Oregon
Kate Brown, Governor

Department of Transportation
Office of the Director
355 Capitol St NE
Salem, OR 97301

DATE: June 7, 2021

MANAGEMENT RESPONSE

FROM: Mac Lynde, Deputy Administrator, Delivery & Operations Division & Debris Management Task Force member; Frank Reading, Area Commander, ODOT Wildfire Cleanup
RE: Management Response to *"Independent Review of the ODOT Hazard Tree Operation"*

The 2020 September wildfires go down in history as one of Oregon's most devastating disasters, burning more than one million acres, destroying thousands of homes, and claiming the lives of nine Oregonians. Afterwards, communities were confronted by devastation and loss, and swaths of dead burned trees blocking roads, toppling over highways, and interfering with rebuilding and cleanup efforts. ODOT and the Debris Management Task Force were charged with immediately going to work to remove wildfire debris and significant, unprecedented progress continues.

Originally charged by the Governor's Office and the Wildfire Economic Recovery Council to move swiftly as an adaptive emergency response operation, this work has evolved over time to reflect best practices, the critical needs of wildfire survivors, operational discoveries in the field, and to ensure that Oregon values including community safety and environmental stewardship are reflected in every aspect of the operation.

Earlier this year, as progress continued and emergency response work was more visible in communities, general concerns were raised about the hazard tree removal operation, the decisions being made about hazard tree determinations, and the qualifications of the individuals making these decisions. To further investigate these concerns, ODOT sought out the assistance of an experienced hazard tree professional with in-depth forestry and arboriculture expertise, with no previous involvement in the operation, to evaluate the work and make any potential recommendations. Galen Wright, of Washington Forestry Consultants, Inc. was hired to conduct these field reviews and assess the outcomes and protocols of the work underway.

ODOT appreciates the thoroughness of Mr. Wright's review and the independent critical assessment of the operation to keep Oregon travelers and communities safe. Mr. Wright's findings reinforce both the complex and unprecedented nature of the hazard tree removal process underway, while underlining what is currently working should this type of work become an unfortunate new reality for Oregon. ODOT appreciates and acknowledges Mr. Wright's summary of findings as follows:

> *"It is our finding that ODOT and the Debris Management Task Force has the necessary operational plan, protocols, contracts, and requirements necessary to conduct and provide quality assurance for this hazard tree mitigation program for the 2020 Oregon wildfires. No changes are recommended to the current protocols."*

Mr. Wright's review was informed by experiencing on-the-ground field work and reviewing numerous guiding documents and operational plans currently used in the field. ODOT and the Task Force appreciate the synthesis of these materials in Mr. Wright's findings. As an adaptive emergency operation, and in the spirit of continuous improvement, internal reviews will also continue throughout the life of the program. Mr. Wright's findings reinforce that quality work is underway while providing a window for what should be monitored or

evolved over time. As a key takeaway from Mr. Wright's findings—and in response to public reactions—ODOT and the Task Force recognize that if hazard tree removal work becomes more frequent for Oregon that there are opportunities for expanded statewide collaboration to further refine criteria, process, and how a variety of stakeholders can work together to find solutions to this complex recovery challenge.

In Response to the Review

In response to Mr. Wright's specific findings, ODOT and the Task Force appreciate the summary of confidence in the work underway while acknowledging that there is always room for adaptation. Most notably, this includes an acknowledgement that this work requires the discretion and individual expertise of trained professionals and with this comes a certain amount of professional judgement, similar to many other technical disciplines. Because of this, the need to keep overriding guiding principles and values firm while building and evolving the criteria used to make determinations for individual trees is paramount to a successful operation. ODOT and the Task Force will continue to set forth this approach and adapt criteria and process improvements as necessary to ultimately keep communities and travelers safe while adhering to FEMA reimbursement requirements, new challenges presented in the field, and incorporating a range of safety, environmental, and public input considerations throughout.

Mr. Wright's findings also suggest that a small percentage of fire-damaged trees exist on the landscape that should be marked, but were not, as state crews work to conserve as many trees as possible. Mr. Wright also identified a smaller percentage of trees that he felt should not have been marked due to their diameter and distance from the highway. Professional arborists and foresters in the field will continue to weave this feedback into their assessment work and will remain diligent in ensuring that no more trees are removed than absolutely necessary while surgically removing those dead or dying trees posing safety threats.

To note, Mr. Wright's report also provides a helpful snapshot of the scope and scale of fire-damaged hazard trees being cut or removed in these areas. The report states that the hazard tree operation comprises less than one percent of the total one million acre fire burn area, and it was found that more than half (58.3%) of the fire-damaged trees in this area are being left or monitored for conservation and monitoring purposes, per the criteria used to evaluate potentially hazardous dead or dying trees:

> *"In addition, WFCI determined that the number of cut trees marked amount to 41.7% of the population of trees along the corridors, with 58.3% of the trees being preserved."*

In response to Mr. Wright's review that—of the 1,200 crew members and more than 40 certified arborists or professional foresters on contract—one arborist may not fully meet the qualifications as outlined in the contract, ODOT and the Task Force appreciates this finding as field contractors navigate the challenges of hiring a large number of professionals from a small pool of candidates in the future. While this operation acknowledges that a range of experience levels and expertise exist on this project, those with more entry-level experience are supervised by more experienced colleagues and work within a multi-review system. Those with lesser experience have their work reviewed by lead workers, helping to narrow opportunities for inaccuracy. The feedback that one individual, though certified, did not fully meet the qualification criteria due to their entry-level status is noted and operations have been adjusted to ensure only those meeting specific contract criteria are making final determinations for hazard tree cutting and removal.

Lastly, in addition to the situational awareness that Mr. Wright's findings provide, other checks-and-balances are also in place to ensure fire-damaged tree evaluations and markings are thorough and accurate. Arborists and foresters overseeing tree marking are paid hourly rather than by the tree to create a clear separation of duties and eliminate conflicts of interest. Tree cutters are only allowed to cut marked trees and are paid on a per tree basis. Tree cutters are liable for a $2,000 fine for each unmarked tree that is cut. ODOT incident commanders, environmental monitors, a monitoring firm acting as operation inspectors, a disaster consulting

firm with expertise in FEMA reimbursement procedures, and the Army Corps of Engineers all monitor field operations daily as well.

