LINCOLN MANAGEMENT UNIT

LINCOLN CREEK

Description:

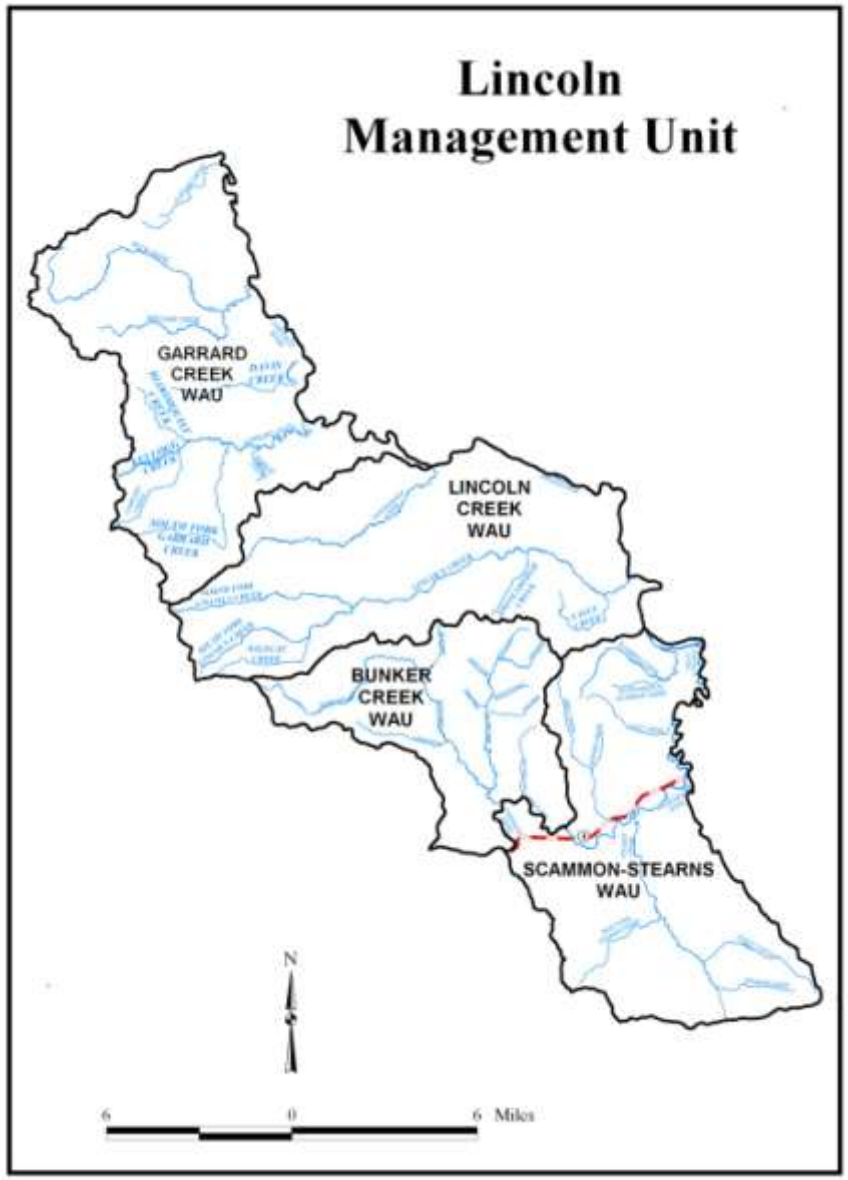
Lincoln Creek joins the Chehalis River at RM 61.9 near the city of Centralia. Several tributaries provide habitat for coho salmon including Eagle Creek, Sponenberg Creek, Wildcat Creek, and the North and South Fork Lincoln Creeks (Phinney and Bucknell 1975).

The headwaters of Lincoln Creek start in the Willapa Hills. The upper reaches are generally confined, while the lower reaches flow through broad valleys (Phinney and Bucknell 1975). The land use in this subbasin is a mix of timber use, agriculture, and rural residences. Coho are present in the Lincoln Creek subbasin but there is very limited steelhead use. In the past, chum salmon have used this area, but are now uncommon.

