

1 Appendix F  
 2 **National Marine Fisheries Service and U.S.**  
 3 **Fish and Wildlife Service Matrices**

4 This appendix provides detailed information based on the 1996 National Marine Fisheries Service  
 5 (NMFS) and 1998 U.S. Fish and Wildlife Service (USFWS) Matrices of Pathways and Indicators. Details  
 6 are provided for the Columbia River (including North Portland Harbor), Columbia Slough, and Burnt  
 7 Bridge Creek for the NMFS Matrix. Only the Columbia River is discussed for the USFWS bull trout  
 8 matrix because potential bull trout presence within the action area is limited to this waterbody. The  
 9 following sections provide an assessment of existing conditions by indicator and the predicted effects of  
 10 the project on each indicator.

11 **COLUMBIA RIVER AND NORTH PORTLAND HARBOR – NMFS**  
 12 **MATRIX**

13 Table F-1 summarizes the effects of the proposed action on diagnostic pathways and indicators in the  
 14 Columbia River and North Portland Harbor. The rationale for the effects of the action appears in the text  
 15 below.

16 **Table F-1. NMFS Matrix of Pathways and Indicators Summary for the Columbia River and**  
 17 **North Portland Harbor**

Pathway Indicators	Environmental Baseline			Effects of the Action(s)		
	Properly Functioning	Functioning At Risk	Not Properly Functioning	Restore	Maintain	Degrade
<b>Water Quality:</b>						
Temperature			X		X	
Sediment			X		X (permanent)	X (temporary)
Chemical Contamination			X		X	
<b>Habitat Access:</b>						
Physical Barriers	X				X (permanent)	X (temporary)
<b>Habitat Elements:</b>						
Substrate			X		X	
Large Woody Debris			X		X	
Pool Frequency			X		X	
Pool Quality			X		X	
Off-Channel Habitat			X		X	
Refugia			X		X	
<b>Channel Condition and Dynamics:</b>						
Average Wetted Width/ Maximum Depth Ratio			X		X	
Streambank Condition	X				X	
Floodplain Connectivity			X		X	

Pathway Indicators	Environmental Baseline			Effects of the Action(s)		
	Properly Functioning	Functioning At Risk	Not Properly Functioning	Restore	Maintain	Degrade
<b>Flow/Hydrology:</b>						
Peak/Base Flows			X		X	
Drainage Network Increase			X		X	
<b>Watershed Conditions:</b>						
Road Density and Location			X		X	
Disturbance History			X		X	
Riparian Reserves		Not Applicable			Not Applicable	

1

2 **Water Quality**3 **Temperature**

4 Columbia River water temperatures at Washougal, Washington, range from approximately 6 degrees (°)  
5 Celsius (C) (43° Fahrenheit [F]) in early spring to approximately 22°C (72°F) in late summer (USGS  
6 2007). Temperatures in the action area are assumed to be comparable. Within the action area, the  
7 Columbia River does not meet Oregon Department of Environmental Quality (DEQ) standards for  
8 temperature and is 303(d)-listed (DEQ 2007). No Total Maximum Daily Load (TMDL) for temperature  
9 has been proposed at this time (DEQ 2009). For at least part of the year, water temperatures exceed the  
10 matrix standard of 60°F for spawning and 64°F for migration and rearing. Therefore, this indicator is *not*  
11 *properly functioning*.

12 The proposed project would not further degrade riparian vegetation, impact cool water sources, or reduce  
13 flow. The project will provide treatment and/or infiltration for more than 500 percent of new pollutant-  
14 generating impervious surface (PGIS) draining to these water bodies (previously untreated PGIS will be  
15 treated). This will possibly have a slight but insignificant benefit to temperatures. The project will  
16 *maintain* this indicator.

17 **Sediment/Turbidity**

18 In-stream substrate in the action area consists mainly of sand with a very low proportion of gravel.  
19 According to the matrix, less than 17 percent fines in gravel indicates that substrate is *not properly*  
20 *functioning*.

21 Turbidity in the action area is very low. From October 2002 to September 2007, the Washington State  
22 Department of Ecology (Ecology) conducted water quality sampling in the action area approximately  
23 3 miles upstream of the Interstate 5 (I-5) bridges (Ecology 2009a). Of 36 samples, all were  
24 12 nephelometric turbidity units (NTU) or under; 28 were 5 NTUs or under. This is extremely low  
25 turbidity.

1 Best management practices (BMPs) will be implemented to minimize sedimentation and turbidity during  
2 construction. Nevertheless, suspended sediment and turbidity levels are likely to be elevated within the  
3 approved mixing zones (approximately 300 feet) during in-water work. Therefore, the project may  
4 *temporarily degrade* this indicator. Long-term scour is not anticipated to occur. Stormwater treatment  
5 may cause a slight but insignificant reduction in the amount of total suspended solids entering the  
6 Columbia River and North Portland Harbor. The proposed project is expected to *maintain* conditions in  
7 the long term.

## 8 **Chemical Contamination/Nutrients**

9 The Columbia River and North Portland Harbor are on the DEQ 303(d) list for the following parameters:  
10 temperature, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs),  
11 dichlorodiphenyltrichloroethane (DDT) metabolites (e.g., dichlorodiphenyldichloroethylene [DDE]), and  
12 arsenic (DEQ 2007). The Columbia River is on Washington's 303(d) list for temperature, PCBs, and  
13 dissolved oxygen (Ecology 2009b). The U.S. Environmental Protection Agency (EPA) has approved  
14 TMDLs for dioxin and total dissolved gas in the Columbia River (DEQ 1991, 2002). In addition to the  
15 contaminants listed above, dissolved copper, a neurotoxicant that damages the olfactory abilities of fish,  
16 is also known to be present above naturally occurring levels in the Columbia River. Studies indicate that  
17 dissolved copper in the action area may occur at levels known to injure salmonids (WSDOT 2005;  
18 Ecology 2006; DEQ 2009).

19 Because the action area has numerous 303(d) listings and high levels of contamination from industry,  
20 agriculture, and roadways, this indicator is *not properly functioning*.

21 During the course of construction, the project will implement a temporary erosion and sediment control  
22 (TESC) plan, a Work Area Isolation Plan, and a Pollution Control Plan to minimize the risk of  
23 introducing chemical contaminants into the Columbia River and North Portland Harbor. Therefore, the  
24 project will not release chemical contaminants into these water bodies and will *maintain* this indicator.

25 There will be no permanent impacts to chemical contamination in these water bodies. Risk of  
26 contamination from equipment is restricted to the duration of the project. Untreated runoff from I-5 on  
27 Hayden Island and the existing I-5 bridges currently discharges directly to the river. Stormwater run-off  
28 will undergo a high level of treatment before being discharged into the Columbia River and North  
29 Portland Harbor; approximately 500 percent of new PGIS will undergo treatment (previously untreated  
30 PGIS will be treated). This may have a beneficial effect for this indicator, although not a significant one.  
31 Overall, the project will *maintain* this indicator.

