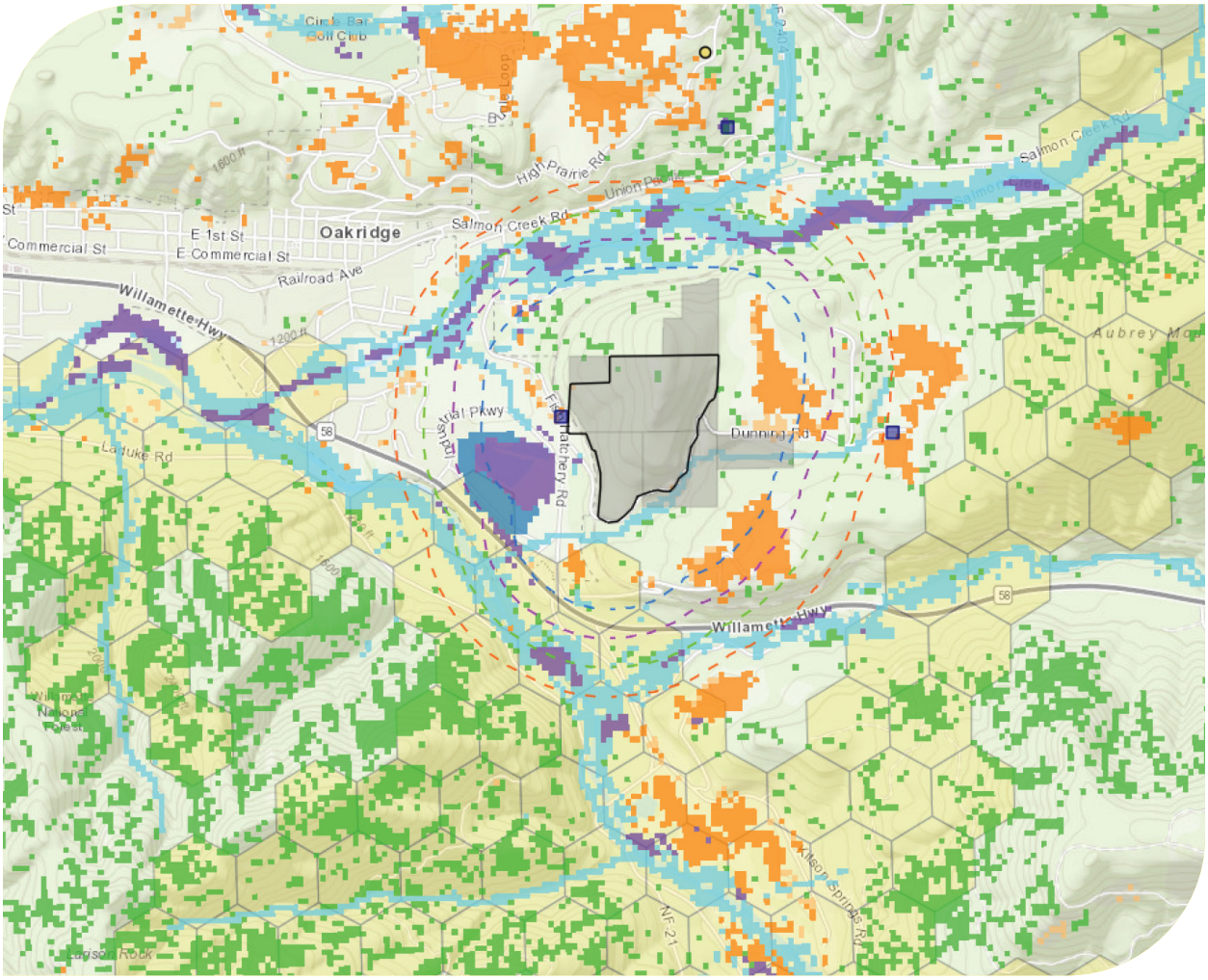

TV Butte Quarry: Environmental Impact Assessment

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WINTER 2025
OAKRIDGE

PPPM 495/595: ADVANCED GIS | SCHOOL OF PLANNING, PUBLIC POLICY AND MANAGEMENT

UNIVERSITY OF OREGON
Oakridge MOUNTAIN BIKING CAPITAL OF THE NORTHWEST
SCI Sustainable Cities Institute
SCYP Sustainable City Year Program

Acknowledgments

The author wishes to acknowledge and thank the City of Oakridge for making this project possible. Specifically, the author thanks the following City of Oakridge staff for their assistance and contributions that were instrumental in the completion of this report:

Rick Zylstra, Community Development Director

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About SCI

The Sustainable Cities Institute (SCI) is an applied think tank focusing on sustainability and cities through applied research, teaching, and community partnerships. We work across disciplines that match the complexity of cities to address sustainability challenges, from regional planning to building design and from enhancing engagement of diverse communities to understanding the impacts on municipal budgets from disruptive technologies and many issues in between.