Major Tributaries: Eagle, Sponenberg, Wildcat, and North and South Fork Lincoln Creeks, Garrard Creek, Gaddis Creek, Rock/Williams Creek, Bunker Creek, Scammon, Mill, Stearns Creek

Land Uses: Forestry, Agriculture, and Rural Residences

Anadromous Fish Stocks: Coho, winter steelhead, and cutthroat



Lincoln Creek Tier 1 Concerns

Lincoln Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Ecosystem Diagnosis and Treatment (EDT) model shows sedimentation as a major problem in Lincoln Creek	➡ Sedimentation is likely the product of bank erosion, roads, and livestock access. (Wampler et al. 1993).	➡ Determine the extent roads are contributing sediment. ➡ Work with landowners in the lower reaches to reduce livestock access to Lincoln Creek.

Lincoln Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition in the Lincoln Creek subbasin is poor. The riparian corridor along Lincoln Creek is sparsely vegetated with deciduous vegetation up to RM 7.5. From RM 7.5 – RM 10.2 the corridor is mixed with some areas containing conifer (Smith Wenger 2001). ➡ In Lincoln Creek WAU over 40% of the WAU is considered open hardwood and over 30% is considered non-forested.	➡ Conversion of land use from forestry to agriculture or rural residential has contributed to degraded riparian corridors (primarily lower and middle Lincoln Creek subbasin reaches). ➡ Past timber harvesting practices have impacted riparian corridors (primarily upper Lincoln Creek subbasin reaches)	➡ Control invasive species. See Section 5. ➡ Protect and preserve riparian habitat in Lincoln Creek subbasin (Chehalis EDT model rated Lincoln Creek preservation #2 for Chehalis coho benefit). ➡ Restore riparian corridor along Lincoln Creek. Use Wampler et al. 1993 document to identify potential restoration sites.

Lincoln Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures restricts fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4.

Lincoln Creek Tier 2 Concerns

Lincoln Creek Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Lincoln Creek is incised in the middle and lower reaches (C. Stussy, personal observation)	➡ Logjams have been removed from Lincoln Creek according to the Phinney and Bucknell (1975). ➡ Riprap is documented in upper Lincoln Creek and Wildcat Creek. (Smith Wenger 2001).	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain. ➡ Implement soft armoring techniques where riprap occurs using Integrated Streambank Protection Guidelines manual (see Wampler et al. 1993 for riprap locations).

Lincoln Creek Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Lincoln Creek is on the 303d List for temperature. Lincoln Creek also has high fecal coliform levels and low dissolved oxygen levels. (Smith Wenger 2001)	➡ The high temperatures are likely caused by the poor riparian corridor condition. The high fecal coliform levels are likely caused from failing septic systems and livestock (Smith Wenger 2001).	➡ Restore riparian corridor (see 'riparian' actions) ➡ Work with landowners to correct failing septic systems. ➡ Work with landowners to exclude livestock from accessing Lincoln Creek and its tributaries.

Lincoln Creek Tier 3 Concerns

Lincoln Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are likely low. ➡ The Chehalis Ecosystem Diagnosis and Treatment (EDT) model indicates Lincoln Creek needs improved habitat diversity	➡ LWD levels are likely low since riparian conditions are rated poor for the Lincoln Creek subbasin and past practices have removed LWD from Lincoln Creek. (C. Stussy, professional opinion).	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain. The Chehalis EDT model indicates habitat diversity improvements are most needed in Lincoln Creek reaches 1-3, 9-12, NF Lincoln Creek, Wildcat Creek and Eagle Creek. ➡ Revegetate riparian corridor using Wampler et al. 1993 to identify project sites.

Lincoln Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in Lincoln Creek (Phinney and Bucknell 1975).	➡ Phinney and Bucknell (1975) note that water withdrawals may have a significant impact on the water quantity in Lincoln Creek.	➡ Determine if water withdrawals are being followed in accordance with current water rights. ➡ Implement forest practice rules in forested headwaters to eliminate ditchwater connection to live streams. ➡ In the lower and middle reaches of Lincoln Creek recreate wetlands for water storage and off-channel habitat. ➡ Lincoln Creek is closed to further water appropriations (Smith Wenger 2001). ➡ Protect and preserve wetlands and springs in Lincoln Creek subbasin (Chehalis EDT model rated Lincoln Creek preservation #2 for Chehalis coho benefit).

Independence Creek

Description:

Independence Creek's headwaters are in the Willapa Hills and it enters the Chehalis River at RM 51.5. It has several unnamed tributaries that likely provide coho salmon habitat in addition to habitat in the mainstem. The lower reaches of the mainstem consist of a sand and silt bottom. Coho salmon spawning habitat is more common upstream of RM 4.0, where gravel is found (Smith Wenger 2001). Upstream of RM 6.0, the gradient steepens and salmon use is questionable.

