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Waucoma Project

Hydrology Resource Report

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for:
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1.0 Introduction

This is the specialist report that addresses effects to hydrologic resources that will be incorporated into the Waucoma Environmental Analysis (EA). In this report are described the existing conditions, and an analysis of the environmental consequences to hydrologic resources that could be expected as a result of No Action, or by implementing the Proposed Action (as it is defined in Section 3 of the EA).

The emphasis of the analysis of effects to hydrologic resources has been based upon the public scoping process. Comments received from the public helped to discern the focus and scope of the hydrologic analysis. The focus of this report will be on the key hydrologic elements pertaining to water quantity and water quality. Additionally, channel and riparian conditions are evaluated as indices of watershed functionality.

A Proposed Action has been developed that would intend to enhance the long-term presence of huckleberry in the forest understory at a landscape-scale across the Waucoma project area and enhance its vigor. Implementation of the project would be consistent with State and Federal direction and regulations aimed at achieving objectives for hydrologic resources, including Forest Plan standards and guidelines, and sustaining them in a desired condition for the future. Project Design Criteria (PDCs) were developed to avoid or minimize effects to hydrologic resources from proposed activities, and would serve as project-level guidance for implementing the National Core BMP program (USDA Forest Service 2012). PDCs would be requisite for project implementation.

2.0 – Analysis Framework

The spatial scope of this analysis considers a variety of scales, from the landscape level to the site scale. At the landscape scale, the subwatershed (12^{th}-field hydrologic unit) will be the spatial context. At the site-scale, a reach, segment, or an individual feature will serve as the spatial context.

2.1 - Resource Indicators and Measures

Indicators and measures to be used for assessing and predicting effects to hydrologic resources are listed in Table H1. They will be both quantitative and qualitative in character, and are derived using Geographic Information System (GIS), previous analyses in the area, empirical and monitoring data, field reconnaissance, and aerial imagery.

Table H1. Resource Indicators and Measures for Assessing Effects.

Resource Element	Resource Indicator	Measure	Source	Used to Address
Water quality	Sediment delivery Water temperature	Road density and stream crossings 7-day maximum stream temperature	GIS & Field data, WCF[1]	S&G State Standards
Water quantity	Peak streamflow	Watershed impact area	Aerial imagery, GIS, & ARP model[2], WCF[1]	S&G
Riparian Function and Channel Stability	Shade quality, large wood recruitment potential, channel condition	Riparian vegetation & structure Bank erosion & channel substrate	Aerial imagery, GIS, & Field data, WCF[1]	S&G

[1]Watershed Condition Framework, [2]Aggregate Recovery Percent, a hydrologic recovery model (based on work by Christner and Harr 1982).

2.2 - Methodology

Methods used are summarized in Table H2. Results of the analyses are compared to applicable Standards and Guidelines of the Mt Hood Land and Resource Management Plan (USDA Forest Service 1990), as amended by the Northwest Forest Plan (USDA/USDI 1994), research findings, and State water quality standards established by Oregon Department of Environmental Quality (ODEQ) and Oregon Department of Fish and Wildlife (ODFW) for designated beneficial uses.

BMPs and PDCs are the primary tools intended to avoid or mitigate potential effects to hydrologic resources that could result from the Proposed Action. Interdisciplinary team members including a hydrologist, soils scientist, and fisheries biologist participated in the development of the list of PDCs for the Waucoma project. BMPs and PDC were developed specifically for protecting aquatic, riparian, and water resources using the National Core BMP Technical Guide (USDA Forest Service 2012), standard FS contract administration, monitoring, and professional experience.

Table H2. Methods Used for Evaluating the Effects of the Alternatives.

Measure/Data	Utility	Limitation
Road Density and stream crossings - Geographic Information System Generated Site Data	Estimate the relative connectivity of the road system with the stream/drainage network to determine the locations and potential degree of effectiveness of the road system to: 1) intercept and re-direct runoff directly to	Spatial representations in GIS of the road system and stream network may vary in precision and resolution. Accuracy is supported and refined by field verification. Updates and refinements to spatial layers

Measure/Data	Utility	Limitation
	streams, and 2) deliver directly to streams road-generated sediment.	are made to corporate data on a periodic basis.
Water Temperature – AqS stream temperature database.	Empirical data collected from the field. Annual monitoring program of stream temperature. Data specific to a discrete location on a stream for a specified period of time. Continuous diurnal temperature monitoring.	Data sensors may at times malfunction, or can be moved or lost, rendering the quality of the data suspect or incomplete. QA/QC of database inputs imperative to insure data utility for functional analyses.
Watershed Impact Areas - Aggregate Recovery Percentage (ARP) Model	Gives a general idea about the condition of the hydrologic regime in a watershed. Model works well when validated with field data such as stream surveys.	Application of the model for the Waucoma project utilized a number of GIS-derived outputs coupled with aerial photo interpretation to determine hydrologic recovery. These may differ somewhat from what is on the ground due to actual site conditions which are variable across the landscape.
Riparian Function and Channel Stability - Stream Inventories	Surveys provide reach-specific data describing a variety of stream characteristics and conditions. Surveys were conducted using a Nationally standardized protocol by trained resource professionals.	Some of the inventories are older and some conditions may have changed between the time the data was collected and the present.
Water Quality, Quantity, and Riparian Function - Watershed Condition Framework	Universally applied rating system for evaluating the relative functional condition of watersheds based upon a variety of disturbance factors and individual ecological indicators. Informative for landscape-scale prioritization of restoration needs.	Coarse-scale assessment resolution. Sensitivity for project-level evaluations is low. At finer scales, the ratings are more useful if coupled with local empirical data or project-specific modeling outputs.
Effectiveness of PDCs/BMPs to Minimize Effects to Water Resources and Hydrologic Processes	Effectiveness of various erosion control measures in reducing sedimentation is well documented. General effectiveness of buffers in reducing sediment delivery to water sources and other impacts has been researched widely.	Effectiveness of various buffer widths on reduction of effects to surface water is not extensively documented in a wide variety of physical settings.

