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Grasshopper Restoration Project

Hydrology Report

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1.0 Introduction

This report assesses hydrology and watershed function as they relate to the health of aquatic resources within the Grasshopper Restoration project area. The primary aquatic resource attributes assessed for this report include the timing and quantity of streamflows, water quality, and riparian habitat health. The Grasshopper Restoration Project has been designed to ensure compliance with the Mt. Hood Land and Resource Management Plan, as amended by the Northwest Forest Plan including requirements to meet Aquatic Conservation Strategy (ACS) objectives. Project design criteria (PDC) are included within proposed activities to minimize potential negative impacts on aquatic resources. The Grasshopper Environmental Analysis is incorporated by reference and includes PDC in Appendix A.

This report evaluates the consistency of the action alternatives with the Mt. Hood Land and Resource Management Plan, as amended (Forest Plan) and other law, regulation and policy relevant to water quality and hydrologic processes. This report concludes that there will be negligible direct and indirect impacts as a result of the action alternatives and that cumulative impacts will be immeasurable.

2.0 – Analysis Framework

2.1 - Resource Indicators and Measures

Table 1. Resource indicators and measures for assessing direct and indirect effects

Resource Element	Resource Indicator	Measure (Quantify if possible)	Used to address: P/N, or key issue?	Source FOREST PLAN S/G
Water quantity	Peak/base flow changes	Road Density, Watershed Impact Areas (WIA)	Yes	Forest Plan S/G
Water quality	Temperature	Acres of primary shade zone treated Length of Stream with reduced canopy cover	Yes	Forest Plan S/G Oregon State Standards
Water quality	Sediment delivery	Road Density Stream Crossings Temp Road Construction	Yes	Forest Plan S/G
Riparian function and channel morphology	Streamside shade quality, large wood condition/recruitment, and channel stability	RR forest structure, canopy cover, instream wood and substrate condition	Yes	Forest Plan S/G

Existing conditions and expected changes in hydrologic processes, specifically water quality, water quantity, and riparian function and stream channel morphology, were assessed using resource indicators listed in the table above.

2.2 - Methodology

Assessment of current conditions and expected effects is based on data from a combination of sources including:

- Recent aquatics and vegetation field surveys within the project area
- Historic stream surveys within the project area
- Water quality monitoring data
- Watershed Analysis for the White River
- White River post-fire Rapid Assessment Team (RAT) report
- Forest, roads, streams, soils and remote sensing data from corporate databases
- Streamflow data from federal and state water resource organizations
- Hydrologic and watershed modeling tools
- Current research on forest hydrology, riparian areas, microclimate and forestry

Data analysis follows established processes used by the Forest Service and others to evaluate effects of forest practices on streams, water quality and riparian areas[1]. Expected changes in hydrologic condition were compared to the Mount Hood Forest Plan (1990) standards and guidelines, Northwest Forest Plan (1994) policy and guidance, and Oregon State DEQ water quality standards, to ensure compliance with applicable laws and policy. Consistency with management direction is described in section 3.3.

3.0 – Analysis of the Action Alternatives

3.1 – Existing Condition

At the 5th field watershed scale, the proposed project occurs primarily in the White River watershed with a minor component on the North side of the project boundary falling in the Tygh Creek Watershed.

[1] Riparian reserve widths include two site potential tree height along fish bearing streams, or within one site potential tree height along any non-fish bearing intermittent streams, seeps, ponds, or wetlands less than 1 acre. Buffers are measured from the edge of the bankfull channel on both sides of the stream (or water's edge in the case of a pond or wetland). Buffers would be expanded to include slope breaks where appropriate. The inner riparian is defined as the area within a Riparian Reserve that is within 100 feet of a stream. Thus, the inner riparian includes the 60-foot buffers on perennial streams and the 30-foot buffers on intermittent or ephemeral streams where no treatment with the exception of prescribed fire would occur.

Looking at the finer scale 6th field subwatersheds, proposed treatments within the project area occur primarily in the Threemile Creek watershed with minor components in the Boulder Creek, Gate Creek, Rock Creek, and Upper Badger Creek watersheds.