Major Tributaries: None

Land Uses: Forestry, Agriculture, and Rural Residences

Anadromous Fish Stocks: Coho and cutthroat

Independence Creek Tier 1 Concerns

Independence Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Extensive bank erosion was documented in the middle reaches of Independence Creek and two of its tributaries (23.0705 & 23.0712 (Smith Wenger 2001). ➡ Heavy sedimentation	➡ Sedimentation is likely the product of both bank erosion and roads. Road densities are high in the Lincoln Creek WAU, which Independence Creek is in, with 3.4 miles of road per square mile of drainage (Smith Wenger 2001). ➡ Livestock access is an issue in the lower reaches of Independence Creek (Smith Wenger 2001).	➡ Identify extent roads are contributing sediment. ➡ Identify possible solutions to reduce erosion at the sites identified by Wampler and Knudsen (1993). Locations are primarily in the middle and upper reaches. ➡ Work with landowners in the lower reaches to reduce livestock access to Independence Creek.

Independence Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian corridor is in poor condition up to RM 7 (Smith Wenger 2001). ➡ Several tributaries contain poor riparian corridor conditions (23.0697, 23.0705, 23.0707, and 23.0712) (Smith Wenger 2001).	➡ Agriculture, rural residences, and past logging are primary causes for reduced riparian vegetation and canopy loss (Andy Carlson, personal communication). ➡ Chehalis EDT model rated Independence Creek preservation of good riparian habitat as a level 'A' for Chehalis coho benefit.	➡ Control invasive species. See Section 5. ➡ Protect and preserve riparian habitat in Independence Creek subbasin ➡ Restore riparian corridor along Independence Creek. Use Wampler et al. 1993 document to identify potential restoration sites.

Independence Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures restrict fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4.

Independence Creek Tier 2 Concerns

Independence Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are low	➡ LWD levels are likely low since riparian conditions are rated poor for Lincoln Creek WAU, past practices have likely removed LWD from Independence Creek. (C. Stussy).	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Independence Creek Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Low dissolved oxygen in Independence Creek (Smith Wenger 2001).	➡ The suspected cause of low dissolved oxygen in Independence Creek is livestock (Smith Wenger 2001).	➡ Restore riparian corridor (see 'riparian' actions). ➡ Work with landowners to exclude livestock from accessing Independence Creek and its tributaries.

Independence Creek Tier 3 Concerns

Independence Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Lower Independence Creek has riprap in lower reaches. (Smith Wenger 2001)		➡ LWD supplementation plan; install LWD to retain bedload, elevate streambed, allow better connection to floodplain.

Independence Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in Independence Creek (Phinney and Bucknell 1975).	➡ Water withdrawals worsen the low flow conditions during summer low flow periods (Smith Wenger 2001).	➡ Determine if water withdrawals are being followed in accordance with current water rights. ➡ Implement forest practice rules in forested headwaters to eliminate ditchwater connection to live streams. ➡ Protect and preserve wetlands and springs in Independence Creek subbasin (Chehalis EDT model rated Independence Creek preservation as a level 'A' for Chehalis coho benefit).

GARRARD CREEK

Description:

Garrard Creek is a medium sized drainage 45.5 miles long and enters the Chehalis River at RM 45. The larger tributaries within the Garrard Creek basin include Kellogg Creek, South Fork Garrard Creek, and Bloomquist Creek. Garrard Creek's headwaters originate in the Willapa Hills; the upper reaches are generally confined, while the lower reach flows through a broad valley (Phinney and Bucknell 1975). Land uses in the Garrard Creek basin consist of a mix of forestland, agriculture, and rural residences. Garrard Creek currently supports coho and a limited amount of steelhead production. In the past, chum salmon have used the Garrard Creek subbasin, but their presence today is uncommon. It is assumed that coho salmon use all accessible areas for rearing, but these areas have not been mapped or documented. In general, data on salmon and steelhead distribution and production is very limited for this region. (Smith Wenger 2001)

Major Tributaries: Davis, Bloomquist, Kellogg, SF Garrard Creek, Forest

Land Uses: Forestland, agriculture and rural residences

Anadromous Fish Stocks: Coho, winter steelhead, and cutthroat

Garrard Creek Tier 1 Concerns

Garrard Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Extensive bank erosion has been documented in the upper reaches of Garrard Creek and Kellogg Creek (Wampler)	➡ Sedimentation is likely caused by bank erosion because of the "fair" road density rating (Smith Wenger 2001)	➡ Reduce stream reach erosion at sites identified by Wampler et al. (1993). Locations are primarily in the upper reaches.