SCI focuses on sustainability-based research and teaching opportunities through two primary efforts:

1. Our Sustainable City Year Program (SCYP), a massively scaled university-community partnership program that matches the resources of the University with one Oregon community each year to help advance that community's sustainability goals; and

2. Our Urbanism Next Center, which focuses on how autonomous vehicles, e-commerce, and the sharing economy will impact the form and function of cities.

In all cases, we share our expertise and experiences with scholars, policymakers, community leaders, and project partners. We further extend our impact via an annual Expert-in-Residence Program, SCI China visiting scholars program, study abroad course on redesigning cities for people on bicycle, and through our co-leadership of the Educational Partnerships for Innovation in Communities Network (EPIC-N), which is transferring SCYP to universities and communities across the globe. Our work connects student passion, faculty experience, and community needs to produce innovative, tangible solutions for the creation of a sustainable society.

About SCYP

The Sustainable City Year Program (SCYP) is a yearlong partnership between SCI and a partner in Oregon, in which students and faculty in courses from across the university collaborate with a public entity on sustainability and livability projects. SCYP faculty and students work in collaboration with staff from the partner agency through a variety of studio projects and service- learning courses to provide students with real-world projects to investigate. Students bring energy, enthusiasm, and innovative approaches to difficult, persistent problems. SCYP's primary value derives from collaborations that result in on-the-ground impact and expanded conversations for a community ready to transition to a more sustainable and livable future.

Community partnerships are possible in part due to support from U.S. Senators Ron Wyden and Jeff Merkley, as well as former Congressman Peter DeFazio, who secured federal funding for SCYP through Congressionally Directed Spending.

About City of Oakridge

The City of Oakridge, Oregon, is a vibrant community nestled in the foothills of the Western Cascade Mountains, with a population of approximately 3,500 residents within city limits (nearly 5,000 when including nearby Westfir and surrounding areas). Surrounded by the extensive Willamette National Forest, the city provides ample opportunities for activities such as hiking and mountain biking, with nearly 500 miles of trails and five rivers in its vicinity. Oakridge's elevation (1,200-1,700 ft.) results in a favorable climate, characterized by over 300 sunny days annually, while avoiding the fog of the valley and the heavy snowfalls of higher elevations.

Governed by a council-manager system since 1972, Oakridge residents benefit from a robust and supportive municipal administration. The City offers a comprehensive range of services, including street maintenance, water, wastewater, and park utilities, as well as police, fire, and emergency medical services. Additional municipal services include library access, economic development, planning and zoning, and general administrative support. Funding for city operations is derived from property taxes, franchise fees, and other revenue sources, with special projects financed through grants and loans.

In the past decade, Oakridge has secured nearly $11 million in grants and loans for community projects and maintains an annual budget of approximately $10 million.

The citizens of Oakridge cherish their history and cultural heritage, celebrating it through a variety of events and activities throughout the year. The long-standing Tree Planting Festival pays homage to Oakridge's timber town roots, while the Concerts in the Park series offers free performances at the Banner Bank Amphitheater in Greenwaters Park. Additionally, Oakridge features four art galleries, three nearby hot springs, and is conveniently located just 25 miles from Willamette Pass Ski Resort. The Eugene-Springfield metropolitan area, approximately 35 miles away, further enriches the community's cultural offerings with its vibrant arts scene, including music, theater, and access to the University of Oregon.

The City of Oakridge is committed to fostering a safe, livable, and sustainable environment for its residents while promoting economic development and community engagement. As part of its ongoing planning initiatives, Oakridge is exploring various strategies to enhance its sustainability and growth, ensuring that the community continues to thrive for generations to come. The partnership between the Sustainable City Year Program and the City of Oakridge is supported by local stakeholders, enabling University of Oregon students and faculty to collaborate on projects and provide recommendations to address city-identified challenges and opportunities.