Treatment areas that make up approximately five percent or less of total watershed area will not be analyzed. The scope and intensity of proposed treatments on this relatively minor component of watershed area is determined to be inconsequential on hydrologic processes and functionality.

Portions of five separate, geographically disconnected Inventoried Roadless Areas (IRAs) are contained within the proposed project area. In total, these designated IRAs amount to less than 300 acres. There are no municipal water supplies nor other potable water infrastructure sourced from any of these IRAs. The western portion of the planning area is a portion of the Mt. Hood National Recreation Area. This area contains Boulder Creek. There are no treatments proposed in areas designated as A9-Key Site Riparian.

Table 2. Summary of proposed treatment acres for subwatersheds in the project area*.

Watershed Name	HUC 12	Total Watershed Area (Acres)	Project Treatment Acres	Treatment as % Watershed Area
Upper Badger Creek	170703060801	16635	752	4.5%
Boulder Creek	170703060902	14210	511	3.6%
Gate Creek	170703060904	23081	123	0.5%
Rock Creek	170703060905	12391	654	5.3%
Threemile Creek	170703060907	22540	3344	14.8%

*All acres and percentages are approximate.

The Threemile Creek watershed is approximately 22,500 acres and ranges in elevation from approximately 1500 feet to 5200 feet. There is a strong precipitation gradient across the watershed with the high elevation headwaters in the western portion of the watershed averaging roughly 85 inches of precipitation annually while the lower elevations in the east receive around 15 inches of precipitation annually. The watershed has a dominant East-to-West orientation with relatively long, slender headwaters that drain to a broad fan-like valley upstream of the confluence with the White River. Lands managed by the Forest Service account for approximately one third of the total watershed area (7,200 of 22,500 acres) and include the entirety of headwaters.

3.1.1 – Water Quantity: Peak Flow and Base Flow

Peak streamflows in the Threemile Creek watershed are influenced by geo-physical characteristics of the basin, local climatic conditions, and interannual weather variability. Additionally, historic wildfire activity and anthropogenic influences from grazing, timber harvest,

and roads may, at times, influence hydrologic processes, including peak streamflows. Currently, the magnitude of regularly occurring peak flow events (e.g. 2 year flood events) is likely different from the natural range of variability while infrequent peak flow events (e.g. 100 year flood events) are similar to historical natural conditions. The removal of upland downed wood and instream large woody debris, channelization of stream corridors, removal of beaver, and created openings from forest management activities and off-forest agriculture have all contributed to speeding the concentration of streamflows, thereby increasing regularly occurring peak flows (USDA 1995).

Peak flow response indicators for this assessment focus on Watershed Impact Areas (WIAs), as evaluated using the aggregate recovery percentage (ARP) methodology and other site specific factors which can influence hydrologic processes. These factors include but are not limited to road network density, geophysical watershed characteristics, and climate patterns. While the ARP methodology provides important basis for comparison of management alternatives, it's important to recognize that ARP does not provide a wholistic measure of factors that influence hydrologic flow regime. For example, ARP is particularly helpful for evaluating the influence of clearcut-type activities (i.e. created openings) on landscapes that are prone to rain-on-snow events (Christner and Harr 1982) but has certain limitations when characterizing thinning treatments, particularly in areas dominated by rainfall (Grant et al. 2008). The ARP value for the Threemile Creek 6th field subwatershed is calculated to be approximately 80%. This ARP value is estimated to be the maximum extent of WIAs and is considered low to moderate given the geo-physical and hydro-climatic characteristics of the Threemile subwatershed. Therefore, peak flows and their influence on channel forming processes, such as redistributing bedload, coarse sediment, and woody debris, are considered to be properly functioning.