Garrard Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Riparian corridor condition is poor; 53% of riparian corridor is hardwood dominant; 25% converted to non forest use (Lunetta et al.). Low potential for LWD recruitment because of current conditions (Smith Wenger 2001)	➡ The riparian corridor in the Garrard Creek basin has been heavily impacted and the following sites are areas of documented degradation: RM 1.4-3.1; RM 4-5.2, & RM 6.5-7.6 (Smith Wenger 2001)	➡ Control invasive species. See Section 5. ➡ Restore riparian corridor at RM 1.4-3.1, RM 4-5.2, and RM 6.5-7.6

Garrard Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish Passage barrier status is not fully known; assumption is barriers exist that hinder fish passage and impede natural processes. Preliminary investigations show there are several barriers existing on county and private properties in the Garrard Creek subbasin	➡ Placement of undersized stream crossing structures and natural processes (streambed material) restrict fish passage	➡ Correct barrier culverts. See Section 4.

Garrard Creek Tier 2 Concerns

Garrard Creek Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Data need	➡ Several sites have been identified where livestock have direct access to the creek (Luneta et al. 1993)	➡ Work with landowners in the lower reaches to reduce livestock access to Garrard Creek

Garrard Creek Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Base flows have not been met and are closed to further appropriations (Smith Wenger 2001). Low summer flows were noted as a limiting factor in Garrard Creek (Phinney and Bucknell 1975)	➡ The Garrard Creek basin has 14% of forest cover converted to other uses and 47% existing as hardwoods (data from Lunetta et al. 1997). These areas rate "poor" for water quantity due to a likely impact on peak flow events.	➡ Implement forest practice rules in forested headwaters to eliminate ditchwater connection to live streams. ➡ In the lower and middle reaches of Garrard Creek recreate wetlands for water storage and off-channel habitat

Garrard Creek Tier 3 Concerns

Garrard Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ In some areas, the floodplain is not able to function properly, i.e., meandering, due to streambank riprap. (Smith Wenger 2001)	➡ Riprap is situated throughout the Garrard Creek basin. (Smith Wenger 2001).	➡ Replace riprap with soft armoring techniques (see Wampler et al. 1993 for riprap locations). ➡ See LWD section

Garrard Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ The general assumption is that LWD levels are low	➡ Poor riparian conditions ➡ Possible past practices of LWD removal from Garrard Creek	➡ Determine LWD levels and then develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain

Gaddis Creek

Description:

The headwaters of Gaddis Creek originate in the Willapa Hills. The upper reaches are generally confined and steep, while the lower reaches flow through the broad Chehalis Valley (Phinney and Bucknell 1975). Land uses in the Gaddis Creek subbasin are a mix of timber, agriculture, and rural residences. There are approximately 4.9 miles of salmonid habitat in Gaddis Creek (Phinney and Bucknell 1975) and coho are the only documented salmon using it (WDFW Salmonscape 2006). In the past, chum salmon may have also used this subbasin, but are now uncommon (Smith Wenger 2001). It is assumed that coho salmon use all accessible areas for rearing, but many of these areas have not been specifically mapped or documented. In general, salmon and steelhead distribution and production data is very limited in this region (Smith Wenger 2001).

Major Tributaries: None named

Land Uses: Timber, agriculture, rural residences

Anadromous Fish Stocks: Coho and cutthroat

Gaddis Creek Tier 1 Concerns

Gaddis Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Extensive bank erosion was documented in Gaddis Creek. These streams are rated "poor" for sediment quantity, with a note that more information regarding sediment inputs are needed. (Smith Wenger 2001)	➡ Sedimentation is likely the product of both bank erosion and roads. Additional information is needed to understand road contributions of sediment in Gaddis Creek. (Smith Wenger 2001). ➡ Livestock access is an issue in the lower reaches of Gaddis Creek (Smith Wenger 2001).	➡ Identify extent that roads are contributing sediment. ➡ Identify and implement possible solutions to reduce erosion at the sites identified by Wampler and Knudsen (1993). Locations are primarily in the middle and upper reaches. ➡ Work with landowners in the lower reaches to reduce livestock access to Gaddis Creek.