Course Participants

Anika Hall, Architecture/Landscape Architecture Graduate
Michael Castineira, Planning, Public Policy and Management Undergraduate
Dora Schmidt, Planning, Public Policy and Management Undergraduate
Andrew Spawn, Planning, Public Policy and Management Undergraduate
Jackson Weinberg, Planning, Public Policy and Management Undergraduate

Course Description

PPPM 495/595: ADVANCED GIS

This advanced course equipped students with the skills and knowledge necessary to utilize Geographic Information Systems (GIS) for community mapping, spatial analysis, and the evaluation of key urban and regional dynamics—including community livability, resilience, and sustainability. Through hands-on projects, case studies, and collaborative research, students explored GIS tools and methodologies to assess and address real-world challenges in community planning, development, and policy-making.

Executive Summary

StoneBroke LLC proposed the development of Old Hazeldell Quarry, a gravel quarry located on TV Butte just outside of Oakridge, Oregon. The City of Oakridge partnered with students from the University of Oregon to preliminarily evaluate and map the potential environmental impacts of the proposed quarry using publicly available ArcGIS data sets. Specific concerns regarding the proposed development include potential impacts to community health and assets, potential water contamination, and potential wildlife disruption. Informed by standard Environmental Impact Assessment strategies, the students completed a series of spatial evaluations as follows:

- **Social Impacts:** Estimated visual impacts and quarry proximity to residential, commercial, and recreational properties within and around Oakridge.
- **Air Quality Impacts:** Estimated spread of fine particulate matter (i.e. dust) from proposed quarry activities, including gravel crushing, driving on unpaved roads, loading and unloading of trucks, and quarrying.
- **Noise Impacts:** Estimated travel distance of noise from proposed quarry activities, including the use of explosives and truck traffic.
- **Hydrologic Impacts:** Estimated impacts to both private and public water sources, including groundwater and surface water quality.
- **Ecological Impacts:** Quarry proximity to ecologically sensitive habitats and species.
- **Natural Disasters:** Estimated interactions between the proposed quarry site and potential natural disasters, such as floods, earthquakes, and landslides.

Based on the student evaluations completed in this report, the greatest impacts to the Oakridge community anticipated from the presence of the proposed quarry include:

- Changes to views of the landscape, which could be seen from all areas of the city;
- Potential noise disturbances, as loud as a vacuum, which could be heard in the Mill River Park area;
- Disturbance of an existing elk grazing site, though not to prime migratory corridors; and
- Potential localized landslides, which impact the historic landfill and could potentially result in new or increased impacted drainage from the historic landfill area (the latter statement is not supported with modeling or sample results).

Further assessment by qualified professionals is recommended to consider the severity of the potential impacts listed above. Additionally, the authors wish to note that sampling of the historic landfill area and establishment of a surface and groundwater monitoring program would aid in building trust between Stonebroke LLC and the community of Oakridge.

Introduction

In 2015, StoneBroke LLC proposed the development of Old Hazeldell Quarry, a gravel quarry located on TV Butte just outside of Oakridge, Oregon. Potential impacts of the proposed mine on Oakridge residents and surrounding environment spurred the City of Oakridge to partner with the University of Oregon's Sustainable City Year Program (SCYP) to analyze the environmental impacts of the proposed TV Butte Quarry, focusing on air and water quality, wildlife, land use, and community health using publicly available data. Students worked in collaboration with the City of Oakridge to consider and assess aspects related to Oregon's Land Use Planning Goal 5 – Natural Resources, Scenic and Historic Areas, and Open Spaces.

Specific project objectives to be assessed included:

- **Community Health & Assets:** Assess health risks associated with silica dust, air pollutants, and noise exposure in nearby residential and recreational areas.
- **Water Contamination:** Map the quarry's proximity to the abandoned landfill and assess contamination risk into Salmon Creek and local aquifers.
- **Wildlife Disruption:** Map the quarry's proximity to wildlife habitats.