Roads have the potential to interfere with the routing of water, both surface and sub-surface flow, from upland hillslopes to stream channels. Roads with extensive connectivity to flow paths and drainage areas can enhance the hydrologic response of peak streamflow processes, leading to artificial increases in peak flow magnitude (USDA, USDI 1996). Some research indicates that road density in excess of 1.7-2.4 miles/square mile leads to impaired watershed function and corresponding impacts to stream health (USDA-USDI 1994, USDA 2011). On Forest Service lands in the Threemile watershed, road density is between 2.0 and 2.5 miles per square mile. However, this measurement does express important details related to 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). In the Threemile watershed, most roadways are generally disconnected from flow paths and exist well outside riparian reserves, thus interacting with streams primarily at stream crossings. Additionally, there are only 10 locations where roads cross streams with perennial flow and even fewer road crossings of intermittent streams. Overall, this is considered a low degree of interaction with the stream network, and therefore, the potential impact of existing roads on peak streamflow in Threemile is considered low.

According to the White River Watershed Assessment, base streamflows in the Threemile Creek watershed have been influenced by timber harvest, road construction, and water withdrawals for off-forest irrigation. Of these factors, water withdrawals have had the most significant impact on base flows as evidenced by complete dewatering of the creek in some years (USDA 1995). However, the primary factors driving base streamflow conditions in Threemile Creek are related to the amount and timing of precipitation, particularly late winter snowfall and summer rainfall. The interannual variability of these patterns outweighs other factors influencing base streamflow originating from Forest Service (FS) managed lands in Threemile Creek.

3.1.2 – Water Quality: Temperature and Sediment

Threemile Creek water quality impairment has been known to exist because stream temperatures occasionally exceeded state standards. Forest Service monitoring data collected in 1993 and 1994 showed weekly average maximum stream temperature exceeded 18 degrees C, the established standard for the designated beneficial use of anadromous fish passage and salmonid fish rearing. Subsequent data collected by the Forest Service over the course of 14 summer seasons from 1996 through 2019 (data was not collected all years) show that 7-day average maximum stream temperatures near the forest boundary (below the proposed project area) typically stay below 16 degrees C. As a result of this most recent data, stream temperatures in Threemile Creek are considered acceptable in providing for the beneficial uses of the stream.

The limited data available related to instream sediment conditions in Threemile Creek indicate that sediment levels are within the natural range of variability (USDA 2013 and field visits 2019). While Forest Service system road density, calculated between 2.0 and 2.5 miles per square mile, is slightly higher than desired conditions, the vast majority of roads are in upland areas and are hydrologically disconnected from streams. Therefore, the road system is not thought to contribute meaningfully to the sediment load in Threemile Creek. The primary sources of road related sediment likely occur at unpaved road crossings over perennial streams, although only one such crossing, the 4811 road crossing in the headwaters of Threemile Creek, is noteworthy. There are no developed recreation areas or trails within riparian areas of Threemile Creek. Evidence of dispersed camping and recreation use in riparian areas only exists in a few isolated locations and those locations likely contribute only short-term, localized increases in sediment delivery to streams.

3.1.3 – Riparian Function and Channel Morphology

Data from stand exams and the most recent Gradient Nearest Neighbor (GNN) Structure dataset provided by the Landscape Ecology, Modeling, Mapping & Analysis (LEMMA) collaborative research group show riparian reserve forest stands within proposed treatment units are currently dominated by mid-seral characteristics, in a stem exclusion phase of development. These stands lack the structural diversity and large tree component associated with late seral multi-storied forests which are an important aspect for achieving Aquatic Conservation Strategy

objectives. Additionally, stream survey data (USDA 2013) show that all reaches of Threemile Creek are deficient in the presence of Large Woody Debris (LWD).

Consistent with the GNN forest structure dataset, canopy cover in riparian reserves stands is considered extensive. While a few small and isolated portions of the riparian area may have limited canopy cover, the overall condition of the primary shade zone is effective at protecting the stream from exposure to incoming solar radiation (USDA 2013). On approximately 15 percent of the riparian area, where previous regeneration timber harvest has occurred, there is a mix of early-seral conditions and the effectiveness of streamside shade in these stands is currently limited.