The objective of this work remains to remove only dead or dying fire-damaged trees posing a threat to human life and safety over a five year period, and for those families and communities trying to rebuild safely. Throughout, ODOT and the Task Force welcomes feedback to help inform these efforts, and will continue to investigate and take swift and corrective action in response to any reports of mismanagement moving forward.

Future Disasters

The unfortunate reality that Oregon may experience another devastating wildfire event similar to that of 2020 is not taken lightly. Looking forward, both ODOT and the Task Force welcome future discussions and invite input and feedback that balances a range of perspectives rooted in safety and recovery. The ongoing cleanup effort currently underway resulting from the 2020 September wildfires is an immense operation and the first of its kind for Oregon. The lessons learned through this effort will inform planning work already underway as preparations are made in anticipation for the next disaster to impact Oregon.

2020 Oregon Wildfires

INDEPENDENT REVIEW OF THE ODOT HAZARD TREE OPERATION

Beachie Creek Fire – Marion County – OR 22 Corridor
Holiday Farm Fire – Lane County – OR 126 Corridor
Riverside Fire – Clackamas County – OR 224 Corridor

June 2, 2021

Oregon
Kate Brown, Governor

Prepared by: **WASHINGTON FORESTRY CONSULTANTS, Inc.**
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2020 Oregon Wildfires

INDEPENDENT REVIEW OF ODOT HAZARD TREE OPERATION

Contract #: B38394

Beachie Creek Fire – Marion County – OR 22 Corridor
Holiday Farm Fire – Lane County – OR 126 Corridor
Riverside Fire – Clackamas County – OR 224 Corridor

The Oregon Department of Transportation (ODOT) retained Washington Forestry Consultants, Inc. (WFCI) to perform an 'Independent Review of the ODOT Hazard Tree Operation' which was created to respond to the threat to public safety by trees damaged or killed in the 2020 Oregon wildfires.

Executive Summary

To develop an opinion of the hazard tree operation, WFCI:

1) Reviewed ODOT documents created to implement and manage the hazard tree removal program for the 2020 Oregon Wildfires,

2) Completed a detailed assessment of 2,214 sample trees on 83 one-acre sample plots installed systematically along the corridors and 8 plots in the outlying clean-up areas of the above 3 listed fires for a total of 91 sample plots,
3) Reviewed qualifications of the arborists/foresters employed by ODOT contractors to assess and mark hazard trees and provide quality control, and
4) Reviewed over 25% of the data generated by these arborists/foresters for these 3 fires.

Based on this review and field assessment and our extensive experience managing trees and vegetation on rights-of-ways and urban areas, is our professional opinion that:

1) ODOT has the necessary operational plan, protocols, contracts, and requirements necessary to conduct the assessment operations and provide quality assurance to this hazard tree mitigation program for the 2020 Oregon wildfires.
2) That reasonably, over 96% of the trees are being correctly marked based on the current state of knowledge of the forestry profession,
3) 99% of the trees marked for removal by the arborists/forester are dead or in poor condition, and that
4) The majority (98%) of the arborists/foresters utilized in the tree assessment possess the qualifications to do the work.

In addition, WFCI determined that the number of cut trees marked amount to 41.7% of the population of trees along the corridors, with 58.3% of the trees being preserved.

Scope of Services

The specific tasks are:

Task 1 and 1.1 – Coordinate all aspects of the tasks with the Agency Program Director, Wildfire Recovery Area Commander, and Agency Program Manager.

Task 2 and 2.1 – Review and become familiar with the ODOT hazard tree program – specific documents include:

- DROP – the ODOT Hazard Tree and Debris Removal Operations Plan (Ver. 2.0), which also includes the EPP (Environmental Protection Plan).
- ODOT Debris Management Tree Assessment Procedures (Version 9.0) also referred to as the field guide or standards of practice.
- Relevant contracts signed by the hazard tree assessment contractors. The CDR Maguire contract and Mason, Bruce & Girard subcontract were reviewed.

Other provided documents that WFCI reviewed included, but are not limited to:

- ODOT Debris Management Quality Control Program (Version 2.0)
- Notes on Hazard Tree Assessment Process.
- Tree data – Hazard Tree, Cut Tree, Pre-Checks, Collateral Tree, and Detagged Tree Lists. Only the Hazard Tree List created in the Krinkle and Debris Tech software applications was reviewed in detail.

Tasks 3 and 3.1 – Review of a 25% sample of collected 'hazard tree list' data (Krinkle and Debris Tech) across all 3 fire areas. Determine:

- If, in WFCI's professional opinion the appropriate trees are being identified as hazards as described by the contract and relevant documents.
- If they were marked or identified for removal by an individual with the proper qualifications.
- That the contractors followed appropriate procedures as defined in their contract and associated documents.

Task 4 and 4.1 - a review (the "Field Review") of no less than 3% and no more of 5% in the 3 Fire Corridors to assess the compliance of hazard tree identification.

- The field assessment will audit whether the marked and unmarked trees are consistent with the ODOT Debris Management Tree Assessment Procedures (Version 9.0), specifically does the tree present a safety hazard to the public that requires mitigation by removal (or snag creation) of the tree.
- The Contractor shall provide a draft and one final report (the "Field Review Report") which includes discussion for each Fire Corridor.

Limitations of the Assignment

The Services performed by the Contractor (WFCI) does not include making a decision about specific trees. Services are limited to the review of hazard tree identification performed by ODOT (by and through their consultants and DAS Version 2.0 – OPO PSK/PA Form C007-G082820 Page 24 contractors). All observations and recommendations provided by the Contractor (WFCI) to ODOT will be at the sole discretion of ODOT to address and implement.

Methodology

A kick-off meeting was held in Salem, OR on May 17, 2021 with the following individuals for WFCI to gain information, perspective, and provide our approach to the hazard tree program independent audit.

The following individuals were in attendance:

Attendee	Organization	Title
MacGregor Lynde	ODOT	Agency Program Director
Frank Reading	ODOT	Area Commander
Robert Fiegener	ODOT	Executive Analyst Wildfire Recovery Crew
Joe Squire	ODOT	Deputy Area Commander
Reggie Fay	Mason Bruce & Girard	Contractor – Quality Assurance
Jared George	CDR Maguire, Inc.	Contractor – Monitor Firm
Galen Wright	Washington Forestry Consultants, Inc. (WFCI)	Independent Reviewer

Field Sampling. -- Following this kick-off meeting, a sampling methodology was designed to view work in the field and collect information on marked and unmarked trees in the 3 fire corridors. The methodology was designed to avoid bias in the selection of trees to review, while achieving a representative sample of the work. This sample will then be used to predict with reasonable certainty the status and recommended mitigation of the population of trees in the corridors.

