost effective".
2. Annual benefits are shown as average annualized habitat units (AAHU), meaning net average annual HU gain over the life of the project.

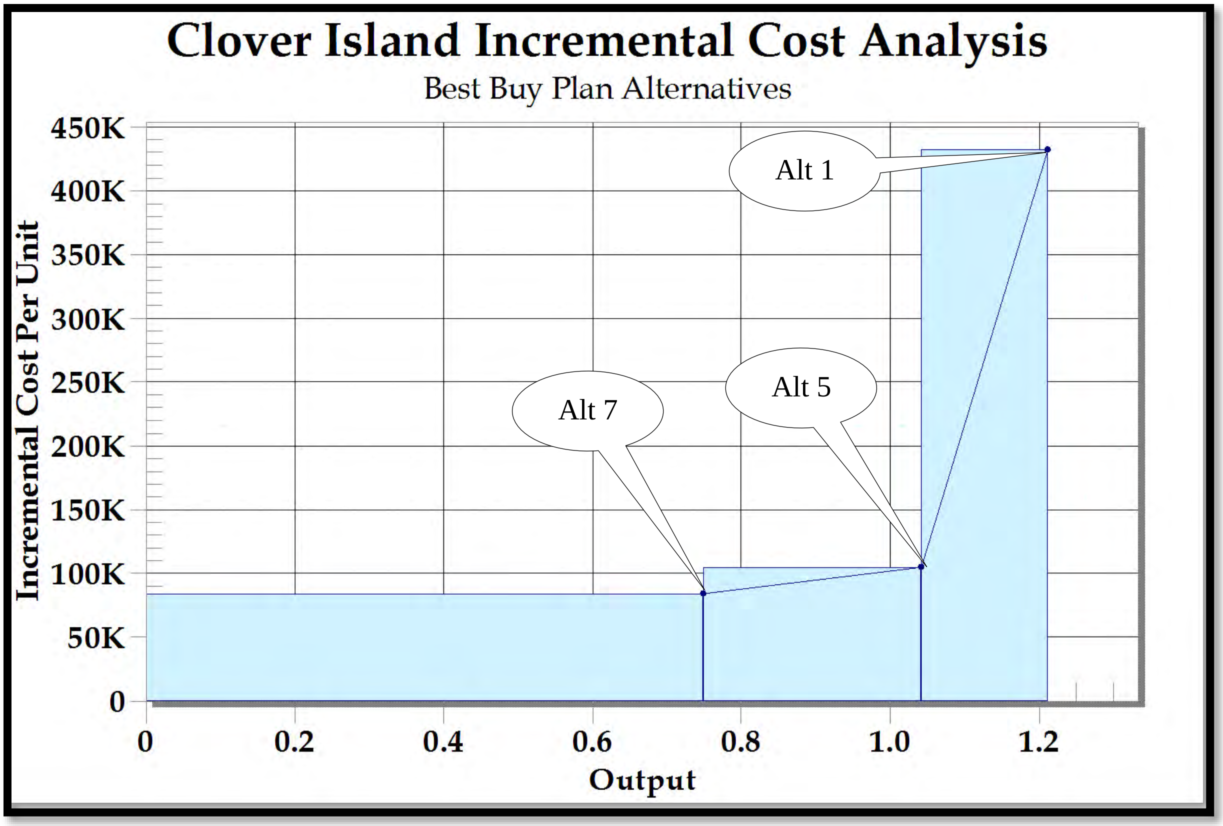

Figure 6. Cost Effectiveness/Incremental Cost Analysis Results Showing the Three "Best Buy" Alternatives

Note: Output value is AAHUs.

Table 11. Net Yellow Warbler AAHU Calculation for Alternatives 1, 5, and 7.

Alternative	Year	Yellow Warbler HSI	Acres	Cumulative HU	Gross AAHU	Net AAHU
No Action/Future Without Project	0	0	1.67	0	0	
	5	0	1.67	0	0	
	10	0	1.67	0	0	
	25	0	1.67	0	0	
	50	0	1.67	0	0	
	Total	-	-	0	0	**0**
Alternative 1	0	0	1.67	0	0	
	5	0	1.67	0	0	
	10	0.24	1.67	1.02	0	
	25	0.40	1.67	8.09	0	
	50	0.89	1.67	27.05	1	
	Total	-	-	36.17	0.72	**0.72**
Alternative 5	0	0	1.67	0	0	
	5	0	1.67	0	0	
	10	0.24	1.67	1.02	0	
	25	0.40	1.67	8.09	0	
	50	0.89	1.67	27.05	1	
	Total	-	-	36.17	0.72	**0.72**
Alternative 7	0	0	1.67	0	0	
	5	0	1.67	0	0	
	10	0.15	1.67	0.62	0	
	25	0.33	1.67	6.02	0	
	50	0.66	1.67	20.8	0	
	Total	-	-	27.43	0.55	**0.55**

Table 12. Net Juvenile Salmonid AAHU Calculation for Alternatives 1, 5, and 7.

Alternative	Year	Juvenile Salmonid HSI	Acres	Cumulative HU	Gross AAHU	Net AAHU
No Action/Future Without Project	0	0.53	1.28	3.41	0	
	5	0.53	1.28	3.41	0.07	
	10	0.53	1.28	3.41	0.07	
	25	0.53	1.28	10.22	0.20	
	50	0.53	1.28	17.03	0.34	
	Total	-	-	34.06	0.68	**0**
Alternative 1	0	0.67	1.28	3.41	0	
	5	0.67	1.28	4.26	0.09	
	10	0.77	1.28	4.58	0.09	
	25	1.00	1.28	16.93	0.34	
	50	1.00	1.28	31.95	0.64	
	Total	-	-	57.72	1.15	**0.47**
Alternative 5	0	0.53	1.28	3.41	0	
	5	0.53	1.28	3.41	0.07	
	10	0.63	1.28	3.73	0.07	
	25	0.87	1.28	14.38	0.29	
	50	0.87	1.28	27.69	0.55	
	Total	-	-	49.2	0.98	**0.3**
Alternative 7	0	0.53	1.28	3.41	0	
	5	0.53	1.28	3.41	0.07	
	10	0.63	1.28	3.73	0.07	
	25	0.63	1.28	12.14	0.24	
	50	0.87	1.28	23.96	0.48	
	Total	-	-	43.24	0.86	**0.18**

Table 13. Combined Net AAHU for Best Buy Alternatives.

Alternative	Salmonid Net AAHU	Warbler Net AAHU	Total NET AAHU
No Action/Future Without	0	0	0
Alternative 1*	**0.47**	**0.72**	**1.21**
Alternative 5	0.30	0.72	1.04
Alternative 7	0.18	0.55	0.75

*Alternative 1 is the Tentatively Selected Plan

5. CONCLUSIONS

Model results suggest that implementation of Alternative 1 or 5 would restore ecological habitat function for juvenile ESA-listed salmonids on Clover Island, with an additional HU benefit to migratory songbirds. Use of the HUs calculated through the HEP to populate the CE/ICA suggests that these alternatives are a “best buy,” capable of producing a satisfactory outcome for aquatic and riparian species. Either alternative would implement an alternative bank stabilization technique (choked boulder toe) that is identified in literature as beneficial to fishes and accepted by resource managers.

Implementation of either Alternative 1 or 5 would greatly improve shallow water habitat and ecosystem function that may be utilized by all species and life stages of rearing and migrating salmonids, as well as non-salmonid and resident fishes; however, under Alternative 1, the construction of the submerged aquatic bench would unquestionably restore aquatic habitat to fully functional, eliminate existing predator habitat, and capture a rare opportunity to implement a complete habitat restoration in this reach of the Columbia River. Therefore, Alternative 1 is the Tentatively Selected Plan.

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Clover Island Section 1135 Ecosystem Restoration

Kennewick, Washington

Clover Island Feasibility Report and Integrated Environmental Assessment

APPENDIX B, HYDROLOGIC AND HYDRAULIC ANALYSES

Clover Island Section 1135 Ecosystem Restoration

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APPENDIX B, HYDROLOGIC AND HYDRAULIC ANALYSES

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B.1 INTRODUCTION

B.1.1 Background

Construction of the McNary Lock and Dam (McNary) on the Columbia River began in 1947, and all hydropower units were in operation by 1957. The project includes a dam, a reservoir (Lake Wallula), a powerhouse, a navigation lock, two fish ladders, and a system of levees and pumping plants (USACE, 2015). Following completion of McNary dam, backwater effects raised the water level behind the dam, forming Lake Wallula. The McNary Dam Levee System (Tri-Cities Levees) were constructed along the Columbia River banks to reduce flood risks to Kennewick, Pasco, and Richland, Washington. Encroachment by the levees further added to the rise of the pool. As a result, many small islands and lowlands in the river became submerged. Clover Island, the subject of this study, was initially a bar feature within the river, but was subsequently expanded and connected to the mainland as part of the Port of Kennewick (Figure B-1).

Figure B-1. Clover Island and Vicinity

Clover Island is located in the city of Kennewick, in Benton County, in the Southeastern part of the State of Washington. The island is located at River Mile 328.9 within the middle reach of the Columbia River, between the Snake River and Yakima River confluences (Figure B-3). The island is considered one of the more attractive places in the region. Several recent developments have been undertaken on the island, both for economic development, as well as to provide additional recreational opportunities and enhanced ecosystem benefits. Many boaters visit the island, and fishing and other outdoor recreation are popular. Improvements have been made to the island's trails, as well as to the aquatic habitat near the shorelines. Examination of opportunities for increased riparian and aquatic habitats is the focus of this report.

B.1.2 Purpose

The primary purpose of the hydrologic and hydraulic analyses performed for this report is to project potential aquatic habitat behavior for proposed riverine measures that might improve fisheries habitat for salmonids and other species within the reach. The intended hydraulic effect is to create discontinuities in the flows adjacent to Clover Island through the use of flow deflectors. Rock flow deflectors were proposed during the June 2014 charrette to positively impact the flow regime and substrate quality where installations are desired. A secondary purpose is that the hydraulic information generated for this study supports designs by other disciplines for components needed to stabilize and protect proposed riparian enhancement measures.

B.1.3 Existing Conditions

Clover Island is located within the backwater pool created by McNary Dam (Lake Wallula). This has increased flow depths while significantly reducing flow velocities under most conditions. There is only limited potential for reversing these depth and velocity changes.

The existing characteristics include moderate flow depths along the shoreline (~10'-20'), presumably of a dominant sand/gravel bed surface, with warmer water temperatures. The existing shoreline has been reinforced in an attempt to reduce erosion, primarily through the use of rubble placement and poured (e.g., waste) concrete. This has created a veneer of concrete along the bankline that is not conducive to plant recruitment and growth, and often creates overhanging concrete "hideouts" that provide habitat for predator species. An inlet for the island's historic water supply intake creates a notch in the northern shoreline of the island. The area of the notch is shallower (~4'-10'), with lower velocities and subsequently lower circulation. The bed surface of the notch is finer as well, both because of the lower velocities and because adjacent island shoreline that roughly parallels river flow produces a "shadow" that precipitates deposition of finer material.

The downstream end of the island is made up of finer fills that are more readily eroded. The adjacent existing aquatic conditions appear favorable for salmonids, however.

B.2 HYDROLOGIC ASSESSMENT

Hydrologic computations are an integral part of the Section 1135 study, in estimation of the performance of the proposed measures. A wide range of river flows were examined for preliminary design and evaluation purposes for the hydraulic analysis. The study leveraged existing information where available. Frequency analysis was established for McNary Lock and Dam by the U.S. Army Corps of Engineers, Walla Walla District, and is shown in Figure B-2. The figure illustrates flood frequency curves at different locations of McNary's pool. The basis for development of these curves was measured data from nearby U.S. Geological Survey (USGS) gages, supplemented with numerical modeling. The upstream USGS gage (12472800), Columbia River below Priest Rapids Dam, WA., records flows from water year (WY) 1917 to the present, and is located on the main stem of the Columbia River, about 67 miles upstream of Clover Island. Figure B-3 shows the gage location in relation to the island; the point where the Yakima River joins the Columbia River, about 6 miles upstream the island; and the Snake River confluence. The frequency curves captured in Figure B-2 were used in the development of boundary conditions for Clover Island modeling, and were derived from statistical analysis of USGS 12472800, along with the relationships described in the figure notes.

Table B-1 tabulates a wide range of exceedance probability flows obtained from Figure B-2. Exceedance probability is defined as chance of river discharge exceedance for any given year. These flow exceedance probabilities and discharges were primarily used for modeling and design.

Table B-1. Estimated Flood Probability Discharges near Clover Island above the Snake River Junction

Exceedance Probability (%)	50	20	10	5	2	1	0.5	0.2
Flow (cfs)*	240,000	310,000	360,000	400,000	450,000	480,000	510,000	550,000

*Cubic feet per second

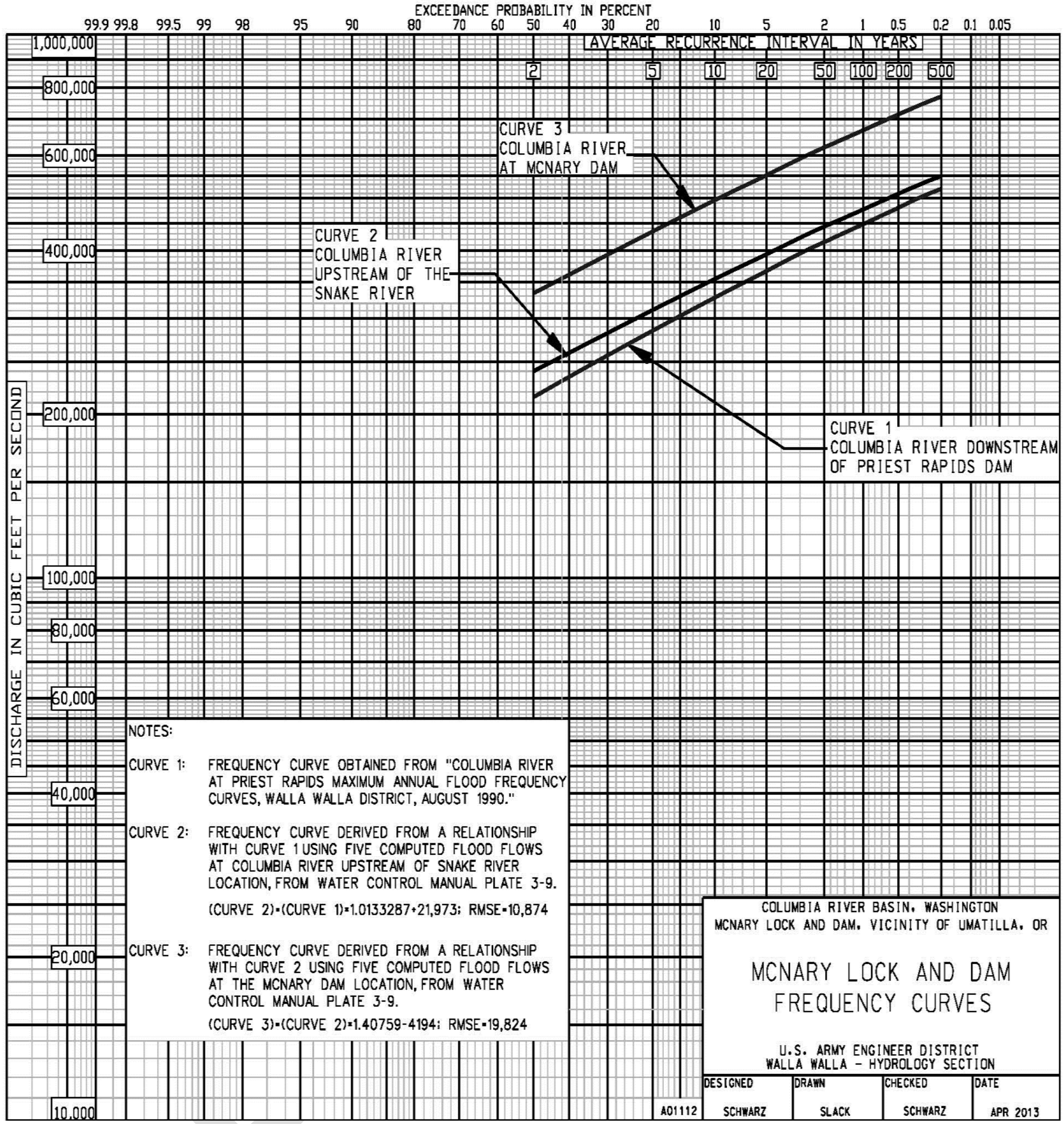


Figure B-2. McNary Lock and Dam Frequency Curves

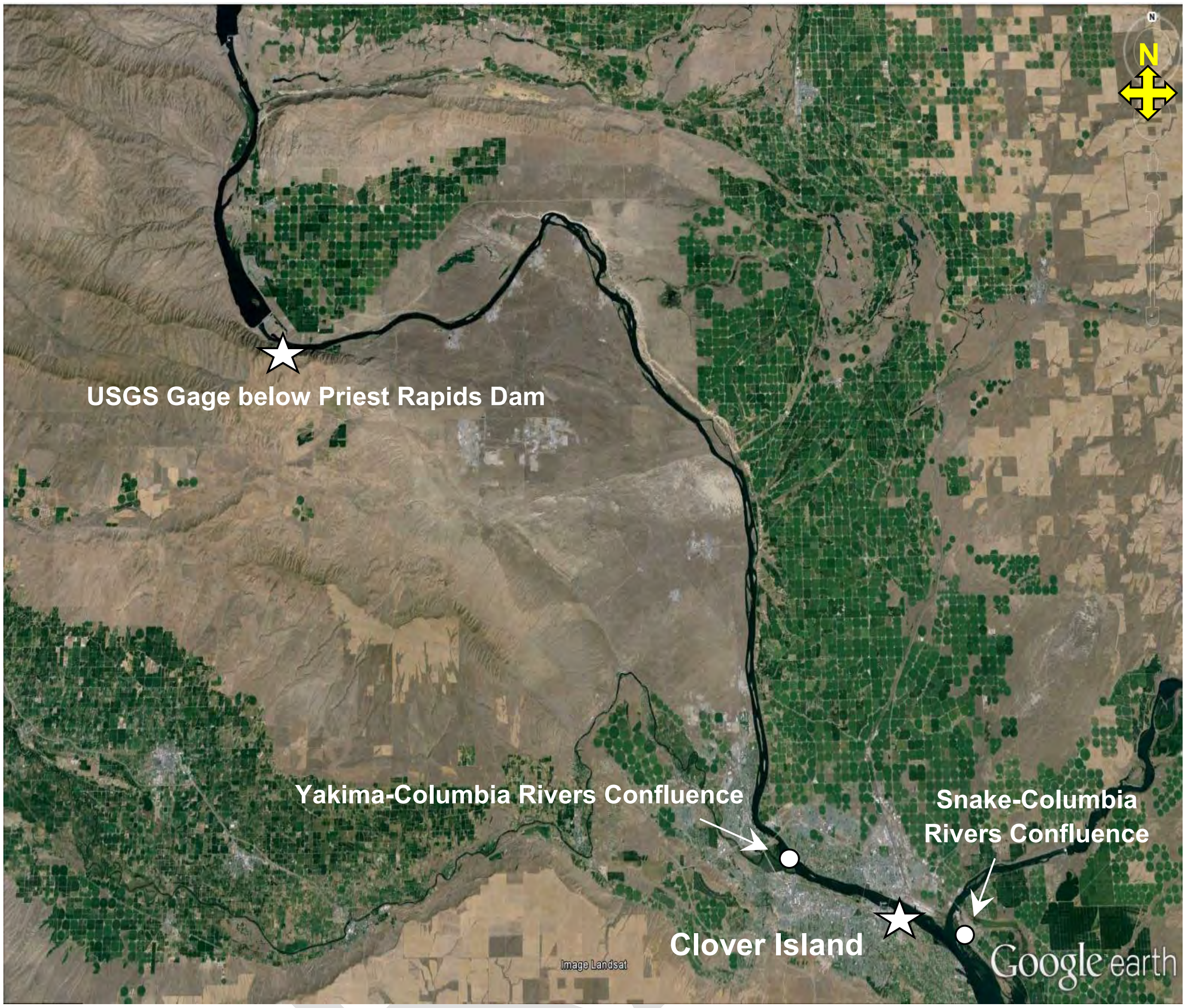


Figure B-3. Key Hydrologic Locations – Clover Island, Priest Rapids Dam, Yakima River, Snake River

B.3 HYDRAULIC MODELING

The Hydrologic Engineering Center River Analysis System Two-Dimensional model (HEC-RAS 2D) 5.0.0 Beta version, released in October 2014, was used to assess potential measures identified for Clover Island. The HEC-RAS 2D flow modeling captures a higher level of hydrodynamic fidelity than a 1D model. The model computes velocities, water depths, and water surface elevations with emphasis on points surrounding structures and the island's shorelines. The model provides capabilities such as the refined mesh cells, which act as a layer on top of the detailed terrain layer, which in turn provides more accurate information about a number of hydrodynamic parameters at each point of interest. A key feature built into the model is the RAS Mapper window, which provides a window for viewing model results, as shown in Figure B-4. It depicts depth and river velocity profiles.

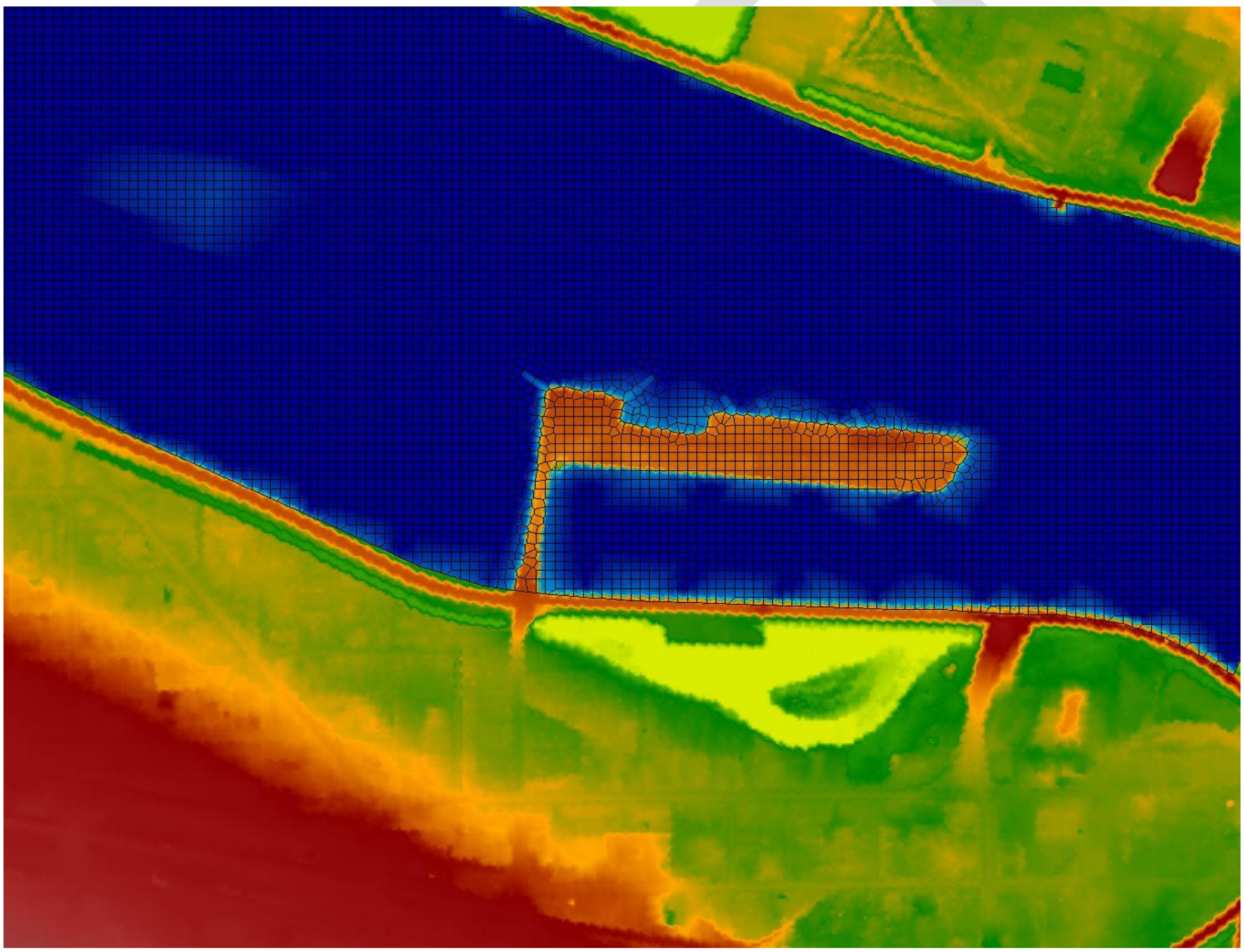


Figure B-4. Clover Island HEC-RAS 2D View Window Image Using Terrain Layers in RAS Mapper

Figure B-5 shows the overall 2-D modeling grid of the river segment, bounded by the levees on the two sides, and two cross-section boundaries from the existing unsteady HEC-RAS model upstream and downstream in the river. Only a short segment of the

Columbia River, approximately 9,300 ft in length, around Clover Island was modeled two-dimensionally, to keep model run times at a reasonable duration. Grid element size was selected initially at 50-ft-by-50-ft elements to keep computation times at a manageable level. Individual grid-cells were then hand-adjusted to better capture more abrupt features, such as the causeway connecting the island to Kennewick. Review of the 2-D model response appeared to represent hydraulic behaviors consistent with engineering experience, and was judged adequate for initial analysis of proposed hard features, discussed later.

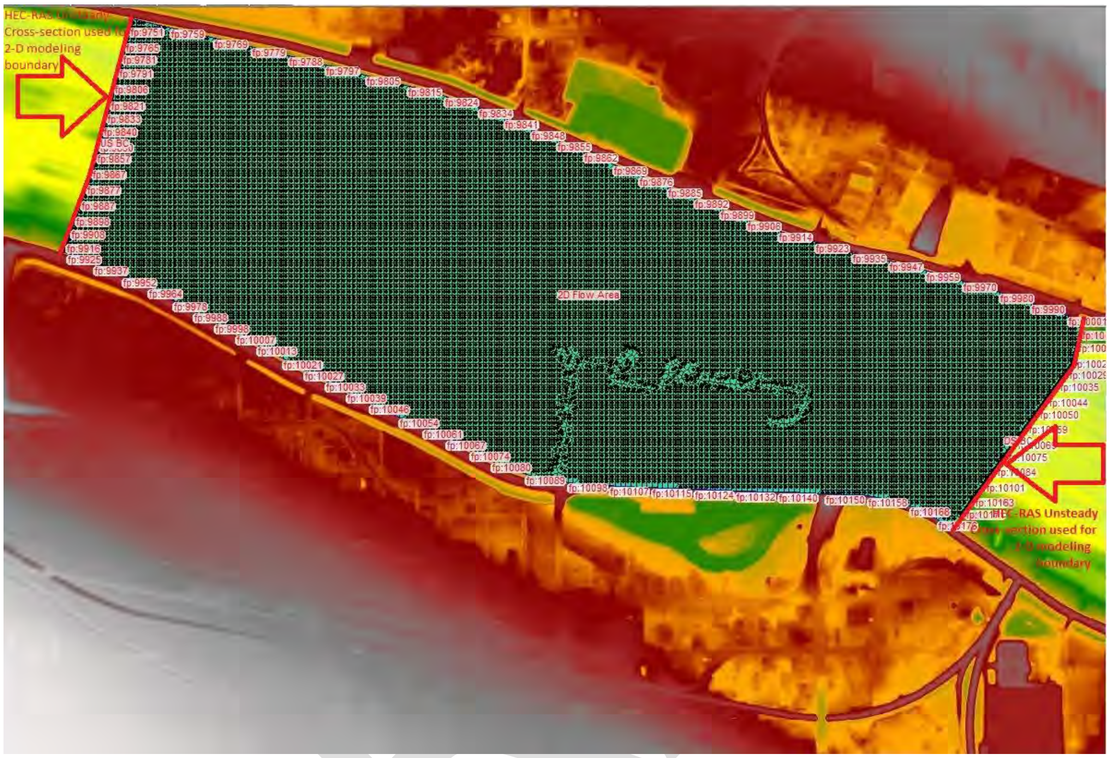


Figure B-5. Overall HEC-RAS 2-D modeling grid.

B.3.1 Modeling Assumptions and Boundary Conditions

To accomplish the identified potential measures evaluation for each area of interest for Clover Island from a hydrologic and hydraulic stand point, analyses were performed based on assumptions that are necessary to configure a numerical model. Effective development of modeling assumptions and appropriate boundary conditions are essential to successful modeling and attainment of accurate results. All elevations are in North American Vertical Datum of 1988 (NAVD88). The selection of initial water surface elevation was based on the typical river water surface level during average discharge. A rating curve for the McNary pool was generated in advance with steady state flow conditions between Priest Rapids and McNary Dam from previous studies pertaining to the Columbia River Treaty Studies; this report leveraged existing modeling from the Columbia River Treaty 2014/2024 Review, Datasets and Models for Flood Risk Assessment Report (Bonneville Power Administration and US Army Corps of Engineers, August 2012). The terrain grid used for development of the 2-D model geometry was the most current available for the study. Agency guidance requires relatively brief formulation and analysis time windows, as well as effective distribution of other available study resources (*i.e.,* funding), that often necessitates use of existing information. The merged terrestrial LiDAR terrain and bathymetry information had been down-sampled from somewhat higher resolution parent data, but was thought by the modeling team to produce adequate reproduction of prototype response in the relatively low-gradient energy and topography environment of the study area. The rating curve for the Clover Island Section 1135 study was generated using 20 years of flow records, from 1 October 1995, through 6 December 2014, in the previous (CRT) study's steady state one-dimensional HEC-RAS model.

Figure B-6 shows that the selected initial water surface value, 344.41 ft, agrees well wit the average river flows during normal conditions. The initial value is located along the relatively flat portion of the left side of the curve, the typical range during normal operations. This was found to be a good starting point for the model runs.

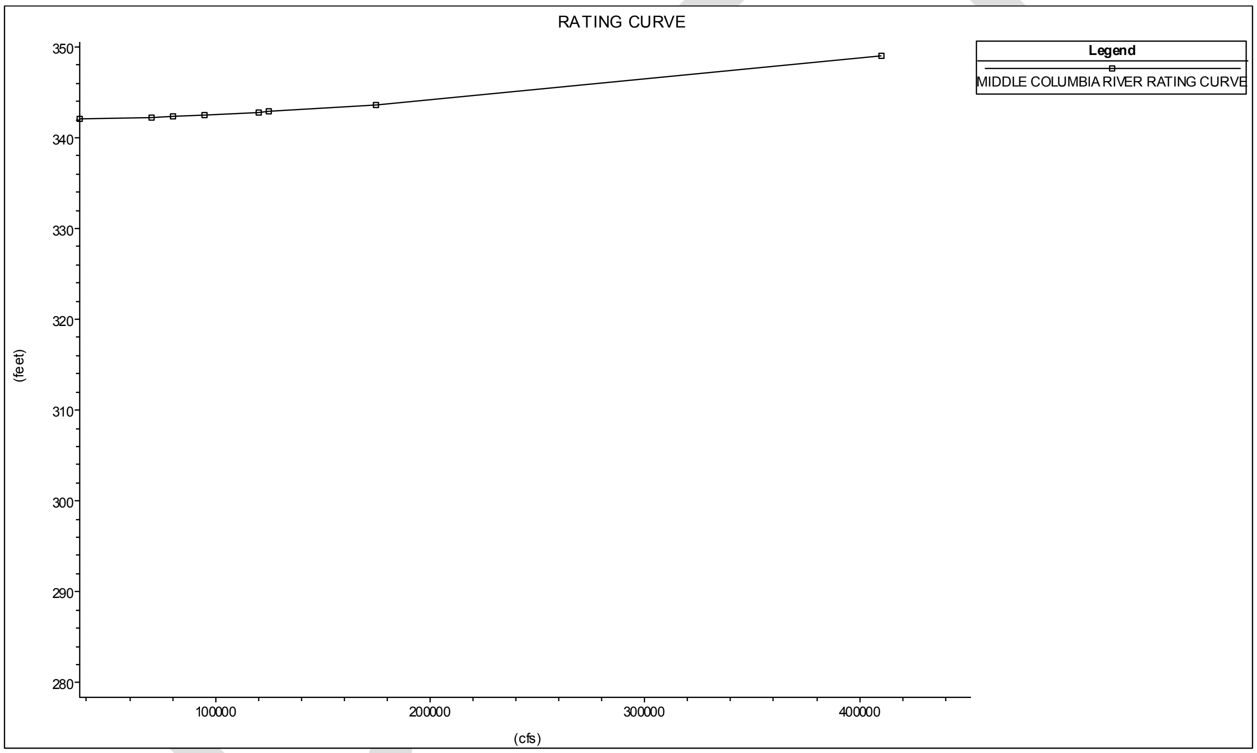
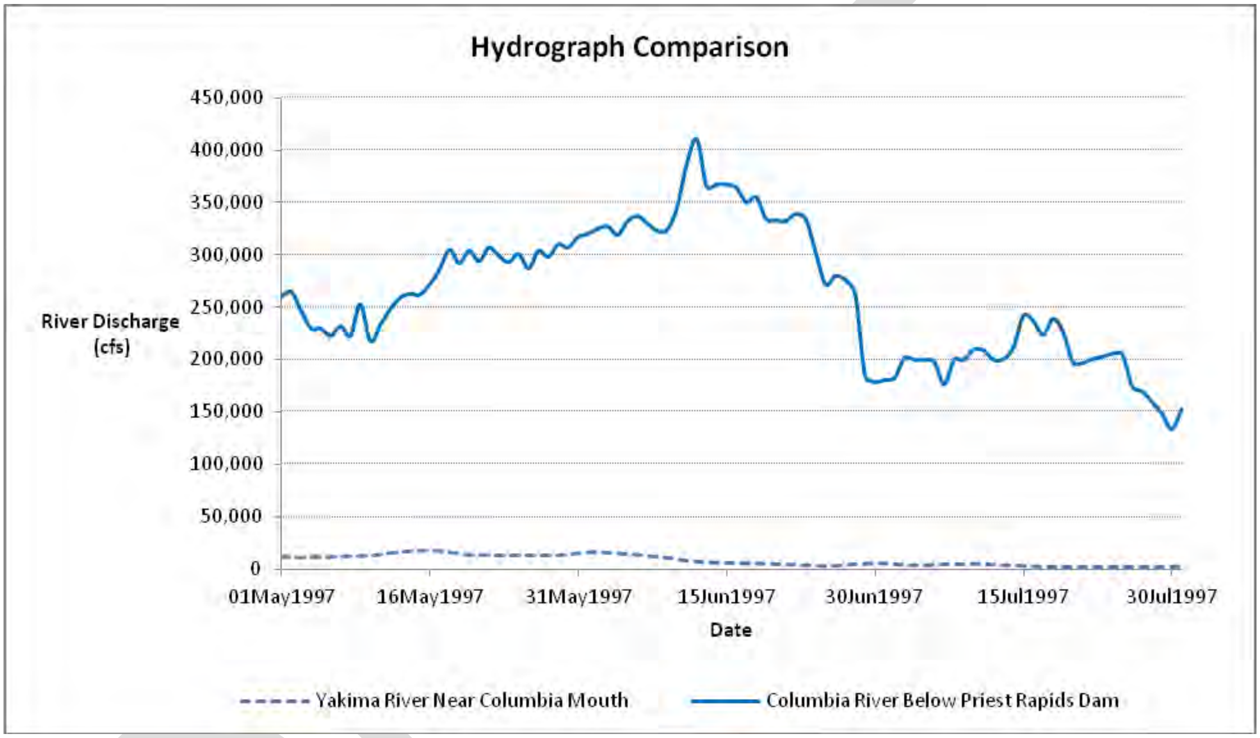


Figure 6. HEC-RAS McNary pool rating curve, for flows above 40K cfs, above the Columbia/Snake Rivers confluence

Two boundary conditions were set for the unsteady HEC-RAS 2-D model. First, it was assumed that during major flood events the Yakima River contributing flows were negligible as compared to flows in the mainstem, gaged below Priest Rapids Dam; therefore, the time series discharges from the USGS 12472800 gage were used to set the upstream boundary conditions. Figure B-7 illustrates the basis for this assumption and compares the Yakima and Columbia Rivers' discharges for the months of May through July of WY97, a relatively high runoff year. Secondly, the previously-generated McNary pool rating curve (Figure B-6) was used as the downstream boundary condition to run all proposed deflector placement options. For accurate calibration, the 2D Full St. Venant equation (Full Momentum) was used, as it provides greater accuracy than modeling with the Diffusion Wave equation. The Diffusion Wave equations, which tend to produce faster and more stable model runs, was judged acceptable for use in running scenarios to model with-project conditions (i.e., with deflectors in place) following model calibration. Model calibration was achieved by adjusting user-defined variables, primarily Manning’s roughness coefficient, to minimize differences between computed and measured river stage at the USGS Columbia River on Clover Island at Kennewick, WA (12514500) gage records for April 2014.



Yakima River vs. Columbia River below Priest Rapids Dam Discharge Comparison

B.3.2 Design Discharges

A first step in evaluating the performance of the proposed measures is to first model the existing conditions (no action alternative) for comparison. In order to design flow deflectors, discussed later, with long-term stability that is suitable without the need for frequent maintenance dredging or grade control, it was also necessary to evaluate how the normal and high range of flows affect structures’ integrity and meet habitat requirements during critical periods. In this appendix, design discharge was based on locating the average pool level that would determine proposed flow deflectors’ top structure levels in relation to water surface by the shore of the island. In addition, an assessment was made based on analyzing the 5-percent and 1-percent-annual-chance (ACE) exceedance flood magnitudes. These objectives shaped the modeling strategy employed.

McNary pool level is driven by dam operations, which also impacts backwater effects on the island. Figure B-8 illustrates records obtained from USGS gage 12514500 located on Clover Island; it has shown that water levels fluctuate between the lowest records of 338.81 feet (NAVD88) in 12 March, 2003, to as high as 346.50 feet (NAVD88) in 12 June, 1997, with an average of 342.64 feet (NAVD88). Normally, biological objectives can drive project design for low flows; however, the abundant depth of water in McNary's pool keeps water quality in a favorable range for habitats.

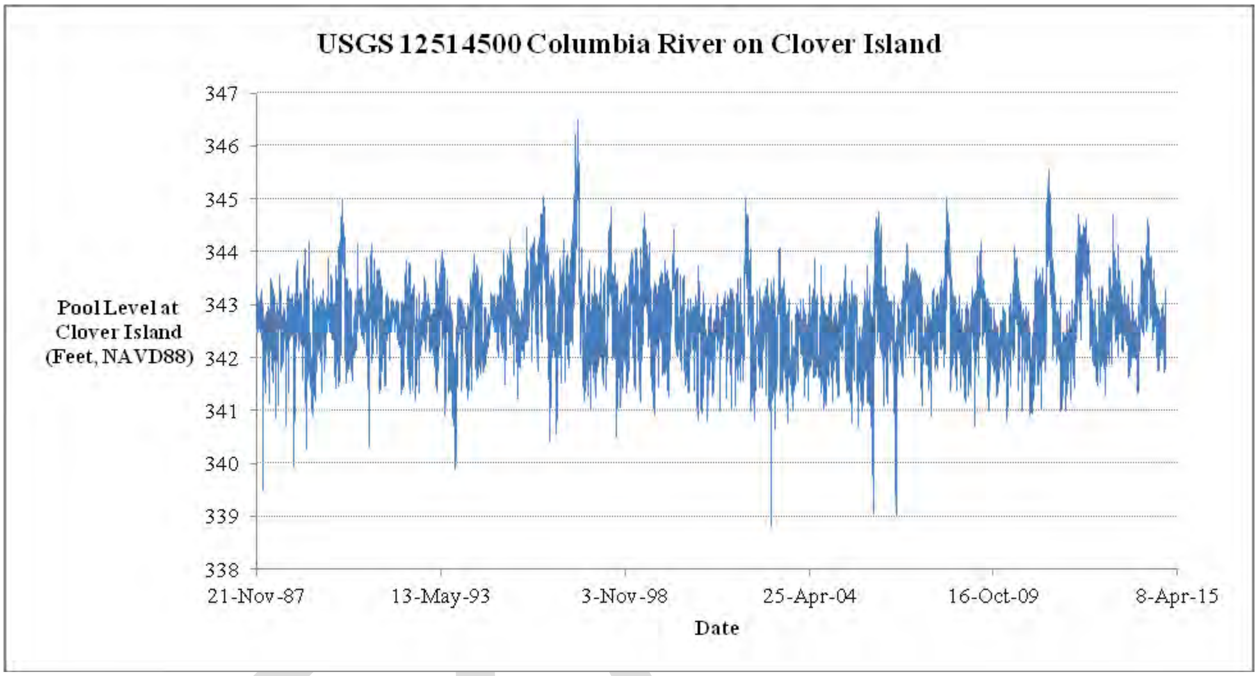


Figure B-8. McNary's Pool Levels on Clover Island

B.3.3 Hydraulic Computations

B.3.3.1 Model Calibration

The objective of calibrating the existing conditions model to the observed gage data on Clover Island is to refine user-selected variables to better reproduce prototype behavior. Following calibration, there is then more confidence that the numerical model will predict the most important responses of the prototype to perturbations that could be difficult to observe in the short term, such as rare, high-flow events, or constructed features proposed for implementation.. The model run was intended to calibrate to the USGS gage 12514500, Columbia River on Clover Island, WA. In this appendix, the model was calibrated for flows captured in the April 2014 time window by adjusting the 2D flow option parameters and the computation time intervals until absolute error difference between the actual gage readings and model stage results were minimized (∑Δ <~ 0.01 feet). The April 2014 time sequence was chosen for calibration because: a) it was a recent, quality-assured, complete record, and b) it offered a relatively high range of flow conditions in a relatively brief period of time (rising limb of the spring freshet). These were judged by the modeling team to be the most appropriate type of test event for the evaluating the 2-D model response. While the resulting modeled stage shape did not necessarily mimic the observed gage stage records at the Clover Island gage (USGS 12514500), the model did respond in general to the discharge changes adopted for the upstream model boundary (discussed further below). This may relate to the gage's physical location on the island, which is in the relatively calmer water near the marina between the landward side of the island and the levee on the south side of the island. The gage is likely impacted by backwater effects in the constricted area, as well as from disturbance by boats that use the south entrance for docking. The modeled stages did respond reasonably well to the Priest Rapids hydrograph used at the upstream boundary. Model calibration is shown in Figure B-9. Note that, while the stage records at Clover Island can be considered to represent conditions on the island essentially instantaneously, a given release from Priest Rapids Dam must travel a significant distance downstream before it affects conditions at Clover Island (see Figure B-3). To account for this, the recorded discharge from Priest Rapids was shifted temporally to account for the spatial shift (i.e., travel time) between the measurement location and the 2-D modeled area. Thus to capture travel time, the resulting model stage profile was shifted forward by 2 days, the approximate travel time it takes for water to travel from USGS 12472800, Columbia River below Priest Rapids Dam, to Clover Island south entrance location (assuming average stream velocity ~3 to 4 ft/sec in the month of April, 2014).