## 32 **Habitat Access**

### 33 **Physical Barriers**

34 There are no physical barriers to fish passage within the action area, nor are there fish passage barriers  
35 between the action area and the Pacific Ocean. Therefore, this indicator is *properly functioning*.

36 The proposed project will not involve the creation of permanent physical barriers and will *maintain* this  
37 indicator in the long term. However, pile-driving will likely create a temporary migration barrier to all life  
38 stages of listed salmonids using the Columbia River and North Portland Harbor. Cofferdams and  
39 temporary in-water work structures also may create partial barriers to the migration of juvenile fish in  
40 shallow-water habitat. The project will *temporarily degrade* this indicator.

## 1 **Habitat Elements**

### 2 ***Substrate***

3 In the Columbia River and North Portland Harbor, substrate consists mainly of sand, with relatively small  
4 percentages of fine sediments and organic material (NMFS 2002; DEA 2006). Little to no gravel or  
5 cobble is present in the substrate within the action area. Because sand is dominant, this indicator is *not*  
6 *properly functioning*.

7 The project will not alter substrate composition and will therefore *maintain* this indicator.

### 8 ***Large Woody Debris***

9 The action area contains fewer than 80 pieces of large wood per mile of stream. Potential for large woody  
10 debris recruitment is low due to the urbanized nature of the action area and the limited number of mature  
11 riparian trees. Therefore, this indicator is *not properly functioning*.

12 In Oregon, the project will remove three trees from the riparian zone on the south bank of the Columbia  
13 River and two trees from riparian zone adjacent to North Portland Harbor. In Washington, 10 trees will be  
14 removed from the riparian zone on the north shore of the Columbia River. Although the project may  
15 involve some riparian or in-stream restoration, improvements will not increase large wood to 80 pieces  
16 per mile. Therefore, the project will *maintain* this indicator.

### 17 ***Pool Frequency***

18 The Columbia River and North Portland Harbor contain virtually no natural pools within the action area.  
19 Glide habitat is the dominant stream habitat type in this area. Few to no pools are formed or maintained  
20 by large wood, and the potential for future recruitment of large wood in these systems is very low.  
21 Therefore, this indicator is *not properly functioning*.

22 The proposed project is not expected to improve or degrade pool habitat in the mainstem Columbia River  
23 or North Portland Harbor; therefore, the proposed project will *maintain* this indicator.

### 24 ***Pool Quality***

25 Adequate cover is limited to absent due to the lack of large wood, overhanging banks, alcoves, and other  
26 types of cover. The sandy substrate of the Columbia River and North Portland Harbor moves  
27 continuously with the river currents and is likely to cause a reduction in volume of any pools that may  
28 form. Cool water is generally absent, as evidenced by 303(d) list temperature exceedances. This indicator  
29 is *not properly functioning*.

30 The proposed project will not have any effect on pool quality in the Columbia River or North Portland  
31 Harbor. Therefore, the project will *maintain* this indicator.

### 32 ***Off-Channel Habitat***

33 Within the action area, the Columbia River and North Portland Harbor contain few to no backwaters,  
34 ponds, oxbows, and other low-energy off-channel areas. Historic off-channel areas have been filled,  
35 rechanneled, diverted, and otherwise developed for urban use over the past 150 years. North Portland  
36 Harbor may provide some of the only off-channel habitat functions (lower energy flows relative to the  
37 Columbia River). This indication is *not properly functioning*.

1 The project will have no effect on off-channel habitat in the mainstem Columbia River or North Portland  
2 Harbor. Therefore, the project will *maintain* this indicator.

### 3 ***Refugia***

4 Within the action area, the Columbia River and North Portland Harbor contain extremely few refugia  
5 (pools, boulders, large wood, overhanging riparian vegetation). Additionally, riparian buffers are few.  
6 Therefore, this indicator is *not properly functioning*.

7 The project will not improve or degrade refugia in the Columbia River or North Portland Harbor.  
8 Therefore, the project will *maintain* this indicator.

## 9 **Channel Condition and Dynamics**

### 10 ***Width/Depth Ratio***

11 Within the action area, the Columbia River measures on average 2,400 feet wide and 27 feet deep. North  
12 Portland Harbor measures approximately 500-feet-wide by 14-feet-deep (DEA 2006). The width/depth  
13 ratio of each waterway is greater than 12. Therefore, this indicator is *not properly functioning*.

14 The project will have no effect on the width/depth ratio and will therefore *maintain* this indicator.

### 15 ***Streambank Condition***

16 In the action area, the Columbia River is a broad channel constrained by surrounding urban development.  
17 Streambanks along the Columbia River and North Portland Harbor within the action area are stable, and  
18 less than 10 percent of the bank area is actively eroding. Both the left and right banks are armored  
19 upstream and downstream of the bridge. This indicator is *properly functioning*.

20 The project will not affect bank stability and erosion in the Columbia River or North Portland Harbor and  
21 will therefore *maintain* this indicator.

### 22 ***Floodplain Connectivity***

23 Within the action area, there is a severe reduction in connectivity between the Columbia River/North  
24 Portland Harbor and their historic floodplains due to the presence of numerous structures such as  
25 streambank armor, levees, and fills. Overbank flows occur only very occasionally. Wetland extent is  
26 drastically reduced, and the succession of riparian vegetation has been significantly altered. Therefore,  
27 this indicator is *not properly functioning*.

28 The project will not alter floodplain connectivity for the Columbia River and North Portland Harbor;  
29 therefore, it is expected to *maintain* this indicator.

## 30 **Flow/Hydrology**

### 31 ***Peak/Base Flows***

32 Development of the hydropower system on the Columbia River has significantly influenced peak seasonal  
33 discharges and the velocity and timing of flows in the river. The Columbia River estuary historically  
34 received annual spring freshet flows that were on average 75 to 100 percent higher than current flows.  
35 Historical winter flows (October through March) also were approximately 35 to 50 percent lower than  
36 current flows (ISAB 2000). Due to the magnitude of the changes in flow timing and volume, this  
37 indicator is *not properly functioning*.

1 The project will provide a high level of infiltration for stormwater runoff and may have a benefit to  
2 flow, although it will be an insignificant one. The project will *maintain* this indicator.

3 ***Drainage Network Increase***

4 The action area is highly urbanized and contains a dense system of roadways. Since most of the natural  
5 streams in the Portland and Vancouver metropolitan areas have been routed underground into pipes or  
6 diverted into the roadside ditch network, we assume that there is less than a 25 percent increase in the  
7 drainage network due to roads. Therefore, this indicator is *not properly functioning*.

8 The project will not change the course of any surface water body. Therefore, it will *maintain* this  
9 indicator.

10 **Watershed Conditions**

11 ***Road Density and Location***

12 Road density exceeds 3 miles per square mile. There are numerous valley-bottom roads paralleling the  
13 Columbia River and North Portland Harbor. Therefore, this indicator is *not properly functioning*.