On FS managed lands, the channel morphology of Threemile Creek and its perennial tributaries is characterized by moderate to steep, gravel dominated stream reaches. These types of stream reaches tend to have moderate entrenchment and width-to-depth ratios, stable to very stable banks, and relatively infrequent pool spacing (USDA 2007). These characteristics are consistent with stream survey data (USDA 2013) that show less than one percent of the banks are unstable and primary pool frequency is low.

Stream survey data (USDA 2013) show that the abundance of LWD and frequency of pool habitat does not meet LRMP standards and guidelines, but whether, and to what extent, those conditions are outside the range of natural variability, has not been clearly quantified (USDA 1995).

On approximately 7 miles of the mainstem of Threemile Creek that flows through FS managed lands, the upper half has characteristics that make it more sensitive to disturbance while the lower half has a low to very low sensitivity to disturbance (USDA 2013, Rosgen 1996).

3.2 –Environmental Consequences

This section describes the direct and indirect effects from the No Action and Action Alternatives. As stated previously (Section 3), given the minor geographic extent of the project in several watersheds, effects have only been analyzed for the Threemile Creek watershed.

3.2.1 Direct and Indirect Effects of No Action

The No Action alternative would have no direct effects on hydrology and watershed function. There would be no direct short-term changes in hydrologic processes affecting water quantity or water quality. Similarly, there would be no direct changes to riparian function and channel morphology. Interannual variability in precipitation and temperature patterns, particularly patterns of winter snowpack accumulation and summer rainfall, would be the dominant force affecting watershed processes and streamflows.

With the No Action alternative, peak flow and base flow regimes would remain unchanged in the short-term and would respond, slowly and incrementally in the long-term, to increasing canopy cover across the subwatershed. Stream temperatures would continue to provide for the

beneficial uses of the aquatic systems within the project area, with natural variability in weather and climate patterns driving both within-season and interannual variations in water temperature. Sediment delivery to streams, from all sources, would continue to approximate the range of natural variability and current water quality conditions would be maintained. Riparian forest stands would continue to be dominated by mid-seral characteristics and deficiencies in the recruitment of large diameter downed would persist in the long-term.

3.2.2 - Direct and Indirect Effects of Action Alternatives

3.2.2.1 – Water Quantity: Peak Flow and Base Flow

Alternative 1

The Proposed Action would result in new WIAs on approximately five percent of the watershed area, but would retain sufficient overstory canopy cover, on average, for stands to maintain most of their hydrologic effectiveness. The increase in WIAs has the potential to cause small increases in the magnitude of intra-annual peak flows (e.g. return interval less than one year), however such increases would be miniscule to immeasurable.

On approximately 1,100 acres, roughly five percent of total watershed area, post-treatment canopy cover would be slightly less than established thresholds (MTH 1998) and would therefore be classified as WIAs. However, these thinned stands would retain a portion of their overstory canopy, which would continue to play an important role in the patterns of snow accumulation and melt that drive peak streamflow processes. Due to continuing growth post treatment, it would be expected that thinned stands would become fully hydrologically recovered in 30-50 years, depending on individual stand plant communities, and would no longer be considered WIAs. For additional information on stand recovery over time, refer to the silviculture report.

The Proposed Action would include decommissioning 0.4 miles of system road (FS Rd 4810225) and construction of temporary road segments to facilitate tree removal. Due to the location and extent of the proposed road decommissioning, along with its current condition and limited use, this action would have no impact on hydrologic processes in the watershed. Forest Service system road density would remain between 2.0 and 2.5 miles per square mile. Given these conditions, there would be no change to either peak or base streamflow as a result of this aspect of the project.

While the Proposed Action would include construction of approximately 5 miles of new temporary road, BMPs and PDC governing the implementation of temporary road segments would limit hydrologic connectivity and prevent any meaningful concentration of flows through the disruption of flow paths. Impact to hydrologic processes from the construction and use of temporary roads in the Proposed Action would not result in measurable impacts to peak flow magnitude and timing or base flow conditions. Additionally, temporary roads would be obliterated directly following use, returning surface and subsurface flow paths to conditions

that approximate natural function. These actions would effectively limit any long-term indirect effects on hydrologic function.