It was determined that a 3% sample of the population of marked and unmarked trees would be adequate to predict whether the tree selection for mitigation (hazard trees) was being done properly by the tree assessment contractors.

A systematic approach was used to assess the trees. Starting at the edge of the fire corridor, a 1 acre sample plot was inventoried at each highway mile marker. The 1 acre plot was designed with 50% of the plot being on either side of the highway. The plot extended 150 ft. perpendicular to the road (into the forest) and 145 ft. along the highway. Only 2 rangefinder shots were needed to establish the plot boundaries on each side of the highway. This was repeated on the other side of the highway, creating a sample plot that was 300 ft. x 145 ft., or 1

acre in size. A total of 83 plots were taken within the 3 corridors. The highway was not part of the plot.

To sample the private properties that ODOT cleaned that are away from the ODOT highway corridors (WFCI referred to them as 'clusters' in this document), 8 plots (randomly selected from the GIS tree plot layer) were taken, using a 100% inventory per address.

For each plot, trees larger than 6 inches DBH were viewed and evaluated against the criteria ***'Does this tree have a >50% chance of surviving at least 3 years'***. Trees that leaned away from the highway (>15 degrees) were not considered to be hazard trees. Further, trees that had other defects besides fire damage (e.g. slender whips, diseased trees, or structurally defective stems) and these trees threatened targets on the highway were also considered to be hazard trees. This included live trees that would be exposed to prevailing winds and storms by cutting of surrounding trees, and would then be subject to windthrow (blowdown).

For each evaluated marked and unmarked tree on a sample plot, WFCI determined if the tree was a hazard tree (and was it marked) or was not a hazard tree (and was it unmarked). Amount of crown loss to fire and residual live-crown ratio, bark char, and other indicators of damage/potential survival were considered. Instances where WFCI did not agree with the contract arborist/forester's tree designation were tallied and the overall % disagreement was determined.

Data Review. – A 25% sample of the data collected by the tree assessment contractor was reviewed for completeness and accuracy. Since the data was not taken to the field, limits of reasonableness for tree diameter vs. tree height were used, along with tree height vs. distance to the highway. The breakdown of tree condition ratings will be summarized. The number of trees with inconsistent or incomplete data, or that data is obviously incorrect were noted with respect to the overall population of tree data for that fire. A sample of the data produced by each arborist/forester was also reviewed to look for trends or patterns suggesting estimation rather than measurements of the required metric (e.g. DBH, tree height, offset distance).

Qualifications of Tree Assessment Personnel. – The resumes of 44 individuals were reviewed against the criteria - do they have:

1) The International Society of Arboriculture (ISA) Certified Arborist credential, or a
2) Forestry degree from a Society of American Foresters accredited forestry school, and
3) At least 5 verifiable years of post forest fire assessment in Northwest conifer forests along with mixed deciduous tree stands - for tree health and stability, and demonstrated understanding of forest management practice.

Other qualifications including the ISA Tree Risk Assessor, ISA Board Certified Master Arborist (a higher certification then Certified Arborist), ISA Certified Tree Worker, ISA Utility Specialist, CA Registered Professional Forester or an apprentice, Tree Care Industry Association apprentice, journeyman utility arborist, and wildland firefighter credentials/experience were considered.

After creating a qualifications matrix, then WFCI made the determination from the resume review whether the individual met the minimum qualification requirement of the contract. This data will be presented independent of the 3 wildfire corridor summaries since most individuals worked on more than 1 wildfire.

Documents Review. – All documents provided to WFCI by ODOT are listed above. These were reviewed completely and more than once to itemize details related to our audit.

Observations

Study Area. -- The 3 fire corridors covered 82 miles of the Oregon highway system. The majority of the trees deemed hazardous to the highway are located within 150 ft. of the highway shoulder. This creates an area of nearly 3,000 acres that require hazard tree assessment and mitigation by ODOT. Areas where ODOT performed clean-up away from the highway corridors were also sampled – these are referred to by WFCI as 'clusters'. The following Table 1 provides a summary of the study areas:

Table 1. Summary of all sample areas.

Fire	Area	# Miles - Corridor	Approx. Acres of Corridor[1]	# of 1 Acre Sample Plots Installed	# Clusters[2] Outside Corridors	# Clusters Sampled - Outside Corridors	% Clusters Sampled
Holiday Farm	Corridor	23	±836	23			
Holiday Farm	Clusters				17	5	29%
Beachie Creek	Corridor	40	±1,455	40			
Beachie Creek	Clusters				4	3	75%
Riverside	Corridor	19	±691	20			
Sum		**82**	**±2,982**	**83**	**21**	**8**	

[1]*Based on a width 150 ft. on each side of highway – from edge of asphalt.*
[2]*Private properties away from the highway corridors cleaned by ODOT.*

Sample Size. -- A total of 91 sample plots (83 corridor plots + 8 cluster plots) were inventoried to develop our professional opinion on whether the appropriate trees are being identified and marked as hazards by the tree assessment contractors (arborists/foresters) as described by their contract and relevant documents. This WFCI inventory represents a 3.1% sample of the corridor area and a 3.3% sample of the trees. This sample was then used to predict the size of the population of marked and unmarked trees.

Hazard Tree Definition. -- For all 3 corridors and the areas outside of the corridors (clusters) the inventory tallied:

1) Marked trees that WFCI agreed with the 'Removal' designation, that they would have a >50% likelihood of dying within the next 3 years,
2) Unmarked trees that WFCI agreed would have a <50% of dying within the next 3 years,
3) Marked trees that WFCI disagreed with that they have a >50% likelihood of dying within the next three years, and
4) Unmarked trees that WFCI determined should have been marked for removal.

Tree Inventory and Assessment Data. -- The following Table 2 provides of summary of the tree inventory and assessment done by WFCI.

Table 2. Summary of the sample tree inventory/assessment with the projected tree inventory.