Gaddis Creek Tier 1	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Rock, Williams, and Gaddis Creeks have incised channels (L. Crumley, LWC Consulting, personal communication). These streams are rated "poor" for floodplain conditions; further assessment of this impact is necessary. (Smith Wenger 2001)	➡ Poor LWD recruitment from riparian corridor. ➡ Possible LWD removal from Gaddis Creek	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Gaddis Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish Passage barrier status is unknown in Gaddis Creek subbasin. However, even though a comprehensive inventory has not been completed, the assumption is that barriers do exist that hinder fish passage and impede natural processes. This assumption mirrors findings in other subbasins within the Chehalis Basin. Preliminary investigations show there are several barriers existing on county and private properties in the Garrard Creek subbasin.	➡ The placement of undersized stream crossing structures has restricted fish passage and impeded natural processes (streambed material transport).	➡ A formal inventory is needed to comprehensively identify barrier status within the Gaddis subbasin. ➡ Correct barrier culverts. See Section 4.

Gaddis Creek Tier 2 Concerns

Gaddis Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are likely low since Gaddis Creek is incised (see floodplain section)	➡ Since riparian conditions are rated poor for the Garrard Creek WAU (Gaddis Creek is in this WAU) future LWD recruitment will likely be low (C. Stussy, professional opinion).	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain. ➡ More information is needed

Gaddis Creek Tier 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian corridor condition in the Garrard Creek WAU, which Gaddis Creek is in, rates poor with 53% of the riparian corridor being hardwood dominant and 25% converted to non-forest use. Garrard Creek is also considered to have a low potential for LWD recruitment because of the current conditions (Smith Wenger 2001).	➡ A loss of canopy cover was recorded in Gaddis Creek from RM 2.5-3 (Smith Wenger 2001). ➡ Wampler and Knudsen (1993) identify agriculture and logging as causes for reduced riparian vegetation and canopy loss.	➡ Control invasive species. See Section 5. ➡ Further assessment is needed to identify additional areas of impacted riparian habitat. ➡ Restore riparian corridor along Gaddis Creek primarily in the middle and lower reaches that consist primarily of agricultural lands.

Gaddis Creek Tier 3 Concerns

Gaddis Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in Gaddis Creek (Phinney and Bucknell 1975).	➡ The Garrard Creek WAU (which includes Gaddis Creek) has had 14% of its forest cover converted to other uses, 47% of which is in hardwoods. These areas rate "poor" for water quantity due to the likely impacts caused by vegetation conversion that influence peak flow events (Smith Wenger 2001).	➡ Implement forest practice rules in forested headwaters to eliminate ditchwater connection to live streams. ➡ In the lower and middle reaches of Gaddis Creek, recreate wetlands for water storage and off-channel habitat. ➡ More information is needed

Gaddis Creek Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
	➡ Livestock access to Gaddis Creek has been identified in the lower reach (Smith Wenger 2001).	➡ More information is needed ➡ Work with landowners in the lower reaches to reduce livestock access to Gaddis Creek.

ROCK/WILLIAMS CREEK

Description:

The headwaters of Rock/Williams Creek originate in the Willapa Hills and has 32.2 miles of stream (Phinney and Bucknell 1975). The upper reaches are generally confined, while the lower reach flows through the broad Chehalis River valley (Phinney and Bucknell 1975). The land use in Rock/Williams subbasin is comprised of timber, agriculture, and rural residences (Smith Wenger 2001). Rock Creek drains into the Chehalis River at RM 39.3. Both Rock creek and its major tributary Williams Creek provide habitat for coho spawning and rearing. Fall Chinook salmon have also been documented in Rock Creek (Smith Wenger 2001). Chum salmon have used these areas in the past, but are uncommon now (Smith Wenger 2001).

Major Tributaries: Williams Creek

Major Land Uses: Timber, Agriculture, and Rural Residences

Anadromous Fish Stocks: Fall Chinook, spring Chinook, coho, winter steelhead, cutthroat

Rock / Williams Creek Tier 1 Concerns

Rock / Williams Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Extensive bank erosion was documented in Williams Creek and was rated as poor for sediment quantity. It was also note that more information regarding sediment inputs are needed. (Smith Wenger 2001)	➡ Sedimentation is likely the product of both bank erosion and roads. (Smith Wenger 2001). ➡ Livestock access is an issue in the lower reaches of Rock Creek and Williams Creek (Smith Wenger 2001).	➡ Identify extent roads are contributing sediment. ➡ Identify possible solutions to reduce erosion at the sites identified by Wampler and Knudsen (1993). Locations are primarily in the middle and upper reaches. ➡ Work with landowners in the lower reaches to reduce livestock access to Rock Creek and Williams Creek.