Alternative 2

Under Alternative 2, all direct and indirect effects are the same as Alternative 1, with the exception of the degree of hydrologic impairment in WIAs where shelterwood treatments would occur.

Under Alternative 2 there would be approximately 150 acres of shelterwood treatments in the Threemile Creek subwatershed. Shelterwood treatments would occur in Gate Creek and Rock Creek subwatersheds, impacting approximately 0.3% (61 acres) and 0.6% (78 acres) of each watershed, respectively. As with other elements of the action alternatives, shelterwood treatment in these subwatersheds is proposed for such a limited portion of land, which is characterized by moderate slopes (<30%) and outside of riparian reserves, that it is considered inconsequential to hydrologic processes. Similarly, the shelterwood treatments in Threemile Creek subwatershed would amount to less than one percent of the total subwatershed area and approximately two percent of lands of the subwatershed managed by the FS. Areas receiving shelterwood treatment would retain more snow than if they received heavy thinning treatment and therefore shelterwood treatments are more likely to influence peak streamflows. However, the geographic extent of the shelterwood treatments would represent such a small percentage of landscape that any hydrologic impacts from shelterwood activities would be imperceptible.

3.2.2.2 – Water Quality: Temperature and Sediment

Alternative 1

There would be no change in the number of unpaved road crossings as part of this project. However, some unpaved road crossings lie on primary haul routes for log trucks and heavy equipment and would be subject to increased use during project implementation. Additionally, some existing Forest Service system roads that are currently undrivable (e.g. 4811018 and 4811020) would be rehabilitated to allow for localized access of heavy equipment and log trucks. Portions of these roads pass through the outer extent of riparian reserves. The Proposed Action would also allow for construction of temporary road segments that may enter designated riparian reserves if they are constructed on previously decommissioned or abandoned road prisms or skid trails; The total length of such segments would not exceed one-half mile. Implementation of BMPs and PDC to mitigate the erosive forces of precipitation and prevent the concentration of surface flow would help ensure protection of water quality. There would be likely be minor, localized sediment entering waterways in the form of dust from roads and fine sediment from ditch-relief runoff during the first winter storms of the season. However, these quantities of sediment would be minor – undetectable in comparison to existing conditions or the No Action alternative – and would be of short duration. In the long-term, there would be minor, although immeasurable, indirect reduction in sedimentation as a result of road maintenance work that would occur in conjunction with the Proposed Action.

The Proposed Action would include variable density thin (VDT) and sapling thin treatments on less than 400 acres of Riparian Reserves stands. With the exception of 11 sapling thin units (specified in PDC), no treatments would occur in the primary shade zone (due to a 60-foot protection buffer) of perennial streams and wetland areas (also specified in PDC). Sapling thin units with the potential to impact the primary shade zone would occur on approximately 35 acres, which amounts to less than 0.6 miles of stream along Threemile Creek. Stands receiving sapling thin treatments are in early-seral development and currently provide limited streamside shade, particularly during summer months. Removal of small diameter trees from the primary streamside shade zone in these stands could result in miniscule increases in solar radiation reaching the stream but because of their limited extent and current condition, would have no measurable effect on water temperature. In the long-term, there would be indirect benefits to these riparian stands because of improved health and vigor of the remaining trees. Improvement in streamside shade conditions would be accelerated after project implementation. However, because the accelerated improvement occurs on such a small percentage of the riparian area, benefits of this action would not affect stream temperature.

Thinning treatment within 60 feet of perennial streams and waterways would only be implemented in select units (see PDC) using hand crews, not heavy machinery. By eliminating ground disturbing activities within the inner Riparian Reserves there would be no new sediment delivery pathways created by this portion of the Proposed Action and therefore no direct effect on sediment delivery to streams.

Alternative 2

The differences in forest treatments under Alternative 2 would occur well away from riparian reserves and other hydrologically connected areas of the watershed. Therefore, the direct and indirect effects on water quality would be identical to Alternative 1.