		Agree		**Disagree**			
Fire	**Area**	**# Trees Marked**	**# Trees Unmarked**	**# Trees Marked**	**# Trees Unmarked**	**Total # of Sample Trees**	**Projected Total Population of Trees**
Holiday Farm	Corridor	351	316	13	13	693	25,182
Holiday Farm	Clusters	175	79	0	11	265	265
Beachie	Corridor	309	614	17	27	967	33,457
Beachie	Clusters	51	20	0	0	71	71
Riverside	Corridor	86	131	0	1	218	7,532
Sum		**972**	**1,160**	**30**	**52**	**2,214**	**66,507**
%		***43.9%***	***52.4%***	***1.4%***	***2.3%***	***100%***	

A total of 2,214 trees were individually assessed on the 91 fixed area sample plots/clusters. Each cluster plot (plots outside of the highway corridors) was 1 acre as well. The overall numbers of trees that are marked and unmarked were then projected for the trees that we agreed with and disagreed with.

Our inventory projected that there are 66,507 trees on the corridors and clusters in the 3 fires areas. There are actually more, since at the time of this inventory some marked trees had been 1) cut and removed, 2) cut and left, 3) some stumps were buried under chips, and 4) felled trees lay on top of other trees. Also, some of the older white Krinkle tags had also been removed by cutters or others. These challenges however, were **neither a major impact nor a significant obstacle** to a representative inventory and assessment of the tree marking.

Overall, WFCI agreed with 96.3% of the tree marking by the contract arborists/foresters. We disagreed with 1.4% of the marked trees and 2.3% of the unmarked trees.

The areas of disagreement included:

1) Marked trees were beyond reach of the highway and outside of the 1.5x tree height rule-of-thumb to be marked,
2) Preserved trees did not have adequate live-crown ratio to survive,
3) Dead trees were missed that were within the 1.5x threshold, or
4) Trees that were slender whips, would be exposed by clearing, or had other non-fire caused damage that caused them to be hazardous to targets within their reach if they failed.

Live-crown ratio is the measure of the length of stem covered by live foliage to the overall tree height. Foresters consider a 30% live-crown ratio to be the threshold for a tree that is expected to survive and be a long-term tree when doing thinning in a forest stand. It appears that many 'Preserved' trees on the corridors had live-crown ratios of no more than 20%. This suggests that hazard tree marking may be somewhat conservative and may result in more dead trees to mitigate in the next few years. WFCI agrees with this more conservative method of marking hazard trees.

It is our opinion that 96.3% agreement is very good. Considering the variability of the tree populations, the difficult terrain, weather challenges, and variation of damage to each tree from a crown or ground fire, this degree of agreement is as good as can be expected.

Cut vs. Preserved Tree Inventory. -- Overall, in the 3 fire corridor areas that we sampled, 41.7% of the trees were marked for removal while 58.3% of the trees were unmarked (to be preserved). This means that nearly 2/3's of the trees will remain within the 3 highway corridors after hazard tree removal is complete. The numbers of 'Preserved' trees are obviously impacted by the fire behavior (crown vs. ground) and the volume of fuel that impacted its heat intensity and duration. Where fuel is heavy on the ground, tree damage will be greater. Where a crown fire occurs, then this is typically fatal to most trees.

Table 3. Breakdown of the ratio of marked 'Cut' trees to unmarked 'Preserved' trees for the projected population of trees.

Fire	Area	Cut	%	Preserved	%	Sum
Holiday Farm	Corridor	13,227	52.5%	11,955	47.5%	25,182
Holiday Farm	Out	175	66.0%	90	34.0%	265
Beachie	Corridor	11,279	33.7%	22,178	66.3%	33,457
Beachie	Out	51	71.8%	20	28.2%	71
Riverside	Corridor	2,971	39.4%	4,561	60.6%	7,532
Sum		**27,703**	**41.7%**	**38,804**	**58.3%**	**66,507**

Tree Data Set Audits. – Data from examination of over 25% of the data collected by the arborists/forester is presented as a summary of the 'Debris Tech' and 'Krinkle' data sets. These data sets are simply 2 different software applications used to collect the hazard tree and other data. The Krinkle software was used initially to collect data on at least 31,290 trees, then a switch was made to the Debris Tech software later (at least 27,693 trees in the data set were examined).

The Debris Tech software included all of the necessary metrics of the Krinkle software, but added the 'tree condition' rating.

Table 4. **Debris Tech** data set tree condition ratings and tree metrics.

	Tree Condition Ratings					**Metrics**		
Fire	**Dead**	**Poor**	**Fair**	**Good**	**Sum**	**Avg. DBH (in)**	**Avg. TH[1] (ft)**	**Avg. Offset[2] (ft)**
Holiday Farm	7,356	2,172	55	12	9,595	19.7	90.2	86.6
Beachie	8,479	2,646	160	19	11,304	19.7	94.0	85.3
Riverside	6,620	137	24	13	6,794	20.6	107.5	90.8
All 3 Fires	**22,455**	**4,955**	**239**	**44**	27,693	**19.9**	**96.0**	**87.0**
%	***81.1%***	***17.9%***	***0.9%***	***0.2%***				

[1]*TH=Total height of the tree;*
[2]*Offset is the distance from the tree being assessed to the shoulder of the highway.*

The Debris Tech software allowed for collection of 'Tree Condition' while the Krinkle software did not. Coupled with WFCI's finding that we agreed with the tree assessment contractors arborist/foresters marking in over 96% of the trees assessed, Table 4 suggests that over 81% of the trees assessed were dead, a relatively easy visual call for a trained arborist/forester. Further, nearly 18% of the trees were classified as being in 'Poor' condition for a total of 99% being classified as 'Dead' or 'Poor'.

Trees recorded as being in the 'Fair' or 'Good' condition may be trees exposed to windthrow by removal of surrounding trees, or trees with other non-fire damage. Some may be 'Collateral' trees, i.e. necessary removals to cut marked trees safely, though we are not aware whether this update has been done in this version of the Debris Tech data base.

Table 5. Tree metrics in the Krinkle data set.