Interdisciplinary team members also visited the project area to look at system roads, proposed temporary roads, and proposed harvest units to evaluate the potential effects to aquatic, riparian, and water resources that could potentially result from the Proposed Action.

3.0 – Existing Condition

The Waucoma project area is situated in the northern Oregon Cascade mountain range. Mean elevation is about 3,400 feet. Precipitation averages between about 50 to 70 inches annually. A snowpack of 3 to 4 feet deep typically accumulates in most years and persists through the winter.

Because the project area adjoins the crest of the Cascade Range, its physiographic characteristics are more typical of the west side of the mountain range than the east side. Winters are generally cold and wet, and summers cool and moist.

3.1 – Watersheds and the Hydrologic Regime

The project area overlaps portions of four subwatersheds. The majority (98%) of the project area is tributary to the Hood River basin. The remaining portion drains directly toward the Columbia River. Most (92%) of the project area lies within the upper portions of the Lower West Fork Hood River subwatershed (See Table H3).

Table H3. Breakdown of Subwatersheds that the Project Area Overlaps.

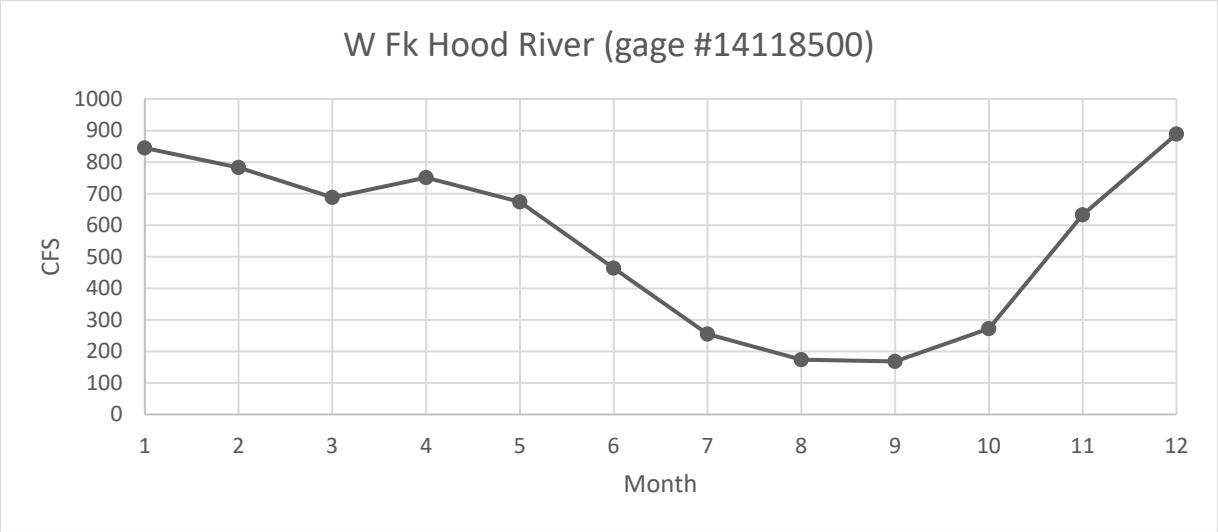
Subwatershed Name	Percent of Subwatershed Area	Percent of Project Area	Percent Forest Service Management
Lower West Fork Hood River	29	92	36
Odell Creek – Hood River	2	6	2
Herman Creek	<1	<1	99
Grays Creek – Columbia River	<1	<2	50

The majority (64%) of the Lower West Fork subwatershed, and nearly all (98%) of the Odell Creek – Hood River subwatershed is privately or county owned. Dominant land uses on non-federal lands include industrial forestry, agricultural production, and rural residential.

The principle streams that flow through the project area are Green Point Creek, North Fork Green Point Creek, Gate Creek and Cabin Creek. They are 2nd- or 3rd-order perennial tributaries to the West Fork Hood River. These mountain streams are primarily high-gradient channels in confined valleys that are dominated by riffles interspersed with pools. Irrigation diversions on Gate and Cabin Creeks, which are tributary to the North Fork Green Point Creek, causes their flow to dry up in lower reaches during the summer.

The naturalized hydrologic regime is characteristic of a mixed rain and snow dominated system. Typically, streamflow is lowest from mid-summer to early fall, and then increases with the onset of fall rains. As winter progresses, streamflow typically decreases somewhat as water is stored in the seasonal snowpack at the higher elevations. Flows then increase through the spring and early summer as the snowpack steadily melts. Then flows gradually decline to base levels during the dry season in summer and early fall. (Figure H1). The greatest peak flows recorded have usually been associated with rain-on-snow events that occurred in the winter months.

Figure H1. Average Monthly Flow Recorded Near the Mouth of the West Fork Hood River 1932 to 1991.