Students of the Advanced Urban GIS course used ArcGIS to develop environmental risk maps highlighting the quarry's potential impacts. Types of analyses considered during the process were informed by specific requests from the City of Oakridge, as well as by common Environmental Impact Assessment processes described by Professor Yang. These included:

- **Proximity and Buffer Analysis:** Identifies how close mining operations are to protected areas, water bodies, and settlements to aid in regulatory compliance and impact mitigation.
- **Viewshed Analysis:** Uses slope, aspect, and elevation data to help determine how views from public resources, such as parks and trail systems, would be affected.
- **Air Quality and Dust Dispersion Modeling:** Uses GIS-based dispersion models (e.g., AERMOD) to estimate the spread of dust and pollutants to aid in setting up air quality monitoring stations.
- **Noise Pollution and Vibration Analysis:** Uses spatial data to model noise propagation from blasting, machinery, and transportation.
- **Hydrological and Watershed Analysis:** Watershed delineation to identify areas affected by water pollution. Hydrological modeling to predict changes in water flow, sediment transport, and contamination spread.
- **Ecological and Habitat Analysis:** Habitat suitability modeling to assess the impact on biodiversity and endangered species. Uses spatial overlay to compare pre- and post-mining habitat conditions.

Information presented in this report is intended to demonstrate the potential environmental impacts of the proposed quarry, as well as provide recommendations for research that builds on the previous studies, all of which have been sponsored by the mining company, StoneBroke LLC. Any opinions and recommendations expressed do not necessarily represent the views of the University of Oregon. Results of the analysis were collected and published in a publicly accessible online Storymap available at: https://arcg.is/jOCrH0.

History and Site Background

In 2016, StoneBroke LLC submitted an initial application for the Old Hazeldell Quarry, a 107-acre gravel quarry proposed to be located on TV Butte just outside of Oakridge, Oregon, in Lane County (Figure 1). The initial application was met with protest from the citizens of Oakridge and was ultimately denied in 2021. Following the submission and denial of their 2016 application, StoneBroke LLC re-submitted their proposal with additional information and reports to address appeals and concerns brought about in the first application. The following are the proposed amendments made in StoneBroke LLC's 2023 Application (Old Hazeldell Quarry, LLC 2023):

1. Amendment to the Lane County Rural Comprehensive Plan (Rural Plan) to include the subject site on the Significant Mineral and Aggregate Inventory;
2. Amendment to the Rural Plan map designation from Forest Land to Natural Resource;
3. Amendment to the corresponding zone map designation from Impacted Forest Lands (F-2) and Non-Impacted Forest lands (F-1) to Quarry and Mine Operations (QM); and
4. Site Review Permit authorization.