Rock / Williams Creek Tier 1	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Rock Creek and Williams Creek have incised channels and Rock Creek has riprap in its lower reach. This subbasin is rated "poor" for floodplain conditions, but quantification of these impacts is needed. (Smith Wenger 2001)		➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Rock / Williams Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish Passage barrier status is unknown in Rock/Williams Creek subbasin. However, even though a comprehensive inventory has not been completed it is assumed barriers exist that hinder fish passage and impede natural processes. This assumption is based on the current awareness of at least two existing blockages.	➡ Placement of undersized stream crossing structures restrict fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4.

Rock / Williams Creek Tier 2 Concerns

Rock / Williams Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are likely low since Rock/Williams is incised (see floodplain section). More data needed.	➡ Since riparian conditions are rated poor for the Garrard Creek WAU (Gaddis Creek is in this WAU) future LWD recruitment will likely be low (C. Stussy, prof. opinion).	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Rock / Williams Creek Tier 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian corridor condition in the Garrard Creek WAU, which the Rock/Williams subbasin is in, rates poor with 53% of the riparian corridor as hardwood dominant and 25% converted to non-forest use.	➡ A loss of riparian vegetation was noted along Rock Creek from RM 1.5-2.9 and in two reaches of Williams Creek (RM 0-1, RM 2.2-3.8). (Smith Wenger 2001). ➡ Wampler and Knudsen (1993) identify agriculture and logging as causes for reduced riparian vegetation & canopy loss.	➡ Control invasive species. See Section 5. ➡ Restore riparian corridor along Rock Creek from RM 1.5-2.9 and Williams Creek from RM 0-1 and RM2.2-3.8).
➡ Garrard Creek is also considered to have a low potential for LWD recruitment because of the current conditions (Smith Wenger 2001).	➡ Poor riparian condition	➡ Restore riparian corridor

Rock / Williams Creek Tier 3 Concerns

Rock / Williams Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in Gaddis Creek (Phinney and Bucknell 1975).	➡ The Garrard Creek WAU (Rock/Williams Creek is in this WAU) has 14% of forest cover converted to other uses and 47% existing as hardwoods. These areas rate "poor" for water quantity due to a likely impacts vegetation conversion has on peak flow events. (Smith Wenger 2001)	➡ Implement forest practice rules in forested headwaters to eliminate ditchwater connection to live streams. ➡ In the lower and middle reaches of Rock /Williams Creek recreate wetlands for water storage and off-channel habitat.

Rock / Williams Creek Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Data need	➡ Livestock access to Rock/Williams Creek has been identified in the lower reach (Smith Wenger 2001).	➡ Work with landowners in the lower reaches to reduce livestock access to Rock Creek and Williams Creek.

Bunker Creek

Description:

Bunker Creek and its largest tributary, Deep Creek, provide habitat for both coho salmon and steelhead trout. Bunker Creek joins the Chehalis River at RM 84.8 from the left bank and has a low gradient. The entire watershed lies within farmland and rural residences. Little is known about fish habitat and distribution in Van Ornum Creek, which enters the Chehalis River at RM 84 (Smith Wenger 2001).

Major Tributaries: Deep Creek; Van Ornum Creek (an independent tributary to the Chehalis River)

Land Uses: Agriculture and rural residences

Anadromous Fish Stocks: Coho, winter steelhead, and cutthroat

Bunker Creek Tier 1 Concerns

Bunker Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ According to the Diagnosis and Treatment (EDT) model, sedimentation is a major problem in Bunker Creek.	➡ The Bunker Creek WAU has a high road density of 4.4 miles of road per sq mile of drainage (Smith Wenger 2001). ➡ Livestock access was also noted in the middle reaches of Deep Creek and Bunker Creek (Smith Wenger 2001). ➡ Sedimentation is likely the product of bank erosion (primarily Bunker Creek), roads, and livestock access. (Smith Wenger 2001).	➡ Determine the extent roads are contributing sediment and identify corrective actions. ➡ Reduce stream reach erosion at the sites identified by Wampler et al. (1993). Locations are primarily in the lower reaches of Bunker Creek. ➡ Work with landowners to exclude livestock access to streams especially in Bunker Creek and Deep Creek.