Source: USGS 2019

Other water bodies within or near the project area include several small lakes and ponds, forested and non-forested wetlands, and many seeps and springs. Black and Rainy Lakes are prominent headwater sources to the North Fork of Green Point Creek, and Ottertail Lake is a source to Green Point Creek.

Rocky soil types that dominate the project area along with the underlying igneous geology that is highly fractured and jointed, are central factors influencing the abundance of groundwater in the area. The groundwater, coupled with water stored in the lakes, ponds, and wetlands contribute to relatively stable base flows of the area.

Farmers Irrigation District (FID) maintains and operates water diversion, storage, conveyance, and hydroelectric systems that serve agricultural producers and other customers in the Hood River valley (USDA 1996). Several of their diversion and conveyance facilities that are located within the project area include:

- Rainy Creek Canal/Pipeline – diverts water from Rainy Creek to upper Gate Creek. These facilities are located on Forest System lands.

- Stanley Smith pipeline and diversions – diverts and transfers water from Gate and Cabin Creeks outside of the project area to Upper Green Point Reservoir. Both of the diversions are located on Forest System lands, along with about 3.5 miles of the pipeline.

At the Gate and Cabin Creek diversions, the FID typically diverts all of the water in the stream during the summer and early fall. During the winter and early spring, only a portion of the flow is diverted, and as much as half or more of the natural flow is bypassed down the stream.

The Watershed Condition Framework (WCF), is a landscape-scale, universally applied rating system used to help determine where watershed restoration should be prioritized on lands administered by the Forest Service. The WCF is based on a rating and scoring system of a variety of aquatic and terrestrial indicators and disturbance factors. The majority (92%) of the project area lies within the Lower West Fork Hood River subwatershed, which is rated by the WCF as *Functioning at Risk*. Causal factors for this rating applicable to the project area include:

- Flow impairment due to diversion for consumptive use from Gate and Cabin Creeks
- Degraded aquatic habitat in certain reaches of Green Point and North Fork Green Point Creeks
- Presence of non-native fish (brook trout)
- Moderately-high road density
- High-risk fire condition class – a result of fire prevention that has truncated the natural fire cycle

3.1.1 – Water Quantity – Existing Conditions

Select stream flow statistics derived from measurements acquired from a former gage that used to be operated by the USGS near the mouth of Green Point Creek are displayed in Table H4. Although the period of record is rather brief and dated (1949-1954), the data provide an insight into the seasonal variation of the hydrologic regime. It indicates that discharge is responsive to the abundant rainfall during the wet season, spring melt of the snowpack, and groundwater maintenance of base flow during the dry season.

Table H4. Daily Mean Discharge (cfs) Statistics for Select Days for the Period of Record at Green Point Creek Gage Station (#14118000).

Day	Min	25th Percentile	Mean	Median	75th Percentile	Max
Aug 31	15	17	20	20	23	23
Nov 1	16	23	34	127	278	508
Feb 1	65	78	121	197	354	449
April 1	78	93	108	172	283	454

Source: USGS 2019

The low margin of variation in the August 31st flow statistics suggests an influence of groundwater in the subwatershed. There is little difference between the minimum and

maximum values, suggesting a fairly stable base supply. This can be inferred to be indicative of reliable re-charge and storage, which is also evident in the commonly found lakes, ponds, seeps, and springs located throughout the higher elevations.

The higher variation between discharge values during the majority of the year, indicate the variability in total precipitation. Rainfall amount, timing, and intensity can affect stream flow widely, and snow accumulation plays a role as precipitation is stored in the seasonal snowpack. The order of magnitude difference between the minimum and maximum discharge values is an indicator of heavy precipitation, or storm events when peak flows typically occur.

Within the project area, current conditions that could have the potential to alter the hydrologic regime and water quantity include:

- The extent and arrangement of watershed impact areas (i.e., created openings or immature canopy of forest cover caused by disturbance)
- The density of roads and their connectivity with the stream network
- Water diversions and withdraws for consumptive uses

For the Waucoma analysis, Watershed Impact Areas (WIA) were defined to be previously disturbed forested areas where the average tree diameter was estimated to be less than 8 inches, *and* the canopy cover less than 70 percent. The area existing as a road surface was also considered in WIA estimates. Forest Plan S&G FW-064 indicates that WIAs at the analysis-area level should not exceed 35 percent. Table H5 exhibits the estimated extent of WIAs within the subwatersheds the project area overlaps.

Table H5. Estimated Extent of Current Watershed Impact Areas (WIA) within the Project Area.

Subwatershed	Percent WIA within the Subwatershed (all ownerships)	Percent of WIA within the Subwatershed (FS Lands)
Lower West Fork Hood River	31	23
Odell Creek – Hood River	25	30
Herman Creek	<1	0
Grays Creek – Columbia River	<1	0

Both the Lower West Fork and Odell Creek subwatersheds exhibit the greatest extent of WIAs on FS lands in the project area. This is largely attributed to regeneration type timber harvests that had occurred during the 1990s that have not yet developed an effective canopy cover. Still in younger stages of stand development, their canopy is characterized by an understory dominated by brush and conifer saplings. Hydrologically, retention of total precipitation in these

stands would be expected to be less than older stands, potentially contributing a greater degree of runoff available to peak flows. Their extent however, is minor and patchy compared to the amount of area covered by an intact effective canopy cover. So the potential increase in the amount of runoff available to peak flows from the WIAs on FS lands in the project area is not considered to be great.