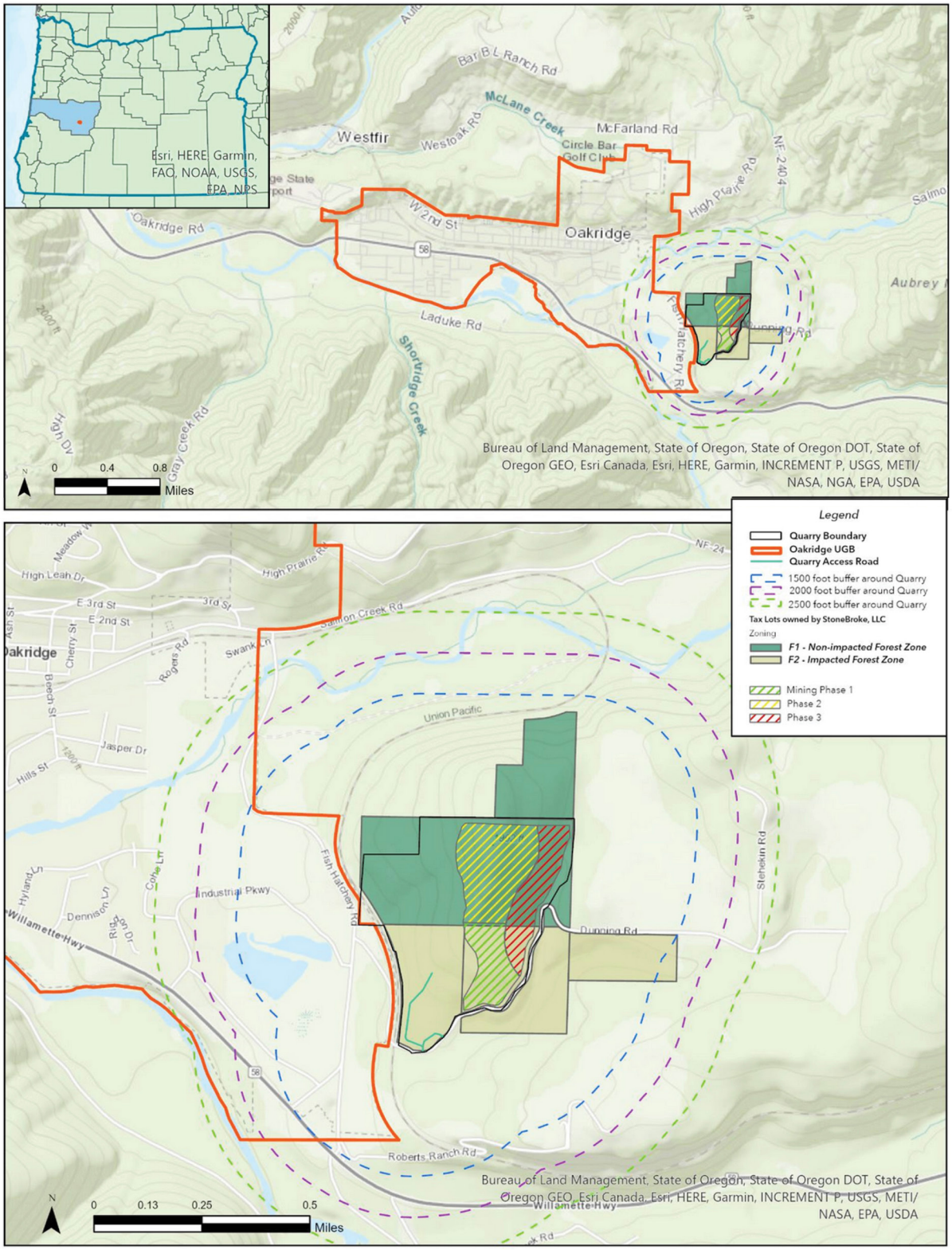


FIG. 1

Quarry boundary, phases, and location

As pictured on Figure 2, site features within the proposed quarry include:

- Quarrying areas, which will be carried out in three phases, hatched in green, yellow, and red;
- a gravel crushing area, pictured in pink;
- an aggregate stockpile area pictured in light blue;
- two debris dump sites pictured in yellow;
- a parking lot, pictured in light green;
- an office building, pictured in teal;
- trucking roads, depicted as teal lines;
- berms to provide stormwater and noise control, depicted as dark blue lines;
- a historic municipal landfill, the Dunning Road Dump, pictured in peach;
- and fences surrounding the historic landfill, depicted as red lines.