3.2.2.3 – Riparian Function and Channel Morphology

Alternative 1

Generally, riparian conditions and function would improve over the long-term as a result of the proposed treatments. While there would be a minor short-term negative impact to the available recruitment of downed woody material, there would be a long-term benefit as tree growth would be accelerated, ultimately providing more abundant recruitment in the larger size classes (over 30”) that are currently underrepresented in the Threemile Creek subwatershed (USDA 2013). The VDT and sapling thin treatments being proposed in the outer riparian zone (the zone outside of the 60-foot and 30-foot no-cut buffers) would hasten the development of structural complexity in stands that are currently silviculturally stagnant (see silviculture report). These treatments would contribute to accelerated achievement of Aquatic Conservation Strategy objectives. Documentation of consistency with ACS objectives is included in the project record and on the project website. The direct and indirect effects of thinning these stands would be beneficial by reducing competition and accelerating growth of the remaining trees. Over the long-term, the recruitment of larger diameter downed wood would play an important

role in channel forming processes, building more complex channel features that would tend to hold water longer and provide more productive habitat for aquatic organisms. Thinning treatments in the outer riparian zone would occur on approximately 40 percent of the riparian reserve network within the Threemile Creek portion of the Grasshopper planning area. This amounts to less than 25 percent of total riparian reserve network on FS managed lands within the Threemile Creek subwatershed.

Because thinning treatments to the inner riparian zone, as defined by 60-foot and 30-foot no cut buffers, would be avoided, it would remain intact and undisturbed. The inner riparian zones would continue to be dominated by a continuous forest cover. The availability of streamside woody debris would remain high in the small and medium size classes and an abundance of organic inputs would continue to be available within the riparian network.

Treatment buffers within the inner zone of riparian areas would also protect the integrity of streambanks, and by extension, near-stream erosional processes that could alter substrate conditions and related channel forming processes. Additionally, riparian reserves along approximately 1.5 miles of Threemile Creek in the uppermost portion of the watershed would receive no treatment because they are either outside of the project area or excluded by PDC. This additional area of no treatment would further minimize potential negative impacts to channel morphology.

Alternative 2

The proposed treatments for Riparian Reserves are identical between alternatives. Therefore the direct and indirect effects on riparian function for Alternative 2 would be identical to Alternative 1.

3.2.2.4 – Inventoried Roadless Areas (IRA) and National Recreation Areas (NRA)

The Grasshopper Project proposes to treat approximately 80 acres designated as IRA within the Threemile Creek subwatershed and approximately 200 acres in neighboring subawatersheds (Gate Creek and Upper Badger Creek). Each of the areas with this designation are in upland forested areas that are disconnected hydrologically from streams and waterbodies. There are no drinking water nor municipal water supply sources on lands administered by the Forest Service within, or directly downstream, of the Grasshopper Project. The proposed action within units designated as IRA when implemented with the specified project design criteria, would have no direct effect on water quality. Indirect effects would occur as a consequence of changes in canopy which, in turn, impacts snowpack accumulation and melt patterns, including rain-on-snow processes. However, these indirect effects would be negligible and immeasurable.

Sapling and commercial plantation thinning is proposed for some portions of the Mt. Hood National Recreation Area (NRA). The Omnibus Public Land Management Act of 2009 established the Mt. Hood NRA within the planning area (Public Law111.11.) Activities would not degrade the protection, preservation, and enhancement of values for which the NRA was established

including watershed values. Hydrologic features within the NRA would be protected with PDC as in other areas.

Table 3. Resource indicators and measures.