The extent of the road system in the project area also has the potential to affect water quantity, particularly available runoff to contribute to peak flows (Harr et al 1975 and Wemple et. al. 1996). Road density is a measure often used as an indicator of the potential for a road system to affect peak flows. Generally, road densities that exceed 3 miles per square mile indicate there is a likelihood that road-related runoff could be measurably affecting peak flows at the subwatershed scale, particularly when they are connected to the stream network.

As an indicator however, road density does not gage completely the degree of connectivity of a road system with the stream network across a landscape. Assessing the intersection of the road system with the stream network can provide further certainty of a road network's potential effect on peak flows (Furniss et. al. 2000). Table H6 displays the estimated road density and number of road crossings within the project area stratified by subwatershed.

Table H6. Road Density and Connectivity to the Stream Network.

Subwatershed	Current Road Density (mi/mi^2)	Number of Road Crossings Over Streams	Likelihood of the Road System to Affect Peak Flows
Lower West Fork Hood River	2.1	30	Low to Moderate
Odell Creek – Hood River	4.8	1	Very Low
Herman Creek	0.0	0	NA
Grays Creek – Columbia River	4.3	0	None

The potential for the road network in the project area to intensify the availability of runoff to contribute to peak flows is greatest in the Lower West Fork subwatershed. The road system within it is well connected to the stream network. It's estimated that this represents about 5 percent of the total road mileage in the project area that can potentially contribute intercepted runoff directly to streams. This would indicate that the overall likelihood for the road network to augment peak flows is low to moderate (contributing length is low, but there are many crossings). There are however, specific segments of road that have a higher likelihood to contribute runoff to localized stream reaches because they are directly connected to them. In

particular, there are segments of the main arterial routes of Forest Service roads 2810 and 2820 that cross directly over reaches of the perennial stream network.

Within the other subwatersheds of the project area, the likelihood of the road system to affect peak flows is low to negligible. This is primarily due to the very low extent of overlap with these subwatersheds, and because the location of the Forest Service roads within them is high in the subwatershed where streams are few and connectivity to them almost non-existent.

Additional flow modification of streamflow within the project area can be attributed to the water diversions and withdraws, principally from Gate and Cabin Creeks which have been in use for many decades. Both Creeks are direct tributaries to the North Fork Green Point Creek. These diversions are owned and operated by the FID as authorized by a Special Use Permit granted by the Forest Service, and supply water for storage in the Green Point Reservoirs under water rights administered by the State of Oregon. Consideration of FIDs water rights and use would be outside the scope of this analysis.

Generally, the majority of water is diverted during the wet season to help fill the reservoirs. During this time, a proportion of the discharge is diverted, but not all of it. A portion of the winter and spring flows routinely bypass the diversions. Peak storm discharge would be attenuated to a degree, but some of it flows naturally downstream.

Once filled, the amount of water diverted to the reservoirs is decreased to a maintenance flow. In the late summer and early fall, when demand is typically greatest and natural flow the lowest, it is common for the base flow of both streams to be entirely diverted. This substantially decreases the amount of base flow in both Gate and Cabin Creeks below the diversions during the summer and early fall. Recovery of base streamflow can be observed in most years further downstream, presumably from gains from hyporheic zone inputs and springs (Forest Service 1979 and 1991).

Further deficits to base flow as a result of past timber harvest and the current mix of structural forest stages in the project area are not believed to be as great, nor clearly discernable. Recent research conducted by Perry and Jones (2016) has correlated a potential for base flow deficits in subwatersheds that exhibit a prominence of younger plantations in the western Cascades. But in the project area, only about 24 percent of its extent is comprised of younger plantations. So the extent of base flow deficits that could be attributable to young plantations is considered to be low. There are also year around inputs from many observed groundwater features in the project area that could be contributing to the maintenance of base flows further downstream.

3.1.2 – Water Quality – Existing Conditions

Water quality within the project area is good. None of the streams or lakes have been on the State's 303(d) list for impaired waters. There have not been any pollutants identified that are adversely impacting stream reaches within the project area. The WCF denotes a water quality rating for the subwatersheds overlapping the project area as *properly functioning*.

Though data is limited, stream temperature on measured reaches appears to mostly be within State Standards for fisheries. Monitoring conducted by the Forest Service in reaches that flow across FS lands in Green Point Creek from 2003 to 2005 indicated that the 7-day maximum stream temperature never exceed 10 degrees Celsius. Spot samples taken in late July from North Fork Green Point Creek suggest that water temperatures were also within standards for spawning (13 deg C). Spot observations taken from Gate Creek exceeded the spawning standard, but were within the rearing and migration standard (18 deg. C). Though the data is not rigorous, sampling from the late-summer months indicate that stream temperatures in perennial reaches have not been markedly elevated.

Streamside shade within the project area is primarily intact. Aerial imagery shows that the majority of streamside vegetation on FS lands is currently dominated by a continuous forested canopy. That cover is comprised of a mix of forest structure types ranging from young to old, and interspersed with a common component of hardwoods. Older-forest structure is less extensive than mid-seral canopy types along streams. Yet shade quality is not considered to be diminished nor limiting, and has been recovering for decades from early 20th century timber harvest. Near-stream openings in the project area do occur naturally, primarily as talus slopes, which are abundant along certain reaches.

Sedimentation impacts to water quality are not known to have been measured in the project area; data is sparse. The natural sediment regime would mostly be considered related to an infrequent denuding type of disturbance, such as wildfire; or a large episodic storm event such as a rain-on-snow event. Landslides and surface erosion are not dominant processes associated with the landforms within the project area.