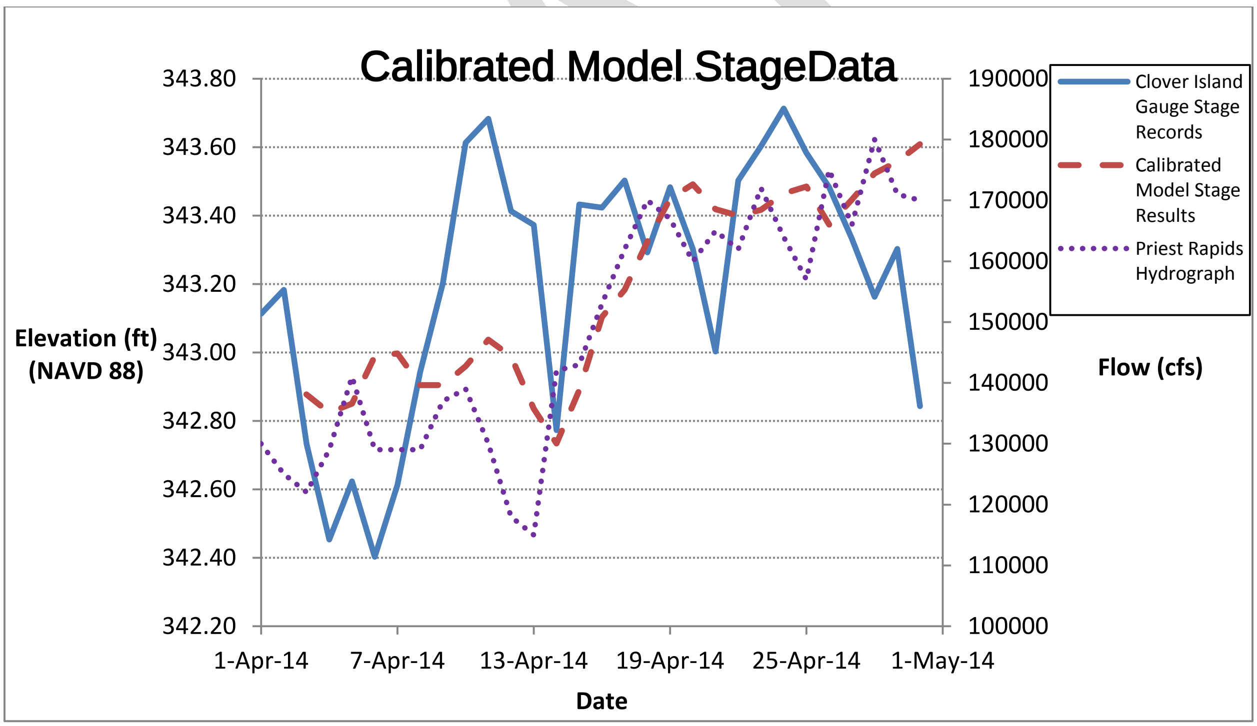


Figure B-9. Clover Island Stage Model Calibration

Ideally, the modeling team would have preferred to see higher correlation between the stage records recorded at Clover Island and the model-generated stages. However, a number of simplifying assumptions were made in assembling the model that excluded what were judged to be lesser influences on the potential hydraulic behavior at the island. Several of these are discussed elsewhere in this appendix, and include:

- routing changes to the outflow hydrograph from Priest Rapids Dam as it traveled downstream to the model boundary
- upstream translation of forebay elevation changes at McNary Dam
- relatively minor inflows by the upstream Yakima River (and lesser inflows)
- likely disturbances in measured stages at the island from motorized boat traffic in and out of the significant marina

The first two of these listed above are probably the most significant simplifications. The releases from Priest Rapids Dam can fluctuate significantly over brief time periods, due to primary hydropower operations. These fluctuations would likely be 'smoothed out' considerably by the time they traveled all the way to Clover Island. Similarly, forebay elevations fluctuate downstream at McNary Dam, also primarily from hydropower operations, though over a relatively narrow elevation range (typically 2 ft).

The model did respond to the simplified boundary conditions incorporated into the Clover Island 2-D model, and was judged to track well with the imposed upstream boundary hydrograph and downstream stage boundary. This was considered appropriate for evaluating potential deflector feature impacts and benefits, discussed below. No attempt was made to validate the calibrated model, since the simplifications of the imposed boundary conditions did not lend itself well to comparison to the measured stage data.

B.3.3.2 Shoreline Flow Deflectors

A conceptual measure to install flow deflectors along the shoreline of Clover Island in order to create more favorable aquatic conditions within this reach of the river was proposed, and determined the bulk of the hydrologic and hydraulic scope of this appendix. (In this appendix, the word “vane” may be used interchangeably with “flow deflector” to deliver the same meaning.)

A flow deflector is defined as an elongated obstruction with one end on the bank of a stream and the other end projecting into the flow. Generally, deflectors may be permeable, allowing water to flow through at reduced velocities, or impermeable, blocking current. Deflectors have been used successfully for river bank protection as well as habitat features. Design parameters for these channel features should be developed that will meet the objectives and provide stability under the range of anticipated flow conditions. This would necessitate rock sizing to resist forces imposed by anticipated flows, and adequate footing to withstand anticipated local scour.

The objective of placing flow deflectors along the shoreline is to create discontinuities in the flows adjacent to the island through the redirection of flows. This was conceptually judged to have potential to achieve a number of benefits to aquatic species, including:

- Create depositional areas on the upstream side of the deflectors.
- Flush out finer sediments downstream of the deflector, creating a coarser substrate (e.g., gravels, cobbles).
- Create heterogeneity within the flow field near the island shoreline (i.e., areas of varying velocity).
- Redirect flow into "the notch" as it passes over the crest of the notch deflector, to increase circulation of freshwater into the more-stagnant notch area. This would be expected to increase dissolved oxygen levels and decrease water temperatures somewhat.
- As an expected secondary benefit, shift the highest undermining scour forces away from the shoreline, thereby preserving the proposed newly-created riparian habitat (e.g., plantings).

B.3.3.3 Alternative Measures Evaluation

Several scenarios were considered for the purpose of evaluating flow deflector designs. A model run with high year observed flows was selected to evaluate higher flow conditions for design purposes. In Figure B-10, the month of June in 1997 was shown to have peaks close to those projected for the 5-percent-annual-chance exceedance flood. In addition, the projected 1-percent-annual-chance exceedance flood was added to the model run by scaling the 1997 event to match the 1-percent-chance exceedance event peak discharge. To configure the elevations of each flow deflector crest, it was necessary to specify the starting point level of deflectors around the island. Flow deflectors at the various locations were designed with the landside crests all at about the same elevation. The average terrain elevation at the waterline on the island was estimated at 343.35 feet (NAVD88). Figure B-11 shows the top limit level of a deflector in relation to gage reading in the beginning of a runoff season for an average flow year (e.g., 2014).

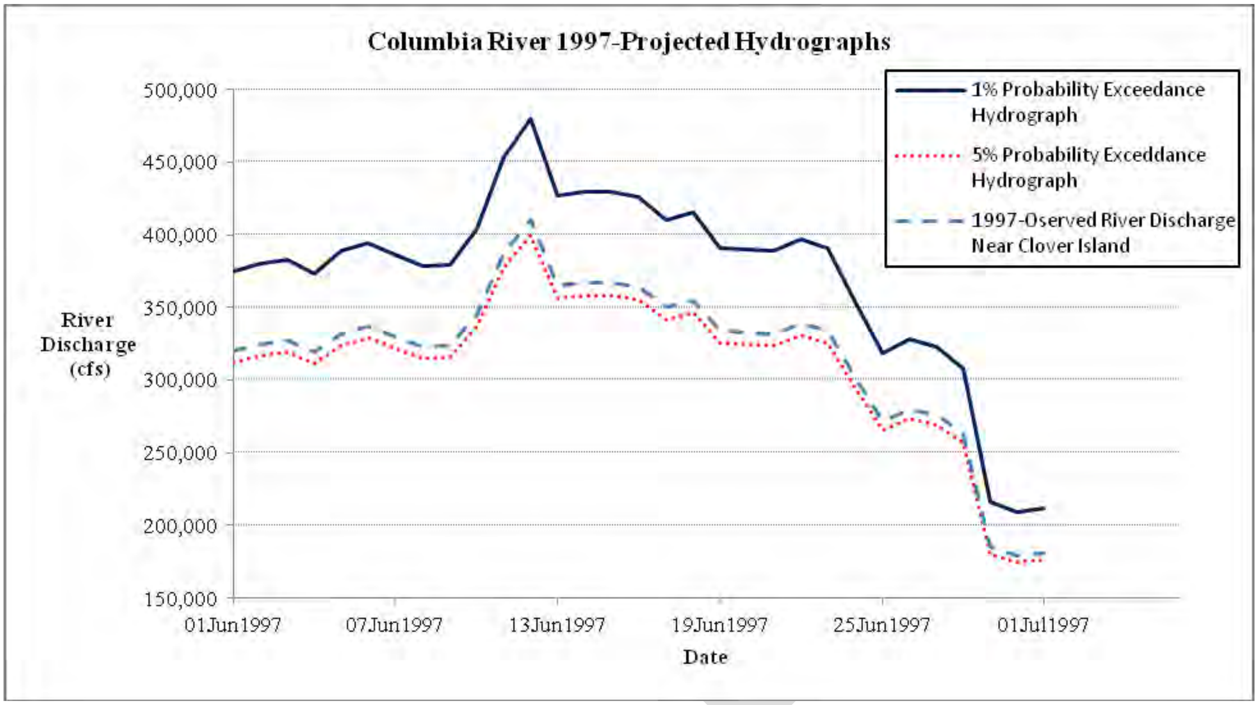


Figure B-10. Scaled June 1997 Projected 5-Percent- and 1-Percent-Chance Exceedance of River Discharge near Clover Island

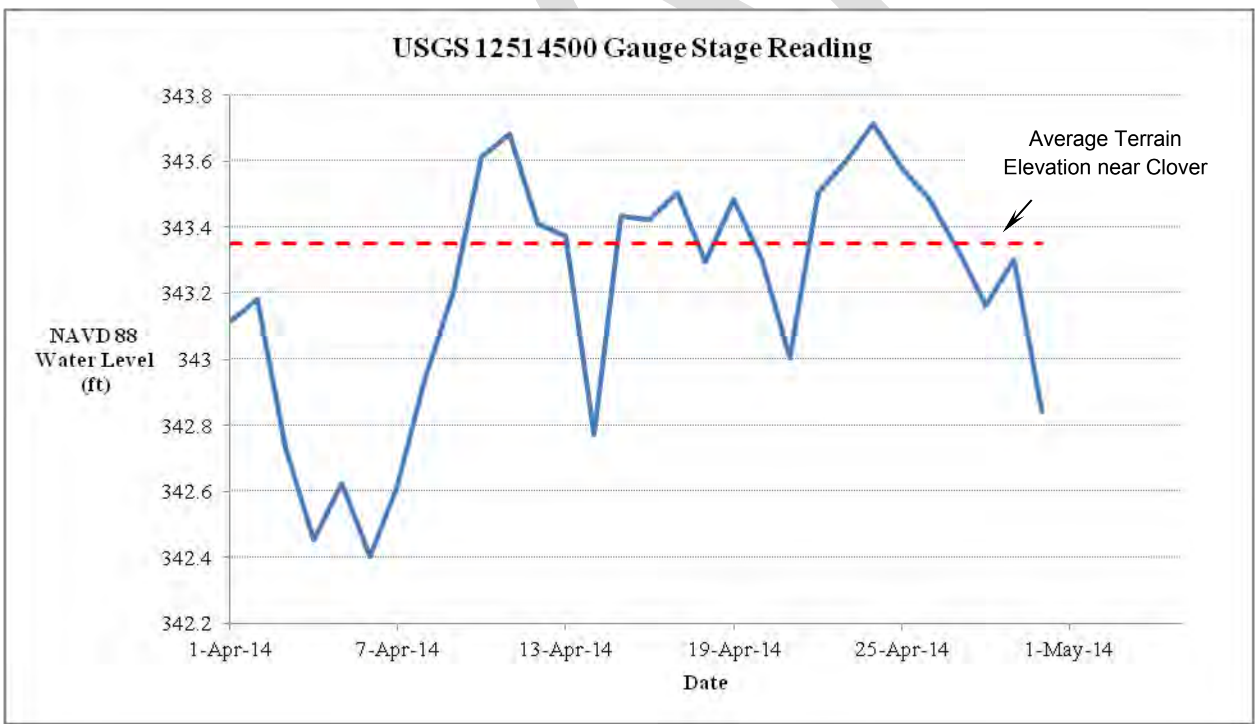


Figure B-11. April 2014 Daily Average Water Surface Elevation on Clover Island

The ArcGIS geographic information system (Arc-Map GIS 10.1) program and ArcGIS 3D Analyst were used to support design efforts by creating continuous terrain layers for the proposed flow deflectors off the island. Certain design criteria were determined to accomplish the task. The average top terrain elevation on the island's shorelines is about 343.35 feet (NAVD88), as described previously. Channel bed levels as measured from the bathymetry data below the flow deflectors' far ends are 331.18, 338.28, 334.11, 337.5, and 336.2 feet (NAVD88) for deflectors 1 through 5, respectively. Each deflector's far end top elevation was designed to sit at an elevation of 338.3 ft (NAVD 88), which approximates the pool minimum water surface that McNary Dam operates to (McNary's minimum operational pool is 338.35ft). These unit measures were used to generate the GIS layers of structures. Figure B-12 shows the generated initially proposed deflectors as part of the GIS layer used for modeling. Figure B-13 conceptually depicts a typical deflector side profile; estimates of deflectors' heights are listed in Table B-2.

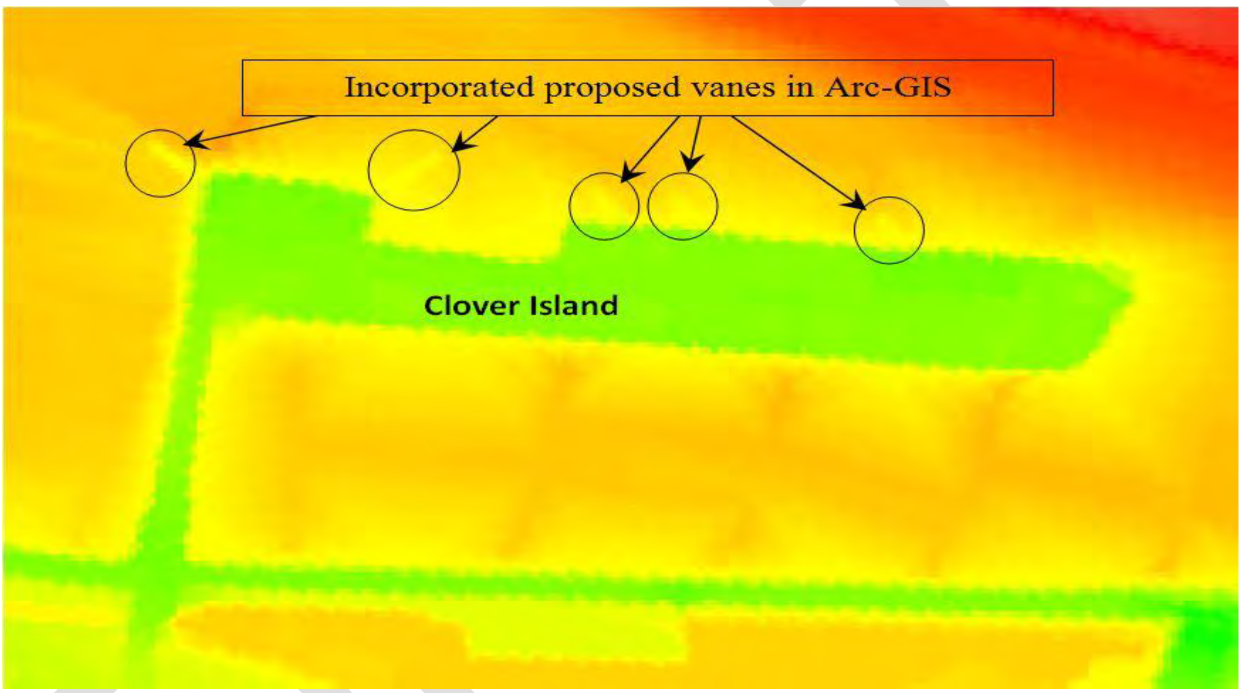


Figure B-12. Demonstration of Proposed Flow Deflectors on Clover Island

Table B-2. Deflector Heights

Crest top elevation at riverside end (feet)	338.3
River bed elevation (feet)	
Deflector 1	333.0
Deflector 2	331.2
Deflector 3	334.1
Deflector 4	337.5
Deflector 5	336.2
Crest top height measured to Island, (Ht, feet)	5.05
Crest top height from water surface, (Ht/2, feet)	2.52

Note: All listed elevations are in NAVD 88.

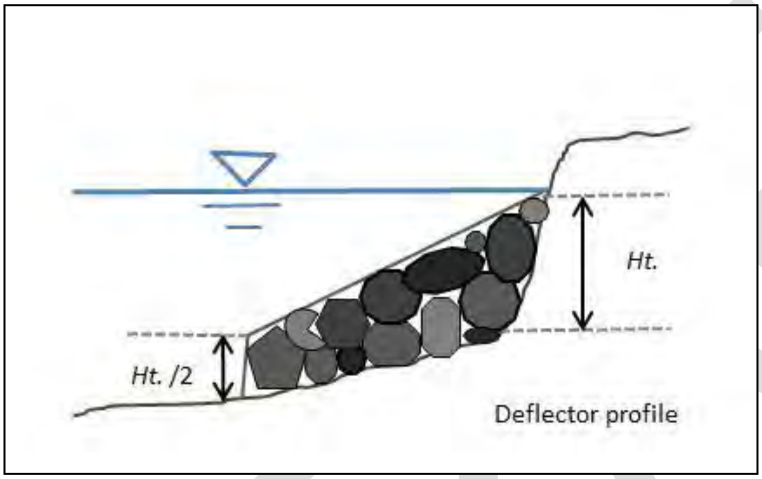


Figure B-13. Deflector Side View

B.3.3.3.1 Flow Deflector Orientation and Lengths

The orientation of a flow deflector, which is defined as the angle between upstream or downstream bank and the axis of the deflector (Figure B-14), was initially specified based on engineering judgment. The length of each flow deflector seen in Table B-3 is based on the estimated length necessary to shift the current away from or into (see Area 2, below) the island bank. Dimensional recommendations from section 5.5 of a technical paper by Julien and Duncan (2003) were used as a starting point for deflector dimensioning. The recommended length is 1/3 the spacing between two adjacent structures located in the same area.

The island was divided into five areas during the June 2014 charrette (Figure B-15), and flow deflectors were proposed for four of those five areas. Orientation of deflectors as specified in each potential measure were determined based on the following:

Area 1 – A single flow deflector in this area is intended to create deposition of sediments on the upstream side of deflector. It is also expected to shift the highest erosion forces of river flows away from the shoreline, thereby preserving proposed newly-created riparian habitat (e.g., plantings).

Area 2 – A single flow deflector in Area 2 is expected to create deposition of sediment on the upstream side of the deflector, as well as flush out finer sediments downstream of the deflector, thus creating a coarser substrate and greater variability. Improvement of water quality within "the notch" by redirecting flow into the notch as it passes over the crest of the deflector, to increase circulation of fresh water, is also anticipated. This would be expected to increase dissolved oxygen levels and decrease temperatures somewhat in this more stagnant area. A secondary benefit is also expected in shifting of the highest undermining scour forces away from the shoreline, thereby preserving the newly-created riparian habitat (e.g., plantings).

Areas 3 & 4 – Flow deflectors in these two areas are expected to provide similar benefits by depositing sediments on the upstream sides of deflectors, flush out finer sediments downstream, thereby preserving proposed newly-created rapirian habitat. In addition, the deflectors would likely enhance water temperatures and disolved oxygen levels downstream of the deflectors as overtopping flows were energized.

Area 5 – No deflectors are proposed for area 5.

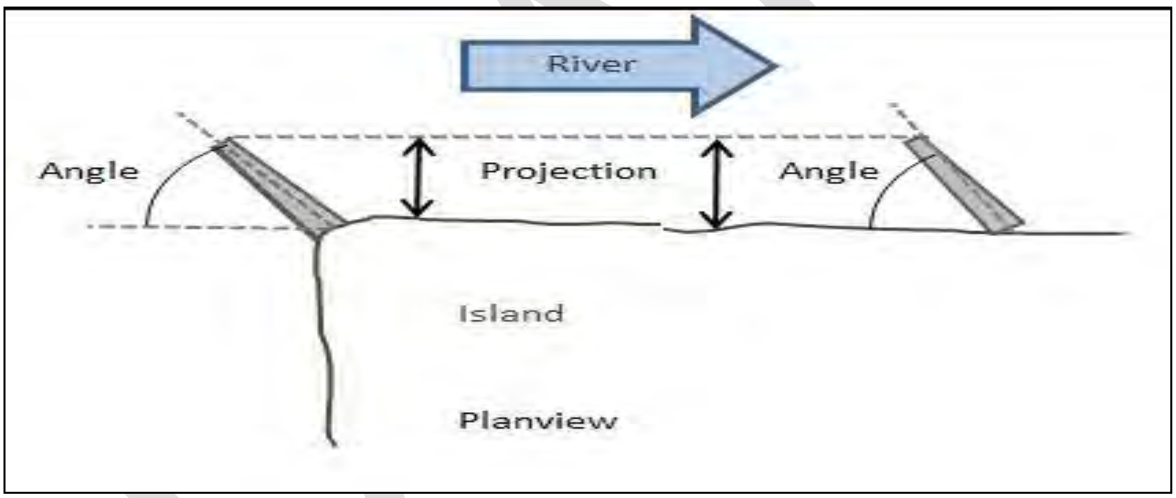


Figure B-14. Plan View of Flow Deflector Orientation

Figure B-15. Project Formulation Alternative Areas

B.3.3.3.2 Preliminary Evaluation

Flow deflector construction was proposed for implementation at four of the five areas along the shoreline at Clover Island to benefit habitat and water quality in the area. The initially proposed preliminary design criteria called for significant structures projecting from 75 ft to 135 ft normal to the island's north shoreline, with what were judged to be sufficient dimensions to affect flow patterns and transport energies to achieve the desired results. Hydraulic modeling of the initial flow deflector configuration was carried out using the HEC-RAS 2-D application. Scour and substrate analyses were also carried out in support of preliminary cost estimation in order to estimate quantities. The primary flow deflector projected lengths from shorelines were significant and, for simplicity, the deflector top and bottom elevations at their far ends were given the same height value. GIS-based layers were generated from the 5-meter terrain. Initial design criteria for the preliminary analysis is shown in Table B-3.

Table B-3. Initial Proposed Design of Flow Deflectors on Clover Island

Area	Far End Top of Vane Level (feet)	River Bed Elevation Below Far End (feet)	Top Width (feet)	Projection from shoreline (feet)	Angle (to bank normal)*	Length (feet)	Ht. (bank-end) (feet)	Ht./2 (river-end) (feet)	Comment
1	338.17	333	4	75	30°	150	10.35	5.17	
2	338.17	333	4	135	135°	190	10.35	5.17	
3	338.17	333	4	75	50°	100	10.35	5.17	
	338.17	333	4	75	50°	100	10.35	5.17	Increase space between deflectors only with dock relocated
4	338.17	333	4	75	50°	100	10.35	5.17	
	338.17	333	4	75	50°	100	10.35	5.17	Add second only with dock relocated
5	-	-	-	-	-	-	-	-	No deflectors for area 5

*For corner locations, angle refers to bankline parallel to river measuring clockwise from deflector to bank.

Response to Flow Deflectors

Two different simulation runs were used initially in the HEC-RAS 2-D model to assess changes in velocities and water depths at and around flow deflectors on Clover Island. The simulated events are the 5-percent and 1-percent-annual-chance exceedance floods. The 5-percent-chance exceedance event is modeled on the 1997 historic flood with noticeable scaled peaks of around 400,000 cfs, while the 1-percent-annual-chance exceedance scaled peak is at about 480,000 cfs. Results from modeling those peaks were used to analyze regime changes on structures and scour. Tables B-4 and B-5 show a list of several parameters, including the average discharge per unit length, for the 5- and 1-percent-annual-chance exceedance runs, which are used for the scour estimates. The values shown in the tables were obtained from selected mesh cells in the HEC-RAS 2-D model located in the RAS Mapper window, similar to that shown in Figure B-4. Cells are adjacent to deflector side lengths and represent the downstream side of the cell face. The HEC-RAS 2D model run produced the following results (Tables B-4 and B-5) for projected flow simulations, scaled from the June 8, 1997, peak flow event time window.

Table B-4. Initial 5-Percent-Chance Exceedance Computed Hydraulic Parameters from HEC-RAS

Area	Vane ID	Average River Depth (ft)	Flow Area (ft^2)	River Velocity (ft/sec)	Discharge (cfs)	Downstream Face Length (ft)	Discharge per Unit Length (cfs/ft)
1	1	16.18	825	4.04	3334	51	65
		16.18	481	4.79	2302	30	77
		16.18	670	4.93	3302	41	80
2	2	5.22	311	1.74	541	60	9
		5.22	230	2.36	542	44	12
		5.22	88	2.88	253	17	15
3	3	11.63	325	0.84	274	28	10
	4	8.14	320	1.09	349	39	9
		8.14	322	1.88	606	40	15
4	5	11.4	608	1.51	919	53	17
		11.4	238	2.50	596	21	29
		11.4	388	1.61	610	33	18

Table B-5. Initial 1-Percent-Chance Exceedance Computed Hydraulic Parameters from HEC-RAS

Area	Vane ID	Average River Depth (ft)	Flow Area (ft^2)	River Velocity (ft/sec)	Discharge (cfs)	Downstream Face Length (ft)	Discharge per Unit Length (cfs/ft)
1	1	20	1020	4.69	4784	51	94
		20	594	3.32	1972	30	66
		20	828	4.43	3668	41	89
2	2	9.5	566	2.29	1295	60	22
		9.5	418	2.95	1232	44	28
		9.5	159	3.45	496	17	30
3	3	15	420	2.85	1197	28	43
	4	9.5	373	1.84	687	40	17
		9.5	376	3.08	1158	40	29
4	5	14	747	2	1494	53	28
		14	293	3.1	907	21	43
		14	465	1.96	911	33	27

Scour Estimation at Flow Deflectors

To predict scour at flow deflectors, a number of empirical equations were used to calculate magnitudes of scour downstream of the structures. The proposed structures are composed of large riprap, which is the most commonly employed counter measure where foundations need protection against possible undermining by scour. One goal of this assessment was to aid in developing design dimensions for riprap protection for proposed riparian plantings. The variations in flow velocities and plunging flow over the feature tops were also used for assessing scour magnitudes for sizing of the flow deflectors.

Zimmerman and Maniak Equation, 1967 (BoR, 1984)

$$d_s = K\left(\frac{q^{0.82}}{{D_{85}}^{0.23}}\right)\left(\frac{d_m}{q^{2/3}}\right)^{0.93} - d_m$$

Where: d_s = Depth of scour below streambed, ft (m)

K = 1.95 inch-pound units (K = 2.89 metric units)

q = Design discharge per unit width, ft^3/s per ft (m^3/s per m)

D_{85} = Particle size for which 85 percent is finer than, mm

Schoklitsch Equation, 1932 (BoR, 1984)

$$d_s = \frac{KH^{0.2}q^{0.57}}{D_{90}^{0.32}} - d_m$$

Where: d_s = Depth of scour below streambed, ft (m)

K = 3.15 inch-pound units (K = 4.70 metric units)

H = Vertical distance between the water level upstream and downstream of the structure, ft (m)

q = Design discharge per unit width, ft^3/s per ft (m^3/s per m)

D_{90} = Particle size for which 90 percent is finer than, mm

d_m = Downstream mean depth, ft (m)

Veronese Equation, 1937 (BoR, 1984)

$$d_s = K{H_T}^{0.225}q^{0.54} - d_m$$

Where: d_s = Maximum depth of scour below streambed, ft (m)

K = 1.32 inch-pound units (K = 1.90 metric units)

H_T = The head from upstream reservoir to tailwater level, ft (m)

q = Design discharge per unit width, ft^3/s per ft (m^3/s per m)

d_m = Downstream mean depth, ft (m)

To evaluate scour at flow deflectors (d_s, feet), as shown in Figure B-16, it was necessary to run the HEC-RAS 2D model for the aforementioned 5-percent and 1-percent exceedance probability flows (listed previously in Table B-1) to obtain a number of hydraulic parameters to be used with the scour prediction empirical equations. The above (Tables B-4 and B-5) HEC-RAS output parameters were then used to estimate scour magnitudes for preliminary sizing. For the scour magnitude estimates, the Zimmerman and Maniak equation produced what were judged the most consistent scour depths using representative bed material values from a previous nearby study (USACE, 2014). The Veronese Equation produced negative results that were ignored. Table B-6 lists estimated scour depths for the initial flow deflector configurations.

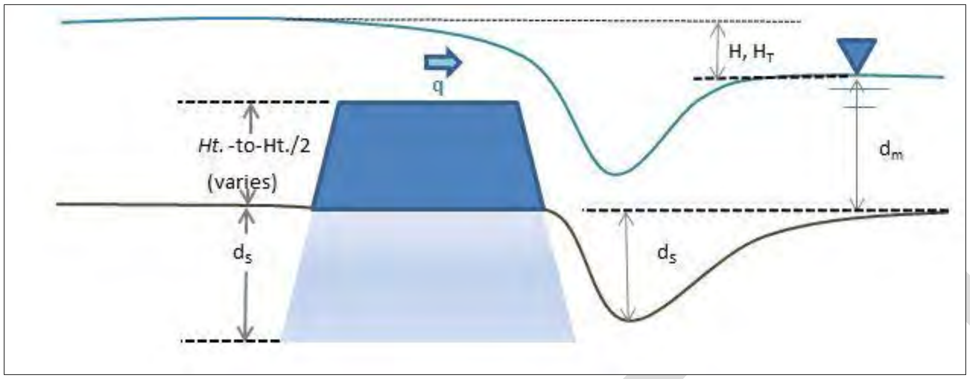


Figure B-16. Conceptual Scour Diagram for Flow Deflectors

Table B-6. Estimated Scour Depths for Initially Proposed Flow Deflectors

Event	**Estimated Scour Depth (feet)**	
	1% Chance of Exceedance	**5% Chance of Exceedance**
Zimmerman and Maniak	7.8	4.6
Schoklitsch	1.1	3.7
Veronese	-2.5	-5.2
Mean Scour Depth (Using positive values only)	**4.4**	**4.1**

<u>Substrate Analysis</u>

To assess changes to substrate characteristics near the proposed flow deflectors, two simulations (5-percent and 1-percent-annual-chance exceedance peaks) without deflectors in place (i.e., no action) were created, and compared with two new simulations with flow deflectors in place for the same flood events. Resulting velocities above and below each vane were determined, and representative grain sizes were estimated from Figure B-17 (reproduced from Plate B-28 of Engineer Manual 1110-2-1601 [USACE 1994]), based on sediment transport principles. Results are listed in Tables B-7 and B-8 for comparison.

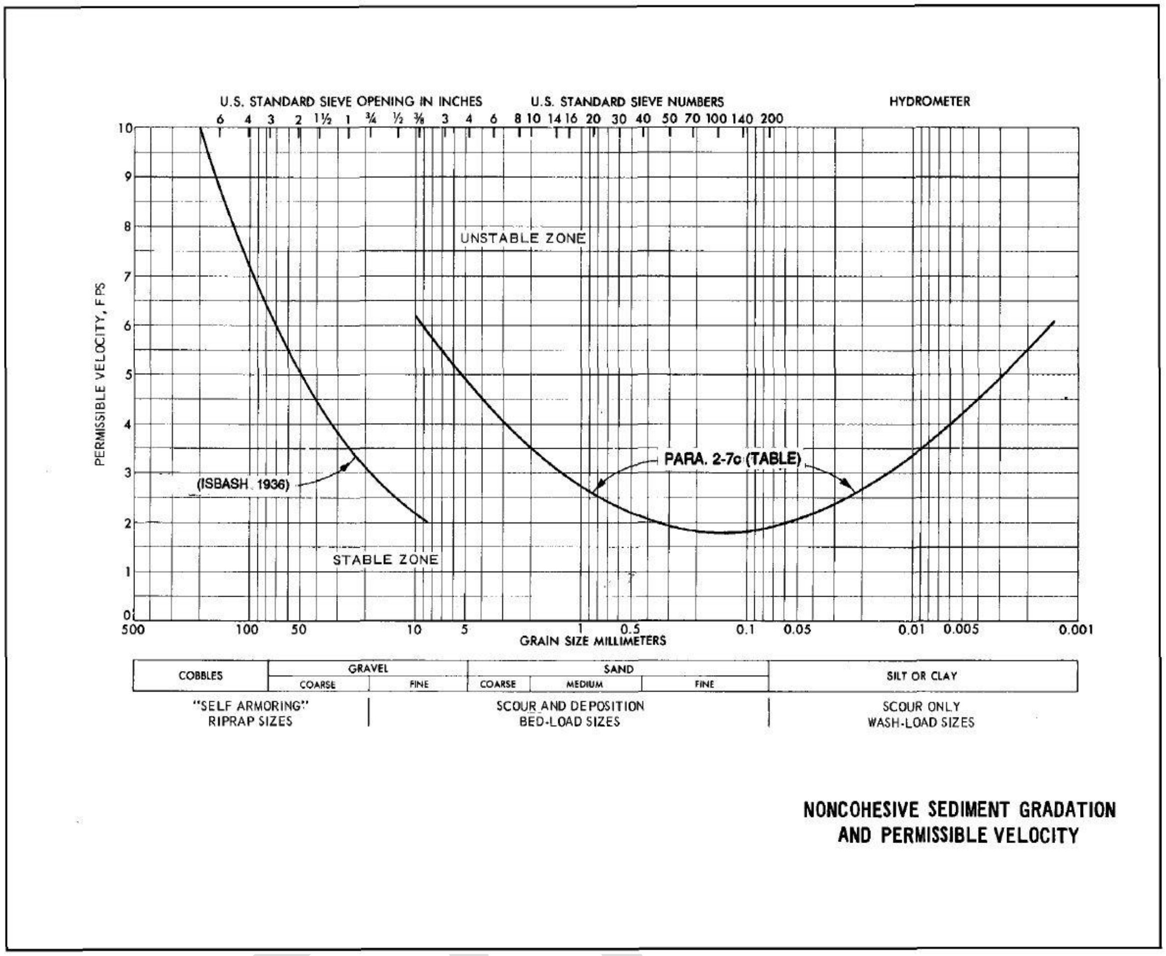


Figure B-17. Sediment Grain Size-Velocity Relationships

Source: Plate B-28 (USACE 1994).

Table B-7. Initially Proposed Flow Deflectors Velocity-Grain Size Results

With Vanes

Simulation Time: 0000 hrs, 11 June 1990 Peak

Upstream

5% ACE Event		Stream Velocity	PARA 2-7c (Table)	
		Mean	Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.01	1.3	0.015
			Medium Sand	Silt or Clay
Area 2	Vane 2	2.52	0.9	0.025
			Medium Sand	Silt or Clay
Area 3	Vane 3	1.40		
	Vane 4	1.70		
Area 4	Vane 5	1.35		
	Max	3.01		
	Average	2.00		
	Min	1.35		

1% ACE Event		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.47	1.85	0.009
Area 2	Vane 2	3.01	1.3	0.015
			Medium Sand	Silt or Clay
Area 3	Vane 3	1.84	0.25	0.08
			Fine Sand	Silt or Clay
	Vane 4	1.7		
Area 4	Vane 5	1.75		
	Max	3.47		
	Average	2.35		
	Min	1.7		

5%-1% ACE Average Events		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.24	1.8	0.015
			Medium Sand	Silt or Clay
Area 2	Vane 2	2.76	1.1	0.017
			Medium Sand	Silt or Clay
Area 3	Vane 3	1.62		
	Vane 4	1.70		
Area 4	Vane 5	1.55		
	Max	3.24		
	Average	2.17		
	Min	1.55		

Simulation Time: 0000 hrs, 11 June 1990 Peak

Downstream

5% ACE Event		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.08	1.3	0.015
			Medium Sand	Silt or Clay
Area 2	Vane 2	1.5		
Area 3	Vane 3	1.67		
	Vane 4	1.53		
Area 4	Vane 5	2.18	0.4	0.055
			Fine Sand	Silt or Clay
	Max	3.08		
	Average	1.99		
	Min	1.50		

1% ACE Event		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.72	2.5	0.0075
			Coarse Sand	Silt or Clay
Area 2	Vane 2	1.96	0.4	0.055
			Fine Sand	Silt or Clay
Area 3	Vane 3	2.1	0.45	0.058
			Fine Sand	Silt or Clay
	Vane 4	2.45	0.7	0.027
			Medium Sand	Silt or Clay
Area 4	Vane 5	2.73	1.2	0.018
			Medium Sand	Silt or Clay
	Max	3.72		
	Average	2.59		
	Min	1.96		

5%-1% ACE Average Events		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.40	1.9	0.01
			Medium Sand	Silt or Clay
Area 2	Vane 2	1.73		
Area 3	Vane 3	1.89	0.25	0.085
			Fine Sand	Silt or Clay
	Vane 4	1.99	0.4	0.055
			Fine Sand	Silt or Clay
Area 4	Vane 5	2.46	0.7	0.027
			Medium Sand	Silt or Clay
	Max	3.40		
	Average	2.29		
	Min	1.73		

Note: Blank fields indicate that grains are in suspension.

Table B-8. Velocity-Grain Size Results with No Flow Deflectors

No Vanes

Simulation Time: 0000 hrs, 12 June 1996 Peak

Upstream

5% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.31	1.8	0.012
			Medium sand	Silt or Clay
Area 2	Vane 2	2.25	0.55	0.035
			Medium Sand	Silt or Clay
Area 3	Vane 3	1.73		
	Vane 4	1.92	0.3	0.07
			Fine Sand	Silt or Clay
Area 4	Vane 5	1.79	0.2	0.09
			Fine Sand	Silt or Sand
	Max	3.31		
	Average	2.20		
	Min	1.73		

1% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	4.03	3	0.007
			Coarse Sand	Silt or Clay
Area 2	Vane 2	2.91	1.2	0.014
			Medium Sand	Silt or Clay
Area 3	Vane 3	2.25	0.55	0.035
			Medium Sand	Silt or Clay
	Vane 4	2.5	0.8	0.028
			Medium Sand	Silt or Clay
Area 4	Vane 5	2.33	0.6	0.035
			Medium Sand	Silt or Clay
	Max	4.03		
	Average	2.80		
	Min	2.25		

5%-1% ACE Average Events

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.67	2.5	0.007
			Coarse Sand	Silt or Clay
Area 2	Vane 2	2.58	0.8	0.028
			Medium Sand	Silt or Clay
Area 3	Vane 3	1.99	0.4	0.055
			Fine Sand	Silt or Clay
	Vane 4	2.21	0.55	0.035
			Medium Sand	Silt or Clay
Area 4	Vane 5	2.06	0.4	0.055
			Fine Sand	Silt or Clay
	Max	3.67		
	Average	2.50		
	Min	1.99		

Simulation Time: 0000 hrs, 12 June 1996 Peak

Downstream

5% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	2.96	1.3	0.015
			Medium Sand	Silt or Clay
Area 2	Vane 2	1.65		
Area 3	Vane 3	1.60		
	Vane 4	2.05	0.4	0.055
			Fine Sand	Silt or Clay
Area 4	Vane 5	2.27	0.55	0.035
			Medium Sand	Silt or Clay
	Max	2.96		
	Average	2.11		
	Min	1.60		

1% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.67	2.5	0.007
			Coarse Sand	Silt or Clay
Area 2	Vane 2	2.11	0.4	0.055
			Fine Sand	Silt or Clay
Area 3	Vane 3	2.09	0.4	0.055
			Fine Sand	Silt or Clay
	Vane 4	2.61	0.8	0.028
			Medium Sand	Silt or Clay
Area 4	Vane 5	2.88	1.2	0.014
			Medium Sand	Silt or Clay
	Max	3.67		
	Average	2.67		
	Min	2.09		

5%-1% ACE Average Events

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.32	1.8	0.012
			Medium sand	Silt or Clay
Area 2	Vane 2	1.88	0.25	0.085
			Fine Sand	Silt or Clay
Area 3	Vane 3	1.85	0.25	0.08
			Fine Sand	Silt or Clay
	Vane 4	2.33	0.6	0.035
			Medium Sand	Silt or Clay
Area 4	Vane 5	2.58	0.8	0.028
			Medium Sand	Silt or Clay
	Max	3.32		
	Average	2.39		
	Min	1.845		

To further assess flow variability that might be gained from the initially proposed vanes, velocities listed in Tables B-7 and B-8 were compared against one another, and their differences are listed in Table B-9.

Table B-9. Initial Proposal Velocity Change Comparison, With- minus Without- Flow Deflectors

Deflector ID	Upstream	Downstream
	Velocity Change (ft/sec)	
Deflector 1	-0.43	+0.08
Deflector 2	+0.18	-0.15
Deflector 3	-0.37	+0.04
Deflector 4	-0.51	-0.34
Deflector 5	-0.51	-0.12

Velocity changes from upstream to downstream would be expected to produce what were judged to be beneficial variabilities in the aquatic conditions and grain size distributions adjacent to the proposed features. Consistent transitions in velocities, from a decreased velocity upstream (negative change) to an increased velocity downstream (positive) would be associated with more beneficial grain size distribution changes around the structures. Coarser materials tend to settle out as finer grains are carried downstream at a given threshold velocity. A decreased velocity upstream of a deflector would promote deposition of finer materials. A velocity increase downstream would flush out fine materials, resulting in a coarser bed substrate. This variability was expected to create pockets of more useable habitat types within the relatively consistent bed within McNary's pool. Somewhat inconsistent changes in the modeled velocities' signs (i.e., positive or negative) indicated low potential effectiveness for the proposed construction, but it was expected that further refinement of the deflector dimensions might improve the effects. Similarly, the relatively low magnitude changes suggested less potential benefit from construction of the features.

B.3.3.3.3 Final Flow Deflector Evaluation

Following the preliminary evaluation and cost estimates, it was determined that the dimensions used to initially size the flow deflectors were unacceptable, and should be reduced primarily in consideration of recreational activities and navigation in McNary's pool. In consultation with the U.S. Coast Guard, constraints on the flow deflectors' dimensions were refined. It was specified that features should not extend out into the river more than 40 feet perpendicular to the island's shoreline. Dimensions of the final flow deflectors evaluated for this study are show in Table B-10.

Table B-10. Final Flow Deflector Dimensions

Area	Top Width (feet)	Projection from bank (feet)	Angle (to bank normal)*	Length (feet)	Ht. (bank-end) (feet)	Ht./2 (river-end) (feet)	Comment
1	4	40	30°	80	5	2.5	
2	4	40	135°	57	5	2.5	
3	4	40	50°	52	5	2.5	
	4	40	50°	52	5	2.5	Increase space between deflectors only with dock relocated
4	4	40	50°	52	5	2.5	
	4	40	50°	52	5	2.5	Add second deflector only with dock relocated
5	-	-	-	-	-	-	No deflectors for area 5

*For corner locations, angle refers to bankline parallel to river measuring clockwise

Similar scour and substrate analyses were carried out for the final flow deflector configuration and thosed described in the preliminary evaluation for the first cost estimate. Hydraulic parameters were determined from the HEC-RAS 2-D model, configured for the final deflector dimensions, and are listed in Tables 11 and 12.

Response to Refined Flow Deflectors

Two different simulation runs were again established in HEC-RAS to determine impact changes seen by velocities and water depths at and around flow deflectors on Clover Island. The simulated events are the 5-percent and 1-percent probability of flood exceedance. The 5-percent-chance event is modeled on the 1997 historic flood with noticeable scaled peaks around of 400,000 cfs, while the 1-percent-chance scaled peak is at about 480,000 cfs. Results from modeling those peaks were used to analyze regime changes on structures and scour. Tables B-11 and B-12 show a list of several parameters, including the average discharge per unit length, for the 5-percent- and 1-percent- chance exceedance runs, which are used for the scour estimates. The values shown in the tables were obtained from selected mesh cells in the HEC-RAS 2-D model located in the RAS Mapper window, similar to that shown in Figure B-4. Cells are adjacent to deflector side lengths and represent the downstream side of the cell face.

Table B-11. The 5-Percent-Chance Exceedance Computed Hydraulic Parameters from HEC-RAS

Area	Deflectors	Average River Depth (ft)	Flow Area (ft^2)	River Velocity (ft/sec)	Discharge (cfs)	Downstream Face Length (ft)	Discharge per Unit Length (cfs/ft)
1	1	17.49	1399	3.75	5247	80	66
2	1	10.37	591	2.06	1218	57	21
3	1	14.48	753	1.36	1024	52	20
	1	11.05	575	1.75	1006	52	19
4	1	12.30	640	1.92	1228	52	24

Table B-12. The 1-Percent-Chance Exceedance Computed Hydraulic Parameters from HEC-RAS

Area	Deflectors	Average River Depth (ft)	Flow Area (ft^2)	River Velocity (ft/sec)	Discharge (cfs)	Downstream Face Length (ft)	Discharge per Unit Length (cfs/ft)
1	1	19.3	1544	4.56	7041	80	88
2	1	12.13	691	2.65	1832	57	32
3	1	16.25	845	2.96	2500	52	48
	2	12.87	669	2.28	1525	52	29
4	1	14.18	737	2.94	2168	52	42

<u>Scour Estimation at Refined Flow Deflectors</u>

Scour depths estimates were again carried out using the three empirical equations previously identified. Results from the scour computations again indicated that the Zimmerman and Maniak method was the most applicable. Negative results were obtained from the other two equations and were discarded. The Zimmerman and Maniak Equation results are listed in Table B-13. To summarize, the average estimated scour depths below river bed surface are: 13, 7, 8.5, 7.0, and 8.0 feet for deflectors 1, 2, 3, 4, and 5, respectively.