	Krinkle Data Set		
Fire	**Avg. DBH (in)**	**Avg. TH[1] (ft)**	**Avg. Offset (ft)**
Holiday Farm	20.3	119.3	71.3
Beachie	19.0	142.3	127.7
Riverside	19.7	100.4	85.4
All 3 Fires	**19.8**	**120.4**	**90.6**

[1]*TH=Total height of tree;*

Comparison of the early Krinkle data set to the Debris Tech data set yields similar results for average DBH and average offset distance. Tree heights averaged near 24 ft. taller in the Krinkle

data set. It is important to note that these 2 data sets are for different populations of trees, and simply reflect the sizes of trees found by arborists/foresters. None of these metrics imply anything other than population metrics. No red flags exist in either data set.

The data entered by each arborist/forester was examined to look for tell-tale signs of estimation of heights, DBH's, and distances, over reporting of tree heights, DBH's that did not correspond to the listed tree heights, or other signs (errors) that the arborist/forester was not following the protocol. This was accomplished by scrolling the databases (viewing an estimation of at least 1/3 of the data per arborist/forester). We found **nothing of concern** in this review.

Quality Control (QC). – Quality Control (review of trees after the arborists/foresters have inspected the trees) is being performed by Mason, Bruce & Girard for the majority of the trees. However, while there is no data to support the extent of QC review in the field, the lack of errors in the datasets and WFCI's high level of agreement suggests that the QC function is adequate.

In summary, it appears that the quality control process and data review by the contractors was thorough, eliminating errors that the arborists/foresters in the field created.

Understanding that the arborists/foresters were assessing hundreds of trees per day in often difficult field conditions, even the best trained person will occasionally have data input errors. The QC process seems to have done a good job of picking up and correcting these types of errors in the data bases.

Qualifications Review for the Arborists/Foresters. -- The WFCI review of the qualifications of the 44 arborists/foresters involved in the tree assessment operations found that 98% of the resumes meet the key requirements of:

1) The International Society of Arboriculture (ISA) Certified Arborist credential, or a
2) Forestry degree from a Society of American Foresters accredited forestry school, and
3) At least 5 verifiable years of post forest fire assessment in Northwest conifer forests along with mixed deciduous tree stands - for tree health and stability, and demonstrated understanding of forest management practice.

The qualification matrix (Attachment #2) also considered closely related experience, qualifications, and credentials before disqualifying a resume.

Summaries by Fire

Holiday Farm Fire. -- The Holiday Farm Fire started about milepost 48 on OR-126 spreading westerly to about milepost 25. Tree sample plots were installed at each of 23 mileposts, for an inventory of all trees on 23 acres. The WFCI inventory found that we agreed with 95.7% of the tree marking with 3.8% disagreement.

Table 6. Holiday Farm Fire summary and % of agreement and disagreement.

Fire	Area	Agree		Disagree		Total # of Projected Trees on Corridor	# of Sample Trees
		# Trees Marked	# Trees Unmarked	# Trees Marked	# Trees Unmarked		
Holiday Farm	Corridor	12,755	11,483	472	472	25,182	693
%		**50.1%**	**45.6%**	**1.9%**	**1.9%**		

Trees on 5 cluster areas away from the corridor were also sampled with 4% disagreement.

Over 99.6% of the trees on the corridor were rated by the arborist/foresters as being 'Dead' or in 'Poor' condition.

Table 7. Holiday Farm Fire tree condition rating and size metric summary.

Fire	Tree Condition Ratings					Metrics		
	Dead	Poor	Fair	Good	Sum	Avg. DBH (in)	Avg. TH[1] (ft)	Avg. Offset (ft)
Holiday Farm	7,356	2,172	55	12	9,595	19.7	90.2	86.6
%	**77%**	**22.6%**	**0.57%**	**0.01%**				

[1] *Total tree height.*

A total of 52.5% of the trees are being cut, and 47.5% preserved on the corridor.

Beachie Creek Fire. -- The Beachie Creek Fire started about milepost 62 on OR-22 spreading westerly to about milepost 22. Tree sample plots were installed at each of 40 mileposts, for an inventory of all trees on 40 acres. The WFCI inventory found that we agreed with 95.4% of the tree marking with 4.6% disagreement.

Table 8. Beachie Creek summary and % of agreement and disagreement.

Fire	Area	Agree		Disagree		Total # of Projected Trees on Corridor	# of Sample Trees
		# Trees Marked	# Trees Unmarked	# Trees Marked	# Trees Unmarked		
Beachie	Corridor	10,691	21,244	588	934	33,457	967
%		**31.9%**	**63.5%**	**1.8%**	**2.8%**		

The 3 clusters that were inventoried found 100% agreement with the marking.

Over 98.4% of the trees on the corridor were rated by the arborist/foresters as being 'Dead' or in 'Poor' condition.

Table 9. Beachie Creek tree condition rating and size metric summary.

Fire	Tree Condition Ratings					Metrics		
	Dead	Poor	Fair	Good	Sum	Avg. DBH (in)	Avg. TH[1] (ft)	Avg. Offset (ft)
Beachie	8,479	2,646	160	19	11,304	19.7	94.0	85.3
%	**75.0%**	**23.4%**	**1.4%**	**0.2%**				

[1] *Total tree height.*

A total of 33.7% of the trees are being cut, and 66.3% preserved on the corridor.

Riverside Fire. -- The Riverside Fire started about milepost 50 on OR-224 (the end of the highway) spreading westerly to about milepost 31. Tree sample plots were installed at each of 20 mileposts, for a 100% inventory of all trees on 20 acres. The WFCI inventory found that we agreed with 99.4% of the tree marking with 0.6% disagreement.

Table 10. Riverside Fire summary and % of agreement and disagreement.

Fire	Area	Agree		Disagree		Total # of Projected Trees on Corridor	# of Sample Trees
		# Trees Marked	# Trees Unmarked	# Trees Marked	# Trees Unmarked		
Riverside	Corridor	2,971	4,526	0	35	7,532	218
%		39.4%	60.0%	0%	0.6%		

No outlying clusters occurred near the Riverside Fire.

Over 99.4% of the trees on the corridor were rated by the arborist/foresters as being 'Dead' or in 'Poor' condition.

Table 11. Riverside Fire tree condition rating and size metric summary.

	Tree Condition Ratings					Metrics		
Fire	Dead	Poor	Fair	Good	Sum	Avg. DBH (in)	Avg. TH[1] (ft)	Avg. Offset (ft)
Riverside	6,620	137	24	13	6,794	20.6	107.5	90.8
%	97.4%	2.0%	0.4%	0.2%				

[1] *Total tree height.*

A total of 39.4% of the trees are being cut, and 60.6% preserved on the corridor.