The natural sediment supply is believed to currently be altered somewhat by human factors, principally the existing road system. Past timber harvest has likely also been a contributing factor in the past, particularly back in the 1920s and 1930s. Within the project area, the primary arterial routes of the 2810 and 2820 roads cross the stream network in the Lower West Fork subwatershed, where the potential delivery of road-related sediment directly to a stream reach is likely. Some crossings exhibit a greater potential than others.

The potential is greatest during high runoff events when the road tread is exposed to erosive forces, and concentrated intercepted flow is diverted from the road surface to the stream network. Maintenance and reconstruction activities aimed at disconnecting the road system further from the stream network have only occurred periodically over the last decade when opportunities arose. So there remains the potential for road-related sediment to impact water quality, but only for a short duration when runoff events of sufficient magnitude to mobilize it occur. Sediment delivery from roads would have been a temporary pulsed input at a small, and local scale.

3.1.3 – Riparian Function and Channel Stability – Existing Conditions

The majority of the perennial stream miles in the project area are confined, with narrow valleys that limit the natural development of a wide floodplain and lateral extension. They have a

relatively high gradient, and they are typically wider than they are deep, with a low degree of sinuosity. Their reaches are characterized by cascades/riffles and step-pools. They are primarily transport-type reaches, where bedload materials, woody debris, and channel obstructions are relatively transient (Montgomery and Buffington 1997). Streambank erosion rates are inherently low as are the aggradation and degradation processes (Rosgen 1996).

Several streams have been surveyed in the project area; but this data is limited. Generally, riparian and channel conditions are not considered to be in an unimpaired, fully functioning status, nor are they considered to be extensively impaired, or functioning at risk (AREMP 2016). There are reaches where in-stream large woody debris and log jams are abundant, and reaches where it is not. There are reaches where substrate, pool quantity/quality, and width-to-depth ratios appear in a natural condition, and then there are some reaches where introduced fine sediment has been observed to be a notable proportion of the substrate (Forest Service 1979 and 1991).

Where small, localized floodplain features occur, complexity and bank stability seem to be maintaining, and remain connected with the main channel. Nearly the entire length of the main channel of North Fork Green Point has been inaccessible and undisturbed for several decades, as there are no roads that encroach into the canyon.

The main stem of Green Point Creek however, is much different. The main arterial road is parallel to the stream, and in places located in the valley bottom. While the majority of these road segments are buffered by a vegetated distance from the main channel, certain ones have encroached into the riparian zone and altered channel configurations at crossings. The extent of these conditions is highly localized.

Vegetative structure in riparian zones within the project area is a mix of seral stages. But both the inner and outer riparian zones throughout the project area are nearly entirely forested, with the exception of naturally occurring talus slopes. Recruitment potential of woody debris from the riparian zone is high. Organic inputs are not lacking.

Channel forming processes are believed to have been disrupted in both Gate and Cabin Creeks where water diversions that serve the FID have been affecting streamflow since the 1920s. Peak flows in their middle reaches below the diversions are believed to have been attenuated appreciably. This decrease in stream power has likely diminished the capability of peak flows to maintain and form quality pools in those reaches, and deceased the natural movement, sorting, and storage of woody debris, bedload, and sediment.

There have been some in-stream restoration projects within specific reaches in the project area. Treatments occurred in lower segments of main Green Point Creek and Gate Creek in the early 1990s. Additionally, the FID identified some gravel augmentation and in-stream large wood projects intended to benefit Gate Creek and other tributaries where their facilities are located.

3.2 - Environmental Consequences (Direct and Indirect Effects)

Direct and indirect effects to hydrologic resources have been evaluated for both the No Action and Proposed Action alternatives. The project area overlaps portions of four subwatersheds. The majority of it, as well as the bulk of the proposed treatments, lie within one of those four subwatersheds (Table H7). Only a very small proportion of the other three subwatersheds would be affected. Hence, for this hydrologic analysis, effects have only been analyzed within the Lower West Fork Hood River (LWFHR) subwatershed.

Table H7. Percent of Subwatershed Overlapped by the Project Area and Proposed Treatments.

Subwatershed Name	Project Area	All Proposed Treatments
Lower West Fork Hood River (LWFHR)	29	11
Odell Creek – Hood River	2	1
Herman Creek	<1	0
Grays Creek – Columbia River	<1	<1

Also, since there are no surface water bodies within or connecting to treatments being proposed within the Grays Creek-Columbia River or Odell Creek-Hood River subwatersheds, site-specific hydrologic effects are considered to be inconsequential, so there will be no further consideration of them in this analysis of effects.

3.2.1 – No Action Alternative

Effects anticipated from No Action would be expected to reflect the existing condition. Management within the project area would be the status quo. In the short-term, effects to hydrologic resources from current management and use in the project area would remain. In the long-term, sans any major disturbance within the project area, trends in the flux and variation of natural and human-related effects that can influence hydrologic response would be expected to continue on their current trajectory.

Water Quantity – Effects of No Action

Existing influences and conditions that factor into effects to water quantity in the project area would remain in play. These would primarily include:

- The extent and arrangement of watershed impact areas (i.e., created openings or immature canopy of forest cover caused by disturbance)

Because the extent of watershed impact areas (WIAs) is currently 31% and patchy in the LWFHR, their contribution to runoff and peak flows in the short-term would be expected to remain very low, and within the natural range of variability. In the longer term, these young stands would continue to grow and develop, and their effect on runoff would gradually decrease. Within an estimated 20 to 40 years they would become hydrologically mature, or "recovered", and no longer considered to be a WIA.