Table B-13. Zimmerman and Maniak Method Results

	Flow Deflector ID				
Variable ACE%	**1**	**2**	**3**	**4**	**5**
	Scour Depth (feet)				
5%	11.5	3.9	4.7	3.3	4.8
1%	14.5	9.5	12.2	10.0	10.9
Average Depth	**13**	**6.7 ~ 7**	**8.45 ~ 8.5**	**6.65 ~ 7.0**	**7.85 ~ 8.0**

<u>Substrate Analysis</u>

The HEC-RAS 2D model was again used to assess bed material benefits associated with constructing flow deflectors in the proposed locations. To semi-quantitatively assess the potential change in grain size distribution, above and below each deflector, two different scenarios associated with the 5-meter terrain were built into the model. The first run, which accounts for no flow deflectors (i.e., existing condition) was compared against a run with the deflectors in place. Both runs used the 5-percent- and 1-percent annual chance of exceedance flows. As with the preliminary evaluation, resulting velocities above and below each vane were used along with Plate B-1 to estimate representative grain size. Results are listed in Tables B-14 and B-15 for comparison.

Table B-14. Velocity-Grain Size Distribution Profile with Flow Deflectors

With Vanes

Upstream

Simulation Time: 0000 hrs, 12 June 1996 Peak

5% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.56	2.1	0.0085
			Coarse Sand	Silt or Clay
Area 2	Vane 2	2.52	0.9	0.025
			Medium Sand	Silts or Clay
Area 3	Vane 3	1.21		
	Vane 4	1.42		
Area 4	Vane 5	1.49		
	Max	3.563		
	Average	2.04		
	Min	1.206		

1% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	4.03	3	0.007
			Coarse Sand	Silt or Clay
Area 2	Vane 2	3.32	1.8	0.012
			Medium sand	Silt or Clay
Area 3	Vane 3	1.99	0.4	0.055
			Fine Sand	Silt or Clay
	Vane 4	1.83	0.25	0.08
			Fine Sand	Silt or Clay
Area 4	Vane 5	2.11	0.4	0.055
			Fine Sand	Silt or Clay
	Max	4.03		
	Average	2.66		
	Min	1.83		

5%-1% ACE Average Events

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.80	2.6	0.007
			Coarse sand	Silt or Clay
Area 2	Vane 2	2.92	1.4	0.015
			Medium Sand	Silt or Clay
Area 3	Vane 3	1.60		
	Vane 4	1.63		
Area 4	Vane 5	1.80	0.2	0.09
			Fine Sand	Silt or Sand
	Max	3.80		
	Average	2.35		
	Min	1.60		

Downstream

Simulation Time: 0000 hrs, 12 June 1996 Peak

5% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.77	2.5	0.007
			Coarse Sand	Silt or Clay
Area 2	Vane 2	1.65		
Area 3	Vane 3	1.57		
	Vane 4	1.67		
Area 4	Vane 5	1.95	0.3	0.065
			Fine Sand	Silt or Clay
	Max	3.77		
	Average	2.12		
	Min	1.57		

1% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	4.8	5	0.0032
			Fine Gravel	Silt or Clay
Area 2	Vane 2	2.28	0.55	0.035
			Medium Sand	Silt or Clay
Area 3	Vane 3	2.3	0.55	0.035
			Medium Sand	Silt or Clay
	Vane 4	2.38	0.55	0.035
			Medium Sand	Silt or Clay
Area 4	Vane 5	2.98	1.3	0.015
			Medium Sand	Silt or Clay
	Max	4.8		
	Average	2.95		
	Min	2.28		

5%-1% ACE Average Events

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	4.29	3.6	0.005
			Coarse Sand	Silt or Clay
Area 2	Vane 2	1.97	0.4	0.055
			Fine Sand	Silt or Clay
Area 3	Vane 3	1.93	0.3	0.065
			Fine Sand	Silt or Clay
	Vane 4	2.03	0.4	0.055
			Fine Sand	Silt or Clay
Area 4	Vane 5	2.47	0.7	0.027
			Medium Sand	Silt or Clay
	Max	4.29		
	Average	2.54		
	Min	1.93		

Note: Blank fields indicate that grains are in suspension.

Table B-15. Velocity-Grain Size Distribution Profile with No Flow Deflectors

No Vanes

Simulation Time: 0000 hrs, 12 June 1996 Peak

Upstream

5% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.31	1.8	0.012
			Medium sand	Silt or Clay
Area 2	Vane 2	2.25	0.55	0.035
			Medium Sand	Silt or Clay
Area 3	Vane 3	1.73		
	Vane 4	1.92	0.3	0.07
			Fine Sand	Silt or Clay
Area 4	Vane 5	1.79	0.2	0.09
			Fine Sand	Silt or Sand
	Max	3.31		
	Average	2.20		
	Min	1.73		

1% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	4.03	3	0.007
			Coarse Sand	Silt or Clay
Area 2	Vane 2	2.91	1.2	0.014
			Medium Sand	Silt or Clay
Area 3	Vane 3	2.25	0.55	0.035
			Medium Sand	Silt or Clay
	Vane 4	2.5	0.8	0.028
			Medium Sand	Silt or Clay
Area 4	Vane 5	2.33	0.6	0.035
			Medium Sand	Silt or Clay
	Max	4.03		
	Average	2.80		
	Min	2.25		

5%-1% ACE Average Events

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.67	2.5	0.007
			Coarse Sand	Silt or Clay
Area 2	Vane 2	2.58	0.8	0.028
			Medium Sand	Silt or Clay
Area 3	Vane 3	1.99	0.4	0.055
			Fine Sand	Silt or Clay
	Vane 4	2.21	0.55	0.035
			Medium Sand	Silt or Clay
Area 4	Vane 5	2.06	0.4	0.055
			Fine Sand	Silt or Clay
	Max	3.67		
	Average	2.50		
	Min	1.99		

Simulation Time: 0000 hrs, 12 June 1996 Peak

Downstream

5% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	2.96	1.3	0.015
			Medium Sand	Silt or Clay
Area 2	Vane 2	1.65		
Area 3	Vane 3	1.60		
	Vane 4	2.05	0.4	0.055
			Fine Sand	Silt or Clay
Area 4	Vane 5	2.27	0.55	0.035
			Medium Sand	Silt or Clay
	Max	2.96		
	Average	2.11		
	Min	1.60		

1% ACE Event

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.67	2.5	0.007
			Coarse Sand	Silt or Clay
Area 2	Vane 2	2.11	0.4	0.055
			Fine Sand	Silt or Clay
Area 3	Vane 3	2.09	0.4	0.055
			Fine Sand	Silt or Clay
	Vane 4	2.61	0.8	0.028
			Medium Sand	Silt or Clay
Area 4	Vane 5	2.88	1.2	0.014
			Medium Sand	Silt or Clay
	Max	3.67		
	Average	2.67		
	Min	2.09		

5%-1% ACE Average Events

		Stream Velocity	PARA 2-7c (Table)	
			Unstable Zone	
		ft/s	mm	mm
Area 1	Vane 1	3.32	1.8	0.012
			Medium sand	Silt or Clay
Area 2	Vane 2	1.88	0.25	0.085
			Fine Sand	Silt or Clay
Area 3	Vane 3	1.85	0.25	0.08
			Fine Sand	Silt or Clay
	Vane 4	2.33	0.6	0.035
			Medium Sand	Silt or Clay
Area 4	Vane 5	2.58	0.8	0.028
			Medium Sand	Silt or Clay
	Max	3.32		
	Average	2.39		
	Min	1.845		

Note: Blank fields indicate that grains are in suspension.

Furthermore, side by side animated snap shots were taken from the HEC-RAS model, with particle tracing activated, around the island during peak flows (e.g., 1-percent-annual-chance exceedance (ACE). The figures qualitatively illustrate the particle movement comparison between the with- and without-deflectors scenarios (Figure B-18).

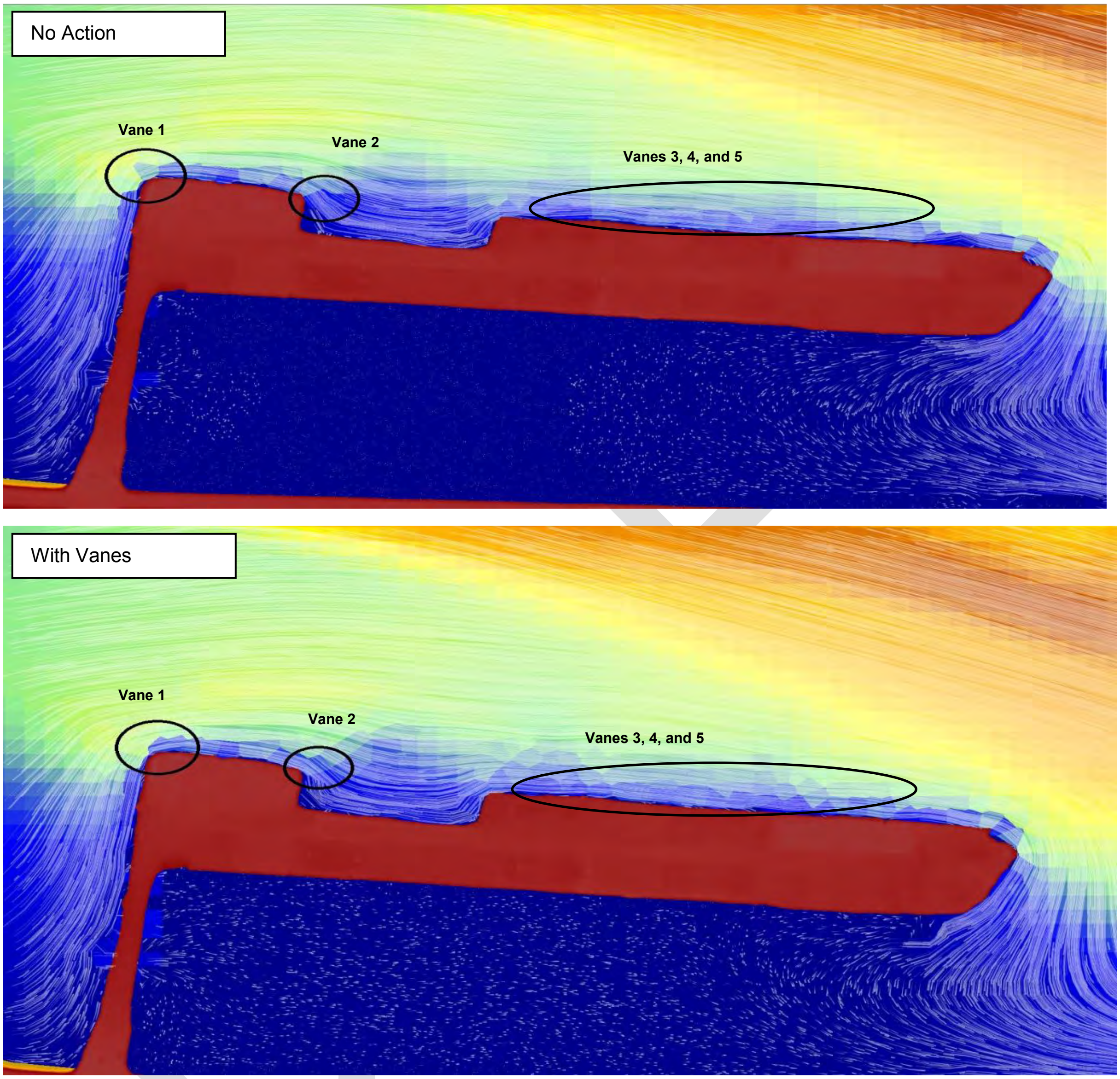


Figure B-18. Screen Captures from HEC-RAS Particle Tracking Visualizations.

Flow deflectors 1 and 2 were emphasized with circles in the figures above to highlight particle movements and to assess deflector impacts comparisons. The particle patterns appear quite similar for with- and without-deflectors. Flow deflector 1 is not diverting significantly more water away from the island shorelines as intended, and deflector 2 shows little tendency of directing significantly more stream flow into the notch. It was also observed that deflector 3, 4, and 5 did not appear highly efficient in breaking the particle patterns from the smooth streaming along the shoreline.

The flow deflectors did have some impacts, with somewhat increased velocities observed at particular locations, though not all, when compared to the *no action* alternative, as shown in Table B-16. An increase in velocity was seen upstream and downstream of most deflectors. Higher stream velocities had been anticipated below deflectors as waters plunged over the structures, due to changes in energy, but are suspect upstream of the deflectors. The magnitudes of this behavior can be seen by comparing Tables B-14 and B-15.

Table B-16. Velocity Change Comparison With and Without Flow Deflectors (average of 1% and 5% runs)

Flow Deflector ID	Upstream	Downstream
	Velocity Change (ft/sec)	
Deflector 1	+0.13	+0.97
Deflector 2	+0.34	+0.09
Deflector 3	-0.41	+0.08
Deflector 4	+0.19	-0.3
Deflector 5	+0.26	-0.11

Results in Table B-16 show that the net velocity change was not consistently significant at each flow deflector. A positive sign indicates that velocity seen in a location upstream of a proposed deflector is higher than the velocity seen at the same location with no deflector in place. A negative sign, on the other hand, reflects a decrease in velocity with a deflector in place. The inconsistency of velocity change magnitudes indicates the probability that the proposed structures would only add minimum to no benefits to the anticipated characteristic grain size effects around the proposed structures and, therefore, low benefits to habitat.

B.4 CONCLUSION

Hydrologic, hydraulic, and rudimentary sediment transport analyses were conducted to evaluate the feasibility of flow deflector construction to improve water quality, substrate variability, and, therefore, improved habitat near the Clover Island shoreline. Initially conceived, relatively large flow deflectors were seen to have some impact on flow velocities and associated characteristic bed material composition near the deflectors as intended. The impacts were not large, but preliminary cost estimates indicated that the construction costs were within program constraints. Further refinement of the flow deflector dimensions, in consideration of recreation and navigation activities within the pool upstream of McNary Lock and Dam, was subsequently undertaken. The subsequent much smaller flow deflectors were determined to have minimal beneficial impacts on the aquatic conditions desired due to the flow regulation imposed by McNary. The final proposed structures using the later design criteria were shown to impact velocities very minimally, with no consistent ability to break stream flows away from shore lines for protection of proposed riparian plantings as seen in deflector 1 (located on the North East corner of the island) particle tracing.

Particle tracing also suggests that the flow deflector 2 (north corner of the notch) could have some ability to increase flows into the notch, as anticipated, but the impacts appear qualitatively marginal. Improvements to aquatic quality where deflector 2 is proposed are similarly marginal, at best.

Also, flow deflectors 3, 4, and 5 (parallel to one another) showed no consistent ability in breaking up flow pattern along the island, based on interpretation of the particle tracings. Minimum velocity changes upstream and downstream vanes show relatively small impacts on favorable substrate characteristics identified as beneficial to habitat.

Other erosion protection practices may be needed in Area 2 (notably at the downstream end of the notch) and at the southeast corner of the island in Area 5, where high shear stresses were observed, and that likely would further erode banks during major flood events. Hydraulic analyses in this report have shown that an alternative without incorporation of flow deflectors would be more suitable for this project, as the flow deflectors would likely not add sufficient benefits to improved aquatic habitat around Clover Island. It is therefore determined that constructing the refined flow deflectors on the Columbia River would have minimal benefit in improving aquatic habitat for the cost and attendant upkeep that would be required.

The other information determined through hydraulic modeling of the reach is of value in the design of stabilization measures to protect proposed riparian habitat improvements.

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Clover Island Section 1135 Ecosystem Restoration
Kennewick, Washington

Clover Island Feasibility Report
and
Integrated Environmental Assessment

APPENDIX C, RECREATION BENEFITS ANALYSIS

Clover Island Section 1135 Ecosystem Restoration

Kennewick, Washington

Clover Island Feasibility Report and Integrated Environmental Assessment APPENDIX C, RECREATION BENEFITS ANALYSIS

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1 INTRODUCTION

The Recreation and Benefits Analysis is presented to support the Clover Island Restoration Feasibility Report and Integrated Environmental Assessment. This Appendix provides a description of the proposed recreation features, estimates the recreation benefits that are created from implementation of the recommended plan – Alternative 1 Max Habitat Restoration A, and provides an estimate of allowable costs for recreation features.

1.1 Authority

The Clover Island Ecosystem Restoration Feasibility Study is being conducted in partnership with the US Army Corps of Engineers and the Port of Kennewick (Port) to recommend a plan for restoring riparian and aquatic habitat and ecosystem functionality on the shores of Clover Island in Kennewick, Washington. The Corps conducted this study under authority of the Water Resources Development Act (WRDA) of 1986 [Public Law (PL)] 99-662], Section 1135, as amended by WRDA 1996, Section 204 (PL 104-303, and codified at 33 USC § 2309) for Project Modifications for Improvement of Environment. The Federal Water Project Recreation Act of 1965 and Policy Guidance Letter No. 59 June 1998, requires full consideration be given to the opportunities afforded by Federal multipurpose and other water projects for outdoor recreation and associated fish and wildlife enhancement.

1.2 Background

On the Columbia River, the impoundment of the McNary Dam pool and construction levees in the 1950s flooded shallow benches along much of the shoreline. As a result inundation and levee construction, natural shallow water aquatic and riparian habitat were eliminated and replaced with steep, riprapped embankments and deep water along the levees. Clover Island, located at River Mile 328.9, within the middle reach of the Columbia River, was impacted by these actions and much of the original aquatic and riparian habitat was lost. The purpose of this Feasibility Study is to evaluate and recommend a plan for restoring aquatic and riparian habitat along the north shore of Clover Island.

Clover Island is owned by the Port of Kennewick (Port) and is located in the City of Kennewick, Benton County, in the Southeastern part of Washington. Although the goal of the Clover Island Ecosystem Restoration project is to restore habitat along the shoreline of Clover Island, the non-Federal Sponsor (NFS), the Port, would like to incorporate recreation features into the habitat restoration project. In 2003, through a collaborative process with the community, stakeholders, and local and State agencies, the Port develop a common vision for Clover Island that prioritized the "enhancement of the environment, aesthetics, and recreation". The Clover Island Master Plan, 2004 (Master Plan) describes the concepts developed through the collaborative process and the recreation concepts are those considered under the recreation benefits analysis for this Feasibility Study. Planned recreation features included as part of this Continuing Authorities Program, Section 1135 project are cost shared facilities as listed in ER 1165-2-400.

The proposed recreation is a river front trail with educational signage that will showcase improved river conditions, reduce visual blight, and expand regional recreational opportunities as a complement to environmental restoration. This project will provide access to one-half mile of restored riparian habitat along and urban shoreline with unobstructed views for public enjoyment and it expands barrier-free trail at a popular location. It is consistent with City planning efforts and builds upon a successful completion of the causeway project which was funded by the Port and City of Kennewick in partnership with a Washington State Recreation Office Aquatic Lands Enhancement Account grant, which has been appreciated and used by the public.

The primary intent of the proposed recreation features is to connect the existing regional Sacagawea Heritage Trail (trail) system on the nearby Tri-Cities Levees to the restored riparian habitat on the north shore of Clover Island. The Tri-Cities (Kennewick, Richland and Pasco) community have been trying to improve the recreation opportunities and connection to the Columbia River. Through their efforts, over 20 miles of levee trails have been created to connect multiple adjacent parks. These parks are heavily used in the urban environment, but none of these parks offer the island recreational opportunities. Clover Island is located at the downstream end of the Sacagawea Heritage Trail system and recent improvements to the causeway have connected the island to the trail system. The proposed restoration features connect the causeway to the restored riparian habitat recommended in the Feasibility Study.

Clover Island is unique because it is the only island within the Columbia River, connected to the regional Sacagawea Heritage Trail system. The proposed recreation features will offer both environmental and recreation opportunities to variety of visitors; hikers, bicyclists, strollers, bird waters, boater, and tourists. The island offers visitors a marina, restaurant, hotel and provides ample parking. The public bus system is located nearby and the island is within walking distance of residential communities. Many of the local residential communities are of low and moderate income, with a high percentage comprised of minorities and youth; groups that often cannot afford to travel to recreational destinations. The proposed recreational features will provide a unique recreational river front and public trail to underserved populations.

2 RECREATION PLAN

The island was separated into five distinct areas for the purposes of the Clover Island Ecosystem Restoration study (for a discussion of the areas see, Appendix D *Geotechnical Evaluation*). Areas 1, 2, and 3 and a small part of area 4 comprise the recreation study area. Planned recreation features include a pathway along the top of bank next to the parking areas, safety lighting, signs and interpretive media, benches, shade structures (if necessary) and trash receptacles and associated utilities. The planned recreation features will not measurably impact the environmental restoration function. Without the environmental restoration efforts on Clover Island, it would be unlikely that recreation features would be added to the island.

2.1 Recreation Features

The proposed restoration features are a sub-set of the total recreation features proposed for Clover Island, complement the actions the NFS completed along the causeway, and are as follows:

Pathways. A meandering pathway/trail will be constructed along the top of the shoreline and follow the shoreline contour. An approximately 1,500-linear-foot, ADA-compliant trail will be an estimated 5 feet to 9 feet in width (Figure 1). Slight variations will be dictated by the topography and slope of the shoreline. Concrete has been selected as the trail material because it will be easily maintained, sustainable, and holds up well to the desert climate. The trail will connect to and extend the causeway tail. It will begin north of the Lighthouse in area 1, travel along the north shoreline to the existing sidewalk at the "notch" in area 2, and from the notch along the north shoreline to area 3 (Figure 2). The trail will connect existing sidewalks between areas 3 and 4. The trail will also extend south an additional 150 feet to connect with an existing sidewalk along Clover Island Drive. Public restrooms already exist at both the east and west ends of the proposed trail.

Figure 1. Recreation Riverwalk Path on Clover Island

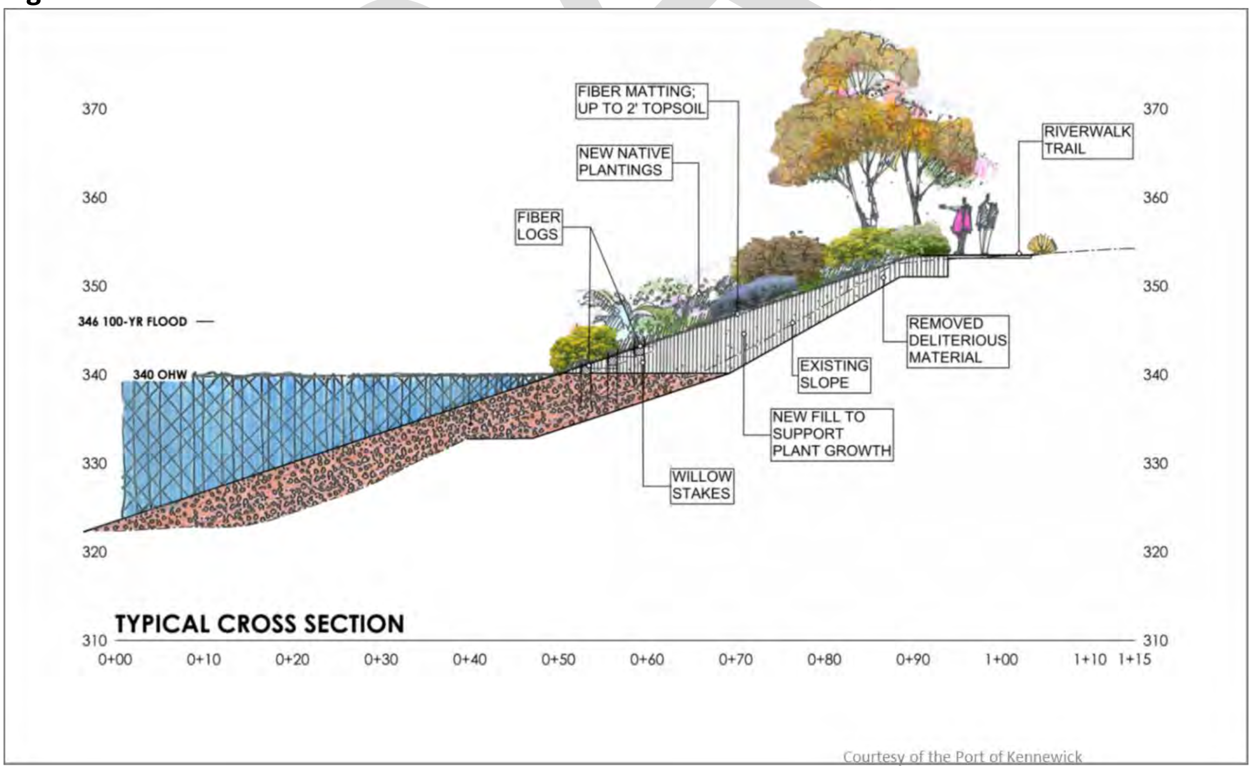
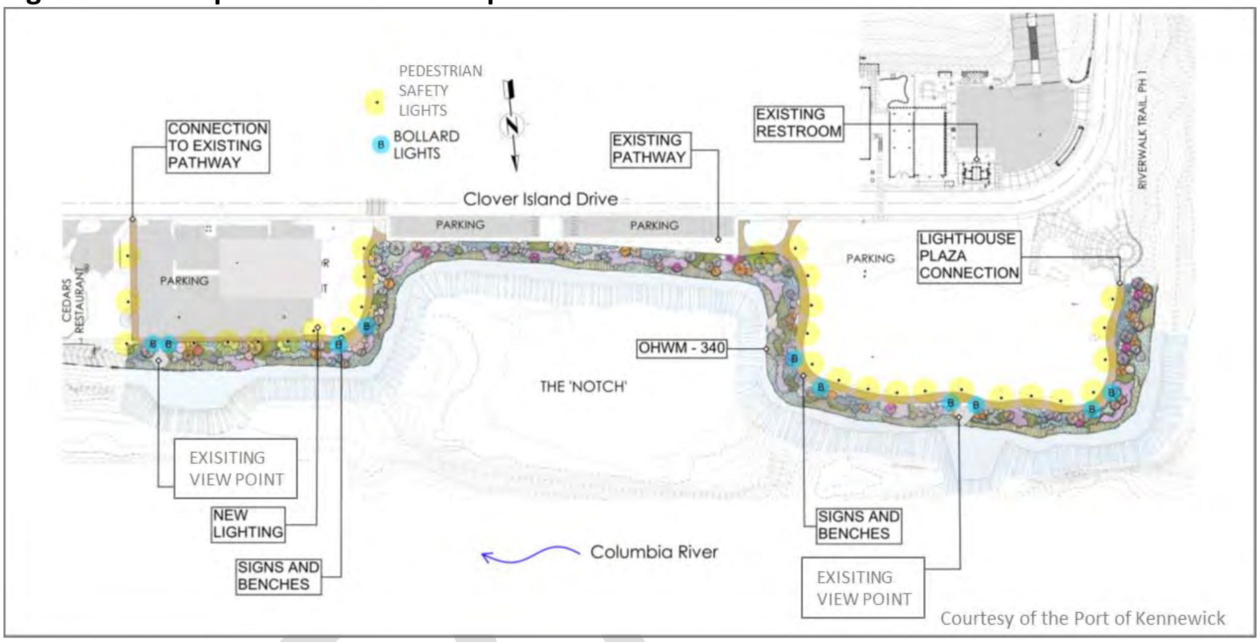


Figure 2. Conceptual Plan of the Proposed Recreation Features at Clover Island



Signs and Interpretive Media. Signs and interpretive media, will be placed along the new trail to educate about native plants and birds that are likely to be seen on the island. These signs will complement the NFS's actions along the causeway which includes installation of signs about island history, shoreline improvements and information about salmon lifecycle.

Seating Areas and Associated Features. Seating areas, benches and shade shelters, if determined necessary due to desert climate, and trash receptacles will be placed along the trail. Existing benches will be incorporated into the plan.

Safety. Pedestrian safety lighting, bollard lighting, and electrical conduit will be installed along the trails, viewpoints and benches for public safety and to minimize vandalism. Lights will be selected and positioned as such to reduce impacts to the habitat. Handrails will incorporated, as appropriate, at trails/viewpoints/overlooks for safety purposes.

3 RECREATIONAL ANALYSIS

The U.S. Army Corps of Engineers (Corps) provides guidance for estimating recreation benefits in Engineer Regulation (ER) 1105-2-100, Planning Guidance Notebook, and Engineer Pamphlet

(EP) 1165-2-502, Ecosystem Recreation – Support Policy Information. The Unit Day Value (UDV) methodology was chosen to determine estimated recreation benefits. It should be noted that recreation benefits and costs were not included in the formulation of alternatives and, therefore, had no influence on selection of the National Ecosystem Restoration Plan.

The UDV methodology relies on expert or informed opinion and judgment to estimate recreational users' average willingness to pay. By applying a carefully thought-out and adjusted UDV to estimated use, an approximation is obtained that may be used as an estimate of project recreation benefits.

The UDV approach in recreation benefit analysis consists of two parts: 1) determining value per visit; and 2) estimating visitation. Determination of the value per visit was completed in accordance to Corps guidance. However, due to a lack of visitation data for the existing conditions, a revised methodology was developed based on visitation from other similar parks.

3.1 Determination of Value per Visit

The first part of analyzing recreation benefits in the UDV method was to determine the value per visit. In accordance with the Corps Economic Guidance Memorandum 17-03, dated 25 October 2016, a team of economists and recreation managers familiar with the area evaluated the proposed recreation features for Clover Island and provided a rating for the criteria shown in the Table 1. Except for the causeway section that was finished in 2011, the existing shoreline on Clover Island has no recreation features and little habitat viewing opportunities. The current shoreline is rock revetment, scrap concrete, and loose cobles with little vegetation, which provide no measurable recreation benefits. The completion of the causeway pathway has created access to Clover Island, and increased the potential for future recreational opportunities. However, under the existing condition, there are no current recreation features associated with the riparian habitat on the island, therefore, the visitation for Clover Island existing conditions (or no project) was assumed to be zero.

The team was intentionally conservative in their evaluations to ensure recreation benefits were not overly estimated. For each criteria listed in Table 1, the team evaluated the proposed recreation features, and provide a value rank based for the expected experience, opportunity, capacity, access, aesthetics, and environmental quality. For example, for the criteria "availability of opportunity", higher points are assigned if the surrounding community has fewer readily available recreational substitutes or options, thus making the project recreational features more appealing; such as the case for Clover Island.

Table 1. Guidelines for Assigning Points for General Recreation

Criteria	Judgment Factors				
Recreation Experience[1] Total Points: 30 Point Value	Two general activities[2] 0-4	Several general activities 5-10	Several general activities: one high quality value activity[3] 11-16	Several general activities; more than one high quality high activity 17-23	Numerous high quality value activities; some general activities 24-30
Availability of opportunity[4] Total Points: 18 Point Value:	Several within 1 hour travel time; a few within 30 minutes travel time 0-3	Several within 1 hour travel time; none within 30 minutes travel time 4-6	One or two within 1 hour travel time; none within 45 minutes travel time 7-10	None within 1 hour travel time 11-14	None within 2 hours travel time 15-18
Carrying capacity[5] Total Points: 14 Point Value:	Minimum facility for development for public health and safety 0-2	Basic facility to conduct activity(ies) 3-5	Adequate facilities to conduct without deterioration of the resource or activity experience 6-8	Optimum facilities to conduct activity at site potential 9-11	Ultimate facilities to achieve intent of selected alternative 12-14
Accessibility Total Points: 18 Point Value:	Limited access by any means to site or within site 0-3	Fair access, poor quality roads to site; limited access within site 4-6	Fair access, fair road to site; fair access, good roads within site 7-10	Good access, good roads to site; fair access, good roads within site 11-14	Good access, high standard road to site; good access within site 15-18
Environmental quality Total Points: 20	Low aesthetic factors[6] that significantly lower quality[7]	Average aesthetic quality; factors exist that lower quality to minor degree	Above average Aesthetic quality; any limiting factors can be reasonably rectified	High aesthetic quality; no factors exist that lower quality	Outstanding aesthetic quality; no factors exist that lower quality

[1]Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.
[2]General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.
[3]High quality value activities include those that are not common to the region and/or Nation, and are of usually high quality.
[4]Likelihood of success at fishing and hunting.
[5]Value should be adjusted for overuse.
[6]Major esthetic qualities to be considered include geology and topography, water, and vegetation.
[7]Factors to be considered to lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.

The point values were estimated for the proposed recreation features at Clover Island and assigned a low to high judgment factor to provide a range, as shown in Table 2.

Table 2. General Recreation Points for Clover Island

Criteria	Possible Points	Actual Point Range (Low to High)
Recreation Experience	30	2-6
Availability of Opportunity	18	1-4
Carrying Capacity	14	3-10
Accessibility	18	5-16
Environmental Quality	20	4-12

After point values were assigned for each criteria, the number of points were converted into dollars using Table 3, as provided in Economic Guidance Memorandum 16-3 (EGM 16-3).

Table 3. Conversion of Points to Dollars (EGM 16-3)

Point Values	General Recreation Values	General Fishing and Hunting Values	Specialized Fishing and Hunting Values	Specialized Recreation Values other than Fishing and Hunting
0	$ 3.96	$ 5.70	$ 27.73	$ 16.10
10	$ 4.70	$ 6.44	$ 28.48	$ 17.09
20	$ 5.20	$ 6.93	$ 28.97	$ 18.32
30	$ 5.94	$ 7.68	$ 29.71	$ 19.81
40	$ 7.43	$ 8.42	$ 30.43	$ 21.05
50	$ 8.42	$ 9.16	$ 33.43	$ 23.77
60	$ 9.16	$ 10.15	$ 36.40	$ 26.25
70	$ 9.66	$ 10.65	$ 38.63	$ 31.70
80	$ 10.65	$ 11.39	$ 41.60	$ 36.90
90	$ 11.39	$ 11.64	$ 44.57	$ 42.10
100	$ 11.89	$ 11.89	$ 47.05	$ 47.05

The UDV costs for the proposed recreation features at Clover Island were estimated for the low, medium, and high General Recreation point ratings and are shown in Table 4.

Table 4. Clover Island Ratings and Corresponding UDV

Judgment Range	Total Score	UDV
Low Score	15	$4.95
Median Score	31	$6.09
High Score	48	$8.22

The proposed recreation features offer unique opportunity at Clove Island. Based on the flowing, the median UDV of $6.09 per day is justified.

- The only island in the middle reach of the Columbia River that will offer recreation opportunities with access to a restored riparian habitat;
- It will connects and extends the downstream end of the Sacagawea Heritage Trail system,
- The island has ample parking, other services such as a marina, hotel, restaurants, to enhance the recreation experience
- It is located close proximity to the bus system;
- It is in walking distance to local low and middle income residences and minority population.

3.2 Estimating Visitation

Along with developing a quality score and value for visitor or recreation experience, the second part of determining recreation benefits is to estimate visitation. The UDV method requires determining the estimated with- and without-project visitation.

3.2.1 Without-project Visitation

No estimates are available for recreation users on the Tri-Cities Levee trail near Clover Island. Since the previous shoreline on Clover Island had no recreation features and few habitat viewing opportunities, it was assumed recreation visitation for the planned recreation features before 2011 was very close to 0 prior to restoration. A thorough survey of existing recreation and projection of future visitation would be preferable, but the cost and additional time needed for such a survey was not practicable given the limited time and funding for this Section 1135 Ecosystem Restoration Feasibility Study.

3.2.2 With-project Visitation

An alternative approach was used to determine visitation at Clover Island because no visitation information was available. The with-project visitation used estimates from nearby parks in the Tri-Cities area and assumed similar visitation at Clover Island. In addition to similar recreation experiences, Clover Island also offers unique island features that are expected to increase total recreation visitation.

All parks, including Clover Island, offer trails, but Clover Island connects to and extends the Sacagawea Heritage Trail on to an island that extends from the shoreline trail into the Columbia River. Another unique feature of Clover Island is the hotel located at the southern-most end of the proposed tail, which would make an ideal trailhead location for the start of bicycle and running events. Other features on Clover Island would be the addition of interpretive signs to display environmental features being restored.

Three years of vehicle counts collected from nearby parks were available (Wye Park, Howard Amon Park, and Leslie Groves Park). Vehicle counts were attained from park rangers, but they do not include the number of people per car. Annual visitation estimates were made using three assumptions; 1.5, 2.5, and 3.5 visitors per car, and are shown in Table 5.

Table 5. Vehicle Counts at Parks in the Proximity of Clover Island

		Annual Estimated Visitors		
Park	**Vehicles Per Year**	**1.5 per car**	**2.5 per car**	**3.5 per car**
Wye Park	3,561	5,342	8,903	12,465
Howard Amon Park	31,238	46,857	78,095	109,333
Leslie Groves Park	52,272	78,408	130,680	182,952

Howard Amon Park is 8.5 miles upstream, adjacent to downtown Richland, with the trail and bike paths through the park and a boat launch, but no marina. Leslie Groves Park is 11 miles upstream of Clover Island. It is in a residential area at the upper end of the trail system, and has a boat launch but no marina. Wye Park is located 5 miles upstream on the same side of the river as Clover Island. It is quite similar to Clover Island, as it is small, has a marina and boat launch, and is adjacent to the levee bike paths. However, Wye Park's marina is only one-third the size of the Clover Island marina, there is no hotel near Wye Park, and parking at Wye Park has about half the spaces as Clover Island. Wye Park is located on the river bank in a closed off channel, while Clover Island is located in the middle of the Columbia River. Therefore, visitor estimates based on Wye Park were used and would provide a conservative estimate for Clover Island.

To account for possible benefit transfer from other parks, a range of reduction in visitation was estimated. The range reduces the estimated visitation to account for users that are coming to Clover Island from other parks they would have used in the absence of this project. The probability of benefit transfer was estimated for 20%, 30%, and 50%. These percentages were chosen to provide an upper and lower bounds of visitation transfer, as shown in Table 6. Due to the unique opportunities available at Clover Island, the upper bound of benefit transfer from other parks was used in the analysis.

Table 6. Estimated Annual Park Visitors Under Three Ranges

	Annual Estimated Visitors			
	Vehicles Per Year	**1.5 per car**	**2.5 per car**	**3.5 per car**
Wye Park	**3,561**	**5,342**	**8,903**	**12,465**
20 % Transfer	2,849	4,274	7,122	9,972
30 % Transfer	2,493	3,739	6,232	8,726
50 % Transfer	1,781	2,671	4,452	6,233

The most likely estimated visitation for Clover Island assumes 2.5 people per car, and a 50% transfer rate from other surrounding parks. Under these assumptions, the estimated annual visitation for Clover Island is 4,452. The estimation was confirmed by park rangers from surrounding parks, and therefore determined to be a reasonable estimate for Clover Island visitation.

The estimated recreation benefits is a product of the visitation and the UDV. Using the visitation estimate of 4,452 visits per year, and the UDV value of $6.09, an annual recreation benefit of $27,104 is estimated. Annualizing this at the current Federal rate of 2.875% (EGM 17-01) for 50 years results in a first cost of $714,000. Recreation benefits are estimated to be $714,000 and costs for the NFS's recreation plan is $709,014. The recreation features with an annualized benefit of $27,095 and the annualized cost of $26,906 are justified, with a benefit to cost ratio of 1.007 to 1.

4 FEDERAL AND NON FEDERAL COST SHARE FOR RECREATION

Corps guidance directs that recreation features cannot increase the Federal cost share by more than 10%. As shown in Table 7, the 75% Federal cost share of the preferred plan is $2,969,130, which results in a $296,913 Federal contribution toward the total recreation costs. The Corps will cost share 50% of the recreation cost up to $593,826. Any cost in excess of that amount will be the responsibility of the NFS. The total allowable cost shared recreation features for Alternative 1 is $593,826, which results in a positive benefit to costs relationship.

Table 7. Recreation Costs for Preferred Plan

Preferred Plan (without Recreation)	$3,958,840
Federal Cost Share (75%)	$2,969,130
10% of Federal Cost Share for Recreation	$296,913
Total Recreation Cost	$593,826
Non-Federal Sponsor Recreation Cost Share	$296,913

To determine the planning level costs for the allowable recreation features, costs were estimated for the recreation features proposed in the Master Plan. Then the recreation features were evaluated to determine if they were acceptable facilities in which the Corps would be allowed to cost share for a day-use, shoreline ecosystem restoration project, in accordance with ER 1105-2-100, Exhibit E-3. Features originally considered included pathways, trails and lighting in area 1, through area 5; three viewing areas with seating, educational signs/kiosks, two cantilevered overlooks with fishing access, and two new docks. The cantilevered overlooks with fishing access and the two new docks were not consistent with facilities allowed for Federal participation, as defined in ER 1105-2-1100, and were removed from consideration.

Planning level costs for the remaining recreation features were estimated to be $709,014 at a

2017 price level. The estimates for these features were limited to standard designs consistent with the nature environment and surrounding area. The allowable cost shared recreation for this project is $593,826, of which the Corps share is $296,913, as shown in Table 7 and the estimated NFS cost is $412,101 ($296,913 cost share portion plus the excess of $115,118), as shown in Table 8. If the NFS choses to provide embellishments to the proposed features or implement the non-cost shared facilities the NFS must bear the full financial burden and ensure those features do not impact on the performance of the ecosystem restoration project. A summary of the planning level cost estimates for recreation features and the Federal and NFS costs are in Table 8. The proposed recreation features described in Section 2 are a sub-set of the recreation features for which the planning level costs were estimated. The detailed cost estimate for the proposed recreation features are described in Appendix H, *Total Project Costs and Baseline Construction Estimate*.

Table 8. Federal and Non Federal Costs for Allowed Recreation Features

Recreation Features	Allowed Facilities
Trails and Lighting in Areas 1 through 5	$ 461,161
Seating and Viewing in three locations	$ 182,376
Educational Kiosks at three locations	$ 65,477
Total Recreation Costs*	$ 709,014

Federal and Non-Federal Share	Costs
Allowable Federal Costs	$ 296,913
Non-Federal Sponsor Cost Share	$ 296,913
Non-Federal Sponsor Additional Costs	$ 115,118
Total Non-Federal Sponsor Costs	$ 412,101

* 2017 price levels

5 CONCLUSION

The cost-shared portion of the recreation cost, $593,826, is justified for the proposed recreation features at Clover Island. The Federal cost share for recreation is $293,913, with the remaining $293,913 the responsibility of the NFS. Any recreation cost in excess of $593,826 is the responsibility of the NFS. The recreation features will not degrade or diminish the environmental benefits of the project, and will provide the opportunity for visitors to view and interact with a unique island environment and the restored aquatic and riparian habitat on the Columbia River.

Clover Island Section 1135 Ecosystem Restoration

Kennewick, Washington

Clover Island Feasibility Report and Integrated Environmental Assessment

APPENDIX D, GEOTECHNICAL EVALUATION

Clover Island Section 1135 Ecosystem Restoration

Kennewick, Washington

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APPENDIX D, GEOTECHNICAL EVALUATION

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D.1 INTRODUCTION

This appendix summarizes results from prior geotechnical site investigations and reports performed for Clover Island. It also will discuss the soil conditions for each area in consideration for riparian restoration. Reports and studies used:

- McNary Levees Seismic Safety Review – Walla Walla District US Army Corps of Engineers, May 2001
- Geotechnical Investigation Report for Conceptual Design, Clover Island Shoreline Improvements Kennewick, WA – PBS Engineering + Environmental, October 2007

Since all studies utilized are recent, no investigations were performed for this study. Most conceptual design was based on the aforementioned reports and several site investigations made by the design charette team. If this project is approved to move in to the Design and Implementation Phase, prior geotechnical investigations will be adequate for design. They appear to characterize the island as a sand and gravel fill.

Figure D-1. Clover Island and Vicinity

However, some of the topographic and bathymetric data used in the development of the planning alternatives were from existing sources that pre-dated the study phase. To reduce uncertainty and minimize design risks, additional surveys for topography and bathometry will be conducted prior to the start of design.

Clover Island is located on the right bank of the Columbia River, in the City of Kennewick, at river mile 329 (Figure D-1).

Figure D-2. Site Location Map

D.2 SUBSURFACE CONDITIONS

The site is located within the stratigraphic horizon of the Ringold Formation and above the regional basalt bedrock of the Columbia River Basalt Group (PBS Engineering + Environmental, 2007).