14 The project will *maintain* the current condition of more than 3 miles of road per square mile.

15 ***Disturbance History***

16 The watershed consists of well over 15 percent “equivalent clear-cut area.” Disturbance is especially  
17 pronounced in riparian areas, and there is little potential for the development of old growth due to intense  
18 urbanization. Therefore, this indicator is *not properly functioning*.

19 The project will *maintain* the current condition of more than 15 percent “equivalent clear-cut area,” with  
20 disturbances concentrated in riparian areas.

21 ***Riparian Reserves***

22 This indicator is specific to U.S. Forest Service (USFS)-managed areas, and therefore, is not applicable in  
23 the context of the Columbia River Crossing (CRC) project.

1 **COLUMBIA RIVER AND NORTH PORTLAND HARBOR – USFWS**  
 2 **MATRIX FOR BULL TROUT**

3 Table F-2 presents the pathways and indicators summary for bull trout in the Columbia River and North  
 4 Portland Harbor. The rationale for the effects of the actions appears in the text below.

5 **Table F-2. Pathways and Indicators Summary for Bull Trout – Columbia River and North**  
 6 **Portland Harbor**

Pathway: Indicators	Environmental Baseline			Effects of the Action(s)		
	Functioning Adequately	Functioning at Risk	Functioning At Unacceptable Risk	Restore	Maintain	Degrade
<b>Subpopulation Characteristics:</b>						
Subpopulation Size			X		X	
Growth and Survival			X		X	
Life History Diversity and Isolation			X		X	
Persistence and Genetic Integrity			X		X	
<b>Water Quality:</b>						
Temperature			X		X	
Sediment			X		X	
Chemical Contamination			X		X	
<b>Habitat Access:</b>						
Physical Barriers	X				X (permanent)	X (temporary)
<b>Habitat Elements:</b>						
Substrate			X		X	
Large Woody Debris			X		X	
Pool Frequency and Quality			X		X	
Large Pools			X		X	
Off-Channel Habitat			X		X	
Refugia			X		X	
<b>Channel Condition and Dynamics:</b>						
Average Wetted Width/ Maximum Depth Ratio			X		X	
Streambank Condition	X				X	
Floodplain Connectivity			X		X	
<b>Flow/Hydrology:</b>						
Peak/Base Flows			X		X	
Drainage Network Increase			X		X	

Pathway: Indicators	Environmental Baseline			Effects of the Action(s)		
	Functioning Adequately	Functioning at Risk	Functioning At Unacceptable Risk	Restore	Maintain	Degrade
<b>Watershed Conditions:</b>						
Road Density and Location			X		X	
Disturbance History			X		X	
Riparian Reserves	Not Applicable			Not Applicable		
Disturbance Regime			X		X	
<b>Species and Habitat:</b>						
Integration of Species and Habitat Conditions			X		X	X (temporary)

1

2 **Subpopulation Characteristics within Subpopulation Watersheds**

3 ***Subpopulation Size***

4 Current bull trout abundance in the mainstem of the Columbia River has not been thoroughly  
 5 documented. However, records indicate that bull trout detections are infrequent and limited to very few  
 6 individuals. There have been only 12 detections of bull trout at, near, or downstream of Bonneville Dam  
 7 from 1941 to 2000. This indicator is *functioning at unacceptable risk*.

8 Due to the low abundance of bull trout in the Columbia River and North Portland Harbor, the project is  
 9 not expected to impact large numbers of bull trout. Core populations occur in Columbia River tributaries  
 10 far from the action area. The project is expected to *maintain* subpopulation size.

11 ***Growth and Survival***

12 Records indicate alarmingly low numbers of bull trout present in the Columbia River mainstem.  
 13 Subpopulations are not likely to recover within 5 to 10 years. Therefore, this indicator is *functioning at*  
 14 *unacceptable risk*.

15 Due to the low abundance of bull trout in the Columbia River and North Portland Harbor, the project is  
 16 not expected to impact large numbers of bull trout. While the project may affect some individuals, these  
 17 effects will not occur at the subpopulation level. Therefore, the project will *maintain* this indicator.

18 ***Life History Diversity and Isolation***

19 The low abundance of bull trout in the Columbia River indicates that the migratory form of bull trout is  
 20 essentially absent. Numerous migration barriers (dams) occur between the action area and subpopulations  
 21 in tributaries such as Hood River, Klickitat River, and Lewis River. These subpopulations are isolated  
 22 from one another. Therefore, this indicator is *functioning at unacceptable risk*.

23 The project will have no effect on the isolation of bull trout subpopulations. Therefore, the project will  
 24 *maintain* this indicator.



## 1 **Persistence and Genetic Integrity**

2 There are numerous migration barriers between the various subpopulations, and they are effectively  
3 isolated from one another. This indicator is *functioning at unacceptable risk*.

4 The project will have no effect on the isolation of bull trout subpopulations. Therefore, the project will  
5 *maintain* this indicator.

## 6 **Water Quality**

### 7 **Temperature**

8 Columbia River water temperatures at Washougal, Washington, range from approximately 6°C (43°F) in  
9 early spring to approximately 22°C (72°F) in late summer (USGS 2007). Temperatures in the action area  
10 are assumed to be comparable. Within the action area, the Columbia River does not meet DEQ standards  
11 for temperature and is 303(d)-listed (DEQ 2007). No TMDL for temperature has been proposed so far  
12 (DEQ 2009). For at least some of the year, water temperatures exceed the Matrix standards of 48°F for  
13 spawning, 54°F for rearing, and 41°F for incubation. Therefore, this indicator is *functioning at*  
14 *unacceptable risk*.

15 The proposed project would not further degrade riparian vegetation, impact cool water sources, or reduce  
16 flow. The project will provide treatment and/or infiltration for more than 500 percent of new PGIS  
17 draining to these water bodies (previously untreated PGIS will be treated). This will possibly have a slight  
18 but insignificant benefit to temperatures, but will certainly not degrade them. The project will *maintain*  
19 this indicator.

### 20 **Sediment**

21 Substrate in the action area consists mainly of sand with a very low proportion of gravel. Substrate is  
22 greater than 20 percent fines. Therefore, this indicator is *functioning at unacceptable risk*.

23 The project will not affect substrate composition in the action area and will therefore *maintain* this  
24 indicator.

### 25 **Chemical Contamination/Nutrients**

26 The Columbia River and North Portland Harbor are on the DEQ 303(d) list for the following parameters:  
27 temperature, PCBs, PAHs, DDT metabolites (e.g., DDE), and arsenic (DEQ 2007). The Columbia River  
28 is on Washington's 303(d) list for temperature, PCBs, and dissolved oxygen (Ecology 2009b). EPA has  
29 approved TMDLs for dioxin and total dissolved gas in the Columbia River (DEQ 1991, 2002). Untreated  
30 runoff from I-5 on Hayden Island and the existing I-5 bridges discharges directly to the river.