Conclusions

The following are our conclusions with respect to the field assessment of marked and unmarked trees in the 3 fire corridors and outlying clean-up areas, the arborist/forester qualifications review, the documents and contracts review, and the data review.

1. We have reviewed the following documents and found them to be complete and consistent in the requirement for hazard tree (risk) assessment along the 3 subject wildfire corridors.
    a. ODOT Hazard Tree and Debris Removal Operations Plan (Ver. 2.0)
    b. ODOT Debris Management Tree Assessment Procedures (Version 9.0)
    c. ODOT Debris Management Quality Control Program (Version 2.0)
    d. Notes on Hazard Tree Assessment Process
2. We have reviewed the protocols and data and found it consistent with the industry standards presented in the 2020 U.S. Forest Service Publication R6-FHP-RO-2020-02 by Sharon Hood, Iral Ragenovich, and Bill Schaupp - *Post-fire Assessment of Tree Status and Marking Guidelines for Conifers in Oregon and Washington*. USDA Forest Services, PNW Regions, 60 pgs.
3. The procedures are consistent with guidelines for tree risk assessment detailed in the ANSI A300 (Part 9) 2017 – *Tree, Shrub and Other Woody Plant Management – Standard Practices - Tree Risk Assessment a. Tree Failure,* American Standards Institute, Inc. Washington, D.C.17 pgs.
4. WFCI agreed with the tree marking done by the contractor arborists/foresters in over 96% of the 2,214 trees reviewed. A difference of opinion occurred with some trees being too short to reach the highway and the 1.5x threshold, some trees had small live-crown ratio's that do not meet the industry standard, but were unmarked, and other trees were slender whips which would be considered structurally defective. This high degree of agreement is considered excellent considering the variability of tree conditions, the difficulty of assessing what is going on inside of the tree after a fire, and the differing levels of experience of the assessors. No changes are recommended to the current protocol, it appears to be working well.

5. The arborist/foresters rated the condition of marked trees as 'Dead' or 'Poor' in over 99% of the cases. Dead trees are dead and are or will become high risk trees quickly, 'Poor' condition trees are not considered to be long-term (less than1-2 years) trees and should be mitigated now, rather than waiting until they are dead and present a risk to public safety and safety for the tree cutter doing the removal. Removal costs will likely be higher if a second operation is done for trees that die later. Bark will be sloughing and decay is occurring.
6. At least 98% of the arborists/foresters qualifications met the basic requirement of the ODOT contract and protocols. The 1 (out of 44) that failed was an ISA Certified Arborist, had experience in another state, but just not 5 verifiable years of post forest fire assessment in Northwest conifer/deciduous forests. WFCI did not consider this 1 individual qualified as per the contract requirement.
7. The ODOT contractors are following appropriate procedures as defined in their contract and associated documents.
8. Overall, in the 3 fire corridor areas, 41.7% of the trees were marked for removal while 58.3% of the trees were unmarked (to be preserved).

Summary

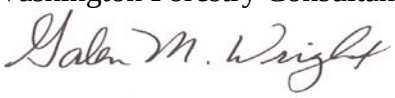
It is our professional opinion that ODOT has the necessary operational plan, protocols, contracts, and requirements necessary to conduct and provide quality assurance to this hazard tree mitigation program for the 2020 Oregon wildfires. Further it is our opinion that reasonably, over 96% of the trees are being correctly marked based on the current state of knowledge of the forestry profession, 99% of the marked trees are dead or in poor condition, and that the majority (98%) of the arborists/foresters utilized in the tree assessment possess the qualifications to do the work.

No changes are recommended to the current protocols.

WFCI reserves the right to modify this report should additional information become available.

Respectfully submitted,

Washington Forestry Consultants, Inc.

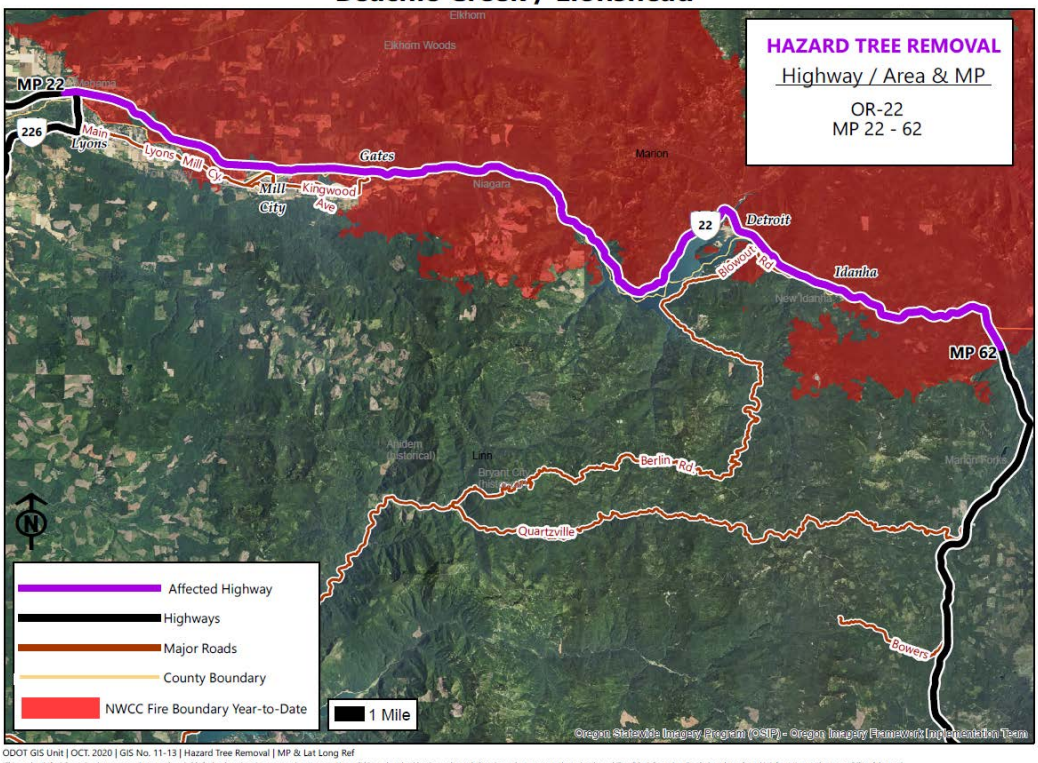


Galen M. Wright, ACF, ASCA
ISA Board Certified Master Arborist-Utility Specialist No. PN-0129BU
Certified Forester No. 44
ISA Tree Risk Assessor Qualified
ASCA Tree and Plant Appraisal Qualified

Attachment #1. ODOT Hazard Tree Assessment Review – Overview of study area (Maps from ODOT).