The original or natural portion of Clover Island is composed of recent (post-Pleistocene) soil deposited by the Columbia River. In the region of the current island created by the 16-acrefill, the soil below the fill is composed of silty sand that was deposited under low-river velocity conditions. This original soil in turn, sits on top of the Ringold Formation. The Ringold Formation is composed of rounded boulders, cobble, and gravel with a matrix of fine to coarse sand. This gravel stratum is about 10 feet thick and sits on top of variable thickness layers of fluvial black sand of basaltic composition (PBS Environmental, 2007).

Based on the subsurface exploration and research performed by PBS Engineering + Environmental (PBS), there are four basic soil layers, or strata, in the vertical section at the island, including the following (from the surface downward):

- (0-11 feet deep) – Near surface fill of variable composition but primarily round pebble gravel and fine sand with a trace of cobble, and includes boulders, concrete, and other man-made fill materials.
- (11-20 feet deep) – Wet, silty sand alluvium that was recently deposited by the Columbia River and represents the original island sediment.
- (20-30 feet deep) – Round pebble gravel and cobble of the Ringold Formation.
- (30+ feet) – Dense, indurated mudstone of the lower Ringold Formation.

The basalt bedrock depth is undetermined according to all prior investigations.

Five test pits were dug by Culbert Construction for PBS on August 28, 2007. PBS characterized the soils using ASTM 2488-00, which is a visual-manual procedure, and laboratory tests, which included ASTM 422-63 (sieve analysis). The locations of these pits are shown in Figure D-3.

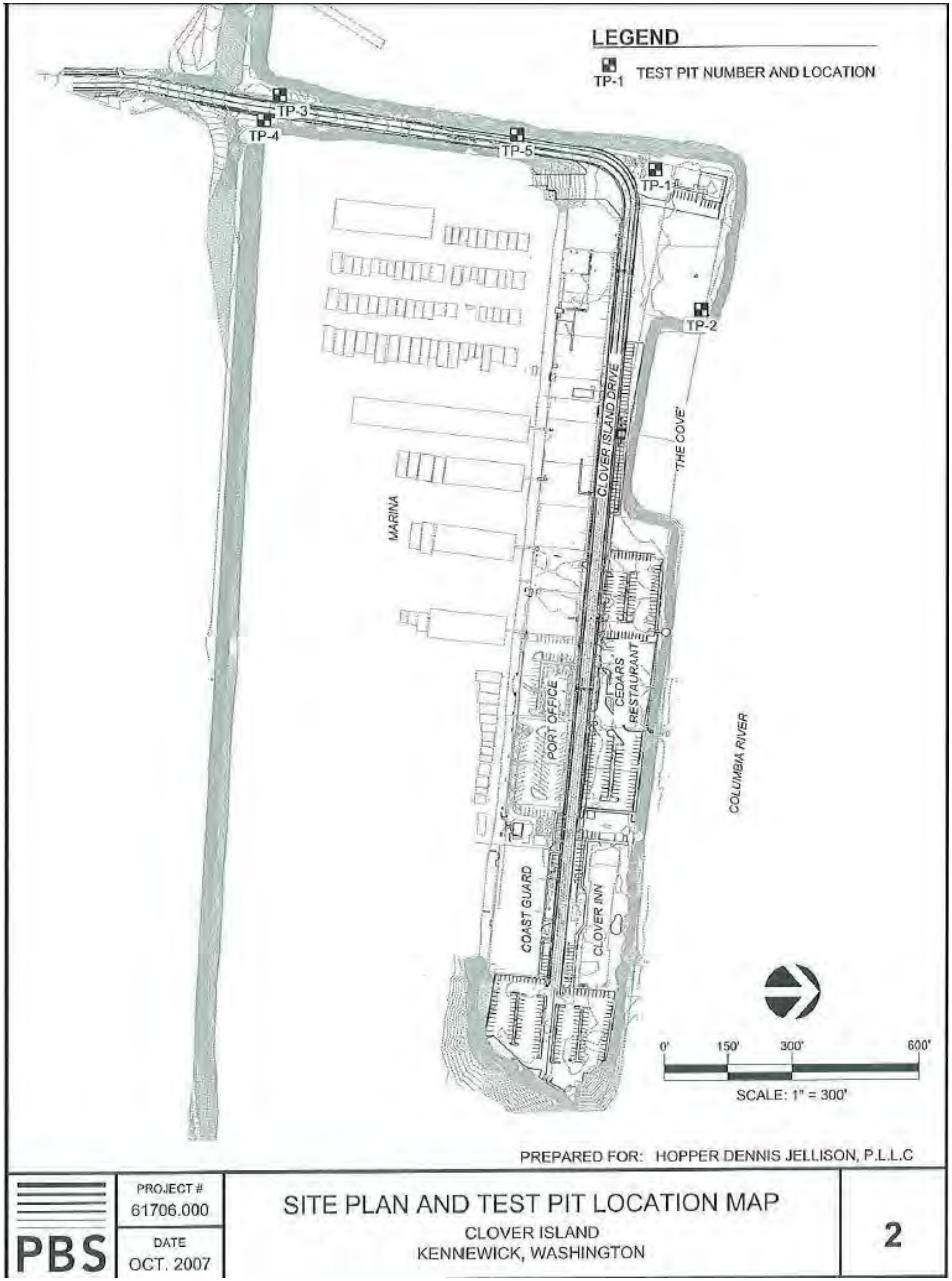


Figure D-3. Site Plan and Pit Location Map

For this design effort, only test pits TP-1 and TP 2 will be utilized, because TP-3 through TP-5 were located on an area that has already been improved by the Port of Kennewick.

D.3 DESIGN ANALYSIS

The objective of this project is to restore aquatic habitat and riparian plant communities along the shoreline of Clover Island. The area surrounding Clover Island is considered the reservoir for McNary Lock and Dam; therefore, most flows are controlled releases from the dam that do not vary much, and range between 80 thousand cubic feet per second (kcf) to 200 kcf. The thalweg is further out from the island, so the island itself experiences much slower velocities. The soil in this area consists of silt, sand, and gravel, which is susceptible to erosion. There is no known bedrock to anchor any type of stabilization effort.

Areas of the Island are identified in Figure D-4 and are summarized below.

Figure D-4. Areas of Habitat Restoration for Clover Island

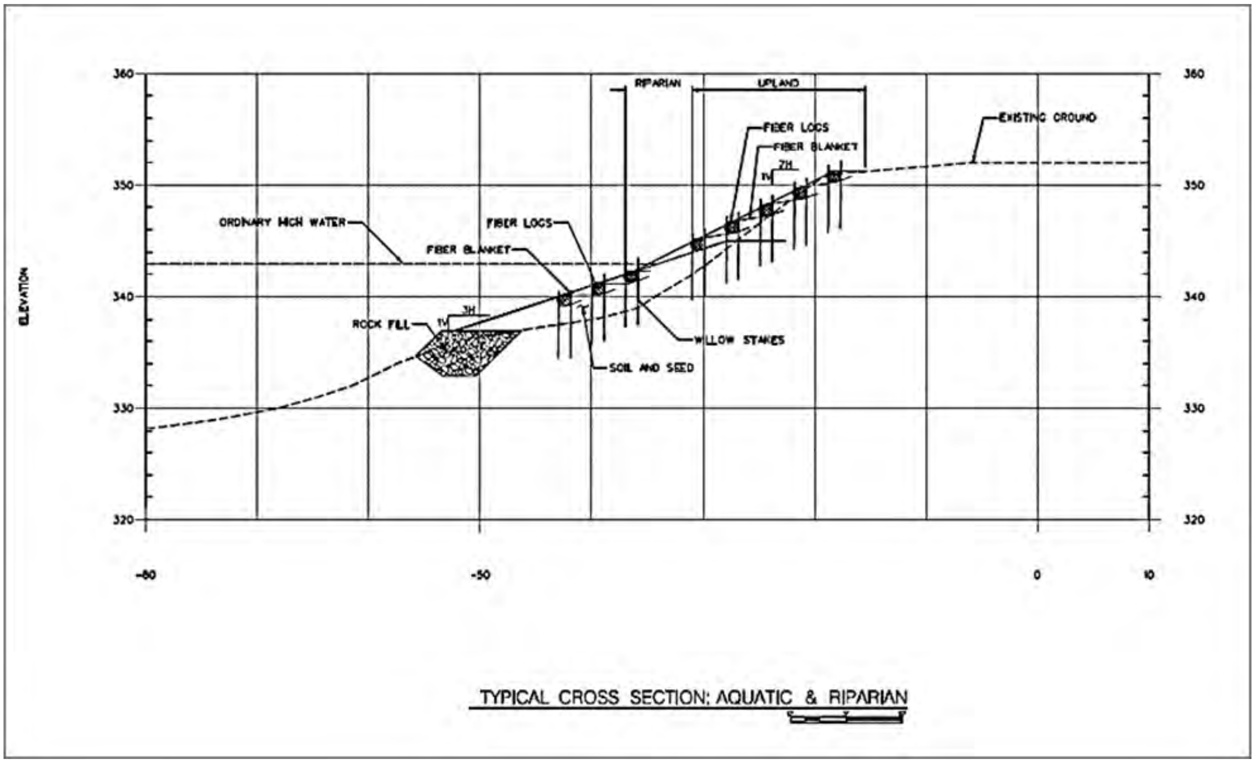
<u>Area 1</u> – Area 1 is located at the northwest corner has been covered in concrete spoils.

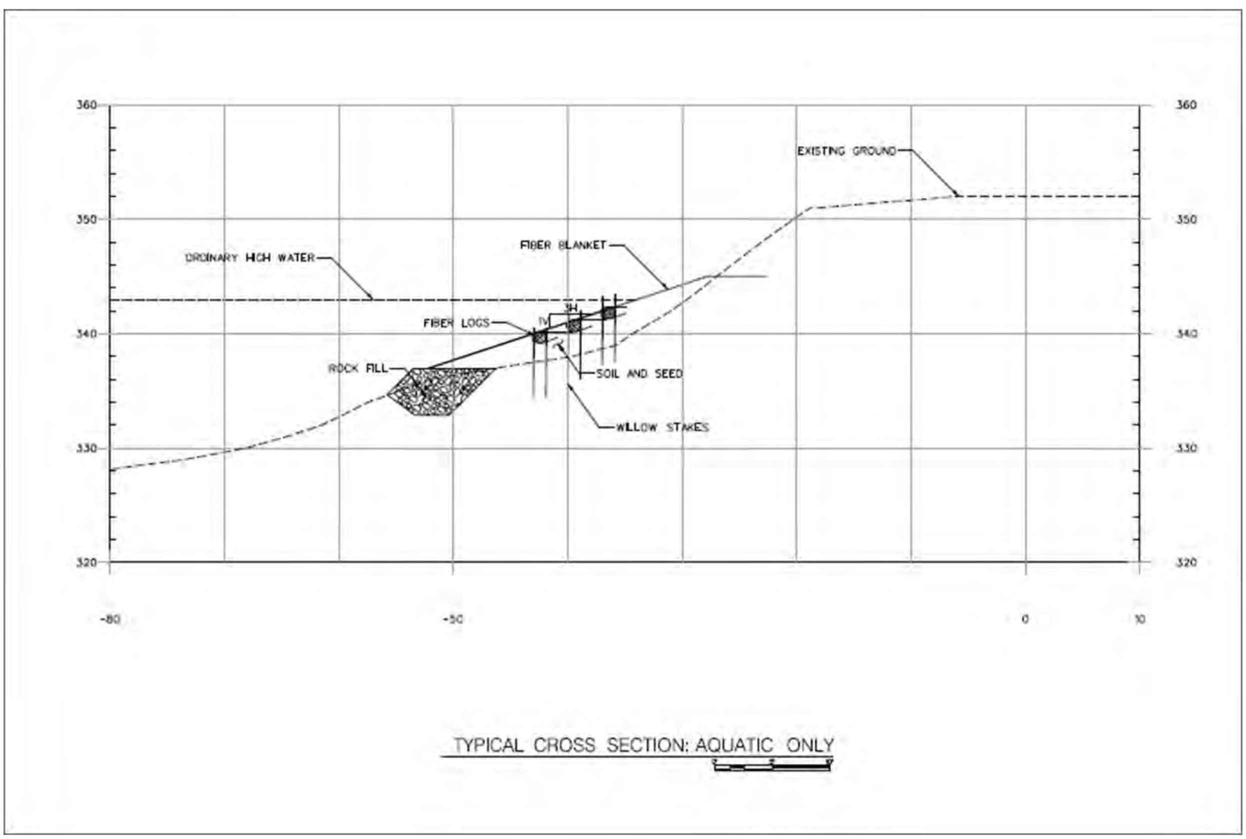
Area 1: Concrete spoils dumped at the northwest corner.

Area 1: North bank.

Although these concrete “caps” are stable and provide adequate bank protection from an engineering standpoint, they do not provide shallow water or riparian habitat for salmonids and other species. Due to these reasons, and to promote a solid root base for planting, this concrete will be removed. After the removal of the concrete, a solid base will be established to create a gentle slope for shallow water habitat back into the bank. Approximately 20-60 feet out from the ordinary high water line, a “choked rip rap” toe will be placed at the base of this new gradual slope. The slope will either be terraced with “biologs” and “biomats” or covered with a geotechnical fabric to retain fine material upslope from the rip rap. The rip rap size is estimated at 2 feet wide for preliminary discussion; however, the size may be adjusted during actual design.

Figure D-5 shows three typical conceptual cross sections for the aquatic only alternatives, the riparian only alternatives, and the combination of aquatic and riparian alternatives. These would apply to all areas and be implemented on the new contoured slope of Clover Island.


RIPARIAN
UPLAND
FIBER LOGS
FIBER BLANKET
EXISTING GROUND
ORDINARY HIGH WATER
FIBER LOGS
FIBER BLANKET
ROCK FILL
1V
3H
2H
WILLOW STAKES
SOIL AND SEED
ELEVATION
360
350
340
330
320
-80
-50
0
10
TYPICAL CROSS SECTION: AQUATIC & RIPARIAN


EXISTING GROUND
ORDINARY HIGH WATER
FIBER BLANKET
FIBER LOGS
ROCK FILL
SOIL AND SEED
WILLOW STAKES
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320
-80
-50
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TYPICAL CROSS SECTION: AQUATIC ONLY

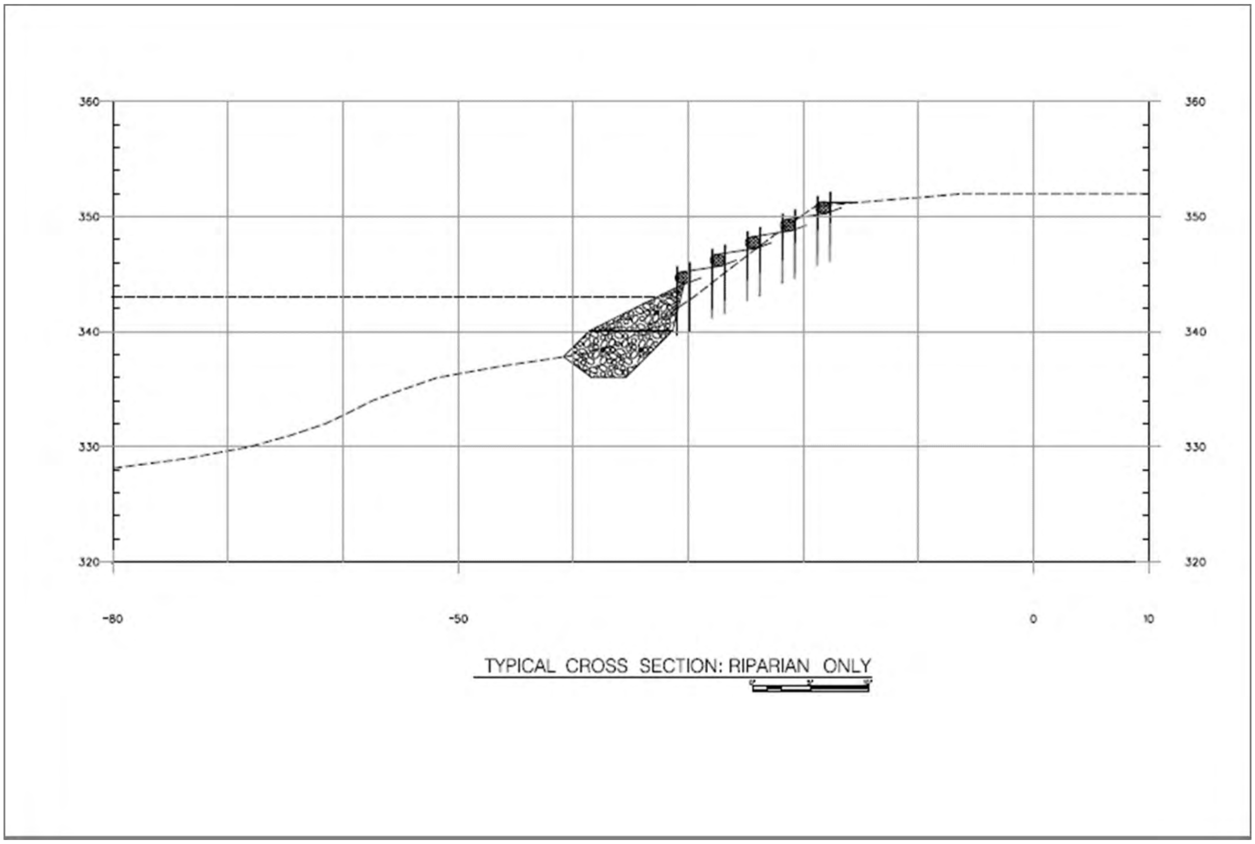


Figure D-5. Three Conceptual Cross Sections of New Contoured Slope of Clover Island

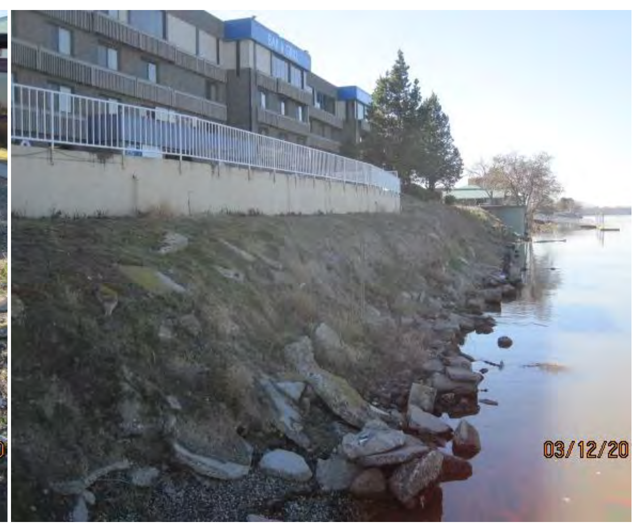
Area 2 (Notch/Cove) – This area is shallower than the rest of the island banks and is suspected to be an old area for the intake to the three Rainey wells that were installed but later abandoned on the island. Site observations indicate this area to be silts, sands, and gravels with more gradual slopes and some established vegetation. Area 2 will also be re-contoured with a "choked rip rap" toe as shown in Figure D-5.

Area 2: Facing northwest.

Area 1: Facing southeast.

Areas 3 and 4 – These areas have steeper slopes than Areas 1 and 2 and also have some concrete spoils within the banks. This area will need to be tested during design to confirm the actual depth of the concrete spoils. If the spoils go too far into the bank slope, then plantings and fill will need to go on top of the existing slope due to the locations of the restaurant on site 3 and the hotel pool on area 4. Removal of the fill may undermine the structures in these areas. Placing fill on top of concrete spoil is risky because the root base may not be able to take hold of the existing slope and provide the necessary slope stability.

Area 3: Facing east.



Area 4: Facing west.

Area 4: Facing southeast

Area 5 – This area is the least geotechnically stable and is already experiencing slope failure. Geotechnical investigations during design will be necessary to help identify the cause of this failure; however, it is suspected to be related to lack of bank armoring and wave action from boats coming out from the marina. The restoration in this area consists of re-contouring the bank with the methods presented in Figure D-5.

Area 5: Facing south.

Area 5: Southeast corner.

D.4 REFERENCES

Natural Resources Conservation Service, Web Soil Survey. September 15, 2015 http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

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Clover Island Feasibility Report and Integrated Environmental Assessment

APPENDIX E, Monitoring and Adaptive Management Plan

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APPENDIX E, Monitoring and Adaptive Management Plan

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SECTION 1 - INTRODUCTION

This appendix presents the feasibility level monitoring and adaptive management plan for the Clover Island Ecosystem Restoration. This plan identifies and describes the monitoring and adaptive management activities proposed for the Project and estimates associated costs and duration. This plan will be further developed in the pre-construction, engineering, and design (PED) phase as specific design details are made available.

1.1 Authority and Purpose

Section 2039 of the Water Resources Development Act (WRDA) of 2007, requires feasibility studies for ecosystem restoration to include a plan for monitoring the success of the ecosystem restoration. According to the WRDA 2007, "monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain project benefits." Section 2039 states that a contingency plan (adaptive management plan) should be developed for all ecosystem restoration projects.

This document lays out the monitoring and adaptive management requirements for the Clover Island Ecosystem Restoration project, and established success criteria and associated adaptive management triggers.

SECTION 2 - PROJECT ADAPTIVE MANAGEMENT PLANNING

The resulting adaptive management plan for the Clover Island Ecosystem Restoration describes and discusses whether adaptive management is needed in relation to the Tentatively Selected Plan (TSP) identified in the Feasibility Study. The plan also identifies how adaptive management would be conducted for the project and who would be responsible for this project specific adaptive management. The developed plan outlines how the results of the project-specific monitoring program would be used to adaptively manage the project, including specification of conditions that will define project success.

The primary intent of Adaptive Management Plan was to develop monitoring and adaptive management actions appropriate for the project's restoration goals and objectives. The specified management actions permit estimation of the adaptive management program costs and duration for the Project. This Section of the Adaptive Management Plan 1) Identifies the restoration goals and objectives identified for the

Project; and 2) Lists sources of uncertainty that would recommend the use of adaptive management for this Project.

Subsequent sections describe monitoring, assessment, and decision-making in support of adaptive management. The level of detail in this plan is based on currently available data and information developed during plan formulation as part of the feasibility study. Uncertainties remain concerning the exact Project features, monitoring elements, and adaptive management opportunities. Components of the monitoring and adaptive management plan, including costs, were similarly estimated using currently available information.

2.1 Project Goals, Objectives, and Restoration Measures

The Clover Island Ecosystem Restoration TSP is a unique project in that it will restore aquatic and riparian habitat in an off-levee location in Lake Wallula, impounded by McNary Dam, on the Middle Columbia River. The goal of the TSP is to restore long-term habitat and ecosystem functions. An effective monitoring program will determine if project outcomes are consistent with the original project planning objectives. The objectives for Clover Island are:

- Restore shallow aquatic habitat for foraging and resting ESA-listed juvenile salmonids
- Restore native riparian habitat and ecosystem function to support aquatic habitat

A plan formulation process was conducted to identify alternative plans that address the project planning objectives. Many alternatives (combinations of measures) were considered, evaluated, and screened to identify the recommended alternative that provided the greatest benefit to the project (see main report for details).

Alternative 1 is the TSP and includes the following key components:

- Existing concrete along the shoreline will be demolished and removed preparatory to the re-grading of banks.
- Shoreline will be re-graded to a 3-foot horizontal to1-foot vertical slope (3:1 ratio).
- Regraded areas will be stabilized with geotechnical textiles and fabrics, such as coir fiber logs and matting.
- A component of the regrading work will involve the construction of a shoreline toe that will stabilize the island’s banks and ensure that riparian plantings will stay in place.

- An aquatic bench consisting of the 3:1 slope will be created to provide optimal depth and substrate for rearing Endangered Species Act-listed salmon and steelhead.
- Once the shoreline regrading is completed, a multi-storied native riparian will be planted along the entire island shoreline slope that will restore plant biodiversity, migratory songbird habitat, and bank cover for juvenile salmonids and other aquatic species.
- An emergent wetland area will be created in an inlet area called “the notch” that will further contribute to biodiversity and provide aquatic and terrestrial food and cover sources.

The transitional structure between riparian and aquatic habitat provides an overall aquatic habitat benefit which is currently missing at Clover Island. This gap in the system has affected fish and wildlife species to include migratory songbirds, native fishes, and possibly furbearers. The restoration of the missing distinguishing characteristics provides overarching habitat at the ecosystem level.

2.2 Project Uncertainty and Risk

Scientific uncertainties and technological challenges are inherent with any ecosystem restoration project because available data and information about any project is never perfect or complete. Adaptive management provides a coherent process for making decisions in the face of uncertainty. Scientific uncertainties and technological challenges are inherent with any ecosystem restoration project.

Risk is defined as the probability of an undesirable consequence. In the context of ecosystem restoration, risk exists because there is uncertainty about realizing positive net benefits from implementing a project. The dominant risks associated with the TSP are the potential for undesirable ecological outcomes that could result from natural hazards or human actions. Potential risks include:

- Inadequate riparian vegetation cover and abundance of invasive and non-native species which inhibit native vegetation growth.
- Unpredictable changes to the riparian or the shallow water habitat could create favorable conditions for predatory species such as smallmouth bass in the aquatic habitat, and piscivorous birds in the riparian and upland habitat.
- Unpredictable flow regimes associated with stochastic events may alter restored shallow water habitat, or erode the graded shoreline.

Many risks can be avoided or minimized by proper design and correct seasonal timing for implementing the proposed measures associated with the recommended alternative. Nevertheless, uncertainty and an associated level of risk have potential to influence the project and compel the need for monitoring and adaptation. These risks will be considered and closely monitored to configure the appropriate adaptation approach.

2.3 Objectives Monitored

Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain project benefits. Monitoring of riparian habitat components utilized in the Yellow Warbler and Juvenile Salmonid Habitat Suitability Index model is appropriate for estimating project success and informing adaptive management of the riparian restoration. The following habitat factors will be monitored, as well as plant survival and percent non-native plants.

A. Total plant survival

B. Percent Hydrophytic Shrubs (Yellow Warbler model)

C. Percent Deciduous Shrub Canopy Cover (Yellow Warbler model)

D. Deciduous Shrub Canopy Height (Yellow Warbler model)

E. Percent Overall Canopy Cover (Yellow Warbler model)

F. Percent Bank Cover (Juvenile Salmonid model)

G. Percent non-native vegetation

These habitat factors and the specifics of HSI modeling are detailed in Appendix A, *Habitat Evaluation Models.* Monitoring is discussed in detail for each of the above factors in Section 3.

SECTION 3 - MONITORING, SUCCESS CRITERIA, ADAPTIVE MANAGEMENT TRIGGER AND ACTIONS

This section describes project potential adaptive management actions, success criteria, adaptive management triggers, and site monitoring.

3.1 Adaptive Management Process

Adaptive management redirects the restoration effort in the event that the system does not function or evolve as predicted. The adaptive management process consists of the following steps, which rely on monitoring.

Step 1. Monitor and assess progress of restoration.

Step 2. Identify potential adverse conditions impacting restoration progress.

Step 3. Identify if potential adverse conditions can or should be remedied.

Step 4. Implement the appropriate adaptive management action, as required.

Step 5. Replanting.

3.1.1 Monitoring

Post-construction monitoring is required to determine whether the project is achieving the success criteria and to support the adaptive management decision-making process. Monitoring is the responsibility of the local sponsor per requirements of Continuing Authorities Program projects.

The post-construction monitoring program is designed to track the initial development of the project area to determine if riparian habitat is developing as projected, and that any adverse impacts are within the expected ranges. Ten years of post-construction monitoring is anticipated.

A plant survey will be conducted in early summer of each year. Plant survival must be monitored and will consist of a consensus of all shrub and tree species planted. For habitat metrics, a minimum of 12 random points, 1 per approximately 300 linear feet of shoreline, will be assigned for sampling for the first monitoring season along the length of the shoreline. At each of the 12 random points, a second survey point will occur at the ordinary high water mark (OHWM) for habitat factor E, percent bank cover for juvenile salmonids, for a maximum of 24 points. The same points sampled in year 1 will be used for all future monitoring for successional comparisons.

At each point, surveyors will measure the following specific habitat factors with their associated methods within a plot with a 9.9-foot radius using the point latitude and longitude as the plot center, and photo document habitat conditions. Plot sizes and measurements for the habitat factors below were derived for this specific monitoring effort. Plot sizes and shrub canopy measurements are not standardized for forestry practices; however, they are appropriate for monitoring riparian growth as the plots will be compared to themselves over time. Standardizing sampling across years and surveys within these methods for this project is appropriate.

A. Total plant survival

Plant survival will be measured as the percentage survival from a census of all plants installed. Survival metrics are presented in Section 3.1.2.

B. Percent Hydrophytic Shrubs (Yellow Warbler model)

The percentage of hydrophytic shrubs will be estimated based on plant counts as the percentage of hydrophytes among all deciduous shrubs within the given sample area.

C. Percent Deciduous Shrub Canopy Cover (Yellow Warbler model)

The percent deciduous shrub canopy cover will be measured with a densiometer, 3.3 feet from the ground surface in approximately the middle of the plot. Densiometers are designed to measure canopy cover at chest height for trees, not shrubs. Therefore, measuring shrub crown cover closer to the ground surface at a standardized height is appropriate for deciduous plants that will reach a maximum height of ≤ fifteen feet. The surveyor should exclude cottonwood, or other tree canopy cover from this measurement as it is shrub-specific. This can be done by ignoring cover reflected in the densiometer from overhead trees, which can be identified by leaf shape and color.

D. Deciduous Shrub Canopy Height (Yellow Warbler model)

Deciduous shrub canopy height will be approximately measured directly with stadia rod, or with a graduated ruler the height estimated via trigonometric or geometric methods. See West (2009) for height estimation details. The shrub canopy height should be measured to the maximum height of the largest deciduous shrub species, excluding tree species such as cottonwood.

E. Percent Overall Canopy Cover (Yellow Warbler model)

The percent overall canopy cover will be measured with a densiometer at chest height, including all overhead cover.

F. Percent Bank Cover (Juvenile Salmonid model)

Percent bank cover will be measured observationally at the OHWM for each sample point. The measurement will entail an estimate of the percentage of complex overhanging root structures, undercut shoreline, and large woody debris within a 3.3-square-foot plot starting at and extending below the OHWM.

G. Percent Non-Native Vegetation

The percentage of noxious weeds and non-native vegetation, if too high within a given plot, may inhibit the establishment of native vegetation. Therefore, within each 9.9-foot radius plot, the percentage of non-native plants will be visually estimated and species documented for future treatment. Survey crews will use a global positioning system (GPS) to map locations of non-native species.

Following each monitoring effort, a report will be prepared that includes a summary of the findings for each of the above habitat factors, as well as the following:

- A table broken out by species planted showing the number of each species that died and the overall % survival.
- Maps of the island that show “hot zones” for high plant mortality and noxious weed abundance.
- A discussion of trends over time relative to invasive species presence and plant survival/mortality to identify if specific species need more attention or replacement with an alternative species.
- An appendix with raw data for each plot.
- Signs of plant disease, predation, or other disturbances.
- The percentage of invasive species. Exotic and invasive species may include any species on the state noxious weed list, or considered a noxious or problem weed by the Natural Resource Conservation Service, local conservation districts, or local weed control boards.
- Observation of wildlife, including non-desirable piscivorous nesting birds.

Monitoring reports shall be submitted to Port of Kennewick at years 1, 3, 5, and 10 post-planting. Monitoring reports shall be submitted by a qualified, professional biologist. The biologist must verify that the conditions of approval and provisions in the adaptive management plan have been satisfied.

3.1.2 Success Criteria

Success criteria were established as follows for the above five habitat factors based on expected growth within ten years, plant survival targets, and noxious weed control. Expected plant growth was used to estimate project benefits over time and provides an appropriate metric for success criteria. Success criteria are detailed below and summarized in Table 1.

A. Plant Survival

Generally, plants must survive at 90% annually for the first 5 years, then at 70% out to ten years. Trees such as cottonwood and alder must survive at 80% between 5 and 10 years.

B. Percent Hydrophytic Shrubs (Yellow Warbler model)

The planting design includes an estimated overall 50 percent hydrophytic shrubs. Therefore, 50 percent or greater hydrophytic shrubs reflects successful across years. Below 50 percent suggests a potential loss of plants.

C. Percent Deciduous Shrub Canopy Cover (Yellow Warbler model)

Percent deciduous shrub canopy cover is estimated to be approximately 25 percent overall at year 1, between 25 and 50 percent at year 3, up to 50 percent by year 5, and over 50% by year 10. Any percentage estimate within these ranges represents success. Shrub canopy cover below these respective ranges suggests a potential growth limiting factor such as a lack water or nutrition.

D. Deciduous Shrub Canopy Height (Yellow Warbler model)

Deciduous shrub canopy height is expected to reach 3.3 feet by year 1, between 3.3 feet and 6.6 feet by year 3, and greater than 6.6 feet by year 5 and year 10. Shrub canopy height below these respective measurements suggests a potential growth limiting factor such as a lack of water or nutrition.

E. Percent Overall Canopy Cover (Yellow Warbler model)

This factor is relative to canopy cover from larger [e.g., willows (*Salix* spp.), cottonwood (*Populus* spp.), chokecherry (*Prunus* spp.), and alder (*Alnus* spp.)], and is not intended or expected to reach a high percentage within the first five years, but should reach 20 percent by year 10. With the exception of losing a large number of trees, no deficiencies or remedies are anticipated for this habitat factor.

F. Percent Bank Cover (Juvenile Salmonid model)

Percent bank cover is expected be less than 10 percent in years 1 and 3, 10 percent in year 5, and 11-20 percent in year 10. If bank cover is less than 11 percent at year 10, additional cover remedy may be required.

G. Percent Non-Native Vegetation

Given the present condition at Clover Island, the percentage of non-native vegetation may be as high as 50% in the first year following ground disturbance. Following treatments, the percentage is expected to be below 30 percent at year 3, below 20 percent at year 5, and below 5 percent at year 10.

Table 1. Summary of Success Criteria for Post-Restoration Monitoring.

Metric	Criteria
Plant Survival	90 percent annually for 5 years (all plants) 70 percent annually years 6-10 (shrubs and herbaceous plants) 80 percent at year ten (trees)
Percent Hydrophytic Shrubs	50 percent or higher annually for 10 years
Percent Deciduous Shrub Canopy Cover	25 – 50 percent annually through year 5 >50 percent years 6 – 10
Deciduous Shrub Canopy Height	3.3 feet by year 1 3.3 – 6.6 feet by year 3 >6.6 feet by year 5 and beyond
Percent Overall Canopy Cover	Up to 20 Percent by year 10
Percent Bank Cover	10 percent by year 5 11 – 20 percent by year 10
Percent Non-Native Vegetation	≤50 percent in year 1 ≤30 Percent in year 3 ≤20 Percent in year 5 ≤5 percent in year 10

3.1.3 Adaptive Management Triggers and Actions

As a broader adaptive management action, noxious weed control will occur throughout the restored riparian to aid in plant establishment and dominance. Herbicide and physical control methods will be employed and adjusted to the appropriate level of effort throughout the life of the project.

If annual plant survival and noxious weed presence and success criteria are not met, action will need to be taken. If after a 5 year period the success criteria are not met for habitat factors, then adaptive management actions may be necessary. Such actions may be undertaken by the sponsors prior to the end of the five years, if deemed appropriate.

Plantings must have 90 percent survival, monitored annually, for the first 5 years after planting. After the first 5 years, survival must be maintained at 70 percent for shrubs and herbaceous plants, and 80 percent for trees out to year 10. Individual plants that die must be replaced in kind (i.e., replace a tree with a tree) with species from the list of approved species from the U.S. Army Corps of Engineers (Corps) and Washington Department of Fish and Wildlife (WDFW).

As part of the adaptive management process, the Port of Kennewick will assess the monitoring data to determine the reasons for not meeting the above criterion. Potential adaptive management response actions are presented in Table 2, and a preliminary planting list is provided in Table 3.

Table 2. Proposed Adaptive Management Actions for Riparian Plantings

Problem	Adaptive Management Actions
Site does not meet plant survivorship or cover requirements (covers all habitat metrics) 90% annually for 5 years (all plants) 70% annually for shrubs and herbaceous plants, 80% trees at 10 years.	• Evaluate reasons for mortality (e.g., poor soil conditions, insufficient moisture, incorrect planting, browsing by wildlife, vandalism). • Address cause for mortality and replant to exceed survivorship or cover requirements (Sponsor is responsible for replacing plant materials that die during the 10 year monitoring period). • Provide protective measures if appropriate. • Modify monitoring period, if necessary. • Replace dead plants with a different species if certain species are experiencing high mortality
Over-competition by invasive species, meaning more than 20% cover in the restoration area at year 5 (covers all habitat metrics).	• Evaluate predominant invasive species in the restoration areas. • Initiate invasive species control protocols appropriate to species type, conditions of infestation area (wetland or buffer), and level of infestation (e.g., herbicide application, mowing, etc.). • Various treatment methods to include herbicide, biological controls, and removal will be considered and implemented as appropriate.
Site meets plant survivorship, but not expected percent canopy cover or height (habitat metrics B, C, D)	• Evaluate reasons for poor plant performance (e.g., poor soil conditions, insufficient moisture, incorrect planting, browsing by wildlife, vandalism). • Address plant performance issues as appropriate through irrigation, fertilizer application, pruning, etc.
Site does not meet expected percent bank cover (habitat metric E)	• Evaluate reasons for improper bank cover (e.g. either too much or too little overhanging shrub and tree canopy or root structures. • Remove or add plants as appropriate in concert with the other riparian metrics. This will likely be the most difficult metric to manage.

Table 3. Preliminary Native Plant List for Clover Island Riparian Restoration.

Common Name	Scientific Name	Planting Zone*
Coyote Willow	*Salix exigua*	SI
MacKenzie Willow	*Salix prolixa*	SI
Creeping Spikerush	*Eleocharis palustris*	SI
Softstem Bullrush	*Schoenoplectus tabernaemontani*	SI
Broad-leaved Cattail	*Typha latifolia*	SI
Black Cottonwood	*Populus trichocarpa*	LT
Redosier Dogwood	*Cornus sericea*	LT
Woods Rose	*Rosa woodsii*	LT
Golden Currant	*Ribes aureum*	UT
Mockorange	*Philadelphus lewisii*	UT
Saskatoon Serviceberry	*Amelanchier ainifolia*	UT
Western Chokecherry	*Prunus virginiana*	UT
Gray Rabbitbrush	*Chrysothamnus viscidiflorus*	UT
Basin Big Sage	*Artemisia tridentata*	UT
Sandberg's Bluegrass	*Poa secunda (ssp. sandbergii)*	UT
Great Basin Wildrye	*Leymus cinereus*	UT
Sand Dropseed	*Sporobolus cryptandrus*	UT

*SI (seasonal inundation/riparian), LT (lower transition/mesic), UT (upper transition/mesic-xeric)

SECTION 4 - MONITORING AND ADAPTIVE MANAGEMENT COST ESTIMATE

The cost estimate for monitoring and adaptation of the Clover Island is based on the monitoring requirements and potential range of adaptive management measures described in Section 3. A summary of costs is presented in Table 4, and are cost shared between the Corps and the Port of Kennewick with 25% of the costs the responsibility of the Port.

Table 4. Cost Estimate for Monitoring and Adaptive Management

Monitoring Component	Estimated Cost per year	Assumptions
Riparian Planting Success	$8,000-$12,000	See section 2.1.4 for monitoring description. Monitoring includes vegetative survey, evaluation for invasive species, and observation of wildlife. Annual monitoring reports shall be submitted to Port of Kennewick 1, 3, 5, and 10 years after planting. Monitoring reports shall be submitted by a qualified professional biologist.
Invasive Plant Control	$6,000-$7,500 (cost does not include removal of invasive species)	See section 2.1.4 for monitoring description. Includes an annual inspection of project area for invasive plant species including estimates of infestation, and GPS mapping of infestation areas.
Cost per Year	$14,000-$19,500[1]	
5-year Monitoring Cost (assumes no escalation)	$70,000-$95,500	

[1]Based on rehabilitation of other restoration work, operation and maintenance costs are expected to be minimal once vegetation becomes established.

SECTION 5 - REFERENCES

West, P.M. 2009. Tree and forest measurement. Springer-Verlag, Berlin, Germany.

Clover Island Section 1135 Ecosystem Restoration

Kennewick, Washington

Clover Island Feasibility Report and Integrated Environmental Assessment

APPENDIX F, REAL ESTATE PLAN

To Be Released With Final Report

Clover Island Section 1135 Ecosystem Restoration

Kennewick, Washington

Clover Island Feasibility Report and Integrated Environmental Assessment

APPENDIX G, ENVIRONMENTAL COMPLIANCE

Clover Island Section 1135 Ecosystem Restoration

Kennewick, Washington

Clover Island Feasibility Report and Integrated Environmental Assessment

APPENDIX G, ENVIRONMENTAL COMPLIANCE

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G.1 ENVIRONMENTAL CONDITION OF THE PROPERTY REPORT

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CLOVER ISLAND ECOSYSTEM RESTORATION FEASIBILITY PROJECT, SECTION 1135

ENVIRONMENTAL CONDITION OF PROPERTY REPORT

U.S Army Corps of Engineers
Seattle District

September 2015

Prepared By
U.S. Army Corps of Engineers
Seattle District
Environmental Engineering & Technology Section

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ACRONYMS & ABBREVIATIONS

ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
ECP	Environmental Condition of Property
HTRW	Hazardous, Toxic or Radiologic Waste
REC	Recognized Environmental Conditions
U.S.	United States
USACE	United States Corps of Engineers

1.0 INTRODUCTION

1.1 Purpose

The purpose of conducting this Environmental Condition of Property Report (ECP) is to identify recognized environmental conditions (RECs) of the Clover Island property (the Property) in accordance with American Society for Testing and Materials (ASTM) International E1527-13. RECs means the presence or likely presence of any hazardous substances or petroleum products in, on, or at a property: (1) due to any release to the environment; (2) under conditions indicative of a release to the environment; or (3) under conditions that pose a material threat of a future release to the environment. De minimis conditions are not recognized environmental conditions.

The Property is a portion of Clover Island in Benton County, Washington (Figure 1-1). This ECP Report evaluates the potential for hazardous, toxic and radiological waste (HTRW) which could impact the Clover Island Ecosystem Restoration Project (the Project). The Project consists of development of riparian habitat within a narrowly defined area along the Clover Island shoreline (Figure 1-2).

Figure 1-1 General Location Map

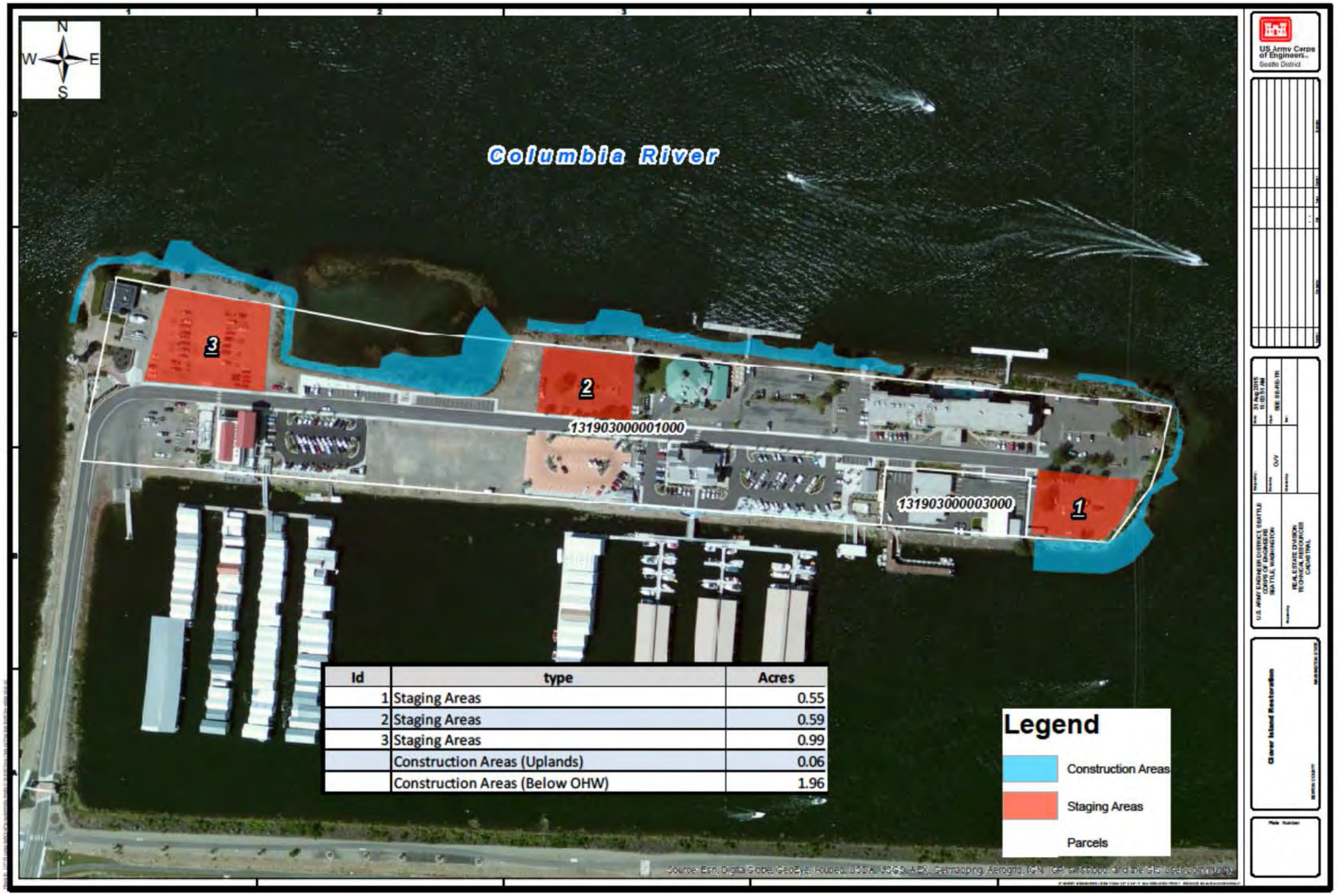

Figure 1-2 Clover Island Project Locations

1.2 Involved Parties

The Non-Federal Sponsor (NFS) for this project is the Port of Kennewick. The project sponsor entered into a Feasibility Cost Sharing Agreement (FCSA) with the U.S. Army Corps of Engineers, Seattle District on March 11, 2015 and is authorized by Section 1135 of the Water Resources Development Act of 1986 (Public Law 99-662).