31 In addition to the contaminants listed above, dissolved copper, a neurotoxicant that damages the olfactory  
32 abilities of fish, is also known to be present above naturally occurring levels in the Columbia River.  
33 Studies indicate that dissolved copper in the action area may occur at levels known to injure salmonids  
34 (WSDOT 2005; Ecology 2006; DEQ 2009).

35 Because the action area has numerous 303(d) listings and high levels of contamination from industry,  
36 agriculture, and roadways, this indicator is *functioning at unacceptable risk*.

1 During the course of construction, the project will implement a TESC plan, a Work Area Isolation Plan,  
2 and a Pollution Control Plan to minimize the risk of introducing chemical contaminants into the Columbia  
3 River and North Portland Harbor. Therefore, the project will not release chemical contaminants into these  
4 water bodies and will *maintain* this indicator.

5 There will be no permanent impacts to chemical contamination in these water bodies. Risk of  
6 contamination from equipment is restricted to the duration of the project. Stormwater runoff will undergo  
7 a high level of treatment before being discharged into the Columbia River and North Portland Harbor;  
8 approximately 500 percent of new PGIS will undergo treatment (previously untreated PGIS will be  
9 treated). This may have a beneficial effect for this indicator, although not a significant one. Overall, the  
10 project will *maintain* this indicator.

## 11 **Habitat Access**

### 12 ***Physical Barriers***

13 There are no physical barriers to fish passage within the action area, nor are there barriers between the  
14 action area and the Pacific Ocean. Therefore, this indicator is *functioning appropriately*.

15 The proposed project will not involve the creation of permanent physical barriers and will *maintain* this  
16 indicator in the long term. However, pile-driving will create a temporary barrier to migration in the  
17 Columbia River and North Portland Harbor. Cofferdams and in-water work structures will also create  
18 temporary, partial barriers to the migration of juvenile fish in shallow in-water habitat. The project will  
19 *temporarily degrade* this indicator.

## 20 **Habitat Elements**

### 21 ***Substrate Embeddedness***

22 In the Columbia River and North Portland Harbor, substrate consists mainly of sand, with relatively small  
23 percentages of fine sediments and organic material (NMFS 2002; DEA 2006). Little to no gravel or  
24 cobble is present in the substrate within the action area. Because sand is dominant, this indicator is  
25 *functioning at unacceptable risk*.

26 The project will not alter substrate composition and will therefore *maintain* this indicator.

### 27 ***Large Woody Debris***

28 The action area contains fewer than 80 pieces of large wood per mile of stream. Potential for large woody  
29 debris recruitment is low due to the urbanized nature of the action area and the limited number of mature  
30 riparian trees. Therefore, this indicator is *functioning at unacceptable risk*.

31 The project will not remove any riparian trees of significant size. Although the project may involve some  
32 riparian or in-stream restoration, improvements will not increase large wood to 80 pieces per mile.  
33 Therefore, the project will *maintain* this indicator.

### 34 ***Pool Frequency and Quality***

35 The Columbia River and North Portland Harbor contain essentially no pool habitat within the action area.  
36 Glide habitat is the dominant stream habitat type in this area. Few to no pools are formed or maintained  
37 by large wood, and the potential for future recruitment of large wood in these systems is very low. Pool  
38 quality is similarly degraded. Adequate cover is limited to absent due to the lack of large wood,  
39 overhanging banks, alcoves, and other types of cover. The sandy substrate of the Columbia River moves

1 continuously with the river currents and is likely to cause a reduction in volume of any pools that may  
2 form. Cool water is generally absent, as evidenced by 303(d) list temperature exceedances. Therefore, this  
3 indicator is *functioning at unacceptable risk*.

4 The proposed project is not expected to improve or degrade pool habitat in the mainstem Columbia River  
5 or North Portland Harbor. Therefore, the proposed project would *maintain* this indicator.

### 6 **Large Pools**

7 Pools are largely absent from the Columbia River and North Portland Harbor. Therefore, this indicator is  
8 *functioning at unacceptable risk*.

9 The proposed project is not expected to improve nor degrade pool size in the Columbia River or North  
10 Portland Harbor. Therefore, the proposed project would *maintain* this indicator.

### 11 **Off-channel Habitat**

12 Within the action area, the Columbia River and North Portland Harbor contain few to no backwaters,  
13 ponds, oxbows, and other low-energy off-channel habitat. Historic off-channel areas have has been filled,  
14 rechanneled, diverted, and otherwise developed for urban use over the past 150 years. North Portland  
15 Harbor may provide some of the only off-channel habitat functions (lower energy flows relative to the  
16 Columbia River). This indicator is *functioning at unacceptable risk*.

17 The proposed project will have no effect on off-channel habitat in the mainstem Columbia River or North  
18 Portland Harbor. Therefore, the project will *maintain* this indicator.

### 19 **Refugia**

20 Within the action area, the Columbia River and North Portland Harbor contain extremely few refugia  
21 (such as pools, boulders, large wood, overhanging riparian vegetation). Additionally, riparian buffers are  
22 few. Therefore, this indicator is *functioning at unacceptable risk*.

23 The project will not improve or degrade refugia in the Columbia River or North Portland Harbor.  
24 Therefore, the project will *maintain* this indicator.

## 25 **Channel Condition and Dynamics**

### 26 **Average Wetted Width/Maximum Depth Ratio**

27 Within the action area, the Columbia River measures on average 2,400 feet wide and 27 feet deep. North  
28 Portland Harbor measures approximately 500 feet wide by 14 feet deep (DEA 2006). The width/depth  
29 ratio of both waterways is greater than 20. Therefore, this indicator is *functioning at unacceptable risk*.

30 The project will have no effect on the width/depth ratio and will therefore *maintain* this indicator.

### 31 **Streambank Condition**

32 In the action area, the Columbia River is a broad channel constrained by surrounding urbanized  
33 development. Streambanks along the Columbia River and North Portland Harbor within the action area  
34 are stable, and less than 10 percent of the bank area is actively eroding. Both the left and right banks are  
35 armored upstream and downstream of the bridge. This indicator is *functioning appropriately*.

1 The project is will not affect bank stability and erosion in the Columbia River or North Portland Harbor  
2 and will therefore *maintain* this indicator.

### 3 ***Floodplain Connectivity***

4 Within the action area, there is a severe reduction in connectivity between the Columbia River/North  
5 Portland Harbor and their historic floodplains due to the presence of numerous structures such as  
6 streambank armor, levees, and fills. Overbank flows occur only very occasionally. Wetland extent is  
7 drastically reduced, and the succession of riparian vegetation has been significantly altered. Therefore,  
8 this indicator is *functioning at unacceptable risk*.

9 The project will not alter floodplain connectivity for the Columbia River and North Portland Harbor;  
10 therefore, it is expected to *maintain* this indicator.