Resource Element	Resource Indicator	Measure (Quantify if possible)	Existing Condition	Effect of Action Alternatives
Water quality	Sediment delivery	Road Density	2.0-2.5 miles per square mile	minor reduction
		# Stream Crossings	10 perennial 8 intermittent	No Change
		Temp Road Construction	N/A	Less than 0.5 mile in RR ~ 5 miles total
Water quality	Temperature	Acres of primary shade zone treated	N/A	~ 35 acres of early-seral stands would receive sapling thin treatment to accelerate tree growth and improve forest health in the primary shade zone
		Length of Stream with reduced canopy cover	Existing early-seral stands are limited in shade effectiveness	0.6 miles; canopy reduction will improve in the mid-term and beyond
Water quantity	Peak/base flow changes	Road Density	2.0-2.5 miles per square mile	minor reduction
		Extent of Watershed Impact Areas (WIAs)	6th field: 20 Project Area: 25	6th field: 25 Project Area: 38
Riparian function and channel morphology	Streamside shade quality, large wood condition/recruitment, and channel stability	RR forest structure	Dominated by category 4 – mid-seral stem exclusion	Accelerate development of late-seral forest structure
		canopy cover	Effective streamside shade protects stream from undue warming	Overall, no change in primary streamside shade; more open canopy in outer riparian to promote development of late-seral structure
		instream wood	Instream wood is primarily small diameter	Short-term reduction in recruitment of small diameter wood; long-term improvement in recruitment potential of large diameter wood.
		substrate condition	Consistent with natural range of variability; gravel dominated substrate	No change

3.2.2 - Cumulative Effects

The Action Alternatives would create approximately 1,100 acres of new WIAs by thinning forest canopy below hydrologic recovery thresholds (MTH 1998). This would increase the extent of WIAs in the Threemile Creek subwatershed (HUC 170703060905) and White River watershed (HUC 1707030609) by about five percent and less than one percent, respectively. On the portion of land within the Threemile Creek subwatershed that is managed by the FS, WIAs would increase in extent by approximately 13%. Overall, post-treatment forested areas in the Threemile Creek subwatershed would remain about 75 percent hydrologically recovered and the White River watershed would be about 80 percent hydrologically recovered. On the portion of land within the Threemile Creek subwatershed that is managed by the FS, forested areas would be approximately 63% hydrologically recovered post-treatment. The White River watershed scale is appropriate for assessing potential impacts at the landscape scale while the Threemile Creek subwatershed scale is appropriate to assess cumulative effects at a project level. Additionally, assessing FS managed lands as a separate geographic scale provides FS managers with important information about the portion of the watershed that is available to the Agency for vegetative manipulation (LRMP FW-062). The temporal scales assessed by the cumulative effects analysis is the long term; lasting, potentially chronic hydrologic impacts that could be expected to linger for a period of decades or longer as a result of the proposed treatments.

For the Action Alternatives, 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.

Within the White River watershed, the existing WIAs consist mostly of recent patches of regeneration timber harvest and associated young plantations that have been reforested after regeneration harvest, along with burn scars from past wildfire activity, most notably the White River fire, Rocky Burn, and Grasshopper fire. Currently, WIAs across all ownerships within the White River watershed, including FS lands, is estimated to be 18 percent. The Action Alternatives would increase the extent of WIAs across the watershed by an estimated 0.6 percent. On lands managed by the FS, the extent of WIAs is estimated to be about 28 percent and the Action Alternatives would increase this value by an estimated one percent.

Table 4. Estimated percent (area) of WIAs in the White River watershed*.

Area	Existing Extent of WIAs (%)	Change with Action Alternatives (%)
White River Watershed – All Land Ownerships	18	0.6

White River Watershed – FS Managed Lands	28	1.0

*All acres and percentages are approximate.

The Threemile Creek subwatershed covers approximately 13 percent of the total White River watershed area and as a component of this larger area, the same processes and factors affecting hydrologic processes have manifested within Threemile Creek. The existing WIAs in Threemile Creek are predominantly from recent patches of regeneration timber harvest and burn scars from past wildfire activity. Currently, WIAs across all ownerships within the Threemile Creek subwatershed, including FS lands, is estimated to be 20 percent, whereas the extent of WIAs on FS managed lands is estimated to be 25 percent. The Action Alternatives would increase the extent of WIAs across all ownerships within the watershed by an estimated 5 percent and within FS managed lands by an estimated 13 percent.

Table 5. Estimated percent (area) of WIAs in the Threemile Creek subwatershed*.

Area	Existing Extent of WIAs (%)	Change with Action Alternatives (%)
Threemile Creek subwatershed – All Land Ownerships	20	5
Threemile Creek subwatershed – FS Managed Lands	25	13

*All acres and percentages are approximate.