1.3 Legal Description of the Property

Section 31, Township 9, Range 30, the portion of Section 31, Township- 9, range 30 defined as follows: Lot 6 (Catfish Island). Tax Lots 446C, 446B, 446D. Parcel ID 131903000001000

1.4 Scope of Work

The scope of work for this assessment is in accordance with ASTM E1527-13. The methodologies within this ASTM are utilized to identify RECs associated with a property and includes the following tasks:

- Conducting a record search and reviewing all reasonably attainable federal, state, and local government information and records to determine possible onsite sources of hazardous substances and environmental condition of the property.
- Reviewing of all reasonably attainable federal, state, and local government records of adjacent facilities that could have released or likely released contamination to determine possible offsite sources of hazardous substances.
- Analysis of historical data on prior uses of the property and the surrounding area.
- Interviews with the owner and/or tenants or other knowledgeable sources.
- Visual site inspection of the property to identify possible hazardous substance sources.
- Identification of contamination sources using data gathered and evaluation of risk they pose and the effect to the categorization of the environmental condition of the property.
- Identification of all ongoing actions that may affect the environmental conditions of the property.
- Determination of the environmental condition of the property.

These tasks were performed by Cathy Martin (see Appendix A).

2.0 SITE DESCRIPTION & PHYSICAL SETTING

2.1 General Location

Clover Island is located on the right bank of the Columbia River in the City of Kennewick at river mile 329 (Figure 2-1). It is located 15 miles downstream of the Hanford Reach, the last free flowing stretch of the Columbia River above Bonneville Dam that is a critical spawning area for Endangered Species Act listed salmonid species.

Figure 2-1Vicinity Map

2.2 Site Description

Clover Island is connected to the mainland by an approximately 650 foot causeway and is owned and operated by the Port of Kennewick (Figure 2-2). Clover Island has been used as a light industrial site since the 1950s and is currently a marina facility. The existing shoreline is encased in waste concrete in some locations. However, erosion is undercutting concrete surfaces (e.g. parking lots) and the concrete material previously used to stabilize the shoreline (Figures 2-3, 2-4). This has created habitat for warm water predator fish (e.g. bass) that prey on salmonid species. The proposed project area encompasses approximately half of the existing shoreline of the island, although the majority of the work is expected to occur on the north side (Figure 1-2).

Figure 2-2 Clover Island Map

Figure 2-3 Erosion of Shoreline Abutting Parking Lot

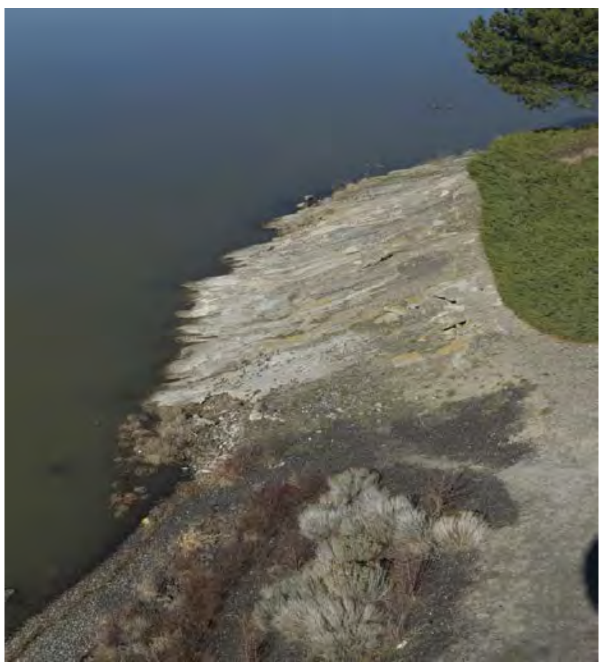

Figure 2-4 Shoreline with Waste Concrete Encasement

2.3 Regional and Site Geologic Setting

Typically geologic information is used to support the inclusion of HTRW findings. In accordance with ASTM E1527-13 (Section 12.2), this step has been omitted because no HTRW risk was identified in the records research in Section 3 or the site reconnaissance in Section 5 of this report.

2.4 Regional climate

Similar to Section 2.3, this step has been omitted from the report because no HTRW risk was identified.

2.5 Regional and Site Hydrogeology

Similar to Section 2.3 and Section 2.4, this step has been omitted from the report because no HTRW risk was identified.

2.6 Surface Water

The Columbia River runs adjacent to the Property on all sides.

3.0 ENVIRONMENTAL DATABASE REVIEW

3.1 Regulatory Agency Databases Records Search

A search of standard environmental records sources as defined in ASTM E-1527–13 was performed to identify RECs. Reviews of records related to the Property and nearby properties kept by both Federal and State regulatory agencies were conducted. This review was used to help identify known or potential sources of contamination that could adversely impact the property. The standard environmental records databases searched are listed below:

http://echo.epa.gov/?redirect=echo

https://fortress.wa.gov/ecy/tcpwebreporting/Report.aspx

The minimum radius was chosen based on the recommended distances in ASTM E-1527–13 (Section 8.2).

3.2 Known or Suspected Environmental Conditions

Database searches revealed two facilities with potential RECs identified within the search radii.

1) Twin City Metals
455 East Bruneau Ave
Kennewick, WA 99336

Soil contaminants above cleanup levels: Priority pollutant metals, petroleum products, polychlorinated biphenyls

2) Consolidated Freightways Kennewick
900 East Bruneau Ave
Kennewick, WA 99336

Soil and groundwater contaminants above cleanup levels: diesel

Twin City Metals is approximately 0.43 miles from the Property. However, it is located on the mainland. There is no physical pathway (other than airborne) by which soil contaminants at this facility could reach the Property in concentrations above a *de minimus* condition. Hence, there is no indication that the Clover Island Ecological Restoration Project would be impacted by Twin City Metals. There are no RECs for this facility.

Consolidated Freightways is approximately 0.47 miles from the Property. However, it is located on the mainland. The physical pathway by which diesel contaminants at this facility could reach the Property are through groundwater transport. However, due to the large volume of water present in the Columbia River, diesel concentrations could not be present above *de minimus* conditions on Clover Island. Hence, there is no indication that the Clover

Island Ecological Restoration Project would be impacted by Consolidated Freightways Kennewick. There are no RECs for this facility.

4.0 PROPERTY HISTORY

The Port of Kennewick purchased Clover Island in 1946. Prior to the construction of McNary Dam (1947-1954), Clover Island was a162-acre low floodway island (Figure 4-1). Due to its low elevation (i.e. below 340 feet elevation), the island was inundated with the construction of McNary dam. Prior to this occurring however, the highest portion of the original island was built up by both depositing dredged material from adjacent areas and importing material. Upon completion in 1953, the “new” island stood at an approximate elevation of 352 feet mean sea level, was 12 feet above the 340-foot ordinary high water elevation of the McNary pool and encompassed approximately 14.3 acres of land (Figures 4 & 5). During the 1960s, an additional 4.1 acres of land was added to the east end of Clover Island bringing the total current acreage to 18.4 acres. The dimensions of the present island are approximately 2200 feet long and 350 feet wide.

Clover Island is currently the home of Metz Marina and boat dock, a clubhouse for the Clover Island Yacht Club, and a U.S. Coast Guard Station, staffed by 13 servicemen. As of 2010, the Port of Kennewick started developing its Clover Island site, revitalizing the Clover Island Marina and building a new retail-office space.

Figure 4-1: “New” Clover Island Superimposed over Original Island (Image courtesy of Port of Kennewick)

5.0 ADJOINING PROPERTY

The upland area of Clover Island is partially developed with primarily commercial and government facilities including the Clover Island Yacht Club, Clover Island Marina, Port of Kennewick offices, Cedars Restaurant, Clover Island Inn, and a U.S. Coast Guard facility. A central asphalt paved road (Clover Island Drive) bisects the long axis of the island. Asphalt parking areas with concrete curbs, gutters, and sidewalks are associated with many of the island's facilities and the remaining island surface is primarily a dirt and gravel mix.

In a Geotechnical Investigation Report for Conceptual Design of Clover Island Shoreline Improvements, (PBS 2007), five test pits were dug in order to characterize subsurface soils. The locations of these test pits are shown in Figure 5-1. In test pit TP-3, pieces of broken concrete pipe were found. The concrete pipe was sampled and analyzed for asbestos content. It was found to contain approximately 25 percent asbestos. Asbestos content at this level requires handling in accordance with 29 CFR 1926.1101. This is a recognized environmental condition that only impacts the Clover Island Ecological Restoration Project if additional concrete pipe is uncovered during construction.

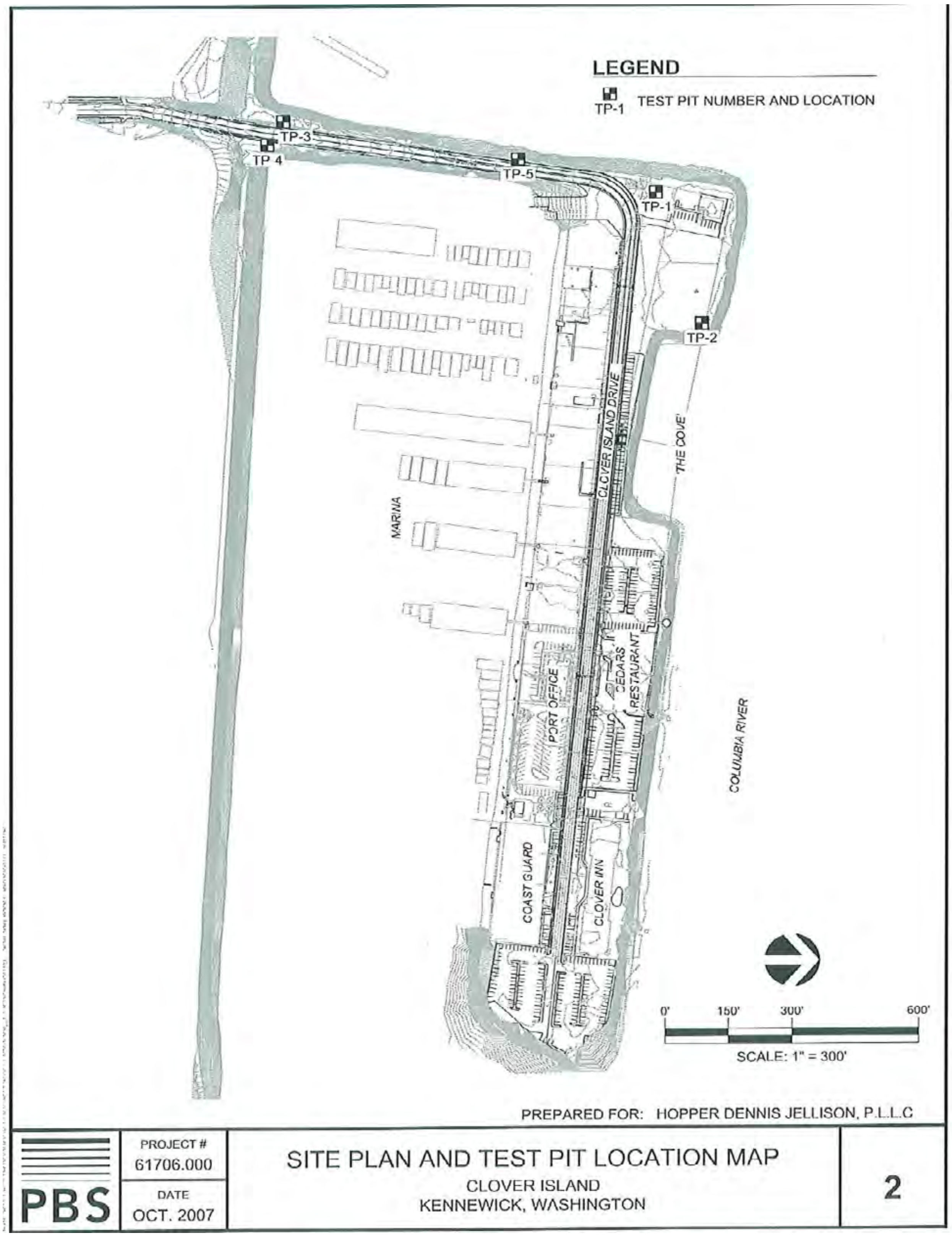

Figure 5-1 Test Pit Locations

6.0 RESULTS OF VISUAL RECONNAISSANCE

No visual reconnaissance was performed for this report.

7.0 INTERVIEW

USACE interviewed Mr. Larry Peterson, Director of Planning and Development for the Port of Kennewick. Mr. Peterson has been with the Port for over 11 years and was determined to have the most complete knowledge of conditions on the property. To the best of his knowledge, there are no RECs associated with the Property or adjoining properties. Mr. Peterson was interviewed and provided written responses to the Interview Questionnaire (Appendix B).

8.0 SUMMARY OF FINDINGS AND CONCLUSIONS

This ECP report was performed in accordance with ASTM Standard E1527-13. USACE concludes that RECs with potential for contaminant concentrations on Clover Island above *de minimus* conditions were not identified. However, based on evidence from the TP-3 excavation, there is the potential for asbestos cement to be present at other shoreline locations where improvements are planned. The ecological restoration contractor should be advised of this potential and operate in accordance with 29 CFR 1926.1101.

REFERENCES

ASTM International.2013. E 1527 - 13 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process

PBS Engineering and Environmental. 2007. Geotechnical Investigation Report for Conceptual Design, Clover Island Shoreline Improvements, Kennewick., Washington. 11 October 2007

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http://www.epa.gov/epawaste/inforesources/online/index.htm

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APPENDIX A

Assessor Resume and Qualifications

ASSESSOR'S PROFESSIONAL EXPERIENCE

Cathy Martin, Chemist

Education:

University of California at Davis, BS, Biochemistry 1982

Brief Summary of Relevant Experience:

Ms. Martin's career includes highly responsible positions in the private and public sector. She has served as a chemist for the U.S. Army Corps of Engineers since 1994.

As a senior Chemist for the Environmental Engineering and Technology Section, Ms. Martin serves as a specialist in the area of environmental chemistry for hazardous, toxic and radiological waste site, investigation, design, implementation and monitoring. Her primary responsibility is for sampling and analysis protocols, data quality management, and analytical laboratory and data validation services. She is also responsible for assessing project-specific data quality and data usability.

Related to her work as a chemist, Ms. Martin writes technical scopes of work, writes and reviews contract specifications, designs sampling processes, ensures project conformity to DOD, Federal, State and local regulations. Ms. Martin reviews Sampling and Analysis Plans and project reports for contractual and technical compliance, participates in technical planning, promotes the use of innovative technologies and audits sample collection activities. She enforces the utilization of the data quality objectives process and three phase quality control throughout the life of the project.

SIGNATURE & QUALIFICATIONS

I declare that, to the best of my professional knowledge and belief, I meet the definition of Environmental Professional as defined in 312.10 of 40 Code of Federal Register (CFR) 312 and the ASTM Standard.

I have the specific qualifications, based on education, training, and experience to asses a property of the nature, history, and setting of the Property. I have developed and performed the Phase I ESA in conformance with the ASTM and CERCLA standards and practices set forth in 40 CFR 312 and the ASTM standard.

PREPARED BY:

Electronically Signed By Ms. Cathy Martin on September, 11 2015

Cathy Martin
Chemist

APPENDIX B

Interview Questionnaire

ENVIRONMENTAL CONDITION OF PROPERTY
Interview Form

This form covers Purpose, Site Location, Current Use of Property and adjacent property, Historical Use of Property and Adjacent Property, User provided Information, Site Reconnaissance, and Records Search and Interviews. Specific Records Search and Interview information will be provided in sections 4.0 and 5.0. Pictures, Maps, Record and Interview information are appendices.

Project Name:	**DACW#:**	**Address/location:**
Clover Island Ecosystem Restoration	N/A	Port of Kennewick: 350 Clover Island Drive Kennewick, WA 99336

1.0 Purpose

This ECP report supports the Clover Island Ecosystem Restoration Project by determining recognized environmental conditions of property (RECs) in accordance with ASTM E1527-13.

2.0 Site Description

2.1 Property Legal Description and Site Address:

See ECP Report Section 1.3

Note: For the purpose of this form the "Property" is defined as the area undergoing ecological restoration. See ECP Figure 1-2.

2.2 Site and Vicinity General Characteristics:

See ECP Report Section 2.0

3.0 General Site Setting

Yes answers must be documented. Records and interviews must be documented.			
a. Current and Past use of Property:			
(1)(a) Is the property used for industrial use?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(1)(b) Is any adjoining property used for an industrial use? For the purposes of this inquiry, adjoining			

property is considered to be property located within a quarter mile of the subject property and individual properties located within a mile of the subject property that exhibit a potential for environmental concern.			
Record Search and/or Interview:	■ Yes	☐ No	☐ Unk
Observed during site visit:	■ Yes	☐ No	
(2)(a) Did you observe evidence or do you have any prior knowledge that the property has been used for an industrial use in the past?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(2)(b) Did you observe evidence or do you have any prior knowledge that any adjoining property has been used for an industrial use in the past?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(3)(a) Is the property used as a gasoline station, motor repair facility, dry cleaners, photo developing laboratory, junkyard, or landfill, or as a waste treatment, storage, disposal, processing, or recycling facility (if applicable, identify which)?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(3)(b) Is any adjoining property used as a gasoline station, motor repair facility, dry cleaners, photo developing laboratory, junkyard, or landfill, or as a waste treatment, storage, disposal, processing, or recycling facility (if applicable, identify which)?			
Record Search and/or Interview:	■ Yes	☐ No	☐ Unk
Observed during site visit:	■ Yes	☐ No	
(4)(a) Did you observe evidence or do you have any prior knowledge that the property has been used as a gasoline station, motor repair facility, dry cleaners, photo developing laboratory, junkyard, or landfill, or as a waste treatment, storage, disposal, processing, or recycling facility (if applicable, identify which)?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(4)(b) Did you observe evidence or do you have any prior knowledge that any adjoining property has been used as a gasoline station, motor repair facility, dry cleaners, photo developing laboratory, junkyard, or landfill, or as a waste treatment, storage, disposal, processing, or recycling facility (if applicable, identify which)?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
b. Specific Property Conditions/Exterior Observations			
(5)(a) Are there currently any damaged or discarded automotive or industrial batteries, pesticides, paints, or other chemicals, hazardous substances or petroleum products in individual containers of >5 gal (19 L) in volume or 50 gal (190 L) in the aggregate, stored on or used at the property or at the facility?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(5)(b) Did you observe evidence or do you have any prior knowledge that there have been previously any damaged or discarded automotive or industrial batteries, pesticides, paints, or other chemicals, hazardous substances or petroleum products in individual containers of >5 gal (19 L) in volume or 50 gal (190 L) in the aggregate, stored on or used at the property or at the facility?			

Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(6)(a) Are there currently any industrial drums (typically 55 gal (208 L)) or sacks of chemicals located on the property or facility?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(6)(b) Did you observe evidence or do you have any prior knowledge that there have been previously any industrial drums (typically 55 gal (208 L)) or sacks of chemicals located on the property or facility?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(7)(a) Did you observe evidence or do you have any prior knowledge that fill dirt has been brought onto the property that originated from a contaminated site?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(8)(a) Are there currently any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(8)(b) Did you observe evidence or do you have any prior knowledge that there have been previously, any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(9)(a) Is there currently any stained soil on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(9)(b) Did you observe evidence or do you have any prior knowledge that there have been previously, any stained soil on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(10)(a) Are there currently any registered or unregistered storage tanks (above or underground) located on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(10)(b) Did you observe evidence or do you have any prior knowledge that there have been previously, any registered or unregistered storage tanks (above or underground) located on the property?			
Record Search and/or Interview: See Section 3.11	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(11)(a) Are there currently any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(11)(b) Did you observe evidence or do you have any prior knowledge that there have been previously,			

any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(12)(a) Are there currently any strong, pungent, or noxious odors located on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(12)(b) Did you observe evidence or do you have any prior knowledge that there have been previously, any strong, pungent, or noxious odors located on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(13)(a) Are there currently any standing surface water, pools or sumps containing liquids likely to be hazardous substances or petroleum products, located on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(13)(b) Did you observe evidence or do you have any prior knowledge that there have been previously, any standing surface water, pools or sumps containing liquids likely to be hazardous substances or petroleum products located on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
c. Facility Conditions or Interior Observations			
(c.)(1) Are there facilities currently on site?	☒ Yes	☐ No	☐ Unk
(c.)(2) Is there evidence or prior knowledge of facilities previously on site?	☒ Yes	☐ No	☐ Unk
If answers (c.)(1) and (c.)(2) are No, than questions 14-16 are ☐ N/A			
(14)(a) Is there currently evidence of leaks, releases or staining by substances other than water, or foul odors, associated with any flooring, drains, walls, ceilings, or exposed grounds on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(14)(b) Did you observe evidence or do you have any prior knowledge that there have been previously any leaks, releases or staining by substances other than water, or foul odors, associated with any flooring, drains, walls, ceilings, or exposed grounds on the property, infrastructure Conditions			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
(15) Describe the means of heating and cooling the buildings on the property, including the fuel source for heating and cooling.			
Electric heat pump			
(16) Describe sumps or drains visually and/or physically observed or identified from the interviews that are present in the buildings on the property.			
None			
d. Infrastructure Conditions			
(17) Identify the source of potable water for the property.			

City of Kennewick municipal water system				
(18) Identify the sewage disposal for the property.				
City of Kennewick municipal sewer system				
(19)(a) If the property is served by a private well or non-public water system, is there evidence or do you have prior knowledge that contaminants have been have been identified in the well or system that exceed guidelines applicable to the water system?				
Record Search and/or Interview: N/A	☐ Yes	☐ No	☐ Unk	
Observed during site visit: N/A	☐ Yes	☐ No		
(19)(b) If the property is served by a private well or non-public water system is there evidence or do you have prior knowledge that the well has been designated as contaminated by any government environmental/health agency?				
Record Search and/or Interview: N/A	☐ Yes	☐ No	☐ Unk	
Observed during site visit: N/A	☐ Yes	☐ No		
(19)(c) Does the property discharge waste water (not including sanitary waste or storm water) onto or adjacent to the property and/or into a storm water system?				
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk	
Observed during site visit:	☐ Yes	☒ No		
(19)(d) Does the property discharge waste water (not including sanitary waste or storm water) onto or adjacent to the property and/or into a sanitary sewer system?				
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk	
Observed during site visit:	☐ Yes	☒ No		
(20)(a) Has there been a discharge of any substance or material from the property that might contaminate the public water system?				
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk	
Observed during site visit:	☐ Yes	☒ No		
(20)(b) Is the property known to be served by asbestos cement mains, lead containing lines, or piping that uses copper and/or lead solder?				
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk	
Observed during site visit:	☐ Yes	☒ No		
(21)(a) Is the property served by a private/nonpublic water system that has been found to be contaminated in excess of drinking water guidelines or otherwise contaminated?				
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk	
Observed during site visit:	☐ Yes	☒ No		
e. CERCLA and Related Liability				
(22) Is there any knowledge of environmental remediation orders or agreements applicable to the property or any facility located on the property?				
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk	
Observed during site visit:	☐ Yes	☒ No		
(23)(a) Is there information on the past existence of hazardous substances or petroleum products with respect to the property or any facility located on the property?				

Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(23)(b) Is there information on the current existence of hazardous substances or petroleum products with respect to the property or any facility located on the property?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(23)(c) Is there information on the past existence of environmental violations with respect to the property or any facility located on the property?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(23)(d) Is there information on the current existence of environmental violations with respect to the property or any facility located on the property?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(24) Is there any knowledge of any environmental site assessment of the property or facility that indicated the presence of hazardous substances or petroleum products on, or contamination of, the property or recommended further assessment of the property?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(25) Is there any knowledge of any past, threatened, or pending lawsuits or administrative proceedings concerning a release or threatened release of any hazardous substances or petroleum products involving the property by any owner or occupant of the property?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
(26) Is there any prior knowledge that any hazardous substances or petroleum products, unidentified waste materials, tires, automotive or industrial batteries, or any other waste materials have been dumped above grade, buried and or burned on the property?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	

3.1 TOXIC SUBSTANCES CONTROL ACT (TSCA):			
a. Is there a transformer, capacitor, or any hydraulic equipment known to contain or likely to contain polychlorinated biphenyls (PCBs) or any records indicating the presence of such?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	

3.2 ASBESTOS ABATEMENT AND INSPECTION:			
If no facilities then ☐ N/A			
a. Were any of the facilities located on the property constructed prior to 1980?			
Record Search and/or Interview:	■ Yes	☐ No	☐ Unk
Observed during site visit:	■ Yes	☐ No	
b. Have all facilities on the property been inspected by a certified asbestos abatement team?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	

c. Is there any documented evidence of asbestos (e.g., tests, surveys, management plan) in any of the facilities on the property?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
d. Has all friable asbestos on the property or within facilities on the property been removed or become subject to an Operation and Maintenance (O&M) program so that it does not create the potential for human exposure?			
Record Search and/or Interview:	☐ Yes	☐ No	■ Unk
Observed during site visit:	☐ Yes	☐ No	
e. Does the site survey of pre-1980 construction identify potential asbestos containing materials (e.g., boiler insulation, floor tiles, building siding, shingles, roofing felt, wall and ceiling insulation, acoustical ceiling tiles, window putty, fuse boxes, heat reflectors, air duct lining)?			
Record Search and/or Interview: N/A	☐ Yes	☐ No	☐ Unk
Observed during site visit: N/A	☐ Yes	☐ No	

3.3 LEAD-BASED PAINT ABATEMENT AND INSPECTION:			
If there were never structures then ☐ N/A			
a. Were any structures or facilities on the property constructed prior to 1979?			
Record Search and/or Interview:	■ Yes	☐ No	☐ Unk
Observed during site visit:	■ Yes	☐ No	
b. Has a screening test been conducted on the property for lead-based paint?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
c. Did the results of the screening tests identify lead-based paint?			
Record Search and/or Interview: N/A	☐ Yes	☐ No	☐ Unk
Observed during site visit: N/A	☐ Yes	☐ No	
d. Is any of the on-site paint peeling or chipped?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	

3.4 FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA):			
a. Are there or has there been any pesticides, fungicides, or herbicides used on the property?			
Record Search and/or Interview:	■ Yes	☐ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
b. In greater than household quantities?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
c. Applied not in accordance with the manufacturers recommendations?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
d. Are there or has there been any pesticides, fungicides, or herbicides stored onsite?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	

e. In greater than house-hold quantities?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
f. Have there been reports or evidence of a spill of any pesticides, fungicides, or herbicides on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	

3.5 MEDICAL/BIOHAZARDOUS WASTE:			
a. Has the property been used for chemical or biological testing?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
b. Has the property been used for burying medical or biohazardous waste?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	

3.6 MUNITIONS AND EXPLOSIVES OF CONCERN (MEC - i.e., military munitions that may pose unique explosives safety risks, including: (A) unexploded ordnance (UXO), as defined in 10 U.S.C. 2710(e)(9); (B) discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or (C) munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.)			
a. Have any citizen complaints or local law enforcement actions occurred regarding MEC on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
b. Has the site served as a small arms test range or otherwise to service weapons?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
c. Are any ranges, berms, open burning/open detonation (OB/OD), training, or impact areas onsite?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	

3.7 RADIOLOGICAL SUBSTANCES:			
a. Has the property ever been suspected to contain radioactive waste, including mixed waste?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
b. Have radiological substances ever been used or services provided on the property?			
Record Search and/or Interview:	☐ Yes	☒ No	☐ Unk
Observed during site visit:	☐ Yes	☒ No	
c. Has the property been surveyed for radon?			
Record Search and/or Interview:	☐ Yes	☐ No	☒ Unk
Observed during site visit:	☐ Yes	☐ No	
d. Did the radon survey indicate test results above 4 pCi/l (pico curies/liter)?			
Record Search and/or Interview: N/A	☐ Yes	☐ No	☐ Unk

Observed during site visit:	N/A	☐ Yes	☐ No	
e. If a radon survey has not been conducted does the vicinity exhibit radon above 4 pCi/l (pico curies/liter)?				
Record Search and/or Interview:	See Section 3.10	■ Yes	☐ No	☐ Unk
Observed during site visit:		☐ Yes	■ No	
f. Do records indicate that nearby structures have elevated indoor levels of radon?				
Record Search and/or Interview:		☐ Yes	☐ No	■ Unk
Observed during site visit:		☐ Yes	☐ No	

3.8 Clean Air Act				
a. Does the facility emit air pollutants into the environment?				
Record Search and/or Interview:		☐ Yes	■ No	☐ Unk
Observed during site visit:		☐ Yes	■ No	
b. Is the facility a type for which new standards of performance (NSPS) have been promulgated? See 40 C.F.R. Part 60 for a list of new source categories and applicable standards.				
Record Search and/or Interview:		☐ Yes	■ No	☐ Unk
Observed during site visit:		☐ Yes	■ No	
c. Is the facility in violation or has the facility been in violation of the NSPS or the permit?				
Record Search and/or Interview:	N/A	☐ Yes	☐ No	☐ Unk
Observed during site visit:	N/A	☐ Yes	☐ No	
d. Is the facility located in a nonattainment area?				
Record Search and/or Interview:		☐ Yes	■ No	☐ Unk
Observed during site visit:		☐ Yes	■ No	
e. Will the facility be subject to maximum attainable control technology (MACT)?				
Record Search and/or Interview:		☐ Yes	■ No	☐ Unk
Observed during site visit:		☐ Yes	■ No	
f. Is the capital expenditure required to meet the requirements of emissions reductions in the new Clean Air Act, i.e., is the facility required to reduce emissions because it is a non-attainment area?				
Record Search and/or Interview:		☐ Yes	■ No	☐ Unk
Observed during site visit:		☐ Yes	■ No	
g. Does the facility incinerate any wastes of any kind?				
Record Search and/or Interview:		☐ Yes	■ No	☐ Unk
Observed during site visit:		☐ Yes	■ No	

3.9 ADDITIONAL ISSUES:				
a. Does the property exhibit any stressed vegetation or diseased wildlife?				
Record Search and/or Interview:		☐ Yes	■ No	☐ Unk
Observed during site visit:		☐ Yes	■ No	
b. Does the property have erosion problems (i.e., gullies, arroyos, sediment loading during storms)?				
Record Search and/or Interview:		☐ Yes	■ No	☐ Unk
Observed during site visit:		☐ Yes	■ No	
c. Are there any floodplains or wetlands?				

Record Search and/or Interview:	■ Yes	☐ No	☐ Unk
Observed during site visit:	■ Yes	☐ No	
d. Are there any sinkholes?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
e. Are there any valuable mineral resources?			
Record Search and/or Interview:	☐ Yes	■ No	☐ Unk
Observed during site visit:	☐ Yes	■ No	
f. Is mold present in facilities on the property?			
Record Search and/or Interview:	☐ Yes	☐ No	■ Unk
Observed during site visit: N/A	☐ Yes	☐ No	

3.10 OTHER CONDITIONS:

Are there any other conditions that exist on the property that should be considered in the decision to outgrant? Describe.

3.7e) According to the Washington State Department of Ecology database (https://fortress.wa.gov/doh/wtn/WTNPortal/#!q0=428) for zip code 99336, a total of 96 test were performed annually with 9 (9.4%) being above 4 pCI/l .

3.11 ADDITIONAL COMMENTS:

Larry Peterson: Clover Island has avoided the industrial use cycle and all associated concerns and the following notes are intended to clarify questions answered with a Yes.
There are two above ground fuel storage tanks (10,000 gallons with secondary containment) utilized for marina fueling (18-40 foot boats) in the general vicinity/adjacent BUT not on the enhancement or staging areas.
There is a 2,500s/f office building constructed in 1969 (former Port admin. offices) which is in the general vicinity/adjacent BUT not on the enhancement or staging areas. No testing of this building has occurred.
A portion of the staging area at the NW end of the island served as the City of Kennewick's potable water intake pumping building during the mid-to late 1950's, but this building was removed and a few small slabs for the remain.
Industrial uses (grain elevator) are located approximately 1,000 feet SE of the island.

4.0 GOVERNMENT RECORDS/HISTORICAL RESOURCES INQUIRY

a. Do any of the following Federal Government record systems list the property or any property within the search distance noted below:

Federal Government Source	Approximate Minimum Search Distance, miles (kilometers)	Response	
Federal NPL site list	1.0 (1.6)	■ Yes	☐ No
Federal CERCLIS list	0.5 (0.8)	☐ Yes	■ No
Federal CERCLIS NFRAP site list	property and adjoining properties	☐ Yes	■ No
Federal RCRA CORRACTS TSD facilities list	1.0 (1.6)	☐ Yes	■ No
Federal RCRA non-CORRACTS TSD facilities list	0.5 (0.8)	☐ Yes	■ No
Federal RCRA generators list	property and adjoining properties	☐ Yes	■ No
Federal ERNS list	property only	☐ Yes	■ No

b. Do any of the following state record systems list the property or any property within the search distance noted below:

State lists of hazardous waste sites identified for investigation or remediation	Approximate Minimum Search Distance, miles (kilometers)	Response	
State – Equivalent NPL	1.0 (1.6)	■ Yes	☐ No

State – Equivalent CERCLIS	0.5 (0.8)	☐ Yes	☒ No
State landfill and/or solid waste disposal lists	0.5 (0.8)	☐ Yes	☒ No
State leaking UST lists	0.5 (0.8)	☒ Yes	☐ No
State registered UST lists	property and adjoining properties	☐ Yes	☒ No
c. Based upon a review of fire insurance maps or consultation with the local fire department serving the property, are any buildings or other improvements on the property or on any adjoining property identified as having been used for industrial use or uses likely to lead to contamination of the property? Please state remarks below.		☐ Yes	☒ No
Remarks:			

5.0 Interviews		
	Name	Position
1	Larry Peterson	Director of Planning and Development, Port of Kennewick
2		
3		
4		
5		
6		

6.0 Records	
1	
2	
3	
4	
5	
6	

7.0 We have performed a Phase I Environmental Site Assessment in conformance with the scope and limitations of ASTM Practice E 1527 of Clover Island Ecological Restoration the property. Any exceptions to, or deletions from this practice are described in Section N/A of this report. This assessment has revealed no evidence of recognized environmental conditions in connection with the property.

Environmental Professional (Print) Cathy Martin	
Environmental Professional's Signature Electronically Signed by Cathy Martin	Date 10 September 2015

8.0 CERTIFICATIONS:
15.a. The Environmental Professional Completing this report:
Name: Cathy Martin
Title: Chemist
Organization: U.S. Army Corps of Engineers, Seattle District
Address: 4735 East Marginal Way South
Phone number: 206-764-3264
Date: 10 September 2015
Qualifications: BS Biochemistry/Environmental Toxicology, University of Calif. at Davis with I have over 20 years of environmental experience.

	"[I, We] declare that, to the best of [my our] professional knowledge and belief, [I, we] meet the definition of Environmental professional as defined in 312.10 of 40 CFR 312 and [I, We] have the specific qualifications based on education, training, and experience to assess a property of the nature, history and setting of the subject property. [I, We] have developed and performed the all appropriate inquiries in conformance with the standards and practices set forth in 40 CFR Part 312."

9.0 RECOMMENDATION:
■ I recommend that the proposed real estate outgrant be approved and that the action proceed.
☐ I do not recommend that the proposed real estate outgrant be approved and recommend that no further review and processing be done.

OPM/ECC Signature	Date

Appendix A
Aerial Photographs

Aerial Photo Date	Flight Date	Source	Item or Feature Observed

G.2 FEDERAL NATURAL RESOURCES LAW COMPLIANCE AND BIOLOGICAL ASSESSMENT

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DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
WALLA WALLA, WA 99362-1876

May 5, 2017

Planning, Programs, and Project (1165-2-26a)
Management Division

SUBJECT: Clover Island Ecosystem Restoration - Biological Assessment – Corps Ref # PM-EC-2014-0059

Mr. Steve Landino
NOAA Fisheries
510 Desmond Drive
Suite 103
Lacey, WA 98503

Dear Mr. Landino:

Pursuant to Section 7(c) of the Endangered Species Act, we request your review and formal consultation on proposed ecosystem restoration project at Clover Island in Kennewick, WA. The purpose of this project is to restore riparian and shallow water rearing habitat along the island shoreline. We have enclosed our biological assessment pertaining to the action. Work is scheduled to occur September 1, 2018 through February 28, 2019.

We determined the proposed action "*may affect, likely to adversely affect*" Middle and Upper Columbia River steelhead, "*may affect, not likely to adversely affect*" spring Chinook salmon, "*may affect*" these species' designated critical habitat, and will "*adversely modify*" Chinook salmon Essential Fish Habitat. These determinations are based on effects that would be caused by the proposed action. Work would occur below the ordinary high water mark to create suitable depth and substrate for juvenile salmonid rearing. Adult and juvenile salmon and steelhead may occur in the action area during the work window. Fish exclusion and relocation measures would be taken prior to working below the ordinary high water mark.

We have provided an electronic copy of this request to Mr. Jody Walters of your staff. If you have any questions or would like additional information about the proposed action, please contact Mr. Brad Trumbo at 509-527-7253 or bradly.a.trumbo@usace.army.mil.

Sincerely,

Michael S. Francis
Chief, Environmental Compliance Section

Enclosure

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
WALLA WALLA, WA 99362-1876

May 5, 2017

Planning, Programs, and Project (1165-2-26a)
Management Division

SUBJECT: Clover Island Ecosystem Restoration - Biological Assessment – USFWS Ref # 01EWFW00-2017-SLI-0658; Corps Ref # PM-EC-2014-0059

Mr. Jeff Krupka
U.S. Fish and Wildlife Service
Central Washington Field Office
215 Melody Lane, Suite 103
Wenatchee, WA 98801

Dear Mr. Krupka:

Pursuant to Section 7(c) of the Endangered Species Act, we request your review and informal consultation on the proposed Clover Island ecosystem restoration, Kennewick, WA. We have enclosed our biological assessment pertaining to the action. Work is scheduled to occur September 1, 2018 through February 28, 2019.

We determined the proposed action *"may affect, not likely to adversely affect"* bull trout and their designated critical habitat. This determination is based on effects that would be caused by the proposed action. Work would occur below the ordinary high water mark to create suitable depth and substrate for juvenile salmonid rearing. Adult bull trout may occur in the action area during the proposed work window. Fish exclusion and relocation measures would be taken prior to working below the ordinary high water mark. The Corps has also determined there would be *"no effect"* on the yellow-billed cuckoo.

We have provided an electronic copy of this request to Mr. Robert Haltner of your staff. If you have any questions or would like additional information about the proposed action, please contact Mr. Brad Trumbo at 509-527-7253 or bradly.a.trumbo@usace.army.mil.

Sincerely,

Michael S. Francis
Chief, Environmental Compliance Section

Enclosure

US Army Corps of Engineers ®
Walla Walla District
BUILDING STRONG®

CLOVER ISLAND ECOSYSTEM RESTORATION

KENNEWICK, WASHINGTON

Federal Natural Resources Law Compliance
and
Biological Assessment

ADMINISTRATIVE RECORD – DO NOT DESTROY

FILE NUMBER: PM-EC-2014-0059

May 2017

SUMMARY

This biological assessment (BA) was prepared pursuant to section 7(a)(2) of the Endangered Species Act (ESA) to evaluate the effects of restoring the Clover Island shoreline to a native riparian on listed species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS).

The Corps determined that the proposed activities are “Likely to Adversely Affect” Middle and Upper Columbia River steelhead, and “May Affect, Not Likely to Adversely Affect” Upper Columbia River spring Chinook salmon and Columbia Basin bull trout. The Corps determined that the proposed activities “May Affect” these species’ critical habitat in the project area, and formal consultation is required. The Corps further determined that the project would have “No Effect” on yellow-billed cuckoo. In addition, this document analyzes the project's likely effects on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Finally, the Corps determined that the proposed project would result in no take of species listed under the Migratory Bird Treaty Act (MBTA), and no disturbance or take under the Bald and Golden Eagle Protection Act (BGEPA).

If additional information regarding this document is required, please contact Brad Trumbo, Biologist in the Environmental Compliance Section of the U.S. Army Corps of Engineers, Walla Walla District, at (509) 527-7253, or by email at bradly.a.trumbo@usace.army.mil. Other correspondence can be mailed to:

Brad Trumbo
U.S. Army Corps of Engineers Walla Walla District
201 North Third Ave.
Walla Walla, WA 99362

Electronically Signed By Mr. Brad Trumbo, USACE on May 4, 2017

Brad Trumbo
Biologist/Preparer
U.S. Army Corps of Engineers
Walla Walla District
Environmental Compliance Section

Electronically Signed By Ms. Kristen Shacochis-Brown, USACE on May 4, 2017

Kristen Shacochis-Brown
Biologist/Reviewer
U.S. Army Corps of Engineers
Walla Walla District
Environmental Compliance Section

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APPENDIX A – MONITORING AND ADAPTIVE MANAGEMENT PLAN

ACRONYMS

BA	Biological Assessment
BO	Biological Opinion
BGEPA	Bald and Golden Eagle Protection Act
CFR	Code of Federal Regulations
Corps	Walla Walla District, U.S. Army Corps of Engineers
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act of 1973, as amended
FCRPS	Federal Columbia River Power System
FR	Federal Register
FWCA	Fish and Wildlife Coordination Act
HUC	Hydrologic Unit Code
MBTA	Migratory Bird Treaty Act
MPI	Matrix of Pathways and Indicators
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Marine Fisheries Service
OHWM	Ordinary High Water Mark
PCE	Primary Constituent Element
PL	Public Law
UCR	Upper Columbia River
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
WRDA	Water Resource Development Act

1. Federal Action

1.1 Introduction

The U.S. Army Corps of Engineers, Walla Walla District (Corps), proposes to restore the riparian and shallow water habitat at Clover Island in the Columbia River, Kennewick, WA (Figure 1). Clover Island was originally approximately 162 acres in size (Figure 2), but was inundated by Lake Wallula concluding the construction of McNary Dam in 1957. Prior to inundation, the Corps allowed the Port of Kennewick to place fill material and push material from the lower areas of the original island footprint to a higher elevation on the island, thus creating the current configuration (Figure 3). The configuration of the island post-construction has not substantially changed over 60 years to the present day.

Figure 1. Location of Clover Island, Kennewick, WA.

Figure 2. Clover Island prior to the completion of McNary Dam in 1957. The island was approximately 162 acres in size.