Fire	Corridor	Miles
Riverside	OR-224	19 (mile post 31-50)
Beachie Creek	OR-22	40 (mile post 22-62)
Holiday Farm	OR-126	23 (mile post 25-48)
	TOTALS	**82 miles**

Beachie Creek / Lionshead



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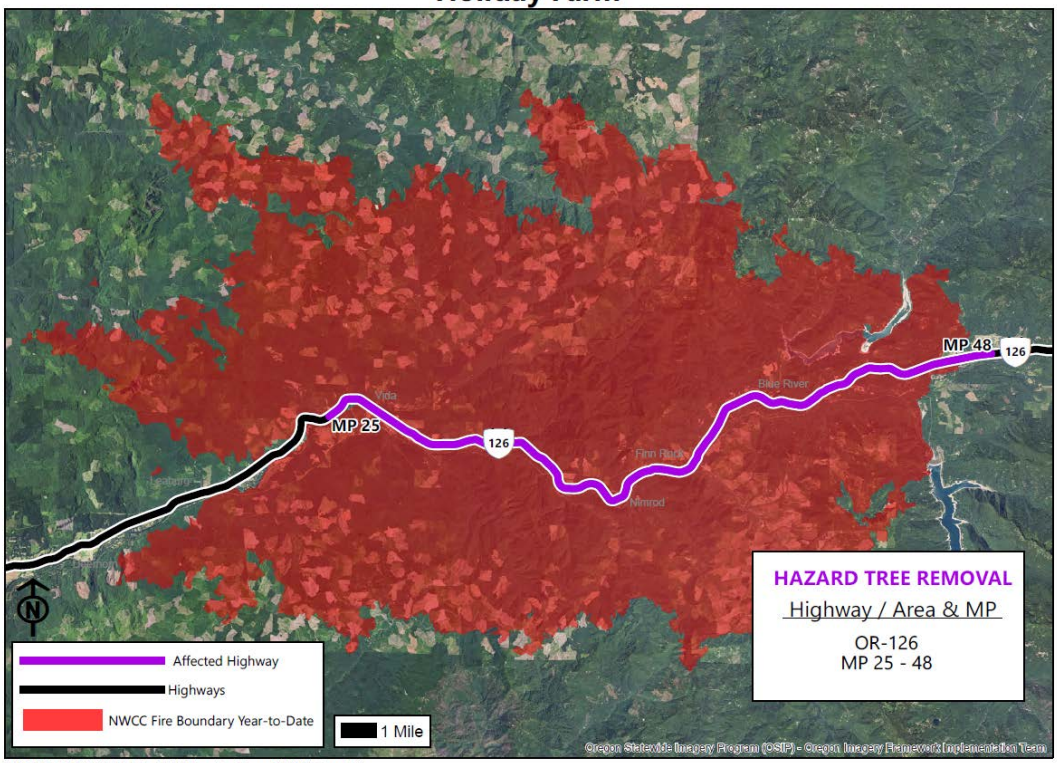
Holiday Farm



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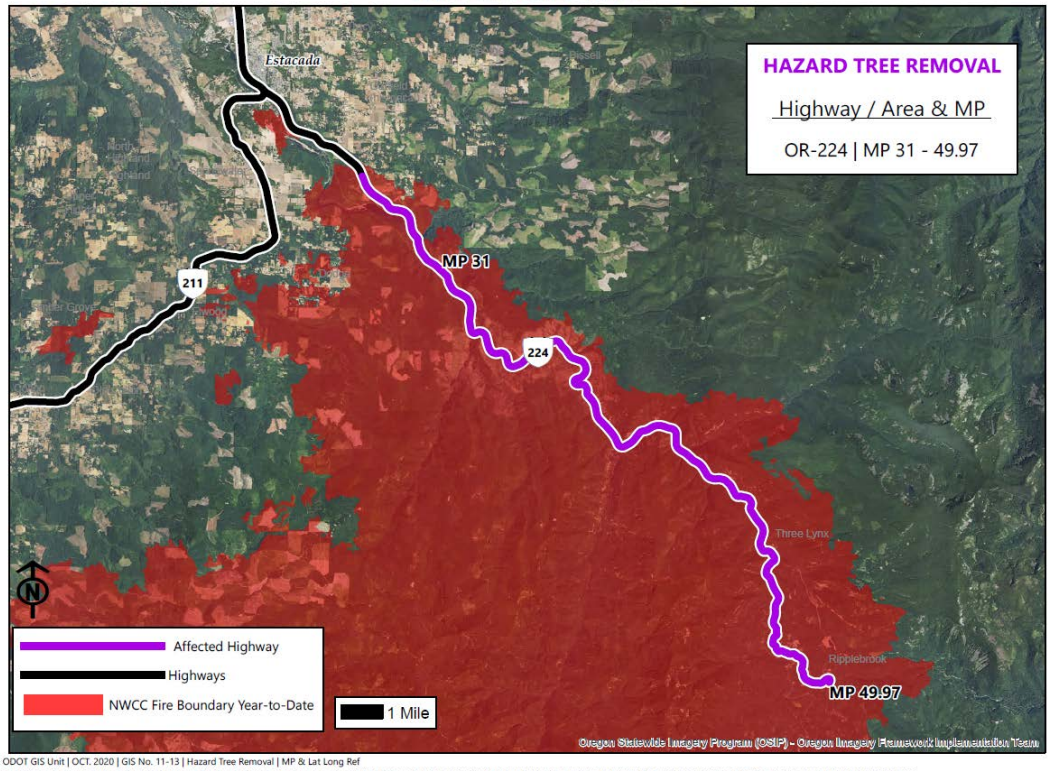
Riverside Fire



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Attachment #2. Qualifications Matrix for Arborists/Foresters

(1 page attached)