Deficits to base flow attributable to the presence of young and mid-seral structural stages in the project area would also be expected to remain low because their extent is not prominent. Year around inputs from the many observed groundwater features in the project area would continue to contribute to the maintenance of base flows downstream.

- The density of roads and their connectivity with the stream network

  The potential for the road network in the project area to intensify the availability of runoff to contribute to peak flows would remain greatest in the LWFHR subwatershed. Within it the road system would continue to be well connected to the stream network.

  An estimated 5 percent (1.2 miles) of the total road mileage in the project area would continue to potentially contribute intercepted runoff directly to streams. Specific segments of road that would have a high likelihood to contribute runoff to localized stream reaches because they are directly connected to them include specific segments of the main arterial routes of Forest Service (FS) roads 2810 and 2820, as well as certain segments of the 2810-630 and 2820-610 roads.

  Reconstruction or improvement projects to decouple the road system from the stream network so that the amount of intercepted runoff would be reduced would not occur. But the overall likelihood for the road network to augment peak flows would remain low to moderate because the amount of contributing length is relatively low, yet there are many crossings along that length (approx. 30) that connect to the stream network.

- Water diversions and withdraws for consumptive uses

  Additional flow modification of streamflow within the project area attributable to water diversions and withdraws, principally from Gate and Cabin Creeks would be expected to remain. These diversions would continue to be owned and operated by the FID, and supply water for storage in the Green Point Reservoirs under water rights administered by the State of Oregon. Their effects on both peak and base flows would not change. Consideration of FIDs water rights and use would be outside the scope of this analysis.

Water Quality – Effects of No Action

Overall, water quality within the project area would be expected to remain good. Streams and lakes would not become likely candidates for inclusion onto the State's 303(d) list of impaired waters. New pollutants would not be expected to be introduced.

No further effects to stream temperature would be anticipated. Observable summer stream temperatures would trend to remain within State standards for beneficial uses and salmonids. Fluctuations to the quality of streamside shade would trend toward natural ranges of variation. Shade quality from past disturbance would remain on a gradual trajectory of recovery.

The natural sediment supply would continue to be somewhat altered by the existing road system. Within the project area, about 1.2 miles of specific segments of the primary arterial routes of the 2810 and 2820 roads, as well as those of certain system spurs (630 and 610 respectively), would continue to be potential sites for delivery of road-generated sediment where they cross the stream network.

The potential would continue to be greatest when high runoff events occur, and concentrated intercepted flow is diverted from the road surface to the stream network. Maintenance and reconstruction activities aimed at disconnecting the road system further from the stream network would not be expected. So there would remain the potential for road-related sediment to impact water quality, but only for a short duration when runoff events of sufficient magnitude to mobilize it occur. Sediment inputs from roads would continue to be temporary, pulsed input at a small, and local scale.

Riparian Function and Channel Stability – Effects of No Action

Generally, riparian and channel conditions would remain as they are, neither unimpaired, nor fully functioning. They would not become further impaired, or lose function over the long-term. There are reaches where in-stream large woody debris and log jams would remain abundant, and reaches where they would be lacking. There would be reaches where substrate, pool quantity/quality, and width-to-depth ratios remain in a natural condition, and then there would be reaches where introduced fine sediment could be observed to be a notable proportion of the substrate.

Vegetative structure in riparian zones within the project area would remain a mix of seral stages. Both the inner and outer riparian zones would continue to be dominated by a continuous forest cover, except where naturally occurring talus slopes are adjacent. Recruitment potential of large woody debris from the riparian zone would remain high, and an abundance of organic inputs would continue to be available within the riparian network.

Certain road segments will continue to impact riparian conditions within the project area. Primarily along the 2810 road, which is parallel to the main stem of Green Point Creek, and in places located in the valley bottom. While the majority of these road segments are buffered by a vegetated distance from the main channel, certain ones have encroached into the riparian

zone and will continue to be factors that have altered channel configurations at crossings. The extent of these conditions would remain highly localized.

Channel forming processes in both Gate and Cabin Creeks will remain disrupted by the water diversions that serve the FID, and that have been affecting streamflow since the 1920s. Peak flows in their middle reaches below the diversions will continue to be attenuated appreciably. This decrease in stream power will continue to diminish the capability of peak flows to maintain and form quality pools in those reaches, and the natural movement, sorting, and storage of woody debris, bedload, and sediment will remain partially diminished.

3.2.2 – Proposed Action

Water Quantity – Effects of the Proposed Action

As a result of commercial timber harvest, the WIAs on FS lands would increase from 23 to 33 percent in the LWFHR subwatershed (Table H8). Conversely, 67 percent of FS lands in the subwatershed would retain an effective canopy (5% is non-forest). This increase would have the potential to elevate slightly the contribution of runoff from FS lands to peak flows at the subwatershed-scale.

In the short-term, this increase would be expected to remain low, and likely only marginally detectable. It would not be expected to greatly intensify peak flows outside of the natural range of variability. In the longer term, these forest stands would grow and their canopy develop. Their effect on runoff would gradually decrease. Within an estimated 40 years they would be expected to become hydrologically mature again, or “recovered”, and no longer a WIA.

Table H8. Percent of Watershed Impact Areas (WIAs) Expected on FS Lands in Response to the Proposed Action.