Bunker Creek Tier 1	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Floodplain conditions in the Bunker Creek subbasin are in fair condition with most of the floodplain connectivity impacts occurring in Deep Creek and lower Bunker Creek. ➡ Van Ornums's floodplain condition is good (Smith Wenger 2001).	➡ Primary cause of floodplain disconnection (channel incision) is past splash damming activities that removes instream structure and does not retain streambed substrate. ➡ Many roads are located along Deep Creek and the lower reaches of Bunker Creek. ➡ Little riprap documented in Bunker Creek subbasin.	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Bunker Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures restricts fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4.

Bunker Creek Tier 2 Concerns

Bunker Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ The Chehalis EDT model indicates Bunker Creek needs improved habitat diversity, although more data is needed	➡ LWD levels are likely low since riparian conditions are rated poor for the Bunker Creek WAU (C. Stussy, professional opinion).	➡ Determine LWD needs for the drainages in the Bunker Creek WAU. ➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Bunker Creek Tier 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition is poor in Bunker Creek and Deep Creek. Only the upper reaches of Bunker and Deep Creeks were considered to have intact riparian corridors (Smith Wenger 2001).	➡ In the Bunker Creek WAU over 27% of the WAU has been converted to non-forest uses and 47% consists of hardwoods (Smith Wenger 2001).	➡ Control invasive species. See Section 5. ➡ Restore riparian corridor along Bunker Creek and Deep Creek. Use Wampler et al. 1993 document to identify potential restoration sites.

Bunker Creek Tier 3 Concerns

Bunker Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in the Bunker Creek WAU (Phinney and Bucknell 1975). ➡ Bunker and Van Ornum Creeks are rated as 'poor' for water quantity (Smith Wenger 2001).	➡ Phinney and Bucknell (1975) note that water withdrawals may have a significant impact on the water quantity in the Bunker Creek WAU.	➡ Bunker Creek is closed to further water appropriations (Smith Wenger 2001). ➡ Determine if water withdrawals are being followed in accordance with current water rights. ➡ Identify potential sites to recreate wetlands for water storage and off-channel habitat (Bunker Creek and Deep Creek should be first priority in the Bunker Creek WAU).

Bunker Creek Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Bunker Creek is on the 1998 303d List for low dissolved oxygen (Smith Wenger 2001). ➡ Fecal coliform is a problem in Bunker Creek (Smith Wenger 2001).	➡ Livestock access to Bunker Creek is listed as the probable cause of low dissolved oxygen (Smith Wenger 2001). ➡ The high fecal coliform levels are likely caused from failing septic systems and livestock (Smith Wenger 2001).	➡ Implement TMDL recommendations for Bunker Creek. ➡ Restore riparian corridor (see 'riparian' actions) ➡ Work with landowners to correct failing septic systems in Bunker Creek. ➡ Work with landowners to exclude livestock access to streams especially in Bunker Creek and Deep Creek.

Scammon, Mill, and Stearns Creeks

Description:

These small- to medium-sized streams provide valuable habitat for coho salmon. In past years, these creeks also supported small runs of chum salmon (Phinney and Bucknell 1975).

Scammon Creek is a left bank tributary that drains into the Chehalis River at RM 65.9. The lower reaches lie within the City of Centralia, while rural residences and agriculture surround the upper reaches (Smith Wenger 2001). The stream bottom of Scammon Creek consists of sand with very little spawning gravels. No known salmon use has been documented in this creek, but it is very likely that coho salmon use the stream for rearing. Coal Creek enters the Chehalis River at RM 71.8 and, like Scammon Creek, is probably used for coho rearing (Smith Wenger 2001).

Mill Creek drains into the Chehalis River at RM 77.85. Mill Creek is low gradient and contains sand and gravel substrate (Phinney and Bucknell 1975). It is mentioned as a "major coho spawning area" by Phinney and Bucknell (1975) and probably provides rearing habitat. Access to the creek is problematic in low flow conditions (Smith Wenger 2001).

Stearns Creek drains into the Chehalis River at RM 78.1. It is a low gradient stream with its lower reaches channelized and void of significant riparian vegetation (Smith Wenger 2001). The middle to lower reaches are surrounded by land used for agriculture and rural residences, with some forested lands in the upper reaches. Coho salmon and winter steelhead trout are documented within Stearns Creek and several of its upper tributaries (Smith Wenger 2001).