Reference #	Company - MBG, CDR MaGuire, or Elite	4 Yr. Forestry Degree from SAF Accredited Institutio	2 Yr. Associate Forestry Degree	Other 4 Yr. Degree	Other 2 Yr. Degree	ISA Certified Arborist Credential	ISA Bd. Certified Master Arborist Credential	ISA Tree Risk Assessor Qualified	>5 years Experience in PNW Forestry/Arboriculture	CA Registered Professional Forester/Apprentice	Wildland Firefighter	Forest Technician - Harvesting and Timber Cruising	Foreman or Journeyman for a Tree Service	TCIA - Tree Care Apprentice/Safety Specialist	ISA Utility Specialist	ISA Certified Tree Worker	Qualified? Yes or No	Reason for Disqualification
1	CDR	X							X		X						Yes	
2	CDR		X			X		X	X								Yes	
3	CDR					X		X	X				X				Yes	
4	CDR					X		X	X					X		X	Yes	
5	CDR				X	X			X				X				Yes	
6	CDR					X		X	X								Yes	
7	CDR				X	X	X	X	X				X	X			Yes	
8	CDR	X				X			X								Yes	
9	CDR	X				X		X	X								Yes	
10	CDR				X	X		X									No	Does not meet 5 yr. experience threshold; No NW post-fire tree experience;
11	CDR	X				X		X	X								Yes	
12	CDR			X		X		X	X					X	X		Yes	
13	CDR	X				X		X	X				X				Yes	
14	CDR				X	X		X	X				X				Yes	
15	CDR				X	X		X	X		X		X		X		Yes	
16	CDR			X		X		X	X								Yes	
17	CDR	X				X		X	X				X			X	Yes	
18	CDR				X	X		X	X								Yes	
19	CDR				X	X		X	X								Yes	
20	CDR			X		X		X	X		X						Yes	
21	CDR					X			X				X				Yes	
22	Elite					X			X		X		X				Yes	
23	Elite	X				X			X								Yes	
24	Elite	X				X		X	X				X				Yes	
25	Elite				X	X		X	X								Yes	
26	Elite			X		X		X	X								Yes	
27	MBG	X				X			X	X							Yes	
28	MBG	X				X			X		X						Yes	
29	MBG	X							X								Yes	
30	MBG	X	X						X	X							Yes	
31	MBG	X				X			X								Yes	
32	MBG	X				X		X	X								Yes	
33	MBG	X							X								Yes	
34	MBG	X				X			X								Yes	
35	MBG	X				X			X								Yes	
36	MBG								X	X		X					Yes	
37	MBG	X				X			X								Yes	
38	MBG			X	X				X								Yes	
39	MBG	X				X		X	X								Yes	
40	MBG	X				X			X				X				Yes	
41	MBG	X					X	X	X								Yes	
42	MBG				X				X				X				Yes	
43	MBG								X		X	X					Yes	
44	MBG			X			X	X	X				X				Yes	

Attachment #3. Photolog (WFCI May, 2021)

Photo A. View of trees on the north side of the highway on the Beachie Creek Fire. Fire crowned out on a portion of this stand (arrow) – these young Douglas-firs at arrow are dead. Many of the other trees have adequate live crown ratio's to survive, but the amount of cambium loss will dictate survival.

Photo B. Both sides of the highway above (Beachie Crk.) had a crown fire – the trees are likely dead.

Photo C. View of trees selectively marked for removal by arborists/foresters – Beachie Crk.

Photo D. View of the crowns of typical marked trees (red arrow). Crown fire has killed these trees. Contrast to trees on right (green arrow) where only ground fire occurred and trees are unmarked and will likely live.

Photo E. View of the lower stem of a bigleaf maple on the Holiday Farm Fire. Note longitudinal cracks in the bark from fire around the base of the tree. The bark has separated from the stem, girdling the tree. It will resprout from the root collar, but the top is likely dead. Leans to highway.

Photo F. View of trees that appear to have survived the ground fire on the Beachie Creek Fire. These trees are not marked for removal.

Photo G. View of trees on Beachie Creek Fire that appear to have survived the ground fire. Only select trees are marked for removal in this area.

Photo H. Red alder and black cottonwood along river. Thin bark and the ground fire easily killed these trees. See Photo I below.

Photo I. View of lower stem of a red alder killed by ground fire. Bark is already cracked and separated from the stem.

Attachment #4. Assumptions and Limiting Conditions

Washington Forestry Consultants, Inc.

1) Any legal description provided to the Washington Forestry Consultants, Inc. is assumed to be correct. Any titles and ownership's to any property are assumed to be good and marketable. No responsibility is assumed for matters legal in character. Any and all property is appraised or evaluated as though free and clear, under responsible ownership and competent management.

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3) Care has been taken to obtain all information from reliable sources. All data has been verified insofar as possible; however, Washington Forestry Consultants, Inc. can neither guarantee nor be responsible for the accuracy of information.

4) Washington Forestry Consultants, Inc. shall not be required to give testimony or to attend court by reason of this report unless subsequent contractual arrangements are made, including payment of an additional fee for such services as described in the fee schedule and contract of engagement.

5) Loss or alteration of any part of this report invalidated the entire report.

6) Possession of this report or a copy thereof does not imply right of publication or use for any purpose by any other than the person to whom it is addressed, without the prior expressed written or verbal consent of Washington Forestry Consultants, Inc.

7) This report and any values expressed herein represent the opinion of Washington Forestry Consultants, Inc., and the fee is in no way contingent upon the reporting of a specified value, a stipulated result, the occurrence neither of a subsequent event, nor upon any finding in to reported.

8) Sketches, diagrams, graphs, and photographs in this report, being intended as visual aids, are not necessarily to scale and should not be construed as engineering or architectural reports or surveys.

9) Unless expressed otherwise: 1) information contained in this report covers only those items that were examined and reflects the condition of those items at the time of inspection; and 2) the inspection is limited to visual examination of accessible items without dissection, excavation, probing, or coring. There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the tree or other plant or property in question may not arise in the future.

10) Even healthy trees can fail under normal or storm conditions. The only way to eliminate all risk is to remove all trees within reach of all targets. Annual monitoring by an ISA Certified Arborist or Certified Forester will reduce the potential of tree failures. It is impossible to predict with certainty that a tree will stand or fail, or the timing of the failure. It is considered an 'Act of God' when a tree fails, unless it is directly felled or pushed over by man's actions.