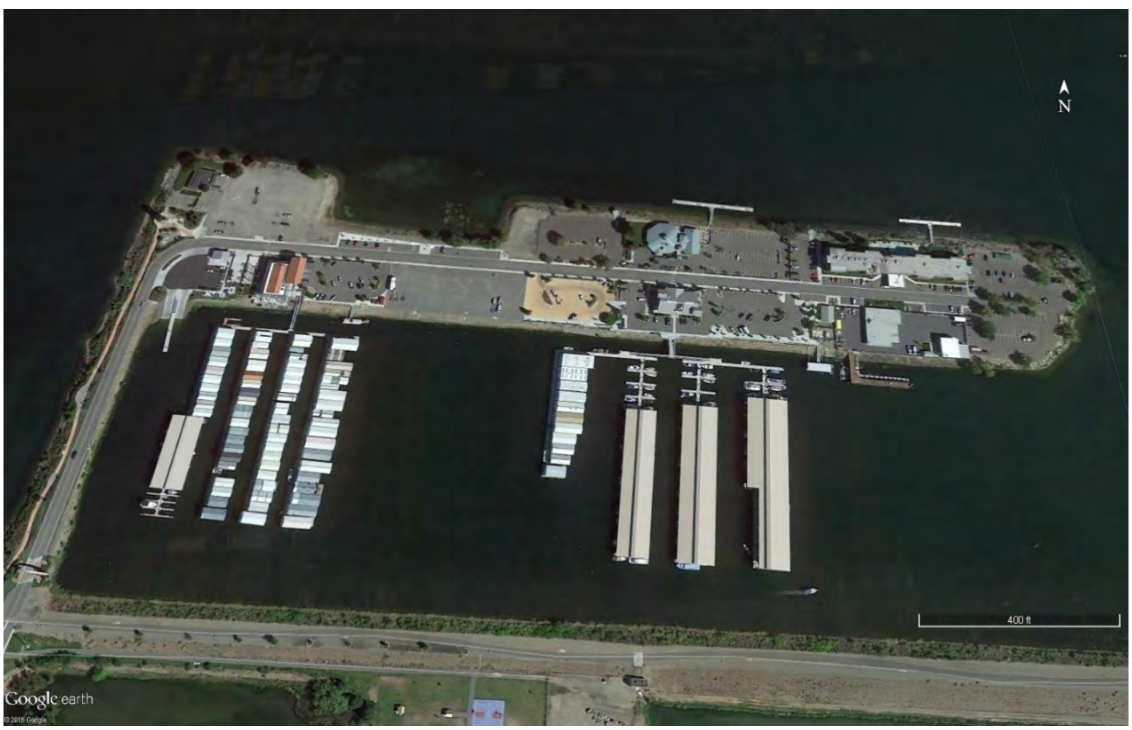

Figure 3. Present-day Clover Island is approximately 16 acres in size and is commercially developed.

The current shoreline is characterized by steep, eroding or concrete-covered slopes with little or no native riparian plant communities (Figure 4). Because of the lack of riparian habitat, the operational fluctuations in the McNary pool continues to undercut concrete material that had been used to stabilize the shoreline. Clover Island generally has no riparian habitat available to provide shade or forage for migrating juvenile salmonids, and no refugia from predator fishes [e.g., smallmouth bass (*Micropterus dolomieu*) and northern pikeminnow (*Ptychocheilus oregonensis*)]. To improve aesthetics and habitat, the western causeway shoreline riparian and shallow water habitat was restored in the winter of 2010 – 2011.

Figure 4. Examples of the present Clover Island shoreline exhibiting little to no riparian vegetation, steep, crumbling banks, and various concrete slabs and pours.

In 2014, the Corps kicked off a feasibility study where constraints and restoration measures were developed that, when combined, created eleven restoration alternatives. This project would implement the selected alternative under the authority of the Continuing Authorities Program (CAP) authorized by the Water Resources Development Act (WRDA) of 1986 [Public Law (PL) 99-662], Section 1135, as amended by WRDA 1996, Section 204 (PL 104-303), and codified at 33 United States Code (USC) § 2309 for Project Modifications for Improvement of the Environment. This authority allows the Corps to study and implement ecosystem restoration where an authorized Corps project has impacted natural resources.

Under CAP, the Corps does not select restoration projects, rather the public identifies a problem created by a Corps project and a non-federal sponsor cost-shares a feasibility study at 50%, and up to 35% of the subsequent design and restoration effort. The Port of Kennewick identified the degraded habitat condition at Clover Island and is the sponsor for this project. Clover Island poses an important restoration site relative to the overall habitat loss in Lake Wallula and its proximity downstream of the Yakima River delta.

Habitat loss has been identified as one of the limiting factors for ESA-listed salmonids and is specifically called out in the *Middle Columbia River Distinct Population Segment ESA Recovery Plan* (NMFS 2009) and the *Yakima Steelhead Recovery Plan* (YBFWRB 2009). Short and long-term habitat objectives were identified in the *Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan* (UCSRB 2007). The proposed action would restore juvenile salmon and steelhead migration habitat at Clover Island which would support each of these recovery plans, including the following specific objectives identified by the UCSRB (2007).

- Protect and restore riparian habitat along spawning and rearing streams and identify long-term opportunities for riparian habitat enhancement.
- Maintain connectivity through the range of the listed species where feasible and practical.

This biological assessment (BA) was prepared pursuant to section 7(a)(2) of the Endangered Species Act (ESA) to evaluate the effects of the restoration action [primarily excavation, riprap placement, and fill below the ordinary high water mark (OHWM)], on ESA-listed species and their critical habitats under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), collectively referred to as the “Services”.

1.2 Previous Consultation

In 2009, the Corps Seattle District, Regulatory Branch consulted with the Services on the original restoration design and construction which encompassed the entire island. In September, 2009, a letter of Concurrence was received from the USFWS on a determination of “May Affect, Not Likely to Adversely Affect” bull trout or their critical habitat. In July, 2010, NMFS issued the Corps a “not likely to jeopardize” biological opinion for ESA-listed Upper and Middle Columbia River steelhead with an Incidental Take Statement of 123 juvenile steelhead. NMFS concurred on the Corps determination of “May Affect, Not Likely to Adversely Affect” for Upper Columbia River spring Chinook salmon, and critical habitat for salmon and steelhead. While the Corps consulted with the Services for the 2010 restoration action, the action was funded by the Port of Kennewick and the restoration project is not a Federal project.

With the beginning of the Corps restoration feasibility study in 2014, the Corps began periodic progress updates and consultation discussions with the Services. Unlike the 2010 restoration, the proposed action would remain a Federal project due to Federal cost-share, although the Port of Kennewick owns the property. A separate consultation is required for the proposed action, but information from the NMFS 2010 biological opinion is still relevant.

1.3 Proposed Action

The proposed action would create a shallow water "bench" below the Ordinary High Water Mark (OHWM), reduce the slope of the streambank around Clover Island, and restore native riparian habitat. Poured and chunk concrete that cover the shoreline, and instream habitat in some areas, would be removed. A trench would be made around the shoreline below the OHWM and riprap would be placed in the trench. Gravel and cobble material would be placed to choke the riprap to eliminate interstitial spaces beneficial to predator fishes. A turbidity curtain would be placed around the shoreline excavation area to contain any sediment dislodged during shoreline toe construction and subsequent filling.

Fill material would be placed against the toe and sloped up to meet the streambank at a 3-foot-horizontal to 1-foot-vertical (3:1) slope, restoring depth and substrate suitable for juvenile salmonid rearing. The shallow water bench would tie into the streambank above the OHWM to reduce risk of erosion during high flow events. At minimum, approximately 1.67 acres of shallow water rearing habitat would be restored.

The streambank would be re-sloped to meet the shallow water bench at the 3:1 slope. A native riparian restoration would be planted including emergent wetland plants in the inlet area of the island near the northwest corner (Figure 3), hydrophytic shrubs along the shoreline, and other native mesic and xeric species as elevation increases up the slope. Approximately 1.28 acres of native riparian habitat would be restored.

Finally, recreation aspects such as new trails and lighting would be placed along the top of the slope where the restoration project ends. Figure 5 provides an example drawing of the choked riprap toe installation and fill to create the shallow water bench and streambank slope. Figure 6 illustrates a rough example of the shallow water bench, wetland, and shoreline restoration areas. Figure 7 illustrates the conceptual final, established planting. The project would require fish removal from between the shoreline and the turbidity curtain via seine nets, and potentially electrofishing.

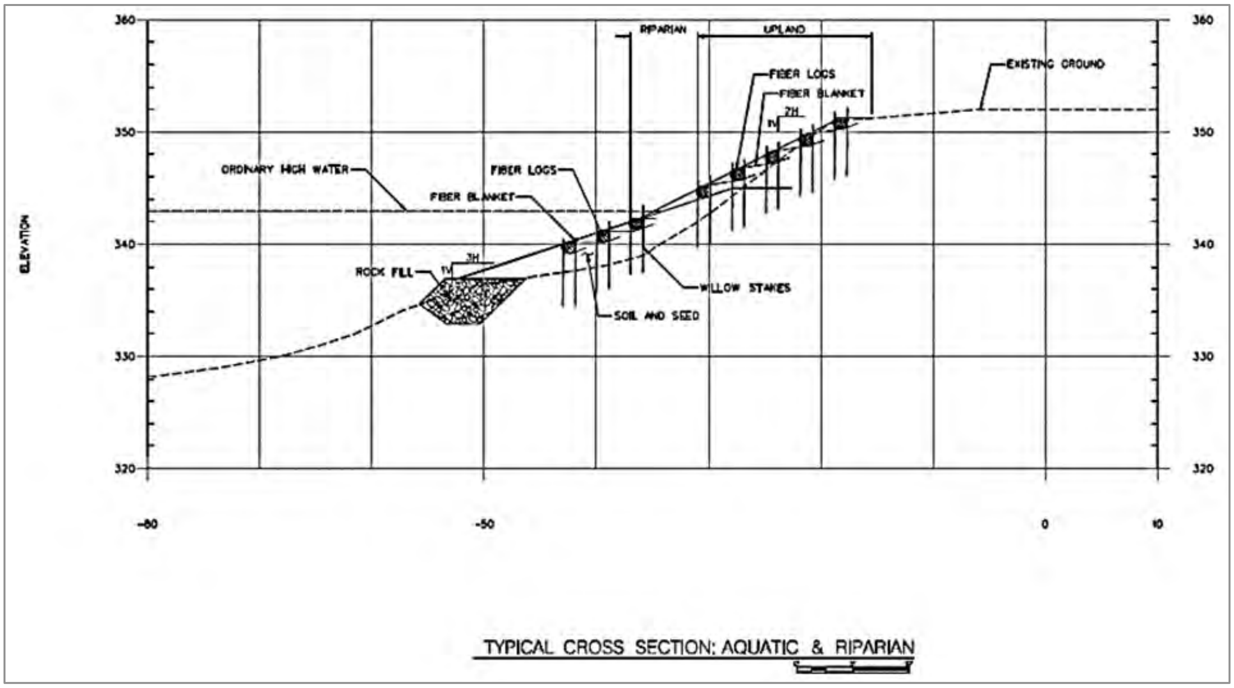

Figure 5. Concept of the shoreline toe and re-sloped streambank with coir fiber logs to control erosion. Measurements are in feet.

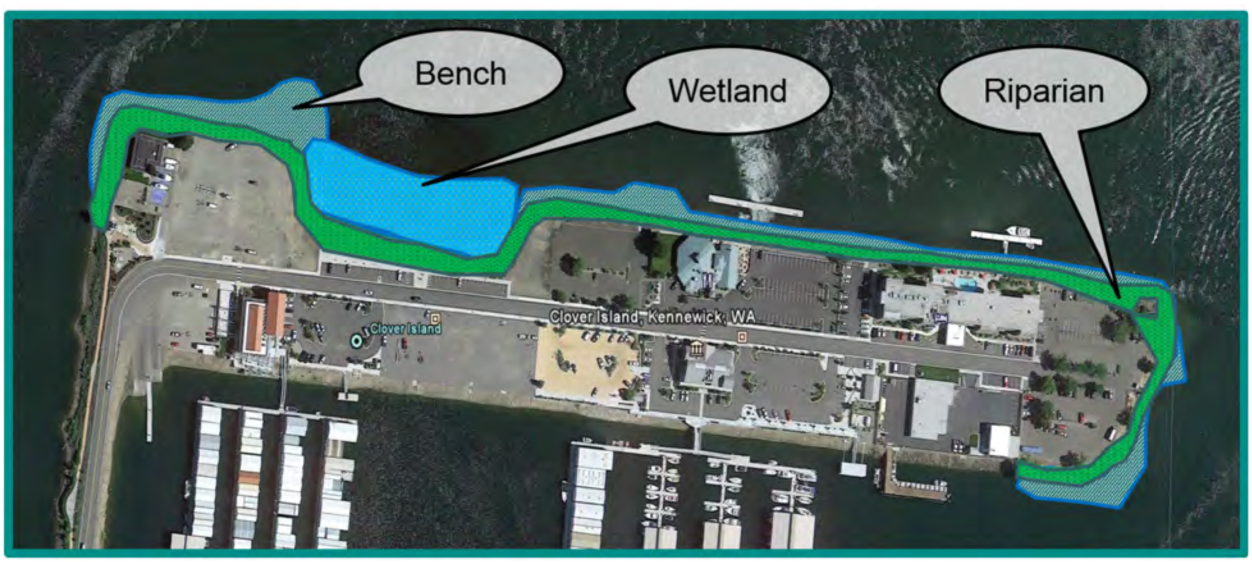

Figure 6. Conceptual plan (not to scale) of the Clover Island ecosystem restoration plan. Areas where the dark blue shallow water bench extend out considerably from the shoreline illustrate deep holes providing predator habitat that will be filled in to create suitable rearing habitat for ESA-listed juvenile salmon and steelhead. The proposed

project will restore approximately 1.67 acres of shallow water habitat and 1.28 acres of riparian habitat.

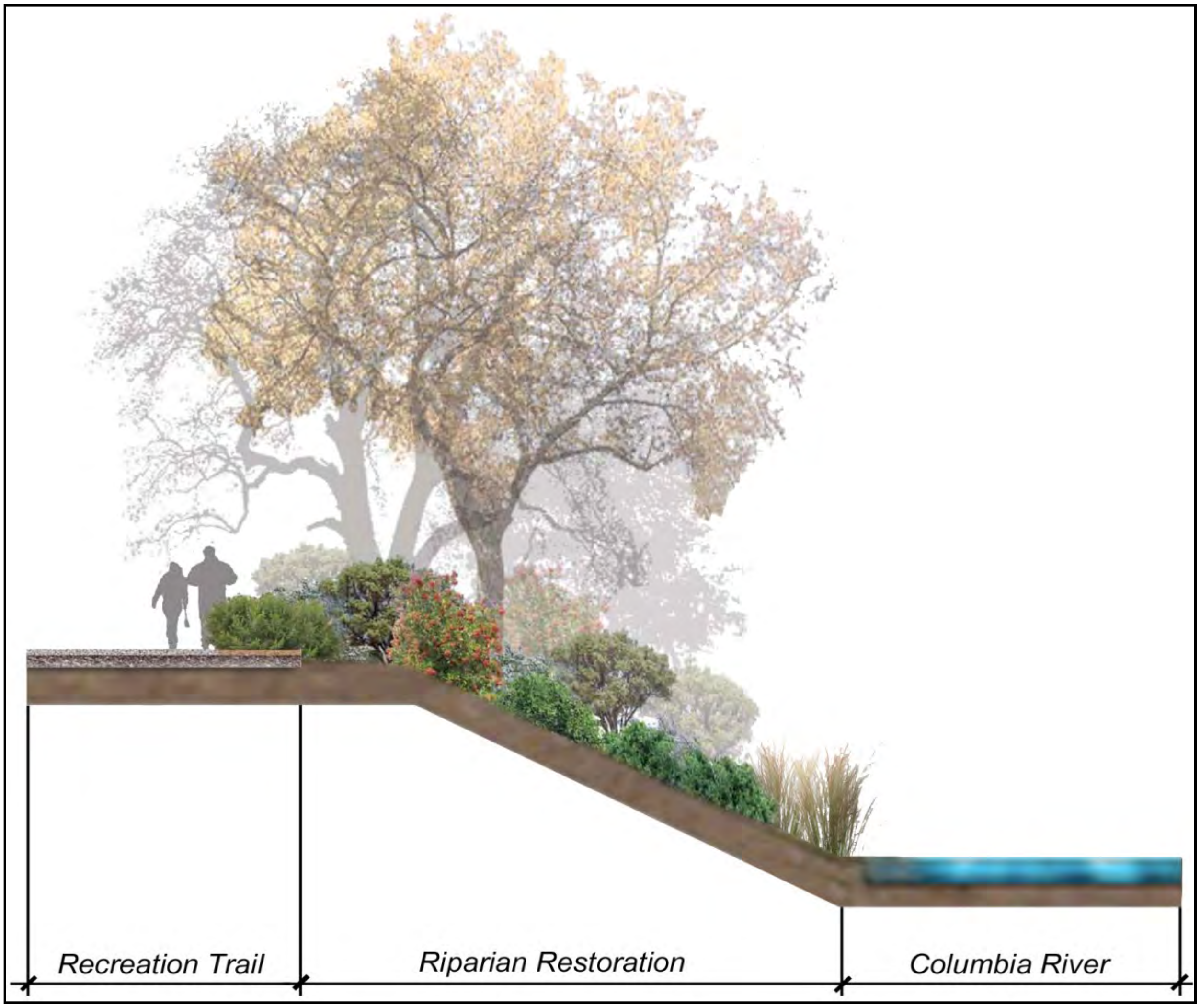

Figure 7. Conceptual illustration of the final, fully established Clover Island restoration.

Upon completion of the restoration, the Port of Kennewick would be required to implement a *Monitoring and Adaptive Management Plan* drafted by the Corps (Appendix A). This plan outlines success criteria based on habitat factors and identifies adaptive management triggers to ensure the restoration meets habitat expectations for a period of ten years. The Port of Kennewick would be required to submit annual reports to the Corps and replace plants as needed to meet success criteria.

1.3.1 Project Description

1.3.1.1 Project Location

Clover Island is located along the south shore in the Columbia River, Kennewick, WA [46°13'2.21"N, 119°6'43.96"W (Figure 1)].

1.3.1.2 Action Area

The Action Area is estimated to encompass approximately 300 acres around Clover Island (Figure 8). This is the estimated area in which fish and wildlife may be disturbed from construction noise. Commercial properties surround the Action Area and Highway 395 runs approximately north/south directly to the east of the work area. The actual work area is estimated to be approximately 15 acres including staging areas (Figure 8).

Figure 8. Clover Island Action Area, approximately 300 acres outlined in turquoise. The work area is outlined in orange and the staging areas are outlined in blue. The Action Area may be slightly larger, smaller, or differently shaped than depicted depending on ambient noise levels and wind direction on a given day.

1.3.1.3 Project Timeline

Construction activity would occur 1 September 2018 through 28 February 2019, encompassing the Corps typical winter in-water work window (15 December through 28 February) followed at lower Snake and Columbia River dams. This window was consulted on for the 2010 restoration as well.

1.3.1.4 Project Sequence

Following is the general, expected construction sequence.

1. Mobilization – Move equipment and materials on-site. Contractor would stockpile materials at staging areas located above the OHWM with appropriate erosion control measures. The contractor would to take extreme care for the duration of the project to ensure that no petroleum products, hydraulic fluid, fresh cement, sediments, sediment-laden water, chemicals, or any other toxic or deleterious materials are allowed to enter or leach into the river.
2. Install floating turbidity curtain with a boat along the in-water work area adjacent to the shoreline for in-water work.
3. Install silt fence at the OHWM along the existing shoreline for shoreline fill and regrading.
4. Mobilize a barge and excavator to trench and fill up to 60 feet offshore in some areas.
5. Trench below the OHWM and place riprap with track hoe. Riprap fill is estimated at 3,252 cubic yards.
6. Place fill using existing and clean, washed, imported gravel and cobble to choke the riprap toe and create the shallow water bench. Fill is estimated at 8,107 cubic yards.
7. De-mobilize the barge and excavator used for offshore work.
8. Clear and grub all invasive plants from the riparian slope that are to be removed, bundle and removed brush, and place in the staging area near the northwest corner of and southeast corners of the island.
9. Demolish and pulverize any concrete materials to a diameter of 12-inch or smaller. Demolition debris would be disposed of at an off-site legal waste disposal site.

10. Remove specified existing sidewalks and curbing and disposed of at an off-site, legal waste disposal site.
11. Relocate existing above grade electrical cabinets and utilities as needed.
12. Establish access routes where necessary along shoreline in order for heavy equipment to construct the shoreline riprap toe and re-slope the streambank.
13. Re-slope the streambank against the shallow water habitat fill to create the 3:1 slope for planting. Fill for the riparian slope is estimated at 1,344 cubic yards.
14. Install coir fiber logs and willow whips along the shoreline and plant emergent vegetation in the notch.
15. Trench and place irrigation and electrical conduit for recreation path lights.
16. Place PVC sleeves and electrical conduits under sidewalks for landscaping irrigation and controls.
17. Construct the restored riparian along the shoreline slope
    a. Placing appropriate coir fiber matting and mulch fabric to control erosion and invasive species regeneration
    b. Planting the multi-storied riparian.
18. Remove silt fencing previously installed at the OHWM.
19. Prep pedestrian walkway areas for placement of concrete using rubber tired backhoe and or loader.
20. Place concrete walkways using concrete trucks and hand tools.
21. Remove miscellaneous materials from job site and staging area.
22. Clean and sweep silt and debris from Clover Island Drive.
23. Demobilize.
24. Monitoring and Adaptive Management (10 years post-construction).

1.3.2 Proposed Impact Minimization Measures and Best Management Practices

1.3.2.1 Impact Minimization Measures

The following impact minimization measures would be implemented by the Corps:

1. A storm water pollution prevention plan would be developed and approved prior to implementation of construction activities. Erosion control measures such as silt fencing and the turbidity curtain would be of sufficient quantity and properly installed prior to any ground disturbing activities, and would remain in place until final slope stabilization is completed.

2. Fish would be excluded from between the turbidity curtain and the work area with seine nets and electrofishing as appropriate, prior to excavating or placing fill below the OHWM. Placement of the turbidity curtain and fish exclusion are expected to occur in sections for in-water work, not encompassing the entire shoreline work area at once. Therefore, migration habitat will still be available at any given time.

3. Fueling and lubrication of equipment and motor vehicles would be conducted in an approved manner that affords the maximum protection against spills. A portable containment berm would be used when fueling equipment and motor vehicles.

4. Fuel dispensing or storage tanks would be double walled, or would otherwise utilize a full containment tanker fueling berm or overnight containment berm.

5. Emergency Spill Response Kits must be available onsite. Kits would include product to absorb or encapsulate up to 25 gallons of hydrocarbons (oils, coolants, solvents). Spill absorbent mats would be in the immediate vicinity of all equipment performing work.

6. All hydraulically operated equipment would be required to use nontoxic, vegetable-based or other biodegradable, acceptable hydraulic fluid substitute rather than petroleum-based hydraulic oil.

7. Construction activities would take steps to minimize interference with or disturbance to fish and wildlife. Proposed construction activities are scheduled to occur 1 September 2018 through 28 February 2019, encompassing the Corps typical winter in-water work window of 15 December through 28 February to avoid disturbance to fish to the greatest extent possible, based on fish passage data at McNary Dam.

8. A qualified biologist would conduct a migratory bird and bald and golden eagle nesting survey onsite prior to beginning work, monitor bald and golden eagle nesting activity during construction, and lead any fish removal and exclusion efforts.

1.3.2.2 Best Management Practices

Typical types of best management practices would depend on site-specific conditions, but would generally include the following.

1. Construction equipment shall be kept in good repair without fuel, hydraulic or lubricating fluid leaks.
2. If leaks or drips do occur, they shall be cleaned up immediately.
3. Drip pans shall be utilized when equipment and vehicles are parked.
4. Equipment repairs shall be performed off the project site.
5. Install and maintain water and sediment control measures at all waterbodies (including dry waterbodies) and runoff points impacted by surface disturbance.
6. The contractor shall make every effort to use environmentally safe chemicals and substances.
7. All equipment shall be washed at a staging area using pressure or steam before entering the project area and when leaving the site to prevent the spread of noxious weeds.
8. Only certified weed-free straw may be used for erosion control during construction and restoration activities.

1.3.3 Conservation Measures

Fish removal and exclusion from the in-water work area would consist of herding via seine and electrofishing as appropriate. A seine would be placed around the work area from shoreline to shoreline to block fish from entering the area. Fish within the work area would then be removed via electrofishing and released outside of the turbidity curtain. Seines would be left in place to exclude fish from the work area until work below the OHWM is complete.

1.3.4 Interdependent and Interrelated Actions

No interrelated or interdependent actions have been identified for this project.

1.3.5 Previous and Ongoing Projects in the Action Area

Previous actions have included the restoration of the west causeway shoreline in 2010 – 2011. Ongoing maintenance of island infrastructure is expected to include parking lots and building construction. Recreational boating has occurred, and will continue to occur around Clover Island because of the marina on the Island and docks at the hotel.

2 Listed Species

2.1 Species Listed for the Project Area

The Corps reviewed the list of threatened and endangered species that pertain to the action area under the jurisdiction of the USFWS on 27 March 2017 [USFWS Ref # 01EWFW00-2017-SLI-0658 (Table 1)], and determined the proposed action would have “no effect” on yellow-billed cuckoo. This species either does not occur in the project area, or would not be affected by the proposed actions. As a result, the yellow-billed cuckoo will not be discussed in detail. The Corps determined the proposed action “may affect” Upper and Middle Columbia River steelhead, Upper Columbia River spring Chinook salmon, and Columbia Basin bull trout. These species will be discussed in detail in the following sections. While the project area is outside of the Snake River Basin steelhead Distinct Population Segment (DPS), these fish are expected to be migrating and overwintering in Lake Wallula during the proposed in-water work window (Keefer et al. 2016). The impacts discussed in this BA relative to steelhead would pertain to the Snake River Basin DPS, should these fish be present during construction.

Table 1. Federal Register (FR) notices for final rules that list threatened and endangered species or designate critical habitats.

Species	Listing Status	Critical Habitat
Steelhead (*Oncorhynchus mykiss*)		
Middle Columbia River	T: 01/05/06; 71 FR 834	Yes: 09/02/05; 70 FR 170
Upper Columbia River	T: 08/24/09; 74 FR 162	Yes: 09/02/05; 70 FR 170
Upper Columbia River Chinook Salmon (*O. tshawytscha*)		
Columbia River DPS	E 06/28/05; 70 FR 123	Yes: 09/02/05; 70 FR 170
Bull Trout (*Salvelinus confluentus*)		
Columbia River DPS	T 06/10/98; 63 FR 111	Yes: 09/26/05; 70 FR 56212; 10/18/10; 75 FR 63898
Yellow-Billed Cuckoo (*Coccyzus americanus*)		
Western U.S. DPS	T 10/3/14; 79 FR 59991	Not Applicable

2.2 Species Status

2.2.1 Middle Columbia River Steelhead

2.2.1.1 Listing History

Middle Columbia River steelhead were first listed as threatened on March 25, 1999 (64 FR 14517), and reaffirmed as threatened on January 5, 2006 (71 FR 834). Protective regulations were issued on June 28, 2005 (70 FR 37160), and critical habitat for this DPS was listed on September 5, 2005 (70 FR 52630).

2.2.1.2 Life History/Biological Requirements

Steelhead exhibit one of the most complex groups of life history traits of any species of Pacific salmonid. These fish can be anadromous (migratory) or freshwater residents. Steelhead can also spawn more than once (iteroparous), whereas most other anadromous salmonids spawn once and then die (semelparous).

Within the range of West Coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity. Most steelhead can be categorized as one of two run types, based on their sexual maturity when they re-enter freshwater and how far they go to spawn. In the Columbia River, summer steelhead enter freshwater between May and October and require several months to mature before spawning; winter steelhead enter freshwater between November and April with well-developed gonads and spawn shortly thereafter. Winter steelhead are called ocean-maturing or coastal type, and summer steelhead, stream-maturing or inland type. The Middle Columbia River steelhead DPS includes the only populations of inland winter steelhead in the United States in the Klickitat River, White Salmon River, Fifteenmile Creek, and possibly Rock Creek.

Steelhead spawn in clear, cool streams with suitable gravel size, depth, and current velocity. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small woody structure. Steelhead may enter streams and arrive at spawning grounds weeks or even months before they spawn and are therefore vulnerable to disturbance and predation. They need cover, in the form of overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water, turbulence, and turbidity.

Young steelhead typically rear in streams for some time before migrating to the ocean as smolts. Steelhead smolts have been shown to migrate at ages ranging from 1 to 5 years throughout the Columbia Basin, but most steelhead generally smolt after 2 years in freshwater (Busby et al. 1996). Most steelhead spend 2 years in the ocean before migrating back to their natal streams. Adults rarely eat or grow upon returning to freshwater.

2.2.1.3 Distribution

Middle Columbia River steelhead include all naturally spawning populations of steelhead in drainages upstream of the Wind River, Washington, and the Hood River, Oregon, up to, and including, the Yakima River, Washington. Major drainages in this DPS are the Deschutes, John Day, Umatilla, Walla Walla, Yakima, and Klickitat river systems (Figure 9). The Cascade Mountains form the western border of the plateau in both Oregon and Washington, while the Blue Mountains form the eastern edge. The southern border is marked by the divides that separate the upper Deschutes and John Day basins from the Oregon High Desert and drainages to the south. The Wenatchee Mountains and Palouse areas of eastern Washington border the Middle Columbia on the north (NMFS 2009).

2.2.1.4 Factors for Decline

All populations of Middle Columbia steelhead use the mainstem Columbia River to migrate to and from the ocean, and all are affected by the mainstem Federal dams, as well as by other forms of development that alter the river environment. Mainstem Columbia River conditions include impaired fish passage, altered water temperature and thermal refuges, and changes in mainstem nearshore habitat (NMFS 2009). In addition, changes in the Columbia River have altered the relationships between salmonids and other fish, bird, and pinniped species. Increases in competition with other fish species and predation from non-native fishes, birds, and pinnipeds continues to limit recovery of salmonid species in the Columbia River.

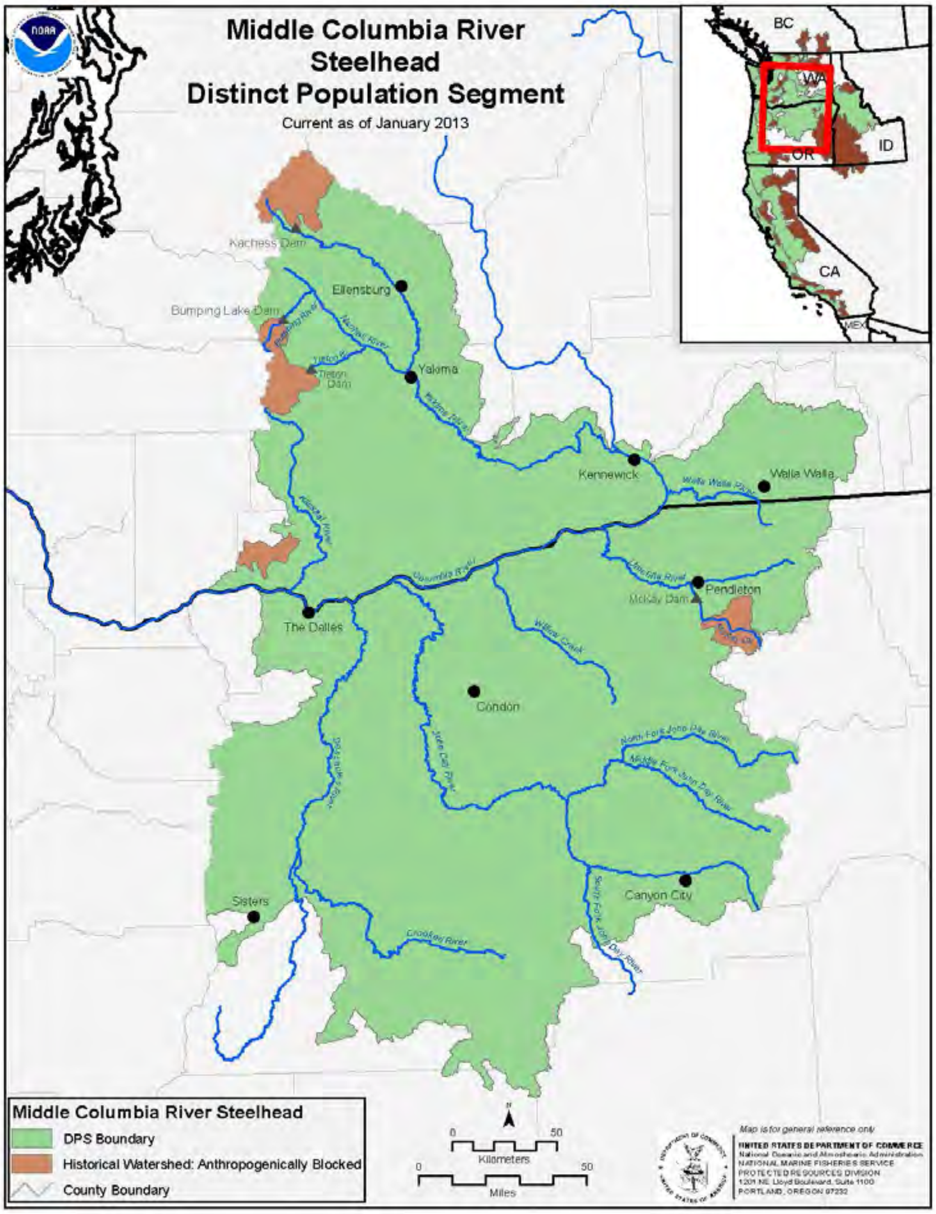

Figure 9. Middle Columbia River steelhead DPS distribution.

2.2.1.5 Local Empirical Information

Middle Columbia River Basin steelhead utilize the project area for migration habitat. Adult steelhead have been regularly counted at McNary Dam fish ladders since the dam's completion. Presently, fish counters count fish in real time and review video of hours when no counters are present at the dam. Although stocks are indiscriminately counted as "steelhead", Passive Integrated Transponder tag passage information is presented for McNary Dam in Figure 10. A significant proportion (approximately 93%) of adult steelhead that pass McNary do so between July 1st and October 31st (Figure 10), and a large portion of these fish overwinter in Lake Wallula (Keefer et al. 2016).

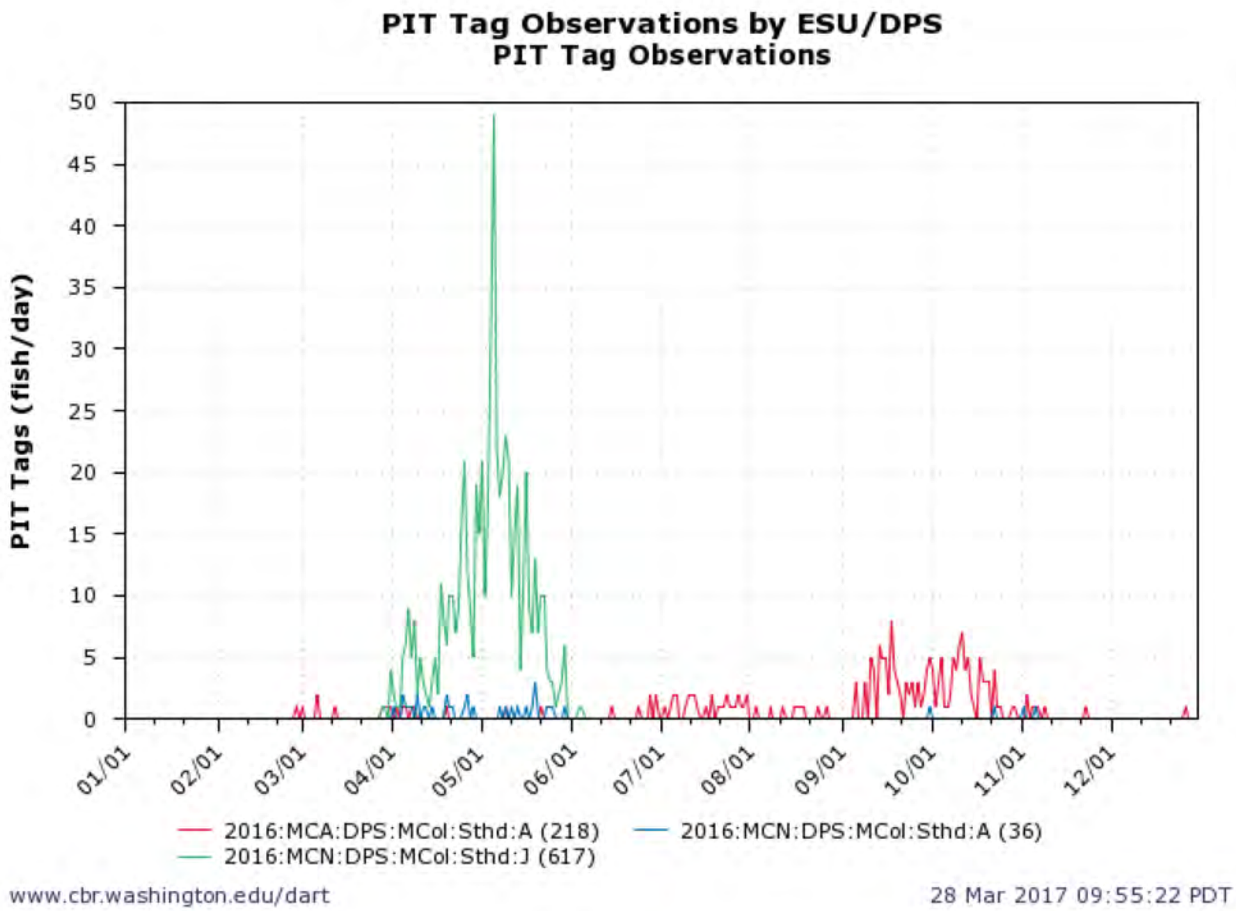

Figure 10. Passage timing and counts of adult (red and blue lines) and juvenile (green line) Middle Columbia River steelhead passing McNary Dam (DART 2017). Data are based on 2016 Passive Integrated Transponder tag detections.

2.2.2 Upper Columbia River Steelhead

2.2.2.1 Listing History

Upper Columbia River steelhead were listed as endangered in August 1997 and then changed to threatened in January 2006, then changed back to endangered by court decision in June 2007. This stock includes all naturally spawned populations of steelhead in streams in the Columbia River Basin upstream from the Yakima River to the U.S.-Canada border.

2.2.2.2 Distribution

The Upper Columbia River ESU consists of steelhead spawning in Columbia River tributary systems upstream of the Yakima River to the Canadian border, specifically the Wenatchee, Entiat, Methow, and Okanogan Rivers [U.S. Federal Register, 18 August

1997 (Figure 11)]. However, the Okanogan River produces very few wild steelhead. The Wells Hatchery stock is also considered part of this ESU (U.S. Federal Register, 18 August 1997).

2.2.2.3 Life History/Biological Requirements

Range-wide, Upper Columbia River steelhead biological requirements include food, flowing water (quantity), high quality water (cool, free of pollutants, high dissolved oxygen concentrations, low sediment content), clean spawning substrate and unimpeded migratory access (with resting areas) to and from spawning and rearing areas. Steelhead use Lake Wallula mainly as a migration corridor. Habitat use in the mainstem Columbia River by steelhead is not well known. Unlike other salmonids, which tend to use a smaller portion of the available habitat at a higher density, steelhead tend to disperse widely throughout the available habitat.

Smolt outmigration past Rock Island Dam peaks in mid-May, but ranges from April to early July (Chelan County PUD No. 1 1998). Smolt outmigration past McNary Dam peaks in May, but ranges from April to early July (Griswold et al. 2005). However, periodically a juvenile UCR steelhead is observed passing McNary Dam as late as October (Griswold et al. 2005). Thus, smolt migration past the action area would generally range from April to early July.

Spawning in the Wenatchee, Entiat, and Methow Rivers occurs from late March through June, and fry emerge and disperse from late spring through August (Chelan County PUD No. 1 1998). As with UCR spring chinook (above), steelhead in the Methow River exhibit a wide range of life history types. Juveniles spend two to seven years rearing in headwater streams and/or the mainstem of each river, and some juveniles from any year class would be almost continually outmigrating during this period (Chelan County PUD No. 1 1998). Most smolts emigrate at age 2+ or age 3+ years.

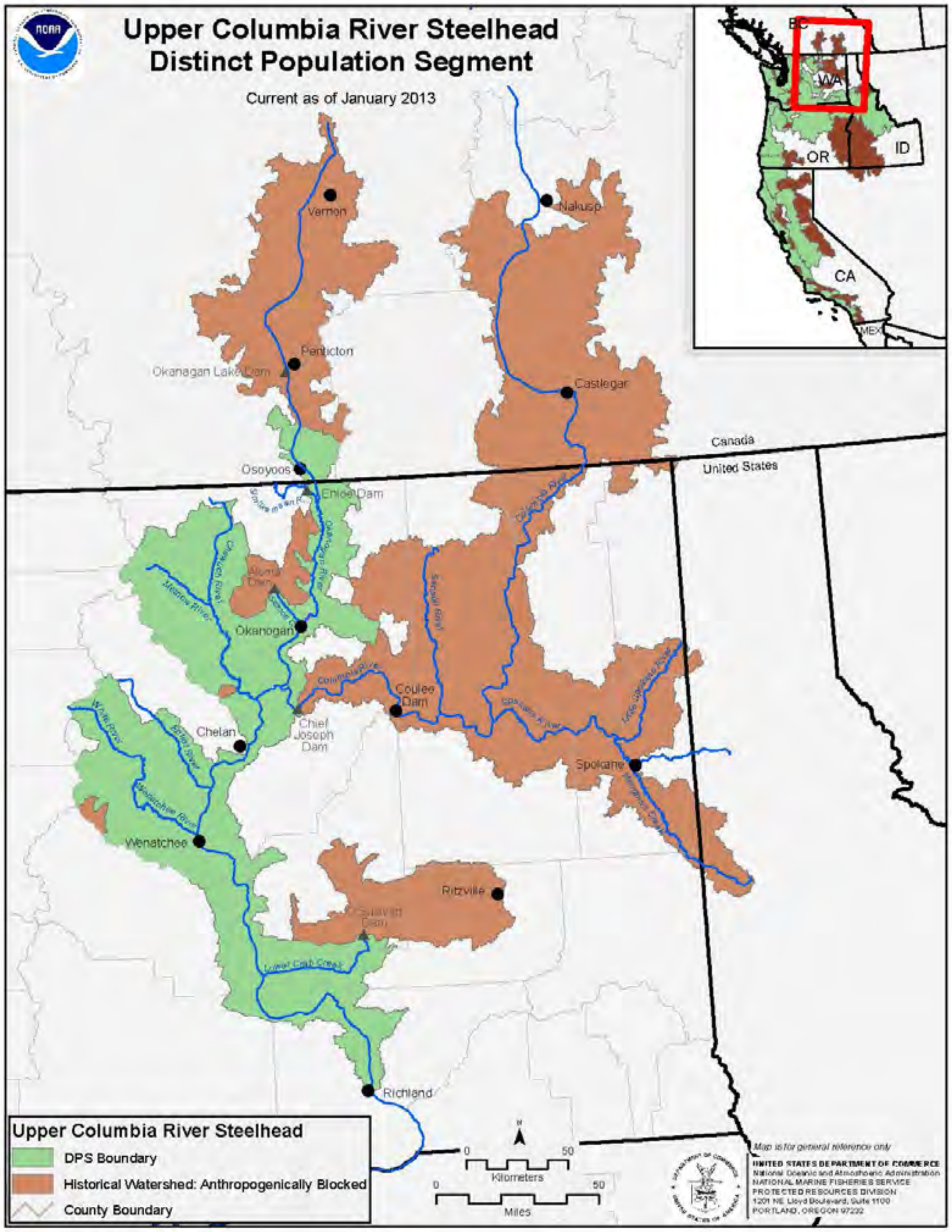

Figure 11. Upper Columbia River steelhead DPS distribution.

2.2.2.4 Factors for Decline

Historic fishing pressure began the decline of salmon populations over 100 years ago. Construction of dams, roads, railroads and levees/shoreline protection, as well as irrigation withdrawals has altered the rearing habitat of juvenile salmon and the migratory habitat of juveniles and adults. Increased predation on juvenile salmonids due to the habitat changes is also a contributor to the declining salmonid population. Prior to the construction of McNary Dam, a large percentage of the shoreline consisted of shallow water with a small particle size substrate. Today, much of the shoreline consists of deeper water bordered by riprap. This change in habitat type is likely a factor in the decline of the Columbia Basin salmonid populations.