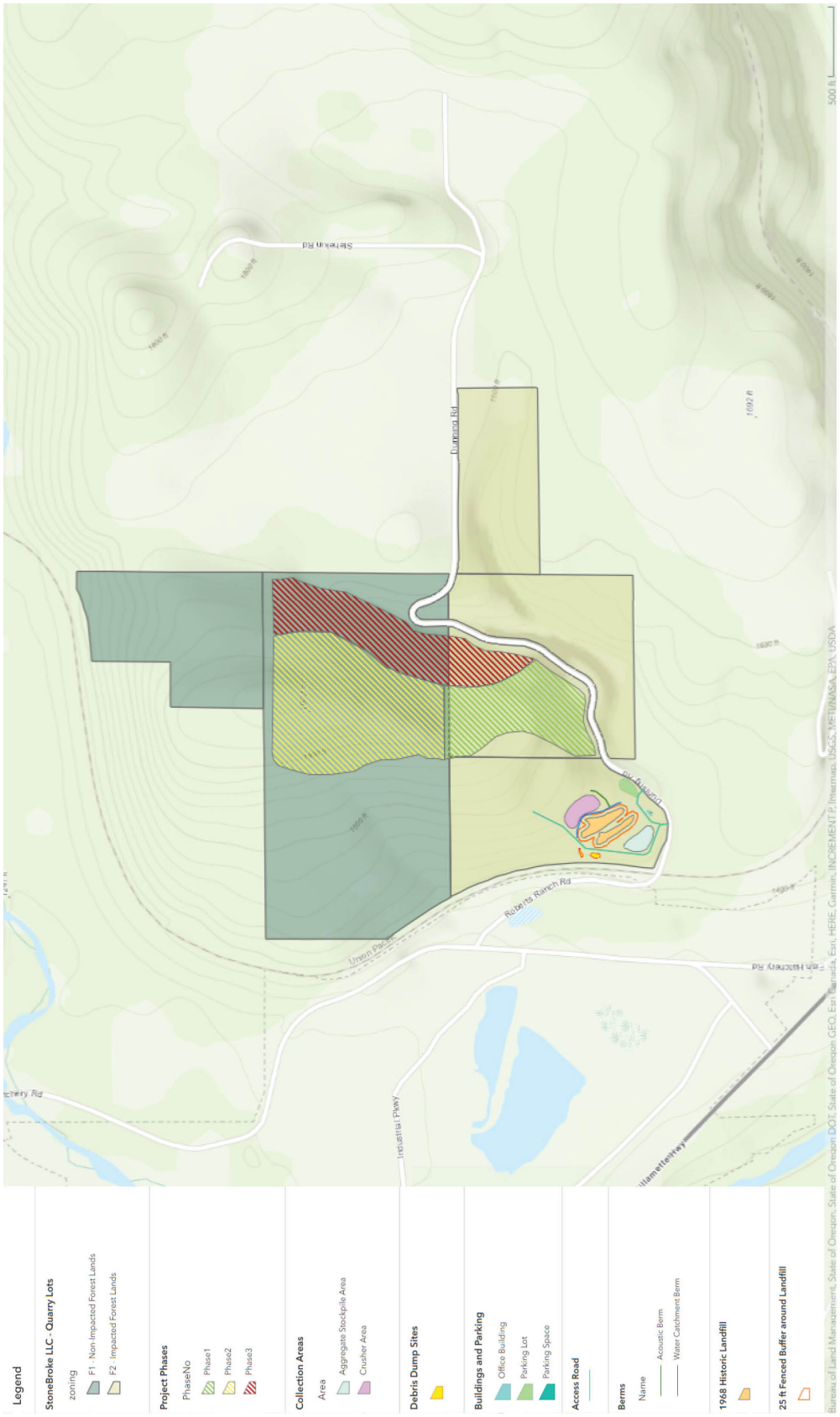


FIG. 2

Site features

Because the proposed quarry is located outside of Oakridge city limits, the final local decision to approve this quarry is up to the Lane County Board of Commissioners. On January 28, 2025, the Board tentatively approved the quarry's second application to rezone this forest land in a 3-2 vote. County staff are currently writing an ordinance in support of rezoning this area for the mining activity (Lewis, 2025).

Many of the citizens of Oakridge are still apprehensive about the potential impacts of the proposed quarry, as evidenced by the majority of public comments submitted during public testimony being in opposition to the quarry (Lewis, 2025). Some of these citizens have grouped together to form "Oakridge Strong," formerly known as "Save TV Butte," a nonprofit leading the fight against the Old Hazeldell Quarry proposal. Their concerns include potential impacts to recreational tourism, wildlife habitat, the visual and auditory experiences from within Oakridge, and water and air quality (Oakridge Strong, 2015). This report aims to provide a preliminary third-party investigation into all these concerns.

The historic Dunning Road Dump operated between 1951 and 1968 and was used for both burial and burning of municipal waste. This landfill is capped (Kelley, 2016) and will be given a 25-foot buffer from all activities at the quarry proposed quarry (Old Hazeldell Quarry, LLC 2023).

In 2016, the Oregon Department of Environmental Quality (ODEQ) performed a site assessment of the proposed quarry site. In the assessment, they noted that though there is no known documentation indicating the presence of hazardous materials at the landfill, there is a possibility of various types and amounts of contamination at the site. ODEQ concluded that future site assessment should include soil sampling, sampling of seeps down to the gradient of the landfill, and groundwater sampling. The landfill was ruled a medium priority for state site assessment, however due to Stonebroke LLC's avoidance of the landfill, the site was not subject to remediation or other oversight (Kelley, 2016). Its presence and potential as a historic contamination source, however, is considered as a priority throughout this assessment.

Environmental Impact Assessment

SOCIAL IMPACTS

Assessment Strategy

The City of Oakridge and the surrounding area comprises four Block Groups defined by the US Census Bureau. Three of these Block Groups fall within the urban growth boundary and technical footprint of the city (Block Groups 2 through 4; Figure 3 and Table 1). Block Group 4 is located directly west of the proposed quarry site and is anticipated to be particularly affected by its presence. Because of this, analysis of the potential social impacts from the proposed quarry included in this report will focus exclusively on Block Group 4.