## 11 **Flow/Hydrology**

### 12 ***Change in Peak and Base Flows***

13 Development of the hydropower system on the Columbia River has significantly influenced peak seasonal  
14 discharges and the velocity and timing of flows in the river. The Columbia River estuary historically  
15 received annual spring freshet flows that were 75 to 100 percent higher on average than current freshet  
16 flows. Historical winter flows (October through March) also were approximately 35 to 50 percent lower  
17 than current flows (ISAB 2000). Due to the magnitude of the changes in flow timing and volume, this  
18 indicator is *functioning at unacceptable risk*.

19 The project will provide a high level of infiltration for stormwater runoff and may have a benefit to flow,  
20 although it will be an insignificant one. The project will *maintain* this indicator.

### 21 ***Drainage Network Increase***

22 The action area is highly urbanized and contains a dense system of roadways. Since most of the natural  
23 streams in the Portland and Vancouver metropolitan areas have been routed underground into pipes or  
24 diverted into the roadside ditch network, we can assume that there is less than a 25 percent increase in the  
25 drainage network due to roads. Therefore, this indicator is *functioning at unacceptable risk*.

26 The project will not change the course of any surface water body. Therefore, it will *maintain* this  
27 indicator.

## 28 **Watershed Conditions**

### 29 ***Road Density and Location***

30 Road density exceeds 2.4 miles per square mile. There are numerous valley-bottom roads paralleling the  
31 Columbia River and North Portland Harbor. Therefore, this indicator is *functioning at unacceptable risk*.

32 The project will *maintain* the current condition of more than 2.4 miles of road per square mile.

### 33 ***Disturbance History***

34 The watershed consists of well over 15 percent “equivalent clear-cut area.” Disturbance is especially  
35 pronounced in riparian areas, and there is no potential for the development of old growth due to intense  
36 urbanization. Therefore, this indicator is *functioning at unacceptable risk*.

1 The project will *maintain* the current condition of more than 15 percent “equivalent clear-cut area,” with  
2 disturbance concentrated in riparian areas.

### 3 ***Riparian Conservation Areas***

4 This indicator is specific to USFS-managed areas and therefore is not applicable in the context of the  
5 CRC project.

### 6 ***Disturbance Regime***

7 Numerous dams throughout the Columbia Basin regulate flows within the action area. As a result, the  
8 stream hydrograph is fairly predictable, subject to infrequent catastrophic events. Although the  
9 hydrograph is stable, it is highly altered from its natural state. The Columbia River channel is highly  
10 simplified, with little hydraulic complexity in the pools or side channels. Therefore, this indicator is  
11 *functioning at unacceptable risk*.

12 The project will have no effect on the disturbance regime at the watershed scale and will therefore  
13 *maintain* this indicator.

### 14 **Species and Habitat**

#### 15 ***Integration of Species and Habitat Conditions***

16 Integration of species and habitat conditions in the action area is currently very poor. Only about 12  
17 detections of bull trout have been recorded in the lower Columbia River at, near, or downstream of  
18 Bonneville Dam from 1941 to 2000. Habitat conditions in the action area are not expected to improve  
19 within 5 to 10 years. The tributary subpopulations of bull trout are separated by many miles of mainstem  
20 Columbia River and several large passage barriers (e.g., Merwin Dam on the Lewis River in  
21 Washington). The subpopulations are effectively isolated from one another. Therefore, this indicator is  
22 *functioning at unacceptable risk*.

23 In-water pile driving will create a temporary passage barrier within the action area. However, given that  
24 few bull trout actually use the action area and given that large dams already isolate the subpopulations  
25 from one another, the project is not expected to cause a significant barrier to migration between  
26 subpopulation areas. The project will also have no effect on survival and recruitment where core  
27 subpopulations occur in the Lewis, Hood, and Klickitat Rivers. Likewise, the project will have no effect  
28 on habitat conditions in these areas. Therefore, the project will *maintain* this indicator.

1 **COLUMBIA SLOUGH – NMFS MATRIX**

2 Table F-3 summarizes the effects of the proposed action on diagnostic pathways and indicators in  
 3 Columbia Slough. The rationale for the effects of the action appears in the text below.

4 **Table F-3. NMFS Matrix of Pathways and Indicators Summary for the Columbia Slough**

Pathway Indicators	Environmental Baseline			Effects of the Action(s)		
	Properly Functioning	Functioning At Risk	Not Properly Functioning	Restore	Maintain	Degrade
<b>Water Quality:</b>						
Temperature			X		X	
Sediment/Turbidity			X		X	
Chemical Contamination/ Nutrients			X		X	
<b>Habitat Access:</b>						
Physical Barriers	X				X	
<b>Habitat Elements:</b>						
Substrate			X		X	
Large Woody Debris			X		X	
Pool Frequency			X		X	
Pool Quality			X		X	
Off-Channel Habitat			X		X	
Refugia			X		X	
<b>Channel Condition and Dynamics:</b>						
Width/Depth Ratio	X				X	
Streambank Condition		X			X	
Floodplain Connectivity			X		X	
<b>Flow/Hydrology:</b>						
Peak/Base Flows			X		X	
Drainage Network Increase		X			X	
<b>Watershed Conditions:</b>						
Road Density and Location			X		X	
Disturbance History			X		X	
Riparian Reserves		Not Applicable			Not Applicable	

5

6 **Water Quality**

7 The City of Portland Bureau of Environmental Service (BES) has done intensive water quality monitoring  
 8 on the Columbia Slough since 1994. They collect water quality data from three sites in the lower  
 9 Columbia Slough, including continuous measurements of temperature, pH, dissolved oxygen, and  
 10 conductivity.

## 1 **Temperature**

2 Columbia Slough is on the 303(d) list for exceedance of temperature standards. The 303(d) list notes  
3 temperatures greater than 17.8°C (64°F) from river mile (RM) 0 to RM 8.5, including the action area. A  
4 draft TMDL is being prepared. Because the Columbia Slough exceeds NMFS standards of 60°F for  
5 spawning and 64°F for rearing, this indicator is *not properly functioning*.

6 The project will not remove riparian vegetation, impact cool water sources, or reduce flow to the  
7 Columbia Slough. There will be a high level of treatment for new and existing PGIS, possibly having a  
8 slight but insignificant benefit to temperatures, but certainly not degrading them. The project will  
9 *maintain* this indicator.

## 10 **Sediment/Turbidity**

11 The Columbia Slough does not exceed 303(d) list standards for turbidity. However, according to the  
12 National Pollutant Discharge Elimination System (NPDES) 1200-COLS permit regulating industrial  
13 discharges to the Columbia Slough, the in-stream target for total suspended solids (TSS) is 25 mg/L in the  
14 Columbia Slough (COP 2009). Downstream of the project area, near Portland International Raceway, less  
15 than 50 percent of City of Portland samples met the target. Generally, though, water clarity improves in  
16 the Columbia Slough with distance upstream from the confluence with the Willamette River. Upstream of  
17 the project area, near the Vancouver Avenue crossing of the Columbia Slough, greater than 90 percent of  
18 the samples met the target.