Current pressures on Upper Columbia River steelhead include loss of quality habitat, predation, poor ocean conditions and limited fishing pressure. The limited amount of suitable habitat available, caused by habitat degradation and passage barriers is the main factor limiting recovery.

2.2.2.5 Local Empirical Information

Based on limited data, steelhead from the Wenatchee and Entiat rivers return to freshwater after one year in salt water, whereas Methow River steelhead primarily return after two years in salt water. Similar to other inland Columbia River basin steelhead, adults typically return to the Columbia River between May and October and are considered summer steelhead. A significant proportion (approximately 93%) of adult steelhead that pass McNary do so between July 1st and October 31st (Figure 12), and a large portion of these fish overwinter in Lake Wallula (Keefer et al. 2016). Most Upper Columbia River steelhead migrate relatively quickly up the mainstem to their natal tributaries. A portion of the returning run overwinter in the mainstem reservoirs, passing over the upper mid-Columbia dams in April and May of the following year. Unlike Chinook salmon or sockeye salmon, some steelhead adults attempt to migrate back to the ocean. These fish are known as kelts, and those that survive may migrate from the ocean to spawn again.

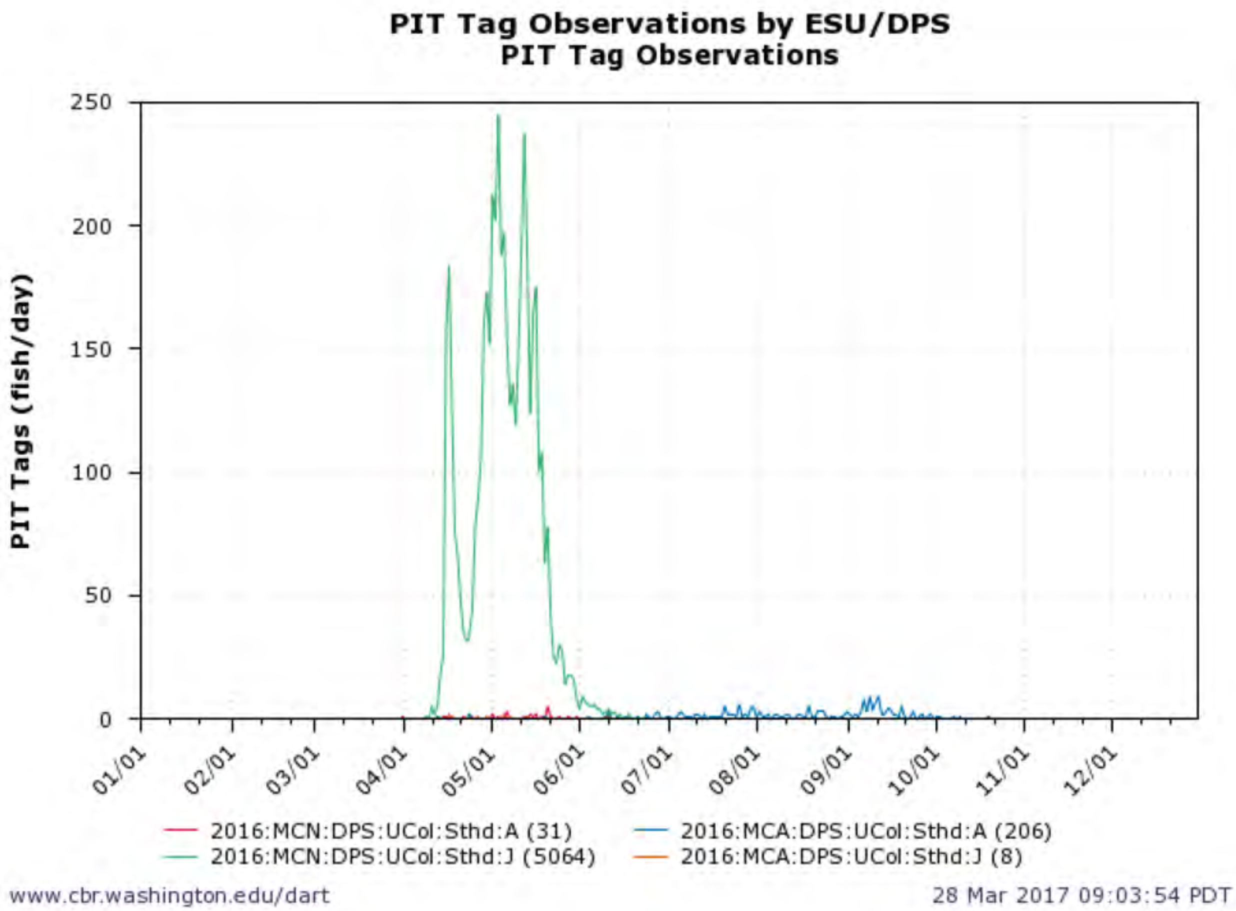

Figure 12. Passage timing and counts of adult (red and blue lines) and juvenile (green line) Upper Columbia River steelhead passing McNary Dam (DART 2017). Data are based on 2016 Passive Integrated Transponder tag detections.

2.2.3 Upper Columbia River Spring Chinook

2.2.3.1 Listing History

The Upper Columbia River spring Chinook salmon were listed as an endangered species on March 24, 1999 and their endangered status was reaffirmed on June 28, 2005.

2.2.3.2 Distribution

The Upper Columbia River spring-run chinook ESU includes all natural-origin, stream-type Chinook salmon spawning in the Wenatchee, Entiat, and Methow Rivers, as well as hatchery populations from the Chiwawa, Methow, Twisp, Chewuch, and White

Rivers, and Nason Creek [Myers et al. 1998; US Federal Register, 25 March 1999 (Figure 13)].

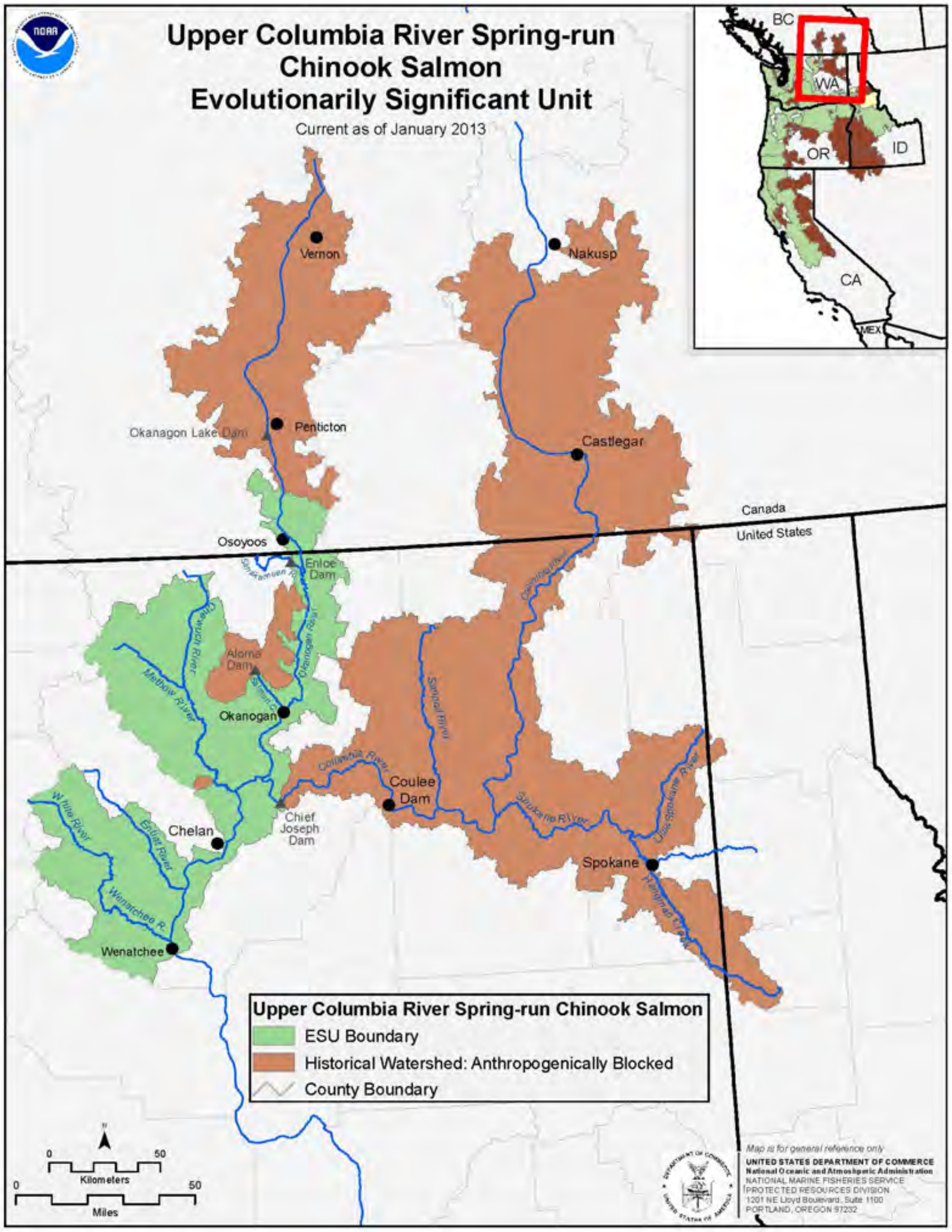

Figure 13. Upper Columbia River spring chinook DPS distribution.

2.2.3.3 Life History/Biological Requirements

Several different strains of Chinook salmon can be found in Lake Wallula during part of the year. Unlisted upper Columbia River fall Chinook salmon are the most common. However, Upper Columbia River spring Chinook, Snake River spring/summer Chinook salmon, and Snake River fall Chinook salmon are also present. Migration timing and life stage development can be different between the strains as they migrate through and use the lake. Upper Columbia River spring Chinook salmon biological requirements include food; high quality, flowing water; clean spawning substrate, resting habitat and unimpeded migratory access to and from spawning and rearing areas.

Adults enter the rivers from mid-April through July, and hold in deep pools with cover until spawning, with spawning occurring from late July through September (Bugert et al. 1998). Spawning occurs in the Wenatchee, Entiat, and Methow watersheds at elevations from 500 to 1,500 meters (Myers et al. 1998). Spawners return to the Wenatchee River from late April through June, and to the Methow and Entiat Rivers from late May through July (Bugert et al. 1998). Adults would be passing the action area from mid-April to mid-June (Chelan County PUD No. 1 1998).

In the Wenatchee, Entiat, and Methow watersheds, fry emergence occurs from late March through early May, and juveniles usually remain in the subbasins through the summer (Bugert et al. 1998). The majority of juveniles outmigrate in their second spring, with the peak occurring from late April through May (Bugert et al. 1998). Multiple (10 and 11, respectively) life-history strategies have been observed in the Methow and Wenatchee watersheds, ranging from spawning, rearing, and overwintering in the upper watershed, to spawning and rearing in the upper watershed and outmigrating (to the Columbia River) in fall/winter (Bugert et al. 1998). Although fewer than in the Methow and Wenatchee Rivers, multiple life-history strategies (five) have also been observed in the Entiat River. The pertinence of the multiple life-history strategy information to the proposed project is that juvenile UCR spring chinook could be in the Columbia River from winter through June, although it is highly improbable that they would be in the action area as pre smolts.

2.2.3.4 Factors for Decline

Current pressures on Upper Columbia River spring Chinook include loss of quality habitat, predation, poor ocean conditions and limited fishing pressure. The limited amount of suitable habitat available, caused by habitat degradation and passage barriers is the main factor limiting recovery.

2.2.3.5 Local Empirical Information

Most juvenile Upper Columbia River spring Chinook migrate downstream through Lake Wallula from late April through early June. Most adults migrate upstream through Lake Wallula during the same timeframe and generally take four to seven days to get through the lake. Three important spawning populations have been identified within this Evolutionarily Significant Unit (ESU): the Wenatchee, Entiat and Methow populations.

Ten-year-average adult chinook passage at McNary is approximately 404,600 fish passing in a given year with the majority of spring Chinook passing April – June (Figure 14). Virtually no adult spring Chinook would be in the project area during the proposed work window.

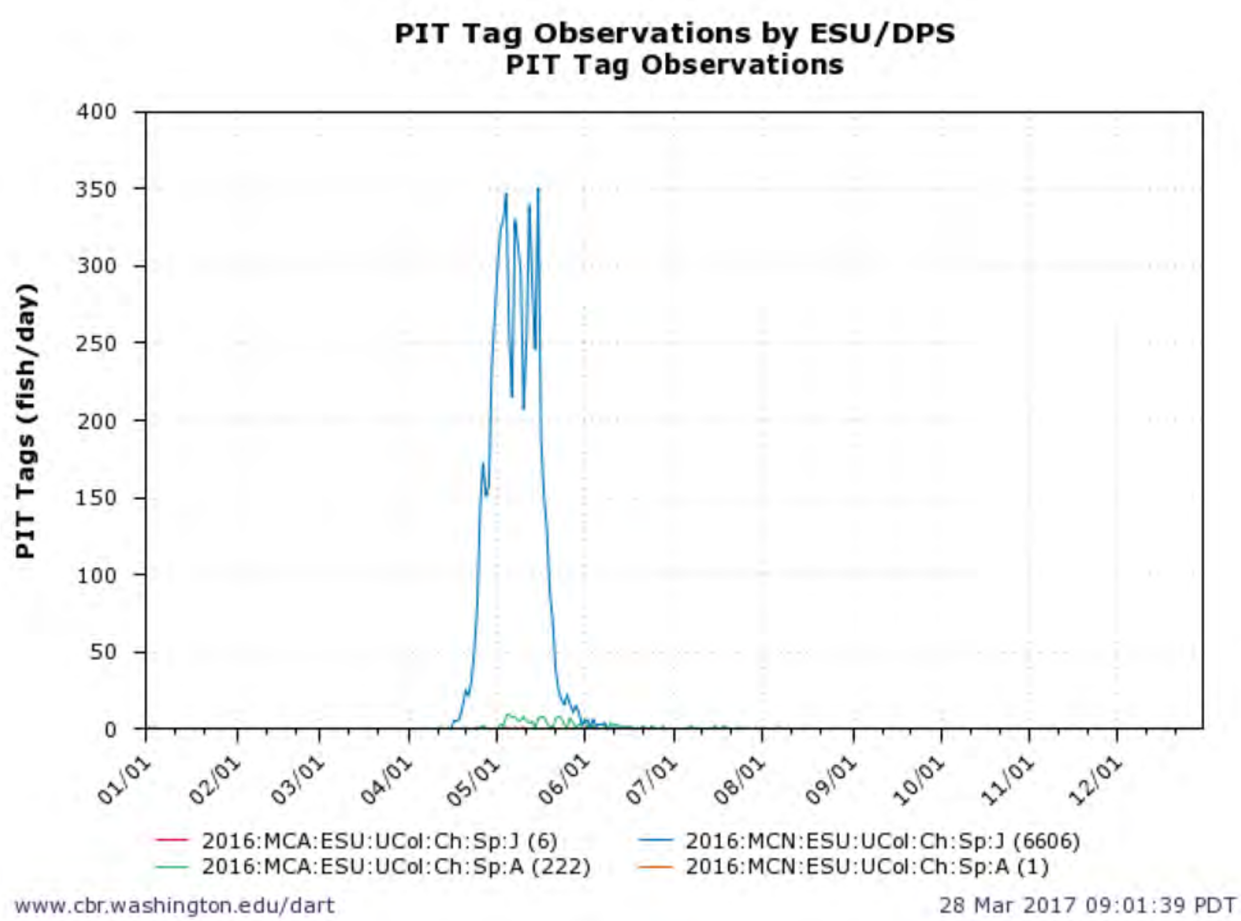

Figure 14. Passage timing and counts of adult (green line) and juvenile (blue line) Upper Columbia River spring Chinook salmon passing McNary Dam (DART 2017). Data are based on 2016 Passive Integrated Transponder tag detections.

2.2.4 Bull Trout

2.2.4.1 Listing History

The USFWS issued a final rule listing the Columbia River population of bull trout as threatened on June 10, 1998 (63 FR 31647), while critical habitat for this species was listed on September 30, 2010. Bull trout are currently listed throughout their range in the United States as a threatened species.

2.2.4.2 Distribution

Historically, bull trout occupied much of the Columbia and Snake River Basins; however, they now occur in less than half of their historic range (Rieman et al. 1997). Populations remain in portions of Oregon, Washington, Idaho, Montana, and Nevada. The Columbia River Distinct Population Segment and Mid-Columbia Recovery Unit are presented in Figure 15. Bull trout are distributed throughout higher elevations in most of the large rivers and associated tributary systems within the Mid-Columbia Recovery Unit.

Bull trout are commonly found in the upper reaches of Snake and Columbia River tributaries, although the use of mainstems by individuals exhibiting a fluvial life history is poorly understood (Borrows et al. 2015). Tagging studies show that movement of bull trout in the Walla Walla Basin is limited, with the exception of the fluvial migration between June and November. The Bull Trout Recovery Plan for the Walla Walla Subbasin includes a goal to ensure that fish can move between spawning and wintering areas, and to ensure that movement can occur between local populations with each core area in a recovery unit.

2.2.4.3 Life History/Biological Requirements

Individual bull trout may exhibit resident or migratory life history strategies. Resident bull trout carry out their entire life cycle in the stream in which they spawn and rear. Migratory bull trout spawn in tributary streams, but eventually travel to larger streams (or lakes) where they overwinter or mature. Habitat components that appear to influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrates and migratory corridors (with resting habitat). Among salmonids, bull trout exhibit the coldest water temperature requirements (Selong et al. 2001; Dunham et al. 2003; Falke et al. 2013), and all life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders and deep pools.

Bull trout normally reach maturity in four to seven years and may live as long as twelve years. Migratory bull trout may travel over one hundred miles to their spawning grounds. They generally spawn from August to November during periods of decreasing water temperatures. Egg incubation is normally 100 to 145 days and fry remain in the substrate for several months.

Bull trout are opportunistic feeders. Their diet requirements vary depending on their size and life history strategy. Juvenile bull trout prey on insects, zooplankton and small fish, while adults and migratory bull trout are dominantly piscivorous.

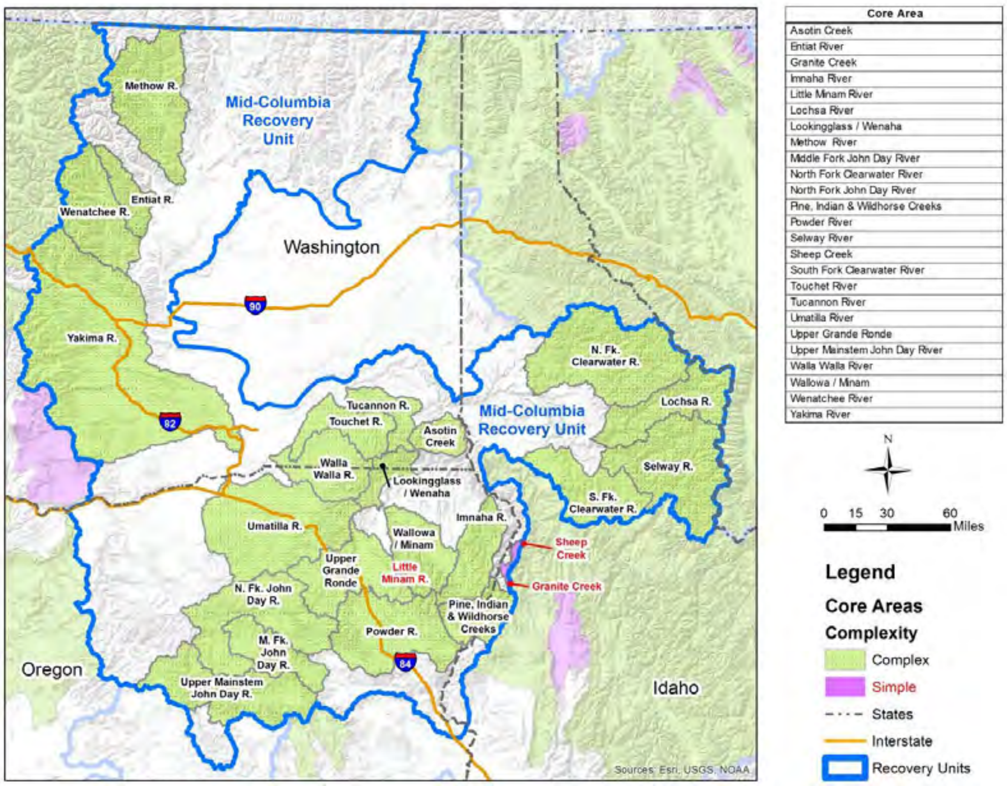

Figure 15. Mid-Columbia bull trout recovery unit (USFWS 2014).

2.2.4.4 Factors for Decline

The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices and the introduction of non-native species. Declining salmon and steelhead populations could also negatively impact bull trout populations by reducing the number of juvenile salmon and steelhead that bull trout might prey on. Altered flow regimes, sedimentation rates, bank erosion and reduced channel complexity all reduce the quality of bull trout habitat. Barriers between isolated populations continue to be a limiting factor for most of the bull trout subpopulations in the Columbia Basin.

2.2.4.5 Local Empirical Information

The few remaining bull trout strongholds in the Columbia River Basin tend to be found in large areas of contiguous habitats in the Snake River basin of the central Idaho mountains, upper Clark Fork and Flathead Rivers in Montana, and several streams in the Blue Mountains in Washington and Oregon. Populations also exist in the Yakima and Methow River watersheds. Numbers of bull trout captured at spawning stations throughout the basin are also regularly recorded. In addition, redd counts are conducted in southeast Washington on the Tucannon River, Butte Creek, and Asotin Creek, and Mill Creek and the forks of the Walla Walla River in northeast Oregon.

Recent studies have also shown Walla Walla River subbasin bull trout migration to, from, and through Lake Wallula above McNary Dam, but very little is known about how many bull trout may migrate into or through the mainstem Columbia and Snake River throughout the year. Anglin et al. (2010) reported that bull trout dispersed into the mainstem Columbia River from the Walla Walla River, and at times, this dispersal included a relatively long migration upstream to Priest Rapids Dam and downstream to John Day Dam. This data suggests that migratory bull trout from the Yakima River subbasin may also utilize the mainstem Columbia River as bull trout of unknown origin are occasionally documented in the Ice Harbor south shore fishway (Barrows et al. 2015).

2.2.4.6 Ongoing Monitoring

Adult salmonid passage monitoring continues at mainstem, as well as data collection via redd surveys and PIT tag detection within the Walla Walla River subbasin. Douglas County Public Utility District collects ancillary data on bull trout populations and movement within the Twisp and Methow Rivers during annual steelhead recruitment and tagging efforts.

2.2.5 Yellow-billed Cuckoo

The yellow-billed cuckoo, in the western portion of North America, were listed as threatened on October 3, 2014. Critical habitat has been proposed, though Washington is not included in the designation. This bird prefers open woodlands with clearings and a dense shrub layer. They are often found in woodlands near streams, rivers, or lakes, but yellow-billed cuckoos occur most frequently and consistently in cottonwood (*Populus spp.)* forests with thick understory (Taylor 2000). In North America, their preferred habitats include abandoned farmland, old fruit orchards, successional shrubland, and dense thickets. In winter, yellow-billed cuckoos can be found in tropical habitats with similar structure, such as scrub forest and mangroves. Individuals may be on breeding grounds between May and August.

In the Pacific Northwest, the species was formerly common in willow bottoms along the Willamette and Columbia Rivers in Oregon, and in the Puget Sound lowlands and along the lower Columbia River in Washington. The species was rare east of the Cascade Mountains in these States. It may now be extirpated from Washington (USFWS 2008).

There are no known occurrences of yellow-billed cuckoo in the action area. ***Therefore, the proposed action would have no effect on any individuals of this species or its proposed habitat.***

2.3. Status of Critical Habitat

2.3.1 Middle Columbia River Steelhead, Upper Columbia River Steelhead, Upper Columbia River Spring Chinook

The designating of critical habitat focuses on certain habitat features called "primary constituent elements" (PCEs) that are essential to support one or more of the salmonid life stages. The PCEs for ESA-listed salmon and steelhead in the project area are broken into two groups relative to fresh or saltwater based on these life history requirements (Table 2).

Critical habitat for Middle and Upper Columbia River steelhead was designated February 16th, 2000, and for Upper Columbia River spring Chinook September 2nd, 2005. Critical habitat for migration and rearing is designated in the lower Columbia River for migration and rearing, but only habitat upriver of Richland, Washington, is designated for spawning as well. Because of the heavy modification to the Columbia mainstem during the 19th and 20th centuries, reaches of the Columbia similar to the one encompassing Clover Island do not support spawning Chinook salmon or steelhead.

Table 2. Primary constituent elements of critical habitat designated for Middle Columbia River Steelhead, and corresponding species life history events.

Primary Constituent Elements		
Site Type	**Site Attribute**	**Life History Event**
Freshwater spawning	Substrate, water quality, water quantity	Adult spawning, embryo incubation, alevin development
Freshwater rearing	Floodplain connectivity, forage, natural cover, water quality, water quantity	Fry emergence, fry/parr growth and development
Freshwater migration	Free of artificial obstructions, natural cover, water quality, water quantity	Adult sexual maturation, adult upstream migration and holding, kelt seaward migration, fry/parr seaward migration
Estuarine areas	Forage, free of obstruction, natural cover, salinity, water quality, water quantity	Adult sexual maturation, adult "reverse smoltification", kelt seaward migration, fry/parr seaward migration, fry/parr smoltification, smolt growth and development, smolt seaward migration
Nearshore marine areas	Forage, free of obstruction, natural cover, water quality, water quantity	Adult sexual maturation, smolt/adult transition
Offshore marine areas	Forage	Adult growth and development

2.3.2 Bull Trout

Bull trout critical habitat was designated in 2005. The USFWS revised the designation in 2010. A final rule was published on October 18, 2010, and took effect on November 17, 2010. A total of 19,729 miles of stream and 488,251 acres of reservoirs and lakes are designated as bull trout critical habitat, including the Walla Walla River, which encompasses the project area.

Based on the needs identified in 50 Code of Federal Regulations (CFR) 17 (75 FR 63898) and the current knowledge of the life-history, biology, and ecology of the species and the characteristics of the habitat necessary to sustain the essential life history functions of the species, the USFWS has identified PCEs for bull trout critical habitat (Table 3).

Table 3. Primary constituent elements (PCEs) of critical habitat designated for bull trout.

Primary Constituent Elements	
Water Quality	Springs, seeps, groundwater sources, and subsurface water connectivity (hyporehic flows) to contribute to water quality and quantity and provide thermal refugia.
Migration Habitat	Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.
Food Availability	An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.
Instream Habitat	Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these environments, with features such as large wood, side channels, pools, undercut banks and clean substrates, to provide a variety of depths, gradients, velocities, and structure.
Water Temperature	Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; stream flow; and local groundwater influence.
Substrate Characteristics	In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.
Stream Flow	A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.
Water Quantity	Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.
Nonnative Species	Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

3 Environmental Baseline

This section provides an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem within the action area. The environmental baseline is a “snapshot” of a species’ health at a specified point in time. It does not include the effects of the action under review in the consultation.

The baseline includes State, tribal, local, and private actions already affecting the species or that will occur contemporaneously with the consultation in progress. Unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultation are also part of the environmental baseline, as are Federal and other actions within the action area that may benefit listed species or critical habitat.

3.1. Historic Conditions

The proposed project area and Columbia River watershed likely contained more trees and shrubs historically than at present when compared to the riparian area of the Hanford Reach. Prior to the settling of Tri-Cities and the construction of the levees, highways, and railroad, the project area would have had a larger riparian area with adequate floodplain connectivity. Mining, cattle grazing, and irrigation draws and diversions have occurred in the past along the Columbia River.

3.2. Current Conditions

Generally, the environment for listed species in the Columbia River Basin, including those species that migrate through the action area, has been dramatically affected by the development and operation of the Federal Columbia River Power System (FCRPS). Hydroelectric dams have dramatically reduced mainstem spawning and rearing habitat and have altered the natural flow regime of the Columbia River, decreasing spring and summer flows, increasing fall and winter flows, and altering natural thermal patterns. McNary Dam yields similar effects as other dams in the migration corridor of the Columbia River, killing or injuring a portion of the smolts passing the dam.

Above, below, and within the action area, low flow velocity and fragmented suitable rearing habitat in Lake Wallula slows smolt migration and increases the risk of predation. Similarly, within and outside of the action area, formerly complex mainstem habitats in the Columbia River have been reduced, for the most part, to single channels, with floodplains reduced in size, and off-channel habitats eliminated or disconnected from the main channel (Sedell and Froggatt 1984; Coutant 1999). Dams also decrease the amount of large woody debris in the Columbia River, reducing habitat complexity and altering the river's food webs (Maser and Sedell 1994).

Since 2002, the number of boat docks have increased by more than 30% in the McNary Reservoir upriver of the Snake River confluence at four marinas, predominantly in excavated backwater habitats greater than 20 feet deep. These commercial or public recreational facilities amount totaled approximately 220,924 square feet of over-water structure in 2010 with about ⅓ to ½ covering shallow water rearing habitat, and the remaining ⅔ to ½ covering habitat deeper than 20 feet.

The "Matrix Pathway for Documenting Environmental Baseline and Effects of Proposed Action on Relevant Anadromous Salmonid Habitat Indicators" summarizes the environmental baseline relative to anadromous salmonids and is presented below in Table 4. The Corps believes that the MPI also generally summarizes the baseline conditions for bull trout, as well as the anadromous species for which it was designed. It summarizes the current conditions, and illustrates that the action, as proposed, will not significantly alter baseline conditions for bull trout.

3.3. Matrix of Pathways and Indicators

NMFS uses the "Matrix of Pathways and Indicators" (MPI) to summarize important environmental parameters and levels of condition for each. USFWS adopted a similar strategy in 1997 based on NMFS' matrix. The NMFS matrix is divided into six overall pathways [(major rows in the matrix); Table 4]:

- Water Quality
- Channel Condition and Dynamics
- Habitat Access
- Flow/Hydrology
- Habitat Elements
- Watershed Conditions

Each represents a significant pathway by which actions can have potential effects on anadromous salmonids and their habitats, and could be used for analyzing bull trout habitat as well.

After several site visits, developing the description of the proposed action, analyzing habitat conditions pre- and post-restoration, and using the matrix to determine the potential impacts of the proposed action, the Corps has determined that the proposed action would maintain the present function of most habitat indicators, and would restore sediment, substrate, refugia, and streambank condition indicators of the environmental baseline, long-term (Table 4). Adverse effects are likely to occur for several conditions affected by turbidity, but adverse effects would be temporary, occurring only during the action, and recovering to the baseline level or an improved condition post-construction. For the purposes of the MPI checklist, "maintain" means that the function of an indicator does not change (i.e., it applies to all indicators regardless of functional level). Each indicator is discussed in the following section.

Table 4. Checklist for documenting environmental baseline and effects of the proposed action on relevant anadromous salmonid habitat indicators

PATHWAYS	**ENVIRONMENTAL BASELINE**			**EFFECTS OF THE ACTION**		
Indicators	**Properly Functioning**	**At Risk**	**Not Properly Functioning**	**Restore**	**Maintain**	**Degrade**
Water Quality:						
Temperature			X		X	
Sediment		X		X		
Chem. Contam./Nut.		X			X	
Habitat Access:						
Physical Barriers			X		X	
Habitat Elements:						
Substrate		X		X		
Large Woody Debris			X		X	
Pool Frequency			X		X	
Pool Quality			X		X	
Off-Channel Habitat			X		X	
Refugia			X	X		
Channel Cond. & Dyn.:						
Width/Depth Ratio			X		X	
Streambank Cond.			X	X		
Floodplain Connectivity			X		X	
Flow/Hydrology:						
Peak/Base Flows			X		X	
Drainage Network Increase			X		X	
Watershed Conditions:						
Road Dens. & Loc.			X		X	
Disturbance History			X		X	
Riparian Reserves			X	X		
Watershed Name: Columbia River			Location: Kennewick, WA			

3.4. Baseline Condition Justification

3.4.1 Water Quality

The *Temperature* parameter is "not properly functioning". Water temperatures at the project site may at times exceed water quality and salmonid physiological standards during the summer months due to the levee system and a lack of riparian vegetation in the Tri-Cities area. Cold water is essential for resident and anadromous salmonid rearing, migration, and survival. This project may improve water temperature locally at Clover Island resulting from riparian restoration, but in the grand scheme of the Columbia River, improvements would be immeasurable.

The *Sediment* parameter is "at risk". Sediment deposition is unlikely within most of the project area as annual spring flows move parallel to the north shoreline sweeping sediment downstream. Some accumulation may occur in the inlet near the northwest corner, but with the installation of wetland plants in the inlet, sediment may deposit in the inlet to the benefit of wetland plants, and potentially macroinvertebrates and fishes. Along the north shoreline deposition is not expected to be influenced by the project.

While this project would not introduce a reoccurring sediment discharge with natural flow fluctuations, in-water work would increase turbidity during construction. Turbidity increases during construction would be contained by sediment fencing and a turbidity curtain, and are expected to cease upon completion of the shallow water bench. Upon project completion, the shoreline would be stabilized with a restored riparian which would reduce the potential for erosion in the future. This project would improve/reduce sediment deposition due to erosion at Clover Island.

The *Chemical Contaminants/Nutrients* parameter is "at risk". Nutrient levels in the Columbia River in the vicinity of Clover Island are sometimes high due to urban and agricultural runoff and wastewater discharge. For this project, excavation equipment would operate below the OHWM where an accidental spill of petroleum products could occur. The equipment would be checked daily for leaks and repaired as necessary. Environmentally friendly lubricants will be specified for equipment used on this project. Equipment and the worksite would be required to have emergency spill containment apparatus immediately available at all times. This project would have no effect on contaminants or nutrients.

3.4.2 Habitat Access

The *Physical Barriers* parameter is "not properly functioning" within the Federal Columbia River Power System. The Federal dams provide fish passage, but some migrants may be delayed. This project won't add to existing physical barriers for upriver migrating adults, but is also not expected to improve existing passage conditions. Fish passage would be maintained during the action. This project would have no effect on habitat access.

3.4.3 Habitat Elements

The *Substrate* parameter is “at risk”. Sand and silt deposits generally do not occur at the project site due to the Columbia River flowing parallel to the north shore of Clover Island. High spring flows sweep sediment across the shoreline, but little deposition of finer material occurs. The Clover Island shoreline is largely cobble and boulder providing fair habitat suitability for juvenile salmonids. This project would improve substrate below the OHWM with the construction of the shallow water bench by placing gravel and cobble.

The *Large Woody Debris* parameter is “not properly functioning”. Large woody debris accumulates along the western shoreline near the levee, but not along the north or east shoreline due to parallel shoreline flow and little opportunity for debris to settle along the shoreline terrain. Large woody debris would not be installed during construction, but as the project matures, it may contribute large woody debris. However the project is not expected to improve the potential for debris to settle along the shoreline. This project would have no effect on the amount of large woody debris along the shoreline.

The *Pool Frequency* parameter is “not properly functioning”. Within the FCRPS there is little opportunity for a natural riffle-run-pool regime to establish. The lack of floodplain connectivity, dams, and levees have reduced the river’s ability to meander and create natural characteristics through geomorphic processes. This project would have no effect on pool frequency in the Columbia River.

The *Pool Quality* parameter is “not properly functioning”. Pool characteristics have been greatly altered by the levee system and it is expected that few pools of adequate depth occur in the leveed reach. This project would have no effect on the pool quality of the river.

The *Off-Channel Habitat* parameter is “not properly functioning”. Little to no off channel habitats exists within the Columbia River, Lake Wallula levee system. The creation of an emergent wetland in the island inlet would provide a small habitat area out of the main river channel flow where juvenile salmonids may rest and feed. The wetland area would provide a very small improvement to off-channel habitat in the Columbia River and is expected to maintain this habitat parameter. Therefore, this project would have no effect on available off-channel habitat in the river.

The *Refugia* parameter is “not properly functioning”. Refugia sources such as large woody debris are limited in the Columbia River, Lake Wallula levee system. This project is not expected to improve the accumulation of large woody debris along Clover Island, but at maturity, the restored riparian may provide large wood inputs. Refugia in the form of complex root structures and overhanging shoreline vegetation is expected as a result of the riparian restoration. This project would improve the available refugia in the Columbia River.

3.4.4 Channel Condition and Dynamics

The *Width to Depth Ratio* parameter is “not properly functioning”. The Columbia River is restricted by the levees around the action area, and the depth influenced by the FCRPS and McNary Dam. Presently, the Columbia River is wider and deeper than under a natural system. Much of the year, Lake Wallula is regulated to approximately 3-5 feet of depth fluctuation and a low flow channel or thalweg is not clearly defined. This project would have no effect on the river’s width to depth ratio.

The *Streambank Condition* parameter is “not properly functioning”. The stream banks within the Tri-Cities are leveed and reinforced with riprap. Generally, only a thin band of riparian vegetation exists along the river, if at all, as the natural riparian and floodplain has been severed from the river. This project would restore native riparian vegetation and a small wetland, thus restoring the streambank condition along the north and east shore of Clover Island.

The *Floodplain Connectivity* parameter is “not properly functioning”. The stream banks within Lake Wallula are defined by the levees and are reinforced with riprap. The natural riparian and floodplain has been severed from the river. This project would have no effect on the river’s floodplain connectivity.

3.4.5 Flow and Hydrology

The *Peak/Base Flows* parameter is “not properly functioning”. The Columbia River is controlled somewhat by FCRPS. The hydrograph has not been modified from its historic condition in the headwaters, but depth fluctuations within the FCRPS are generally controlled to 3-5 feet throughout the year. Spring freshets still occur, but with limited condition fluctuations within-channel. Flows likely peak faster and higher within the levee system compared to natural conditions. This project would have no effect on river discharge.

The *Drainage Network Increase* parameter is “not properly functioning”. Urban development within the Tri-Cities have contributed impervious surfaces and increased local runoff to the Columbia River. This project would not increase impervious surfaces and would have no effect on the watershed’s drainage network.

3.4.6 Watershed Conditions

The *Road Density and Location* parameter is “not properly functioning”. The road network within the Columbia River Basin, particularly in the Tri-Cities, has expanded greatly over the past century. This project does not require building any new roads, but would require creating equipment access to the OHWM. This project would have no effect on the road density of the watershed.

The *Disturbance History* parameter is “not properly functioning”. Large fires have increased in frequency throughout the Pacific Northwest. Runoff after a fire can carry increased amounts of sediment. Agriculture, development, and landslides due to fires and roads also affect the streams within the watershed. This project would have no effect on the disturbance history of the watershed.

The *Riparian Reserves* parameter is “not properly functioning”. In general, there is only a thin band of riparian vegetation, if any, within the leveed Tri-Cities reach of the Columbia River. In many places no riparian trees are present, replaced by riprap. This project would restore the riparian at Clover Island. A complex, multi-storied riparian planted with a variety of native trees, shrubs, and grasses would be created. This project would improve the riparian reserves of the river corridor.

4 Effects of the Action

This section includes an analysis of general project-related effects of the proposed action, as well as specific effects on the species and critical habitat PCEs. Effects from any interrelated and interdependent activities are also discussed.

The primary effects to ESA-listed fishes would come from 1) the installation of the turbidity curtain; 2) the construction of the shoreline toe and filling to create shallow water habitat below the OHWM; and 3) fish exclusion and removal from between the shoreline and the turbidity curtain.

Construction is expected to require approximately twenty-six weeks. All work would be completed with fish removal and exclusion measures employed. Based on the data presented in Section 2, the proposed work window encompasses a part of the year where few ESA-listed fish are present, particularly juveniles. The work window also encompasses the Corps typical winter in-water work window to minimize impacts to ESA-listed salmon, steelhead, and bull trout. Long-term impacts are not expected as the project would result in a restored riparian and improved substrate in the near-shore shallow water rearing habitat.

4.1 Effects on Listed Species

The Corps anticipates that project-related effects would be similar for all ESA-listed fishes in the project area. Therefore, these species will be analyzed collectively.

4.1.1 Elevated Suspended Sediment and Turbidity

Excavation of existing substrate and placement of the riprap toe would dislodge sediment and increase turbidity during construction. Filling to create shallow water habitat is expected to increase turbidity, but fill material would be washed prior to placement to reduce the magnitude of turbidity spikes. Only temporary increases in turbidity are expected with excavation and fill as sediment containment measures are expected to minimize a turbidity plume. Upon project completion, long-term sediment discharge would be reduced/improved by the restored riparian area.

4.1.2 Habitat Alteration

Existing substrate is primarily cobble and boulder material that has eroded from the island shoreline over time (Figure 4). Juvenile ESA-listed salmonids may utilize the Clover Island shoreline for rearing during their outmigration to the ocean; however, this habitat is not expected to be utilized for spawning. The project would affected up to 3,200 linear feet of shoreline, beginning at the terminus of the prior western shoreline restoration and ending at the southeast end of the island (Figure 8).

Placement of riprap and fill to create the shallow water bench would alter habitat at Clover Island. However, riprap would be covered and choked, and suitable rearing habitat created with existing and imported, clean gravel and cobble. The project would improve rearing substrate, depth, and shoreline refugia, as well as minimize or eliminate predator fish habitat.

4.1.3 Chemical Contamination

Operation of equipment requires the use of fuel and lubricants, which, if spilled into a waterbody or into the adjacent riparian zone, can injure or kill aquatic organisms. Petroleum-based contaminants contain poly-cyclic aromatic hydrocarbons (PAHs), which can be acutely toxic to salmonids at high levels of exposure and can cause lethal and sublethal chronic effects to other aquatic organisms (Neff 1985). Equipment would be inspected and cleaned prior to work. The conservation measures stated above would likely reduce the risk of chemical contamination to a level that is insignificant or discountable. Therefore, effects from chemical contamination on ESA-listed species are not reasonably certain to occur.

4.1.4 Noise

Noise resulting from the restoration activities for the proposed project would include noise from human presence, vehicles, and heavy equipment needed for constructing the shoreline toe, shallow water bench, and sloping the streambank. The noise generated from these activities would be similar to noise created from recreational boating, passenger and commercial vehicles traveling on nearby roadways, riverside railroad traffic, barge traffic, and the operation of businesses on Clover Island.

While the majority of research conducted on the effects of noise on aquatic organisms have been focused on marine mammals, studies have shown that ambient noise levels can mask sound, decreasing a fish's sensitivity to noise (Hawkins and Popper 2014; Hawkins and Loughine Ltd. 2015). Ambient noise levels in-river are affected by boat and train traffic, hydropower dam operations (Ingraham et al. 2014), bathymetry, and water temperature (Hawkins et al. 2015). For example, ambient sound pressure noise level in the Ice Harbor Dam tailrace ranges between 105 – 115 decibels (dB) re 1 micro-Pascal (μPa) with most measurements being below 106 dB re 1 μPa (Ingraham et al. 2014). Therefore, underwater noise levels would need to be approximately greater than 106 dB re 1 μPa before fish behavior may be affected in the Ice Harbor Dam tailrace. These data are expected to reflect an ambient noise range similar to what may occur at Clover Island when heavy recreational boat, barge, railroad traffic, or a combination of all three is present. Noise generated by equipment used for the proposed action must be approximately greater than the baseline ambient level before a response may be induced. Salmonids may generally detect sound at a level between approximately 100 – 200 Hertz (Hz), but thresholds are generally higher and frequency dependent (Hawkins and Popper 2014).

The sensitivity of fishes to noise varies, but is generally in the range of 50-2,000 Hertz (Hz) and is best between 200-800 Hz with a threshold of 50-70 dB re 1 µPa (Popper and Fay 1993; Hastings 1995 as cited in FHA 2004). It should be noted that salmonids and eels are hearing generalists and hear primarily below 1000 Hz (Schilt 2007). Studies have shown that Atlantic salmon (*Salmo salar*) exhibit avoidance behavior to low frequency (below 380 Hz [Gill and Bartlett 2010] and as low as 10 Hz). This has also been found in other salmonids (Mueller et al. 1998).

Excavation of the shoreline toe and fill to create the shallow water bench may be accomplished from a barge. While underwater excavation may a nuisance to fishes, there is potential for the barge to rely on spuds to maintain a firm, stationary work platform. The effects of a barge spudding down against the river bottom can be compared to pile driving. Unattenuated near-field (approximately 30 feet) source levels for conventional pile driving has been reported up to 195 dB re 1 μPa (Illinworth and

Rodkin 2007). Near-field exposure was explained by Hawkins and Loughine Ltd. (2015) as the ratio of particle motion to sound pressure which increases closer to the source, but this appears to be variable and source-specific. It has been found difficult to model and assess the effects of intense, complex sound propagation such as pile driving on fishes (Hawkins and Loughine Ltd. 2015). Recent experimental evidence suggests that the basis for physical injury to fishes from percussive pile driving is a combination of energy in single strikes and the number of strikes, but these two are not related in a linear fashion (Halvorsen et al. 2012, as cited in Hawkins and Popper 2014).