Major Tributaries: South Branch Scammon (Scammon Creek), West Fork Stearns, Ripple Creek Coal Creek (Stearns Creek), Wisner Creek (Mill Creek)

Land Uses: Agriculture and rural residences in middle and lower reaches, forestry in the upper reaches

Anadromous Fish Stocks: Coho, winter steelhead, and cutthroat

Scammon Creek, Mill Creek, Stearns Creek Tier 1 Concerns

Scammon Creek, Mill Creek, Stearns Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ According to the Ecosystem Diagnosis and Treatment (EDT) model, sedimentation is a major problem in Stearns Creek. ➡ Bank erosion is a major sediment contributor ➡ Scammon and Coal Creeks have naturally low levels of spawning gravel (Smith Wenger 2001).	➡ In the Scammon-Stearns WAU the road density is 4.9 miles of road per 1 square mile of drainage. This is a high road density - likely contributes sediment (Smith Wenger 2001). ➡ Sedimentation is likely the product of bank erosion in upper reaches of Stearns Creek and roads (Smith Wenger 2001). ➡ Mill Creek was noted as having excessive amounts of livestock access to the stream (Smith Wenger 2001)	➡ Determine the extent roads are contributing sediment. ➡ Reduce erosion in the upper reaches of Stearns Creek as identified by Wampler et al. (1993). ➡ Work with landowners along Mill Creek to reduce livestock access.

Scammon Creek, Mill Creek, Stearns Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures restricts fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4.

Scammon Creek, Mill Creek, Stearns Creek Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Stearns Creek is on the 1998 303d List for low dissolved oxygen (Smith Wenger 2001). ➡ Low dissolved oxygen levels have also been recorded in Coal Creek (Smith Wenger 2001). ➡ Data Gap for Mill, Coal, and Scammon Creeks.	➡ Livestock access is thought to be the likely cause of low dissolved oxygen in Stearns Creek (Smith Wenger 2001).	➡ Determine water quality conditions for Mill, Coal, and Scammon Creeks. ➡ Implement TMDL recommendations for Stearns Creek. ➡ Work with landowners to exclude livestock from accessing Stearns Creek and Mill Creek.

Scammon Creek, Mill Creek, Stearns Creek Tier 2 Concerns

Scammon Creek, Mill Creek, Stearns Creek Tier 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition in the Scammon-Stearns WAU is highly degraded (Smith Wenger 2001). ➡ Over 40% of the WAU is considered open hardwood and over 30% is considered non-forested (Smith Wenger 2001).	➡ Conversion of forestlands to agriculture or rural residences has contributed to degraded riparian corridors in Scammon-Stearns WAU. 53% riparian corridor has been converted to agriculture or urban development. 36% riparian corridor has been converted to hardwoods (Smith Wenger 2001).	➡ Control invasive species. See Section 5. ➡ Restore riparian corridor in the Scammon-Stearns WAU. Use Wampler et al. (1993) and Lunetta et al. (1997) documents to identify potential restoration sites.

Scammon Creek, Mill Creek, Stearns Creek Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low flows are identified as a limiting factor for Stearns and Mill Creeks and have been closed to further water appropriations (Smith Wenger 2001).	➡ Loss and change in vegetation cover (38% of land cover in the Scammon-Stearns WAU has been converted to agriculture and urban development, 43% has been converted to deciduous vegetation) (Smith Wenger 2001).	➡ Determine if water withdrawals are being followed in accordance with current water rights. ➡ Identify potential sites to recreate wetlands for water storage and off-channel habitat; Stearns Creek first priority in WAU)

Scammon Creek, Mill Creek, Stearns Creek Tier 3 Concerns

Scammon Creek, Mill Creek, Stearns Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Stearns Creek is disconnected from its floodplain in the lower reach. ➡ Mill Creek's floodplain condition is rated as fair (Smith Wenger 2001). ➡ Coal Creek and Scammon Creek are data gaps.	➡ The lower reach of Stearns Creek has been channelized primarily for agricultural purposes (Smith Wenger 2001). ➡ Areas of riprap are noted in reaches of Stearns Creek. ➡ Pleasant Valley Road impacts the floodplain in the upper and middle reaches of Stearns Creek (Smith Wenger 2001).	➡ Develop LWD supplementation plan for Stearns Creek and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Scammon Creek, Mill Creek, Stearns Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ The Chehalis EDT model indicates Stearns Creek needs improved habitat diversity, although not much data is available	➡ LWD levels are probably low since riparian conditions are rated poor for the Scammon-Stearns WAU (C. Stussy, professional opinion).	➡ Develop LWD supplementation plan and install LWD where appropriate. This action should start in Stearns Creek because of its potential spawning habitat. ➡ Determine LWD needs.