19 The Columbia Slough contains fine, silty sediment with a relatively high content of organic matter.

20 Because fines exceed 17 percent of substrate composition, and water quality samples are above  
21 acceptable levels for turbidity, this indicator is *not properly functioning*.

22 The project does not include any in-water work in the Columbia Slough. Sediment sources generated by  
23 the project will be limited to construction-related erosion and stormwater inputs. BMPs will be used to  
24 control erosion, so the project will not appreciably affect sediments in the Columbia Slough. The high  
25 level of stormwater treatment will cause a slight but insignificant reduction of TSS entering the Columbia  
26 Slough, but will certainly not degrade this condition. Therefore, the project will *maintain* this indicator.

## 27 **Chemical Contamination/Nutrients**

28 The Columbia Slough is on the 1994/1996 DEQ 303(d) list of water quality-impaired streams for the  
29 following parameters: lead, PCBs, DDE/DDT, dieldrin, and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD),  
30 pH, dissolved oxygen, phosphorous, chlorophyll a, bacteria, and temperature (COP 2009). TMDLs have  
31 been established for all of these parameters except temperature (DEQ 1998). Because the Columbia  
32 Slough has several exceedances of 303(d) list parameters and numerous sources of contamination from  
33 industrial sites and dense roads, this indicator is *not properly functioning*.

34 The project does not include any in-water work in the Columbia Slough. Chemical contaminants are  
35 unlikely to enter the Columbia Slough during construction due to numerous BMPs designed to contain  
36 contaminants. During operation of the project, the high level of stormwater treatment will result in a slight  
37 reduction of contaminants entering the Columbia Slough, and will certainly not degrade this condition.  
38 Therefore, the project will *maintain* this indicator.

## 1 **Habitat Access**

### 2 ***Physical Barriers***

3 There are no known physical barriers to fish passage in the Columbia Slough portion of the action area or  
4 anywhere downstream of the action area to the Pacific Ocean. Therefore, this indicator is *properly*  
5 *functioning*. Upstream of the action area, anadromous fish passage occurs up to NE 18th Avenue.

6 The project does not include any in-water work in the Columbia Slough. The project will *maintain* this  
7 indicator.

## 8 **Habitat Elements**

### 9 ***Substrate***

10 In the lower Columbia Slough portion of the action area, substrate consists mainly of sand, with relatively  
11 small percentages of fine sediments and organic material. Little to no gravel or cobble is present in the  
12 substrate near the action area. Therefore, this indicator is *not properly functioning*.

13 The project does not include any in-water work in the Columbia Slough. Stormwater treatment will  
14 ensure that there will be no changes in sediment-transporting flows and substrate composition. The  
15 project will *maintain* this indicator.

### 16 ***Large Woody Debris***

17 There are fewer than 80 pieces of large wood per stream mile in the Columbia Slough portion of the  
18 action area. In addition, the potential for large wood recruitment is low due to the limited number of  
19 mature trees in the riparian zone within the action area. High levels of urban and commercial  
20 development in the action area discourage the establishment of mature riparian trees. This indicator is *not*  
21 *properly functioning*.

22 The project will have no effect on large wood in the Columbia Slough and will therefore *maintain* this  
23 indicator.

### 24 ***Pool Frequency***

25 Watershed management has highly altered the Columbia Slough, resulting in simplified stream channels  
26 and limited pool frequency within the action area. Field surveys indicate that glide habitat is the dominant  
27 type within the action area. Few to no pools are formed or maintained by large wood, and the potential for  
28 future recruitment of large wood in these systems is very low. This indicator is *not properly functioning*.

29 The project does not include any in-water work in the Columbia Slough. The project will *maintain* this  
30 indicator.

### 31 ***Pool Quality***

32 Insofar as it exists in the Columbia Slough near the action area, pool quality does not meet NMFS (1996)  
33 criteria. Adequate cover is limited to absent due to a lack of complex riparian structure and in-stream  
34 structures such as large wood. This indicator is *not properly functioning*.

35 The project does not include any in-water work in the Columbia Slough. The project will *maintain* this  
36 indicator.



## 1 **Off-Channel Habitat**

2 In the action area, the Columbia Slough contains few to no backwaters, ponds, oxbows, or other low-  
3 energy off-channel areas. These habitats have long ago been filled, rechanneled, diverted and otherwise  
4 developed for urban use. The Columbia Slough may provide some lower energy flows relative to the  
5 mainstem Columbia and Willamette Rivers; however, off-channel habitat within this waterway is  
6 extremely limited. This indicator is *not properly functioning*.

7 The project will not alter off-channel areas of the Columbia Slough and will therefore *maintain* this  
8 indicator.

## 9 **Refugia**

10 Refugia, in the form of deep pools, large boulders, large wood, undercut banks, and overhanging riparian  
11 vegetation, are scarce in the Columbia Slough action area. Dense urbanization limits the potential for  
12 future large wood recruitment. The lack of an adequate riparian buffer further limits future potential for  
13 refugia of any sufficient size, number, and connectivity. This indicator is *not properly functioning*.

14 There is no project work in the Columbia Slough or its riparian area. Some trees may be removed from  
15 the Columbia Slough watershed, but because they will not be removed from the riparian area, the removal  
16 of these trees will not be enough to have any measureable effect on large wood recruitment in the Slough.  
17 Therefore, the project will *maintain* this indicator.

## 18 **Channel Condition and Dynamics**

### 19 **Width/Depth Ratio**

20 The lower Columbia Slough average width is between 100 and 200 feet (BES 2005). The average depth,  
21 based on field observation, is 10 to 15 feet. The width/depth ratio is between 10 and 13. This indicator is  
22 *functioning at risk*.

23 The project does not include any in-water work in the Columbia Slough. The project will *maintain* this  
24 indicator.

### 25 **Streambank Condition**

26 The Columbia Slough appears to be greater than 90 percent stable in the action area and is *properly*  
27 *functioning*.

28 The project does not involve any work on Columbia Slough streambanks, nor will it cause impacts to  
29 streambank scour. Therefore, the project will *maintain* this indicator.

### 30 **Floodplain Connectivity**

31 The Columbia Slough was once a side channel of the Columbia River, but is now separated from the  
32 mainstem by numerous dikes, pumps, weirs, levees, and fills. The Columbia Slough itself has few  
33 wetland and limited riparian areas. It has also been ditched; as a result, overbank flows and connections  
34 with the larger floodplain are rare. Therefore, this indicator is *not properly functioning*.

35 The project will not change the Slough's connectivity with the historical floodplain and will therefore  
36 *maintain* this indicator.

## 1 **Flow/Hydrology**

### 2 ***Peak/Base Flows***

3 The Columbia Slough has undergone profound hydrologic alteration from its original condition.  
4 Originally, the Columbia Slough was a side channel of the Columbia. Today, the Columbia Slough's  
5 original inlet is blocked at the upstream end, and it no longer receives flows from the Columbia.  
6 Numerous dikes, pumps, and weirs regulate flows in the stream. Therefore, this indicator is *not properly*  
7 *functioning*.