Based on the available data, it is unclear how fish will be affected by construction noise. NMFS, in their 2011 McNary Shoreline Management Plan Biological Opinion, determined some adverse behavioral disruption of fish would most likely occur within 73 feet of pile driven activities that exceed 150 dB. While pile driving is a substantially more disruptive source of noise than excavation, and potentially barge spudding, the 73-foot disturbance distance can be reasonably applied to the proposed construction and barge spudding and may encourage salmonids present to leave the work area. The in-water excavation area is expected to be segregated, excluding fish from the immediate work, which will reduce near-field exposure of fishes to barge spudding and excavation.

Noise levels from dry land excavation are expected to be ≤ 120 dB in the immediate work zone (23 feet from source) and ≤ 80 dB approximately 154 feet from the source (Bassett 2008). Excavating and planting along the streambank has potential to transmit vibration and noise into the river; however, surface noise is unlikely to penetrate the water surface to a degree that may disrupt fish (Hawkins et al. 2015). Continuous source exposures such as shipping noise (which is assumed to be similar to equipment operation) have been found to only moderately affect salmonid behavior with little potential for injury or mortality (Hawkins and Loughine Ltd. 2015).

Because excavation noise disturbance is expected to be similar to regular disturbances in the area, the work area would be segregated from fishes and the effects of spudding are uncertain, the response to construction noise exposure, is expected to be insignificant.

4.2 Effects on Critical Habitat

4.2.1 Columbia River Anadromous Salmonids

Effects to PCEs for Middle and Upper Columbia River steelhead and Upper Columbia River spring Chinook are shown in Table 5. The proposed action is expected to affect freshwater spawning, freshwater rearing, and freshwater migration; therefore, only those PCEs will be discussed further.

Table 5. Effects of the proposed action to PCEs of critical habitats for Middle and Upper Columbia River Steelhead and Upper Columbia River spring Chinook and their corresponding species life history events.

Primary Constituent Elements		
Site Type	**Site Attribute**	**Effects of Proposed Action**
Freshwater spawning	Substrate, water quality, water quantity	No Effect
Freshwater rearing	Floodplain connectivity, forage, natural cover, water quality, water quantity	May Affect, Improvement
Freshwater migration	Free of artificial obstructions, natural cover, water quality, water quantity	May Affect, Improvement
Estuarine areas	Forage, free of obstruction, natural cover, salinity, water quality, water quantity	No Effect
Nearshore marine areas	Forage, free of obstruction, natural cover, water quality, water quantity	No Effect
Offshore marine areas	Forage	No Effect

4.2.1.1 Freshwater Rearing

Juvenile steelhead and spring Chinook have been documented rearing in and near the action area. Approximately 3,200 linear feet of cobble and boulder habitat would be excavated for the placement of riprap, then replaced to choke the riprap and fill to create the shallow water bench and re-slope the streambank. Construction would improve substrate for rearing by removing concrete and placing gravel and cobble over the riprap shoreline toe. Negative effects of the proposed actions may include the localized, short-term loss of macro-invertebrates at the project site within the confines of the turbidity curtain. Furthermore, the native riparian will be restored along the island to provide food sources and bank cover for rearing salmonids. ***While the proposed actions may affect freshwater rearing, the Corps expects effects would be insignificant during construction, resulting in improved rearing habitat post-construction.***

4.2.1.2 Freshwater Migration

Steelhead and spring Chinook use the project area for adult and juvenile migration. The proposed action would disturb sediments at the project site and increase turbidity locally within the turbidity curtain. Effects from noise are expected to be minimal from land-based excavation. Minor turbidity and noise from in-water work may have short-term effects that could trigger a behavioral response, likely avoidance of the work area. The disturbance of existing substrate during trenching for the shoreline toe and filling is not expected to impact juvenile salmonid migration. Adult salmonids are expected to be migrating through the mid-Columbia, September – mid-November; however, in-water work is expected to occur in sections. Therefore, near-shore migration habitat will still be available at Clover Island during the proposed work window.

To minimize effects to freshwater migration, the proposed action would be conducted during the fall and Corps typical winter in-water work window outside peak migration times for listed anadromous salmonids. Sediment containment measures would be in place and turbidity is expected to be negligible. In addition, this project would result in a restored riparian and construction would improve substrate by removing concrete and filling to create the shallow water bench. ***While the proposed actions may affect freshwater migration, the Corps expects effects would be insignificant during construction, resulting in improved migration habitat post-construction.***

4.2.2 Bull Trout

Effects to PCEs for bull trout are shown in Table 6. The proposed action is expected to affect water quality, migration habitat, and food availability; therefore, only those PCEs will be discussed further.

Table 6. Effects determinations for the proposed action to the PCEs of critical habitats designated for bull trout.

PCE	Effect Determination
Water Quality	May Affect, Insignificant
Migration Habitat	May Affect, Improvement
Food Availability	May Affect, Improvement
Instream Habitat	No Effect
Water Temperature	No effect
Substrate Characteristics	May Affect, Improvement
Stream Flow	No effect
Water Quantity	No effect
Nonnative Species	No Effect

4.2.2.1 Water Quality

The trenching and construction of the shoreline toe and shallow water bench, and relaxing the shoreline slope would dislodge sediment, but sediment containment measures would be in place including a turbidity curtain. Construction is expected to have minor impacts on water quality. Adult bull trout may be present, but the effects of the action are expected to be short-term, localized, and minor. ***While the proposed actions may have a short-term effect on water quality, the Corps expects effects would be insignificant.***

4.2.2.2 Migration Habitat

The proposed action would alter the shoreline substrate and riparian around Clover Island. Approximately 3,200 linear feet of cobble and boulder habitat would be excavated for the placement of riprap, then replaced to choke the riprap and slope the shoreline and streambank. Migration habitat would ultimately be improved as a result of this restoration project. The current habitat is marginal at best providing no quality migration habitat. Construction would improve substrate by removing concrete and placing gravel and cobble to create a shallow water bench. The riparian would be restored, providing cover, food sources, and shoreline stabilization over time. Adult bull trout are expected to be in the mainstem during the winter, but their utilization of near-shore habitat during the winter months is little known. Sediment and turbidity increases during construction are expected to be insignificant because sediment containment measures would be in place. ***While the proposed actions may have an effect on migration habitat, the Corps expects effects would be insignificant, resulting in improved migration habitat post-construction.***

4.2.2.3 Food Availability

The proposed action would disturb sediment and reduce macro-invertebrate numbers while constructing the shoreline toe and shallow water bench. Macroinvertebrates are expected to recolonize the shoreline post-construction. The streambank would be stabilized with a native riparian restoration. The restored riparian would provide energy and debris, encouraging macroinvertebrate colonization over time, as well as providing terrestrial food sources. ***While the proposed actions may have a short-term effect on food availability during construction, the Corps expects effects of the action would be insignificant, ultimately resulting in improved food sources post-construction.***

4.2.2.4 Substrate Characteristics

The proposed action would alter the shoreline substrate around Clover Island. Increases in sediment and turbidity are expected during construction, but sediment containment measures would be in place and effects would be localized to the shoreline. Construction would improve substrate by removing concrete and placing gravel and cobble to create a shallow water bench. ***While the proposed actions may have a short-term effect on substrate characteristics during construction, the Corps expects effects of the action would be insignificant, ultimately resulting in improved substrate post-construction.***

4.3 Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation. Non-Federal actions are likely to continue affecting listed species. Based on the population and growth trends, cumulative effects are likely to increase.

State and local governments may be faced with pressures from population growth and movement. Growth in business will place increased demands on these governments for buildable land, infrastructure, water, electricity and waste disposal. Such population trends will place greater overall and localized demands in the action area affecting water quality directly and indirectly, and increase the need for transportation and recreation. It is anticipated that Clover Island will increase the number of businesses on the island over time, and this project would result in increased recreation due to the aesthetic improvements of the restored riparian and added recreation features. The effects of private actions are the most uncertain. Private landowners may convert their lands from current uses, or they may intensify or diminish those uses.

Impacts to the aquatic environment that may contribute specifically to the cumulative effects include: water flow fluctuation, degraded water quality, migration barriers, habitat degradation, resource competition and introduction of nonnative species. Because of the aquatic habitat significance of the action area, water quality is of primary concern when evaluating potential effects to listed species. Elevated levels of contaminants in the waterways can adversely affect aquatic species through direct, lethal or sublethal toxicity, through indirect effects on their food supply or through interactions with compounds present in the water.

Agricultural practices associated with irrigation have the potential to adversely affect the aquatic environment. Runoff of irrigation water polluted with pesticides and fertilizers can contribute excessive nutrients, elevated levels of chemicals and substantial amounts of sediment to natural waterways further degrading the water quality of the system. Stochastic high flow events can increase runoff carrying high doses of nutrients, sediment, and possibly contaminants into the Columbia River. Urban and rural land uses for residential, commercial, industrial and recreational activities like boating and golf can contribute pollutants and sediments to surface waters as well. Impacts from contaminant spills could also be significant depending on the nature and quantity of the contaminants involved. Smaller, more frequent spills may add to the degradation of the aquatic environment. These spills may occur at any time throughout the action area with different parties responsible for the contamination.

Some of the potential effects may be offset by habitat restoration projects within the Columbia River Basin, the implementation of water quality standards such as Total Maximum Daily Loads, and improvements in stormwater and wastewater management and systems within the larger cities along the Columbia River and major tributaries. Habitat maintenance at Clover Island would be required by the Port of Kennewick post-restoration for up to ten years to ensure the investment and benefits of habitat restoration are fully realized.

4.4 Effects Determinations

4.4.1 Listed Species

The effects of construction are expected to be minimal and would ultimately result in habitat restoration; however, given Clover Island's proximity to the Yakima River delta, juvenile Middle Columbia River steelhead may be present during the in-water work window, although in low abundance. ***Therefore, the Corps has determined that the proposed action is "likely to adversely affect" Middle and Upper Columbia River steelhead, and formal consultation is required. The Corps further determined the project "may affect, not likely to adversely affect" Upper Columbia River spring Chinook salmon or bull trout.*** The project would have ***no effect*** on Yellow-billed cuckoo. Effects to listed species and critical habitat are summarized in Table 7.

4.4.2 Critical Habitat

The effects of the proposed action on PCEs for anadromous salmonids are insignificant because the action would occur during the fall and Corps typical winter in-water work window when impacts would be minimized, but would ultimately result in habitat restoration by removing concrete, adding gravel and cobble substrate, and planting a native riparian. Changes in habitat would stabilize the Clover Island streambank without obstructing salmonid migration or movement. The proposed action would directly disturb up to 3,200 linear feet of habitat and increase sediment and turbidity, but sediment containment measures would minimize impacts. The effects of the action would not appreciably diminish the value of constituent elements essential to species' conservation during construction, but would improve their value long-term. ***The Corps has determined the proposed project "may affect" critical habitat for all salmonid species, and formal consultation is required.***

5 Magnuson-Stevens Act - Essential Fish Habitat

The consultation requirement of section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) directs Federal agencies to consult with NMFS on all actions, or proposed actions that may adversely affect Essential Fish Habitat (EFH). Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

The project area is located in the Columbia River Hydrologic Unit Code (HUC 170200160603). This HUC was designated EFH for Chinook salmon. Excavation of existing substrate would include the removal of concrete and replacement of gravel and cobble substrate over the riprap toe and filling with clean, washed gravel and cobble to create the shallow water bench. Ultimately, the project would result in restored migration and rearing habitat for juvenile Chinook salmon at Clover Island. The restored rearing habitat would promote juvenile salmon growth and survival.

Although the restoration would be beneficial, during excavation, turbidity and disturbance to macroinvertebrate communities would temporarily modify EFH. ***The action would cause adverse modification to EFH, although affects would be no more than minimal and temporary. Ultimately, the project would results in restored EFH.***

6 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) authorizes the USFWS to evaluate the impacts to fish and wildlife species from proposed Federal water resource development projects that could result in the control or modification of a natural stream or body of water that might have effects on the fish and wildlife resources that depend on that body of water or its associated habitats. The proposed action would be conducted below the OHWM at Clover Island and would disturb substrate; however, the proposed action is habitat restoration, not a water resource development project, and disturbed substrate would be improved relative to the existing condition. ***Therefore, FWCA does not apply to this project.***

7 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. §§ 703-712, as amended) prohibits the taking of and commerce in migratory birds (live or dead), any parts of migratory birds, their feathers, or nests. Take is defined in the MBTA to include by any means or in any manner, any attempt at hunting, pursuing, wounding, killing, possessing or transporting any migratory bird, nest, egg, or part thereof.

The proposed action would have minor impacts to migratory birds from noise disturbance; however, work is scheduled to occur outside of the nesting season. As a precaution, a qualified biologist would conduct a song bird nesting survey at least 10 days prior to beginning construction. The operation of equipment is likely to deter some birds from foraging or seeking refuge in the immediate work area, which is highly disturbed with little or no refuge available. Disturbance may occur in the broader action area, but this disturbance is not expected to deter birds from foraging, or seeking refuge. ***While birds may be temporarily deterred from the work or action area, a trained Corps biologist will conduct pre-construction nesting surveys to avoid nest disturbance. Therefore, the Corps has determined that there would be no take of migratory birds as a result of the proposed action.***

8 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA) prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions, primarily for Native American Tribes. Take under the BGEPA includes both direct taking of individuals and take due to disturbance. Disturbance is further defined in 50 CFR 22.3.

Bald eagles are known to nest throughout southeast Washington and northeast Oregon and can be found roosting and hunting along the Columbia River during the winter months.

Golden eagles are distributed worldwide and occupy habitats from alpine meadows to arid deserts. Washington supports nesting golden eagles east and west of the Cascade Mountains, as well as a winter migratory population from nesting populations in Canada and Alaska. The species has been identified as a state candidate for listing due to declines in the number of nesting pairs at historic nests.

The proposed work is scheduled to occur at the beginning of the eagle nesting season. Given the developed condition of Clover Island, no suitable eagle nesting habitat has been identified on the island and little eagle activity is expected to occur at the island.

Roosting, foraging, or nesting eagles may be present near the action area during the proposed work, but construction activities are not expected to occur outside of the predetermined disturbance buffers. Eagles that may occupy this area are most likely accustomed to the daily activities and related noise levels typically generated by traffic and local business operations. Construction related noise and activities would be short-term and localized.

The proposed action would take place in a highly disturbed and developed area with no suitable eagle nesting habitat, because eagles in the area are likely accustomed to the greater disturbance of businesses, traffic, and people in the surrounding area, and because a trained Corps biologist will conduct pre-construction and periodic eagle nesting surveys to avoid nest disturbance, the Corps determined there would be no disturbance or take of eagles as a result of the proposed action.

9 Effects Summary

The Corps has determined that the proposed action is ***likely to adversely affect*** Middle and Upper Columbia River steelhead, and formal consultation is required. The Corps further determined the project ***may affect, is not likely to adversely affect*** Upper Columbia River spring Chinook or bull trout. Finally, the Corps has determined that the proposed project ***may affect*** critical habitat for all of the above species, would ***adversely modify*** EFH, and formal consultation is required. The Corps has also determined the proposed action would have ***no effect*** on yellow-billed cuckoo or proposed critical habitat. A summary of determinations is presented in Table 7.

Table 7. Effect determinations for the listed species within the area potentially affected by this action.

Common Name	USFWS Species Determination	Critical Habitat Determination
Middle Columbia River Steelhead	May Affect, Likely to Adversely Affect	May Affect
Upper Columbia River Steelhead	May Affect, Not Likely to Adversely Affect	May Affect
Upper Columbia River Spring Chinook	May Affect, Not Likely to Adversely Affect	May Affect
Bull Trout	May Affect, Not Likely to Adversely Affect	May Affect
Yellow-billed Cuckoo	No Effect	None Designated
MSA		
No Adverse Effect		
FWCA		
Covered Under ESA Consultation		
MBTA		
No Take		
BGEPA		
No Disturbance or Take		

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G.3 CULTURAL RESOURCES

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DEPARTMENT OF
ARCHAEOLOGY &
HISTORIC PRESERVATION
Protect the Past, Shape the Future

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

December 1, 2014

Ms. Alice Roberts
Walla Walla District
Corps of Engineers
201 North Third Avenue
Walla Walla, Washington 99362-1876

RE: Clover Island Ecosystem Restoration Project
Log No.: 120114-08-COE-WW

Dear Ms. Roberts;

Thank you for contacting our department. We have reviewed the materials you provided for the proposed Clover Island Ecosystem Restoration Project, Kennewick, Benton County, Washington.

Thank you for your description of the Area of Potential Effect (APE). We concur with your proposed APE.

We look forward to further consultation and the result of your tribal consultation efforts, professional cultural resources review, and determination of effect.

We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4) .

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act and its implementing regulations 36CFR800. Should additional information become available, our assessment may be revised. We look forward to the results of your cultural resources survey efforts and your consultation with the concerned tribes and your determination of effect.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: *rob.whitlam@dahp.wa.gov*

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
WALLA WALLA, WA 99362-1876

August 27, 2015

Dr. Robert Whitlam
Washington State Department of Archaeology
and Historic Preservation
PO Box 48343
Olympia, WA 95804-8343

Dear Dr. Whitlam:

Please find enclosed the *Cultural Resources Compliance Report: Determination of Effect for the Proposed Ecosystem Restoration Project at Clover Island.* The enclosed report contains the recommendation that the proposed ecosystem restoration project at Clover Island in Kennewick, Washington, will result in no adverse effects to historic properties.

Please review the determination of effect and advise whether you agree. If you have any questions contact Mr. Scott Hall 509-527-7278, Scott.M.Hall@usace.army.mil or me 509-527-7274, Alice.K.Roberts@usace.army.mil.

Sincerely,

Alice K Roberts
Chief, Tribal Relations and Cultural Resources

Enclosure

dahp

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

September 3, 2015

Ms. Alice Roberts
Walla Walla District /Corps of Engineers
201 North Third Avenue
Walla Walla, Washington 99362-1876

Re: Clover Island Ecosystem Recovery Project
PM-EC-2014-0059 / 2015-NWW-033
Log No: 120114-08-COE-WW

Dear Ms. Roberts;

Thank you for contacting our department. We have reviewed the professional cultural resources survey report you provided for the proposed Clover Island Ecosystem Recovery Project in the Columbia River at M.328.5, Benton County, Washington.

We concur with your Determination of No Adverse Effect and the stipulation for professional archaeological monitoring. Please provide the draft monitoring plan when available for our review.

We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity must stop, the area secured, and this office notified.

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act and its implementing regulations 36CFR800. Should additional information become available, our assessment may be revised. Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 890-2615
email: *rob.whitlam@dahp.wa.gov*

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
WALLA WALLA, WA 99362-1876

August 27, 2015

Mr. Gary Burke
Chairman, Board of Trustees
Confederated Tribes
of the Umatilla Indian Reservation
46411 Timine Way
Pendleton, OR 97801

Dear Chairman Burke:

Please find enclosed the *Cultural Resources Compliance Report: Determination of Effect for the Proposed Ecosystem Restoration Project at Clover Island.* The enclosed report contains the recommendation that the proposed ecosystem restoration project at Clover Island in Kennewick, Washington, will result in no adverse effects to historic properties.

Please review the determination of effect and advise whether you agree. If you have any questions contact Mr. Scott Hall 509-527-7278, Scott.M.Hall@usace.army.mil or me 509-527-7274, Alice.K.Roberts@usace.army.mil.

Sincerely,

Alice K Roberts
Chief, Tribal Relations and Cultural Resources

Enclosure

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
WALLA WALLA, WA 99362-1876

August 27, 2015

Mr. Jim Boyd
Chairman, Business Council
Confederated Tribes
Of the Colville Reservation
PO Box 150
Nespelem, WA 99155-0150

Dear Chairman Boyd:

Please find enclosed the *Cultural Resources Compliance Report: Determination of Effect for the Proposed Ecosystem Restoration Project at Clover Island*. The enclosed report contains the recommendation that the proposed ecosystem restoration project at Clover Island in Kennewick, Washington, will result in no adverse effects to historic properties.

Please review the determination of effect and advise whether you agree. If you have any questions contact Mr. Scott Hall 509-527-7278, Scott.M.Hall@usace.army.mil or me 509-527-7274, Alice.K.Roberts@usace.army.mil.

Sincerely,

Alice K Roberts
Chief, Tribal Relations and Cultural Resources

Enclosure

The Confederated Tribes of the Colville Reservation
History/Archaeology Program (509) 634-2693
P.O. Box 150, Nespelem, WA 99155 (509) 643-2694

December 15, 2014

HA: U14-0369
14.0459

Alice Roberts
Project Manager, Archaeologist
US Army Corps of Engineers
Walla Walla District
201 N. Third Ave.
Walla Walla, WA 99362

RE: Ecosystem Restoration at Clover Island; T9N/R30E Sec. 31

Alice:

Please be advised your proposed undertaking lies within the traditional territory of the Palus Tribe. The Palus Tribe is a constituent member of and represented by the Confederated Tribes of the Colville Reservation [Colville Confederated Tribes (CCT)]. The CCT is governed by the Colville Business Council (CBC). The CBC delegated to the Tribal Historic Preservation Officer (THPO) the responsibility of representing the CCT with regard to cultural resource management issues throughout the traditional territories of our constituent tribes under Resolution 1996-29. This area includes most of eastern Washington, parts of northeastern Oregon, south central British Columbia, and parts of north central Idaho. In 1996, the CCT also entered into an agreement with the National Park Service to assume state historic preservation officer responsibilities as outlined in Section 101 (d) (2) of the National Historic Preservation Act. The assumption agreement explicitly tasks the THPO to advise and assist Federal and State agencies and local governments in carrying out their historic preservation responsibilities and for the CCT to carry out their responsibilities for review of federal undertakings in regard to cultural resources matters.

We reviewed your letter initiating consultation concerning the Ecosystem Restoration at Clover Island project. There are three sites and one TCP within or near the APE: 45BN22, a pre-contact campsite; 45BN1444 a lithic concentration; 45BN21, a possible burial; and a TCP, a village site. **We look forward to reviewing the EA and commenting at that time.**

These comments are based on information available to us at the time of the project review. We reserve the right to revise our comments as information becomes available. If you have any questions or concerns, please contact Arrow Coyote at (509) 634-2736. Thank you for your time and efforts related to this matter. If you wish to speak to me, my information is below.

Sincerely,

Guy Moura
Tribal Historic Preservation Officer
(509) 634-2695 office; (509) 634-2694 FAX

cc: Rob Whitlam, DAHP
File (AC)
Chrono.

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
WALLA WALLA, WA 99362-1876

August 27, 2015

Mr. Anthony D. Johnson
Chairman, Tribal Executive Committee
Nez Perce Tribe
PO Box 305
Lapwai, ID 83540-3851

Dear Chairman Johnson:

Please find enclosed the *Cultural Resources Compliance Report: Determination of Effect for the Proposed Ecosystem Restoration Project at Clover Island.* The enclosed report contains the recommendation that the proposed ecosystem restoration project at Clover Island in Kennewick, Washington, will result in no adverse effects to historic properties.

Please review the determination of effect and advise whether you agree. If you have any questions contact Mr. Scott Hall 509-527-7278, Scott.M.Hall@usace.army.mil or me 509-527-7274, Alice.K.Roberts@usace.army.mil.

Sincerely,

Alice K Roberts
Chief, Tribal Relations and Cultural Resources

Enclosure

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
201 NORTH THIRD AVENUE
WALLA WALLA, WA 99362-1876

August 27, 2015

Mr. JoDe Goudy
Chairman, Yakama Nation Tribal Council
Confederated Tribes and Bands
of the Yakama Nation
PO Box 151
Toppenish, WA 98948

Dear Chairman Goudy:

Please find enclosed the *Cultural Resources Compliance Report: Determination of Effect for the Proposed Ecosystem Restoration Project at Clover Island.* The enclosed report contains the recommendation that the proposed ecosystem restoration project at Clover Island in Kennewick, Washington, will result in no adverse effects to historic properties.

Please review the determination of effect and advise whether you agree. If you have any questions contact Mr. Scott Hall 509-527-7278, Scott.M.Hall@usace.army.mil or me 509-527-7274, Alice.K.Roberts@usace.army.mil.

Sincerely,

Alice K Roberts
Chief, Tribal Relations and Cultural Resources

Enclosure

G.4 CORRESPONDENCE PROVIDED BY THE PORT OF KENNEWICK

The following letters were submitted to the Port of Kennewick or on their behalf during their application for an Aquatic Lands Enhancement Account Grant in support of the habitat restoration and associated recreation project proposed for the north shore of Clover Island.

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DAN NEWHOUSE
4TH DISTRICT, WASHINGTON
www.newhouse.house.gov

1641 LONGWORTH HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
OFFICE (202) 225-5816
FAX (202) 225-3251

3100 GEORGE WASHINGTON WAY
SUITE 135
RICHLAND, WA 99354
OFFICE (509) 713-7374

402 EAST YAKIMA AVENUE
SUITE 445
YAKIMA, WA 98901
OFFICE (509) 452-3243

VICE-CHAIR
NUCLEAR CLEANUP CAUCUS

Congress of the United States
House of Representatives

HOUSE NATURAL RESOURCES COMMITTEE
SUBCOMMITTEE ON FEDERAL LANDS
SUBCOMMITTEE ON WATER, POWER, AND OCEANS

HOUSE COMMITTEE ON RULES
SUBCOMMITTEE ON LEGISLATIVE AND BUDGET PROCESS
SUBCOMMITTEE ON RULES AND ORGANIZATION OF THE HOUSE

HOUSE AGRICULTURE COMMITTEE
SUBCOMMITTEE ON BIOTECHNOLOGY, HORTICULTURE, AND RESEARCH
SUBCOMMITTEE ON LIVESTOCK AND FOREIGN AGRICULTURE

June 1, 2016

Alison Greene, Grants Manager
Recreation and Conservation Office
1111 Washington Street SE
Olympia, 98504

Subject: Port of Kennewick, ALEA and WWRP-Trails Applications

Dear Ms. Greene,

I am pleased to support the Port of Kennewick's ALEA and WWRP-Trails applications for the Clover Island Northshore Restoration and Riverwalk projects. As a United States Congressman who has the honor of serving the people of Central Washington, I recognize the importance of economic growth on Clover Island and the need for financial assistance to make these strategic improvements.

The Port of Kennewick has completed significant upgrades to the site in partnership with several inter-governmental agencies, including RCO, in recent years. Prior marina enhancements were supported through Boating Facilities grant #06-1885 for marina replacement, ALEA grant #08-1679 for a riverfront pathway and habitat restoration, and Boating Facilities grant #12-1655 for marina parking and restrooms.

Through the current ALEA and WWRP-Trails applications, the Port plans to leverage already finished work by completing shoreline protection and pathways, and restoring riparian habitat; specifically along the northern shore of Clover Island. The proposed section of trail will connect with the ALEA-funded Western Causeway Riverwalk and the 22-mile Sacagawea Heritage Trail, as well as to Kennewick's residential and Historic Downtown District. The total project will cover construction of 1,450 linear feet of path, electrical extensions for safety lighting, trail amenities, protection and restoration of salmon habitat, and interpretive signage.

The Port of Kennewick has seen continued economic growth on Clover Island, due to its ongoing efforts at revitalization. Businesses are thriving, and development interest is high. I believe that enhancements financed by these grant applications would provide excellent benefits to the 4th Congressional District. I ask that you give full and fair consideration to the Port of Kennewick's applications and their requests for funding.

Sincerely,

Dan Newhouse
Member of Congress

Confederated Tribes *of the*
Umatilla Indian Reservation

Board of Trustees & General Council

46411 Timíne Way • Pendleton, OR 97801
(541) 429-7030 • fax (541) 276-3095
info@ctuir.org • www.umatilla.nsn.us

May 23, 2016

Skip Novakovich, President
Port of Kennewick Board of Commissioners
350 Clover Island Drive, Suite 200
Kennewick, WA 99336

Dear President Novakovich:

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) would like to offer our support for your application to the Recreation and Conservation Funding Board to secure funding for shoreline improvements, habitat restoration and public recreational activities on Clover Island.

Clover Island has seen dramatic changes under the vision of the Port of Kennewick and the CTUIR appreciates your work to address the shoreline and habitat degradation that has occurred since inundation of the area by the construction of McNary Dam. The Tri-Cities is immediately down-river from one of last natural stretches of the Columbia River in the Hanford Reach, which also contains the only run of salmon in the lower Columbia that is not listed under the Endangered Species Act. The Port's leadership in this area provides important benefits to the Tri-Cities and the region.

We look forward to completion of this project and to maintaining our partnership with the Port of Kennewick on future projects. We value our relationship we've developed with the Port over the past several years, a relationship that was formalized in our 2013 Memorandum of Agreement.

Please do not hesitate to contact me or our Executive Director Dave Tovey if we can help with this or other projects. Good luck with your funding application.

Sincerely,

Dave Tovey for

Gary Burke, Chair
Board of Trustees

Cc: Tim Arntzen, CEO, Port of Kennewick

State of Washington
Department of Fish and Wildlife
Pasco District Office, Habitat Program
2620 North Commercial Avenue, Pasco, WA 99301
Phone: (509) 543-3319, E-mail, Michael.Ritter@dfw.wa.gov

April 20, 2016

Tim Arntzen, Chief Executive Officer
Port of Kennewick
3500 Clover Island Drive, Suite 200
Kennewick, WA 99336

RE: Clover Island. Support for the Port of Kennewick's Efforts to Further Convert Barren Shoreline into Productive Habitat

Dear Mr. Arntzen:

The Port of Kennewick Administration demonstrates a vision for Clover Island as one that has substantial harmony with the river environment. A quite notable first step in reclaiming historic characteristics that the pre-reservoir Clover Island once provided to fish and wildlife, is their recent conversion of the Island's west causeway into a complex, living shoreline that now emulates those found along the undeveloped Hanford Reach. We support their funding applications to the Recreation and Conservation Funding Board that will help them to extend these shoreline improvements along the northern shore of the Island. We appreciate that these efforts show collaborative planning, coordination, and salesmanship on their part and strongly reflect the suggestions and prescriptions by fish and wildlife biologists of the U.S. Army Corps of Engineers, NOAA-Fisheries, and the Department of Fish and Wildlife.

An extensive system of Columbia River levees throughout the Tri-Cities and post-dam inundation of natural bars and islands for ten miles upstream drastically reduces native-fish and wildlife habitats. A loss of refuge areas, together with the creation of better habitat for both native and non-native predator species, are prevailing ecosystem deficiencies resulting from those levees.

Clover Island is located just sixteen miles downstream of Washington's greatest remaining fall chinook spawning area in the Hanford Reach. The island, in its man-made form, affords a comparatively beneficial variation of the altered environmental conditions for many native species because it impounds the swift river flow and wind. Nutrients, food items, and warmer water already tend to be retained around the Island, just because of its orientation and size. For instance, weeks-old juvenile fall chinook have been known to preferentially aggregate along the west causeway since the recent fish habitat improvements and the Island, with its moderated conditions, may resemble a bit of a desert oasis to these fragile hatchlings.

The proposed conversion of even more barren shoreline to emulate natural river shore will help to further reduce predation, positively influence feeding conditions (much through increased primary productivity); and that will likely attract and support even larger numbers of the young chinook. For these reasons, the Washington Department of Fish and Wildlife has assigned a much-elevated priority to improving the shoreline of Clover Island for a considerable time. We strongly encourage the Port's ecosystem-based approach to economic development of shorelines to be replicated throughout the Tri-Cities reach of the Columbia River.

Please feel free to contact me at 509-543-3319 for additional information relating to our support of the Port of Kennewick's request.

Sincerely,

Michael Ritter

Michael Ritter
Habitat Biologist
Benton and Franklin Counties
Washington Department of Fish and Wildlife

Jerome Delvin
District 1
Shon Small
District 2
James Beaver
District 3

Board of County Commissioners
BENTON COUNTY

David Sparks
County Administrator

Loretta Smith Kelty
Deputy County Administrator

April 26, 2016

Mr. Tim Arntzen, Executive Director
Port of Kennewick
350 Clover Island Drive, Suite 200
Kennewick, WA 99336

Re: Clover Island Shoreline Improvement Project
RCO Grant Applications

Dear Mr. Arntzen:

The Board of County Commissioners extends its support of your efforts to obtain a Recreation and Conservation Funding Board grant for habitat improvements, bank stabilization, and public recreational pathways on Clover Island in Kennewick.

Benton County recognizes the importance of environmental enhancement and public access projects such as the Clover Island Northshore Restoration and Riverwalk Project. We support the Port of Kennewick's goals of creating improved conditions favorable to young salmon, adding native plantings, and developing secure, stable, barrier-free public access to the Columbia River on Clover Island. This project is good for people, good for fish, and good for the economy.

Thank you for your efforts to improve the natural environment and provide shoreline pathways for public access to biking, birding, skating, jogging, and river recreation. This project will surely prove a catalyst for renewed interest in the Columbia River, and a stimulus to the economic future of our community.

Sincerely,

BOARD OF COUNTY COMMISSIONERS

Shon Small, Chairman

cc: Benton County Park Board

P.O. Box 190, Prosser, WA 99350-0190; Phone (509) 786-5600 or (509) 736-3080, Fax (509) 786-5625
commissioners@co.benton.wa.us

KENNEWICK WASHINGTON

Leading the Way

April 25, 2016

Mr. Tim Arntzen, Executive Director
Port of Kennewick
350 Clover Island Drive, Suite 200
Kennewick, WA 99336

Re: Clover Island North Shoreline Restoration & Riverwalk Projects
RCO Grant Applications

Dear Tim:

On behalf of the City of Kennewick, I am writing to demonstrate our full and continued support of your efforts to obtain a Recreation and Conservation grant for habitat improvements, bank stabilization, and public recreational pathways on Clover Island.

The City of Kennewick recognizes the importance of environmental enhancement and public access projects such as the Clover Island Northshore Restoration and Riverwalk projects. And we wholeheartedly support the Port of Kennewick's goals of creating improved conditions favorable to young salmon, adding native plantings, and developing secure, stable, barrier-free public access to the Columbia River on Clover Island.

Thank you for your efforts to improve the natural environment and provide shoreline pathways for public access to biking, birding, skating, jogging, and river recreation. This project will surely prove a catalyst for renewed interest in the Columbia River, and a stimulus to the economic future of our community.

Sincerely,

Marie E. Mosley

Marie E. Mosley
City Manager

Office of the City Manager

210 W. 6th Ave • PO Box 6108 • Kennewick, WA 99336-0108
(509) 585-4238 • Fax (509) 585-4445 • go2kennewick.com

TRI-CITY REGIONAL
CHAMBER OF COMMERCE

April 28, 2016

Mr. Tim Arntzen, Executive Director
Port of Kennewick
350 Clover Island Drive, Suite 200
Kennewick, WA 99336

RE: Clover Island Shoreline Improvement Project
RCO Grant Application

Dear Mr. Arntzen,

On behalf of the nearly 1,200 member businesses of the Tri-City Regional Chamber of Commerce, I write you today in support of the Port of Kennewick's efforts to secure Recreation and Conservation grant funding for shoreline improvements on Clover Island. The Regional Chamber strongly supports economic development and revitalization in our region's downtowns and along the Columbia River. The Port's leadership in this endeavor is greatly appreciated and we hope this grant would allow for more work on habitat improvements, bank stabilization and public recreation on Clover Island.

Our members recognize the importance of a vibrant riverfront that enriches our community while providing great opportunities for outdoor recreation. Projects such as the Clover Island Northshore Restoration and Riverwalk Projects are vital to this effort and we support the Port's goals to improve conditions for young salmon and add native plants to the shoreline. It is also exciting to see that the Riverwalk Pathway will connect to our region's 22-mile long Sacagawea Heritage Trail, providing residents and visitors expanded barrier-free access to Columbia River viewpoints and Clover Island businesses.

Thank you for your efforts to strengthen our economy and quality of life in the Tri-Cities region. These projects will make Clover Island and even greater asset to our community and prove to be a catalyst for renewed interest in our beautiful riverfront.

Sincerely,

Lori Mattson

Lori Mattson, IOM
President & CEO
Tri-City Regional Chamber of Commerce

7130 W. Grandridge Blvd., Suite C • Kennewick, WA 99336
(509)736-0510 • www.tricityregionalchamber.com

April 21, 2016

Mr. Tim Arntzen
Executive Director
Port of Kennewick
350 Clover Island Drive, Suite 200
Kennewick, WA 99336

Re: Clover Island Shoreline Improvements
RCO Grant Applications

Dear Tim:

The Cedars Restaurant fully supports your application to the Recreation and Conservation Funding Board for both a *Washington Wildlife and Recreation Program – Trails* grant, and an *Aquatic Lands Enhancement* grant. As we understand, this project will help implement the *Bridge to Bridge; River to Railroad* community-wide project by removing concrete rubble, enhancing the shoreline, and adding public access to the river-related amenities on Clover Island.

The project would be of specific importance to the Cedars since it will greatly enhance the ability of restaurant patrons to enjoy the northern shoreline and river amenities. It will also provide barrier-free connection from our site to the lighthouse, western causeway and the Sacagawea Heritage Trail. We believe that these improvements will enhance the visitor experience and draw traffic to local businesses such as ours. This project will also help create better riparian habitat and a visually pleasing shoreline.

We strongly support the Clover Island Northshore Restoration and Riverwalk projects, and specifically the Port's continued work toward improving the shoreline experience for the Tri-City visitors and wildlife.

Sincerely,

David W. Mitcham
Cedars Restaurant, LLC

CLOVER ISLAND INN
"it's an island thing"
435 Clover Island Drive
Kennewick, WA 99336

April 21st, 2016

Mr. Tim Arntzen
Executive Director
Port of Kennewick
350 Clover Island Drive, Suite 200
Kennewick, Wa. 99336

RE: Clover Island Shoreline Improvements
RCO Grant Applications

Dear Tim:

The Clover Island Inn fully supports your application to the Recreation and Conservation Funding Board for the Clover Island Northshore Restoration and Riverside projects. As we understand, this project will help implement the Bridge to Bridge; River to Railroad community-wide project by removing concrete rubble, enhancing the shoreline, and adding public access to the river-related amenities on Clover Island.

The project would be of specific importance to the Clover Island Inn since it will greatly enhance the ability of hotel patrons to enjoy the shoreline and river amenities, and to directly access viewpoints, the Western Causeway Trail and the 22 mile Sacagawea Heritage Trail. The improvements will enhance the visitor experience and draw traffic to local businesses. It will also help create better reparian habitat and a visually pleasing shoreline.

We strongly support the Clover Island Shoreline Improvement Project and specifically the Port's implementation of the Bridge to Bridge; River to Railroad community-wide plan and improving the shoreline experience for the Tri-City visitors and wildlife.

Sincerely,

Mark Blotz / General Manager / Partner
Clover Island Inn

Clover Island Yacht Club

June 6, 2016

Mr. Tim Arntzen
Executive Director
Port of Kennewick
350 Clover Island Drive, Suite 200
Kennewick, WA 99336

Re: Clover Island Northshore Restoration and Riverwalk
RCO Grant Application Support

Dear Tim –

The Clover Island Yacht Club fully supports your application to the Recreation and Conservation Funding Board for grants from the Aquatic Lands Enhancement and Washington Wildlife and Recreation Program Trails programs. As we understand, this project will help implement the *Bridge to Bridge; River to Railroad* community-wide project by removing concrete rubble, enhancing the northern island shoreline, and extending the Riverwalk Trail to expand public access to the river-related amenities on Clover Island.

The project would be of specific importance to the Clover Island Yacht Club since it will greatly enhance the ability of our members and their visitors to enjoy the shoreline and river amenities, and to access river viewpoints. In addition, the improvements will enhance the visitor experience and draw traffic to local businesses. It will also help to create better riparian habitat and a visually pleasing shoreline.

Thank you for your efforts to improve the natural environment and provide shoreline pathways for public access to biking, birding, skating, jogging, and river recreation. This project will surely prove a catalyst for renewed interest in the Columbia River, and a stimulus to the economic future of our community.

Sincerely,

Jolene Grimes

Jolene Grimes, Commodore
Clover Island Yacht Club

HISTORIC DOWNTOWN
KENNEWICK
PARTNERSHIP

RECEIVED
JUN - 6 2016
PORT OF KENNEWICK

May 6, 2016

Mr. Tim Arntzen
Executive Director
Port of Kennewick
350 Clover Island Drive, Suite 200
Kennewick, WA 99336

Re: Clover Island Shoreline Improvement Project
RCO Grant Applications

Dear Tim,

The Historic Downtown Kennewick Partnership is happy to offer our full and continued support of your efforts to obtain Recreation and Conservation grants for shoreline stabilization, habitat improvements, and public recreation access on Clover Island.

Our Partnership recognizes the importance of environmental enhancement and public access projects such as the Clover Island Shoreline Improvement Project. And we wholeheartedly support the Port of Kennewick's goals of creating improved conditions favorable to young salmon, adding native plantings, and developing secure, stable, barrier-free public access on the Island.

Thank you for your efforts to improve the environment and provide waterfront paths for the public to enjoy birding, biking, running, and river recreation. We expect this project will help local salmon, increase interest in the Columbia River, and enhance our local economy.

Sincerely,

Dan Smith
Executive Director
Historic Downtown Kennewick Partnership

P.O. Box 6552, Kennewick, Washington 99336 • 509.582.7221 • FAX 582.9720 • www.historickennewick.org

P.O. Box 2241
Tri-Cities, WA 99302-2241

509-735-8486

1-800-254-5824
www.VisitTRI-CITIES.com
info@VisitTRI-CITIES.com

April 28, 2016

Mr. Tim Arntzen, Executive Director
Port of Kennewick
350 Clover Island Drive, Suite 200
Kennewick WA 99336

Re: Clover Island Northshore Restoration and Riverwalk Improvements
RCO / ALEA & WWRP-Trails Applications

Dear Tim:

On behalf of Visit TRI-CITIES and our Tri-Cities Rivershore Enhancement Council, I am writing to express our continued support of the Port of Kennewick's efforts to obtain Recreation and Conservation grants for improved natural habitat, a stable shoreline, and barrier-free public paths on Clover Island.

We applaud enhancement projects, such as the Clover Island Northshore Restoration and Riverwalk Project, which appeal to both visitors and residents. In addition, we wholeheartedly encourage the Port's goals of increasing recreation access, incorporating native plants, and improving habitat for salmon on the Columbia River.

We appreciate your efforts to preserve and enhance our natural environment and to expand riverfront access for visitors who wish to run, bike, and walk along the river. Projects such as this draw visitors to our area, improve our citizens' quality of life and promote a healthy economy for the community.

Sincerely,

Kris Watkins

Kris Watkins
President & CEO

Alliance for a Livable and Sustainable Community
1000 Columbia Park Trail Richland, WA 99352 www.alsctc.org

April 25, 2016

Mr. Tim Arntzen,
Executive Director
Port of Kennewick
350 Clover Island Drive, Suite 200
Kennewick WA 99336

Re: Clover Island Northshore Restoration and Riverwalk Project
RCO Grant Applications

Dear Mr. Arntzen,

The Alliance for a Livable and Sustainable Community is pleased to support your request for grant funding from the Recreation and Conservation Office to create shoreline access for outdoor recreation and increase riparian habitat on Clover Island.

This Shoreline Improvement Project aligns with our focus on improved quality of life in the Tri-Cities region. We believe this project promotes community health and wellness, while also protecting and preserving the unique attributes of our natural environment. We are excited that the proposed pathway will connect to the Sacagawea Heritage Trail, meeting residents' needs for barrier-free access to walk, run, bike, or skate along the waterfront. We also support the Port's goals of creating habitat conditions favorable for young salmon and adding native plantings to the shoreline.

Thank you for your efforts to provide riverfront pathways for public recreation and access to nature. We fully support this project and anticipate it will benefit local residents, visitors and the regional economy.

Sincerely,

Carol Moser

Carol Moser,
President, ALSC

Clover Island Section 1135 Ecosystem Restoration

Kennewick, Washington

Clover Island Feasibility Report and Integrated Environmental Assessment

APPENDIX H, TOTAL PROJECT COSTS AND BASELINE CONSTUCTION ESTIMATE

To Be Released With Final Report