At the watershed scale, a total increase of one percent in the extent of WIAs on FS managed lands resulting from the Action Alternatives is a considered inconsequential and would have no cumulative effect on hydrologic processes. At the subwatershed scale, an increase of 5 percent in the extent of WIAs is a relatively low amount and would have no measurable impact on water quantity, water quality, riparian function or channel forming processes. On the portion of lands managed by the FS, the increase in WIAs would reach a threshold of concern (38%) (USDA 1990). Therefore, the action alternatives would require an exception to Forest Plan standards FW-062 and FW-064. However, because WIAs on FS lands would be dominated by conditions that facilitate a moderate degree of hydrologic function rather than complete impairment, and because of the geophysical and site specific characteristics of the watershed, the extent of WIAs would not lead to measurable changes in inter-annual peak flows. There could be minor changes in peak flows with return intervals less than about 2 years (Grant et al. 2008), however given the stream channel characteristics (USDA 2013) these flows would not have any meaningful influence on bedload movement and channel morphology (USDA 2007).

Stands receiving shelterwood treatments would increase the extent of WIAs by as much as two percent of FS managed lands within the Threemile Creek subwatershed. All other treated stands,

including those receiving relatively heavy VDT, would still retain a portion of the overstory that would partially function as an effective forest canopy. Thinning treatments would not render stands completely ineffective but could accelerate snowmelt processes under certain conditions (Grant et al. 2008). It is estimated that the canopy of stands proposed to be heavily thinned, would still function to a degree and would maintain a portion of their hydrologic effectiveness in the first year after treatment (MTH 1990). Due to continuing growth in treated stands, it would be expected that effectiveness of the post-treatment canopy would increase. The thinned stands would become hydrologically recovered in about 30-50 years, depending on stand plant communities and intensity of treatment, and would no longer considered to be a WIAs. For additional information on stand recovery over time, refer to the silviculture report.

3.2.3 - Degree to Which the Purpose and Need for Action is Met

This report has described how the action alternatives meet the purpose and need of the Grasshopper project described, in part as, "Enhance and restore forest diversity, structure, and species composition including pine/oak habitat and riparian reserves". For additional details about how the purpose and need is met, please refer to the Aquatic Conservation Strategy objectives summary.

3.3 - Consistency with Management Direction

The Mt Hood Land and Resource Management Plan (LRMP)

The action alternatives would be consistent with all but two of the LRMP Standards and Guidelines (S&Gs) for water resources (FW-054 to FW-079).

The two S&G where the action alternatives would not be considered consistent are standards FW-062 and FW-064. Therefore, a Forest Plan exception would be required for these two S&G. FW-062 states, "Not more than 35% of an area available for vegetative manipulation should be in a hydrologically disturbed condition at any one time." FW-064 states, "Watershed impact areas at the subbasin or area analysis level (I.e. typically 3000 to 6000 acres) should not exceed 35%".
Refer to the Cumulative Effects analysis in the body of this report for details about the extent of WIAs in the Grasshopper project area and potential effects of WIAs on hydrologic processes and watershed function.

The Northwest Forest Plan Record of Decision (ROD)

The ROD includes Standards and Guidelines (S&G) specifically related to management activities in Riparian Reserves. Additionally, the ROD details the Aquatic Conservation Strategy (ACS) as a means for maintaining and restoring the productivity and resilience of riparian and aquatic ecosystems across federal lands of the western Pacific Northwest. The alternatives for the Grasshopper project have been developed in such a way as to ensure compliance with ROD S&G as well as ACS objectives. A detailed summary about consistency with ACS objectives is included in the project record and on the project website.

Clean Water Act Compliance

Requirements associated with the Federal Clean Water Act (CWA) and Oregon Department of Environmental Quality water quality regulations will be met through implementation and monitoring of

PDC and BMPs, following guidance in USDA National Best Management Practices for Water Quality Management on National Forest System Lands (USDA 2012).

5.0 - References Cited

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