8 The project will not change the current configuration of the Columbia Slough. Stormwater runoff  
9 generated by the project will continue to be regulated by pumps located downstream of the project area.  
10 Therefore, the project will *maintain* this indicator.

### 11 ***Drainage Network Increase***

12 The drainage network of the Columbia Slough appears to be somewhat, but not highly, altered by roads.  
13 This indicator is *at risk*.

14 The project will cause only minor changes to the drainage network and will therefore *maintain* this  
15 indicator.

## 16 **Watershed Conditions**

### 17 ***Road Density and Location***

18 Road density exceeds 3 miles per square mile. Numerous roads occur alongside streams and in valley  
19 bottoms. Therefore, this indicator is *not properly functioning*.

20 The project will *maintain* the current condition of more than 3 miles of road per square mile.

### 21 ***Disturbance History***

22 Upland habitat in the action area is highly urbanized. Functionally speaking, forested habitat no longer  
23 occurs in the action area, and “equivalent clear-cut areas” exceed 15 percent. There is no potential for  
24 development of old-growth forest. Disturbance is concentrated along streams and in riparian areas.  
25 Therefore, this indicator is *not properly functioning*.

26 The project will *maintain* the current condition of more than 15 percent “equivalent clear-cut area” with  
27 disturbance concentrated in riparian areas.

### 28 ***Riparian Reserves***

29 This indicator is specific to USFS-managed areas and therefore is not applicable in the context of the  
30 CRC project.

1 **BURNT BRIDGE CREEK – NMFS MATRIX**

2 Table F-4 summarizes the effects of the proposed action on diagnostic pathways and indicators in Burnt  
 3 Bridge Creek. The rationale for the effects of the action appears in the text below.

4 **Table F-4. NMFS Matrix of Pathways and Indicator Summary for Burnt Bridge Creek**

Pathway Indicators	Environmental Baseline			Effects of the Action(s)		
	Properly Functioning	Functioning At Risk	Not Properly Functioning	Restore	Maintain	Degrade
<b>Water Quality:</b>						
Temperature			X		X	
Sediment/Turbidity			X		X	
Chemical Contamination/ Nutrients			X		X	
<b>Habitat Access:</b>						
Physical Barriers		X			X	
<b>Habitat Elements:</b>						
Substrate			X		X	
Large Woody Debris			X		X	
Pool Frequency			X		X	
Pool Quality			X		X	
Off-Channel Habitat			X		X	
Refugia			X		X	
<b>Channel Condition and Dynamics:</b>						
Width/Depth Ratio	X				X	
Streambank Condition	X				X	
Floodplain Connectivity			X		X	
<b>Flow/Hydrology:</b>						
Peak/Base Flows			X		X	
Drainage Network Increase			X		X	
<b>Watershed Conditions:</b>						
Road Density and Location			X		X	
Disturbance History			X		X	
Riparian Reserves		Not Applicable			Not Applicable	

5

## 1 **Water Quality**

### 2 **Temperature**

3 A temperature gauge at Leverich Park (gauge BBC 2.6) within the action area indicated that from mid-  
4 May through late September 2008, the highest annual running 7-day average of maximum temperatures  
5 exceeded 17.5°C (63.5°F) 92 times (Ecology 2008). The 303(d) list includes Burnt Bridge Creek as a  
6 stream that exceeds standards for temperature (Ecology 2008). Because the stream exceeds the standard  
7 of 60°F for spawning and nearly exceeds the standard of 64°F for migration and rearing, this indicator is  
8 *not properly functioning*.

9 The project will not remove trees from the Burnt Bridge Creek riparian area. Therefore, the project will  
10 *maintain* this indicator.

### 11 **Sediment/Turbidity**

12 In general, turbidity is not considered to be a parameter of concern in Burnt Bridge Creek (Ecology  
13 2009a). Burnt Bridge Creek does not appear on the 303(d) list for streams impaired by turbidity (Ecology  
14 2008). However, substrates are dominated by sands and fines (WDFW/MHCC 1999; PBS 2003), and  
15 indicates that this parameter is *not properly functioning*.

16 The project does not include any in-water work in Burnt Bridge Creek. Sediment sources generated by the  
17 project will be limited to construction-related erosion and stormwater inputs. BMPs will be used to  
18 control erosion so that the project will not appreciably affect sediments in the Columbia Slough. The high  
19 level of stormwater treatment will result in a slight but insignificant reduction of TSS entering the  
20 Columbia Slough, and will certainly not degrade this condition. Therefore, the project will *maintain* this  
21 indicator.

### 22 **Chemical Contamination/Nutrients**

23 The 303(d) list shows 16 segments of Burnt Bridge Creek that exceed standards for fecal coliform  
24 bacteria, dissolved oxygen, and temperature (Ecology 2009b). The 2008 303(d) list also shows 12  
25 segments of Burnt Bridge Creek with pH impairments (Ecology 2009a). Naturally occurring  
26 concentrations of phosphorus in the groundwater, coupled with nutrient inputs from urban and  
27 agricultural runoff, has supported nuisance growths of algae and further degraded the aquatic habitat  
28 (COV 2007). Of nine samples taken between July and August 2008 at a gauge near Leverich Park,  
29 bacteria were above water quality standards in six of the samples, and pH was above standards in one  
30 sample (Ecology 2009a). Upper reaches of the stream pass through farmland, where the use of chemical  
31 fertilizers and pesticides likely contribute chemical contamination and nutrients to the stream.

32 Burnt Bridge Creek does not appear on the 303(d) list as having water quality issues related to chemical  
33 contaminants. Most runoff from the project area is discharged into the ground through buried infiltration  
34 facilities. However, there are three stormwater outfalls from I-5 that discharge runoff into Burnt  
35 Bridge Creek.

36 Because Burnt Bridge Creek has several reaches on the 303(d) list, and numerous potential sources of  
37 chemical and nutrient inputs exist, this indicator is *not properly functioning*.

38 The project does not include any in-water work in Burnt Bridge Creek. Chemical contaminants are  
39 unlikely to enter the creek during construction due to numerous BMPs designed to contain contaminants.  
40 The stormwater treatment BMPs will treat a high proportion of currently untreated PGIS, and therefore

1 may cause a slight but insignificant reduction of contaminants entering Burnt Bridge Creek. Therefore,  
2 the project will *maintain* this indicator.

### 3 **Habitat Access**

#### 4 ***Physical Barriers***

5 In 2007, the Washington Department of Fish and Wildlife (WDFW) evaluated fish passage in Burnt  
6 Bridge Creek and identified four partial barriers in and downstream of the action area. Because of these  
7 partial barriers, this indicator is *functioning at risk*.

8 The project does not include any in-water work in Burnt Bridge Creek. Therefore, the project will  
9 *maintain* this indicator.