Existing Percent of WIAs	Percent change Resulting from Commercial Thinning	Percent change Resulting from Shelterwood Harvest	Effect of Proposed Action
23	5	5	33

The extent of shelterwood harvest being proposed would amount to an estimated 2 percent of the LWFHR subwatershed as a whole. The contribution of runoff from these treatments to peak flows at the subwatershed-scale would be considered very low and undetectable. It would be expected that the potential for effects of these treatments to elevate peak flows at this scale would also be low.

Deficits to base flows attributable to the presence of young and mid-seral structural stages in the project area would also be expected to remain low because their extent would not be greatly increased by the proposed treatments at the watershed scale. Year around inputs from

the many observed groundwater features in the project area would continue to contribute to the maintenance of base flows downstream.

The potential for the road network in the project area to intensify the availability of runoff to contribute to peak flows would decrease within the LWFHR subwatershed. About 18 miles of open roads would be closed, or re-closed. Another 0.5 miles of road would be decommissioned. Overall open road density would decrease from 2.3 to 1.5 miles per square mile in the LWFHR subwatershed.

Closures and decommissioning would entail decoupling where possible those segments of road from the stream network (sometimes termed “storm-proofing). The amount of miles currently connected directly to the stream network would be expected to decrease from 1.2 to 0.7 miles. At least 3 road crossings over streams would likely be eliminated.

On the remaining open road system, reconstruction and maintenance projects would be expected to improve road drainage further. Additional cross-drain culverts, ditch line improvements, and upgrades to the road tread would occur to lessen the effect of certain road segments to intercept and route concentrated runoff directly to streams. The main Arterial routes of FS roads 2810 and 2820, as well as certain segments of the 2810-630 and 2820-610 roads would be improved.

Overall, the likelihood for the road network to augment peak flows would be expected to decrease. There would remain however, a proportion of the road system that would continue to be connected to the stream network, but their contribution to peak flow runoff would remain low.

Water diversions and the amount of withdraw would not be expected to change. Effects to peak and base flows would remain in their existing condition. Water facility operations in the project area are not within the scope of this EA or the Proposed Action, and would continue to be administered by the FID as regulated by the OWRD and conditions of their Special Use Permit.

Water Quality – Effects of the Proposed Action

Overall, water quality within the project area would not be expected to change appreciably as a result of the Proposed Action. Streams and lakes would not become likely candidates for inclusion onto the State’s 303(d) list of impaired waters. New pollutants would not be expected to be introduced. BMPs and PDCs would be expected to be effective at minimizing any impacts to water quality.

No further effects to stream temperature would be anticipated. Observable summer stream temperatures would trend to remain within State standards for beneficial uses and salmonids. Effects from commercial thinning treatments within the Riparian Reserve network would be low. It is estimated that less than 5 percent of the total perennial stream length would be subject to treatments in the outer riparian zone. Treatments to the inner zone would be avoided, and it would remain intact and protected. The quality of streamside shade would

remain functional and within the natural ranges of variation. Shade quality from past disturbance would remain on a gradual trajectory of recovery.

The natural sediment supply would continue to be somewhat altered by the existing road system. But the degree of alteration would be expected to decrease in the LWFHR due to road closures (approx. 18 miles) and a small amount of decommissioning. Overall open road density would decrease from 2.3 to 1.5 miles per square mile.

Closures and decommissioning would entail decoupling where possible those segments of road where they are directly connected to the stream network (sometimes termed “storm-proofing). The amount of miles currently connected directly to the stream network would be expected to decrease from 1.2 to 0.7 miles. At least 3 road crossings over streams would likely be eliminated.

On the remaining open road system, reconstruction and maintenance projects would be expected to improve road drainage further. Additional cross-drain culverts, ditch line improvements, and upgrades to the road tread would occur to lessen the effect of certain road segments to route intercepted flow and road generated sediment directly to streams. The main Arterial routes of FS roads 2810 and 2820, as well as certain segments of the 2810-630 and 2820-610 roads would be improved.

The potential for log-haul and activities by heavy equipment to increase road-generated sediment would be minimized by BMPs and PDCs aimed specifically at preventing unwanted effects to water quality. Monitoring on the Mt. Hood National Forest has indicated that their effectiveness to minimize the delivery of road-related sediment resulting from log haul has been reliable in most of the sampling. Log-haul during wet conditions has been limited using contractual administration. For winter conditions over snow, primary haul would be routed down the designated Kingsley Road, which is mostly paved. Winter haul on FS gravel roads would be limited to frozen or snow covered conditions, so that sediment generation would be kept to a minimum.

Overall, the likelihood for the road network to contribute sediment to streams would be expected to decrease. There would remain however, a proportion of the road system that would continue to be connected to the stream network, but their contribution to sediment delivery would remain low. The potential would continue to be greatest when high runoff events occur, and concentrated intercepted flow is diverted from the road surface to the stream network. But only for short durations when runoff events of sufficient magnitude to mobilize sediment would occur. Sediment inputs from roads would continue to be a temporary, pulsed input at a small, and local scale.

Riparian Function and Channel Stability – Effects of the Proposed Action

Generally, riparian and channel conditions would remain as they are, neither unimpaired, nor fully functioning. They would not become further impaired, or lose function over the long-term. There are reaches where in-stream large woody debris and log jams would remain abundant,

and reaches where they would be lacking. There would be reaches where substrate, pool quantity/quality, and width-to-depth ratios remain in a natural condition, and then there would be reaches where introduced fine sediment could be observed to be a notable proportion of the substrate.