### 10 **Habitat Elements**

#### 11 ***Substrate***

12 Substrate within Burnt Bridge Creek is dominated by fine sediment (COV 2007). Gravels and sand  
13 substrate were also noted within the action area, but were not dominant. Although there are some discrete  
14 locations where suitable spawning is known to occur, substrate is not functioning at historical levels.  
15 Additionally, fines are dominant in the portions of the creek that intersect the action area. Therefore, this  
16 indicator is *not properly functioning*.

17 The project does not include any in-water work in the Columbia Slough. Stormwater treatment may  
18 decrease the amount of suspended sediments entering the stream and will ensure that there will be no  
19 changes in sediment transporting flows and substrate composition in the stream. The project will *maintain*  
20 this indicator.

#### 21 ***Large Woody Debris***

22 Burnt Bridge Creek has fewer than 80 pieces of large wood per stream mile. Wood present in the creek is  
23 generally small, sparsely distributed, and not sufficient to provide adequate fish cover. Leverich Park and  
24 the Washington State Department of Transportation (WSDOT) mitigation site are the only areas that  
25 contain several large-diameter trees. Other than that, large wood recruitment potential is limited.  
26 Therefore, this indicator is *not properly functioning*.

27 The project will have no effect on large wood in Burnt Bridge Creek and will therefore *maintain* this  
28 indicator.

#### 29 ***Pool Frequency***

30 Pool habitat within Burnt Bridge Creek is generally absent. Some pool habitat is present in Leverich Park  
31 (WDFW/MHCC 1999); however, most of the habitat within the action area consists of glides. This  
32 indicator is *not properly functioning*.

33 The project does not include any in-water work in Burnt Bridge Creek. The project will *maintain* this  
34 indicator.

**1 Pool Quality**

2 Pool quality within Burnt Bridge Creek does not meet NMFS (1996) criteria. Good cover is not present  
3 due to lack of complex riparian structure and in-stream structures, elevated water temperatures, shallow  
4 depth, and fine sediments. This indicator is *not properly functioning*.

5 The project does not include any in-water work in Burnt Bridge Creek. The project will *maintain* this  
6 indicator.

**7 Off-Channel Habitat**

8 Burnt Bridge Creek contains very little off-channel habitat. During high water, some off-channel habitat  
9 is present near the WSDOT wetland mitigation site. There were no other off-channel areas observed  
10 within the action area. This indicator is *not properly functioning*.

11 The project will not alter off-channel areas of the creek and will therefore *maintain* this indicator.

**12 Refugia**

13 Within the action area, the aquatic habitat complexity of Burnt Bridge Creek is low due to the simplified  
14 channel and the scarcity of overhanging vegetation, large wood, boulders, off-channel habitat, undercut  
15 banks, and other habitat features known to provide refugia for sensitive aquatic species. Within the action  
16 area, there is little potential for future large wood recruitment. The lack of an adequate riparian buffer  
17 further limits potential for refugia of any sufficient size, number, and connectivity. This indicator is *not*  
18 *properly functioning*.

19 There is no work in the creek or its riparian area. Some trees may be removed from the Burnt Bridge  
20 Creek watershed, but not enough to have any measureable effect on large wood recruitment. Therefore,  
21 the project will *maintain* this indicator.

**22 Channel Condition and Dynamics****23 Width/Depth Ratio**

24 The Burnt Bridge Creek width/depth ratio is less than 10 within the action area, and therefore this  
25 indicator is *properly functioning*. Within the action area, channel width ranges from 5 to 15 feet, and  
26 depths range from 3 to 6 feet.

27 The project does not include any in-water work in the creek. Therefore, the project will *maintain* this  
28 indicator.

**29 Streambank Condition**

30 Within the action area, the Burnt Bridge Creek streambank is stable, and less than 10 percent of the bank  
31 area is actively eroding. Segments of the stream are armored within the action area. This indicator is  
32 *properly functioning*.

33 The project does not involve any work on Burnt Bridge Creek streambanks, nor will it cause impacts to  
34 streambank scour. Therefore, the project will *maintain* this indicator.

## 1 **Floodplain Connectivity**

2 Burnt Bridge Creek passes through a valley constrained by surrounding land uses. Within the action area,  
3 portions of the banks are armored, and the adjacent area is heavily urbanized. Although some off-channel  
4 habitat and wetlands are present adjacent to the stream channel within the action area, these areas have  
5 been drastically reduced from historic conditions. Riparian vegetation and successional processes have  
6 been altered significantly in the action area. Floodplain connectivity is limited. This indicator is *not*  
7 *properly functioning*.

8 The project will not change connectivity with the historical floodplain and will therefore *maintain* this  
9 indicator.

## 10 **Flow/Hydrology**

### 11 **Peak/Base Flows**

12 The Burnt Bridge Creek watershed is heavily urbanized. Numerous stormwater outfalls discharge to the  
13 creek. Additionally, the creek has been lengthened several miles from its original headwaters at Falk  
14 Road to its current location in east Vancouver near NE 162nd Avenue. All of these factors have increased  
15 peak flows, reduced base flows, and altered flow timing in comparison to historical conditions. This  
16 indicator is *not properly functioning*.

17 Stormwater treatment will increase the proportion of runoff infiltration within the action area, possibly  
18 resulting in a slight but insignificant benefit to flows. The project will *maintain* this indicator.

### 19 **Drainage Network Increase**

20 The lower Burnt Bridge Creek watershed is highly urbanized and contains a dense system of roadways.  
21 The upper watershed contains numerous agricultural areas with drainage ditches. Given that nearly every  
22 natural stream in the watershed has been rerouted to underground pipes or diverted to roadside ditches,  
23 we can assume that there have been significant increases in the network density. This indicator is *not*  
24 *properly functioning*.

25 The project may slightly alter drainage networks by providing additional stormwater treatment and by  
26 rerouting some roadside ditches. This may cause slight changes in the drainage network, but these  
27 changes will be insignificant relative to size of the entire network. The project will therefore *maintain* this  
28 indicator.

## 29 **Watershed Conditions**

### 30 **Road Density and Location**

31 The Burnt Bridge Creek watershed is heavily urbanized, containing on average more than 3 miles of road  
32 per square mile. Valley-bottom roads are numerous. Therefore, this indicator is *not properly functioning*.

33 The project will *maintain* the condition of greater than 3 miles of road per square mile.

### 34 **Disturbance History**

35 The Burnt Bridge Creek watershed is characterized by urban, residential, and rural developments, with  
36 very little undisturbed land remaining. “Equivalent clear-cut areas” account for well over 15 percent of  
37 the watershed, disturbance is concentrated in riparian areas, and the developed setting precludes  
38 development of late-successional/old-growth forest. Therefore, this indicator is *not properly functioning*.

1 The project will *maintain* the condition of greater than 15 percent “equivalent clear-cut areas,” with  
 2 disturbances concentrated in riparian areas and low potential for development of late-successional/  
 3 old-growth forest.

4 **Riparian Reserves**

5 This indicator is specific to USFS-managed areas and therefore, is not applicable in the context of the  
 6 CRC project.

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