Vegetative structure in riparian zones within the project area would remain a mix of seral stages. Effects from commercial thinning treatments within the Riparian Reserve network would be low. It is estimated that less than 5 percent of the total perennial stream length would be subject to treatments in the outer riparian zone. Treatments to the inner zone would be avoided, and it would remain intact and protected.

The inner riparian zones would continue to be dominated by a continuous forest cover. The availability of streamside woody debris would remain high. Recruitment potential of large woody debris from the riparian zone would remain high, and an abundance of organic inputs would continue to be available within the riparian network.

Certain road segments will continue to impact riparian conditions within the project area. Primarily along the 2810 road, which is parallel to the main stem of Green Point Creek, and in places located in the valley bottom. While the majority of these road segments are buffered by a vegetated distance from the main channel, certain ones have encroached into the riparian zone and will continue to be factors that have altered channel configurations at crossings. The extent of these conditions would remain highly localized.

Channel forming processes in both Gate and Cabin Creeks will remain disrupted by the water diversions that serve the FID, and that have been affecting streamflow since the 1920s. Water facility operations in the project area are not within the scope of this EA or the Proposed Action, and would continue to be administered by the FID as regulated by the OWRD and conditions of their Special Use Permit.

3.2.3 - Cumulative Effects

The spatial scope of this cumulative effects analysis for hydrologic resources is the Lower West Fork Hood River subwatershed. At this scale of resolution, project-level impacts are customarily reliably detectable and measureable. At larger scales, measures of project-level impacts can be less meaningful and reliable because they would likely become diluted by a myriad of confounding and competing factors across a broader area. The temporal scales to be concluded will be the long term. Generally referring to lasting, potentially chronic impacts that could be expected to linger at least 20 years or more.

For the Proposed Action, the analysis of hydrologic cumulative effects has focused on the extent of change expected to the forest canopy as a result of timber harvest. WIAs are used as the standard of measure. For this analysis the extent of WIAs serve as an indicator of the cumulative effect to hydrologic processes that could be collectively coupled to changes in water quantity, water quality, riparian function, and channel forming processes that would be expected to persist over the long-term.

The majority (64%) of the land in the subwatershed is privately owned and managed, primarily as industrial timberlands. About 5 percent is considered to be non-forest. The existing WIAs on non-Forest Service system lands consist mostly of young plantations and second-growth that have been reforested after regeneration timber harvest. Recent patches of regeneration harvest are also included. Currently, WIAs across all ownerships within the entire LWFHR subwatershed, including FS lands is estimated to be 31 percent (Table H9).

Table H9. Estimated Percent (area) of WIAs in the LWFHR Subwatershed

Existing Condition All Ownerships	Change with Proposed Action
31%	4%

Cumulative effects in subwatersheds the size of the LWFHR (20,000 to 30,000 acres) have been detectable when WIAs approach about 30 to 35 percent. These however, have primarily been associated with WIAs considered to be created openings (entirely denuded forest canopy) or conversion to hardened surfaces or other land uses (ex. roads, parking lots, agricultural).

Cumulative effects as indicated by the extent of WIAs in the subwatershed, could be affecting hydrologic resources to a measureable degree. While there is no empirical evidence, and there is a margin of error associated with the methodology to estimate the extent of WIAs, there is a likelihood of cumulative effects at the subwatershed scale across all ownerships.

The contribution of the Proposed Action to cumulative effects in the subwatershed however, is considered to be lower. Forest Service lands amount to approximately 36 percent of the entire LWFHR subwatershed. The majority of the acreage considered to be WIAs would continue to be associated with non-Forest System lands.

An increase of 4 percent resulting from the Proposed Action is a relatively low amount of area. Thinned stands would still retain a portion of overstory canopy that would partially function as an effective forest canopy. Thinning treatments would not render them completely ineffective. Recovery of thinned treatments to become fully effective and functional would be expected in about 20 years.

BMPs and PDCs designed to minimize unwanted impacts to water resources would further minimize the contribution of the Proposed Action to cumulative effects at the subwatershed scale. Riparian Reserves would continue to function and act to minimize effects. Road treatments such as reconstruction, maintenance, and closures on FS lands would further reduce the potential for proposed activities to magnify cumulative effects.

On non-Forest System lands, even-aged management would be expected to dominate forest practices to meet industrial timberland primary objectives. Road construction would likely accompany the need to access individual, localized stands. Also, water diversions would continue to serve the needs of the FID and its customers in the agricultural industry. Combined, the cumulative effects of this project when added to other past actions as well as foreseeable and ongoing actions would be a small contribution to cumulative effects in the subwatershed.

3.3 - Consistency with Management Direction

The Proposed Action as planned would be considered consistent with the LRMP Standards and Guidelines (S&Gs) for water resources (FW-054 to FW-079).

Relative to WIAs, the LRMP indicates that they should not exceed 35 percent for subwatersheds of several scales (FW-063 and 064). It is also indicated that WIA pertain to FS lands (FW-061 and 062), but that all ownerships within a subwatershed be considered (FW-066 and 067).

Because the Proposed Action would increase the extent of WIAs by a small percentage (4%), and that the BMPs and PDCs prescribed for the project would be expected to minimize watershed effects, and that road related projects would decrease existing impacts, the contribution to cumulative effects is considered to be relatively minor.

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