Block Group	Group 1	Group 2	Group 3	Group 4
2020 Population	1,251	1,147	915	1,257

TABLE 1

Population of Block Groups within and around Oakridge, Oregon

State of Oregon 2020

Land use types in this area, which may be affected by the presence of the proposed quarry, include parks and recreational areas, commercial districts, and residential properties. A viewshed analysis was completed examining whether the area of the proposed quarry site can be seen from each of these areas to determine the potential visual impact. The visibility assessment was completed using the Viewshed Analysis included in ArcGIS Pro's Spatial Analysis toolset. The process involved placing four dots within the proposed quarry area from which a visibility map was created and colored in a gradient based on how many of the visibility dots could be seen.

Additionally, students completed a proximity analysis to examine the land uses and significant buildings which may be affected by their proximity to the proposed quarry. The buffer zones illustrate proximities of 1,500, 2,000, 2,500, and 3,000 feet.

The City of Oakridge's long-term development goals should be considered in thinking of potential future impacts that the proposed quarry might have. Of note, this includes the planned Oakridge Mill Park, a space for recreation and exercise. The concept plans for the park were developed in 2019, and a potential layout is pictured in Figure 4 (City of Oakridge 2019).

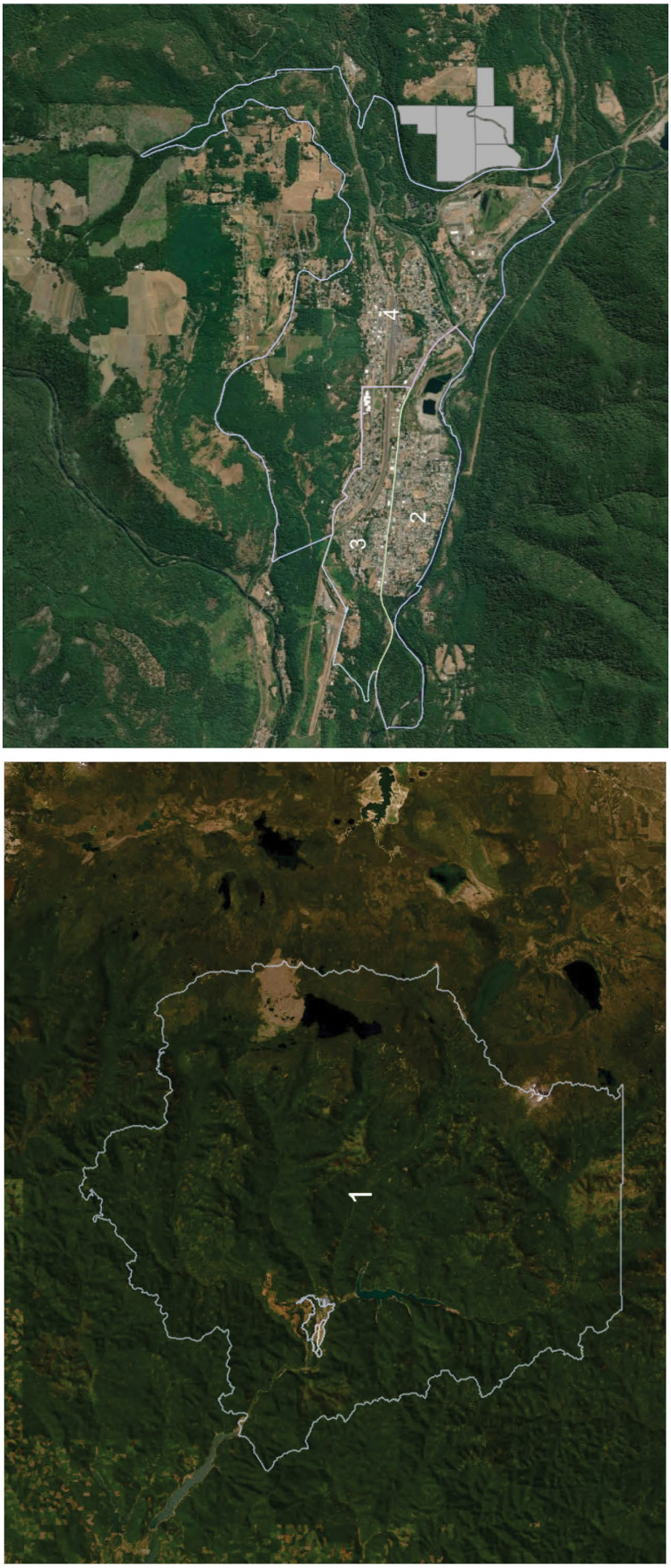


FIG. 3

Location of Block Groups within and around Oakridge, Oregon

State of Oregon 2020

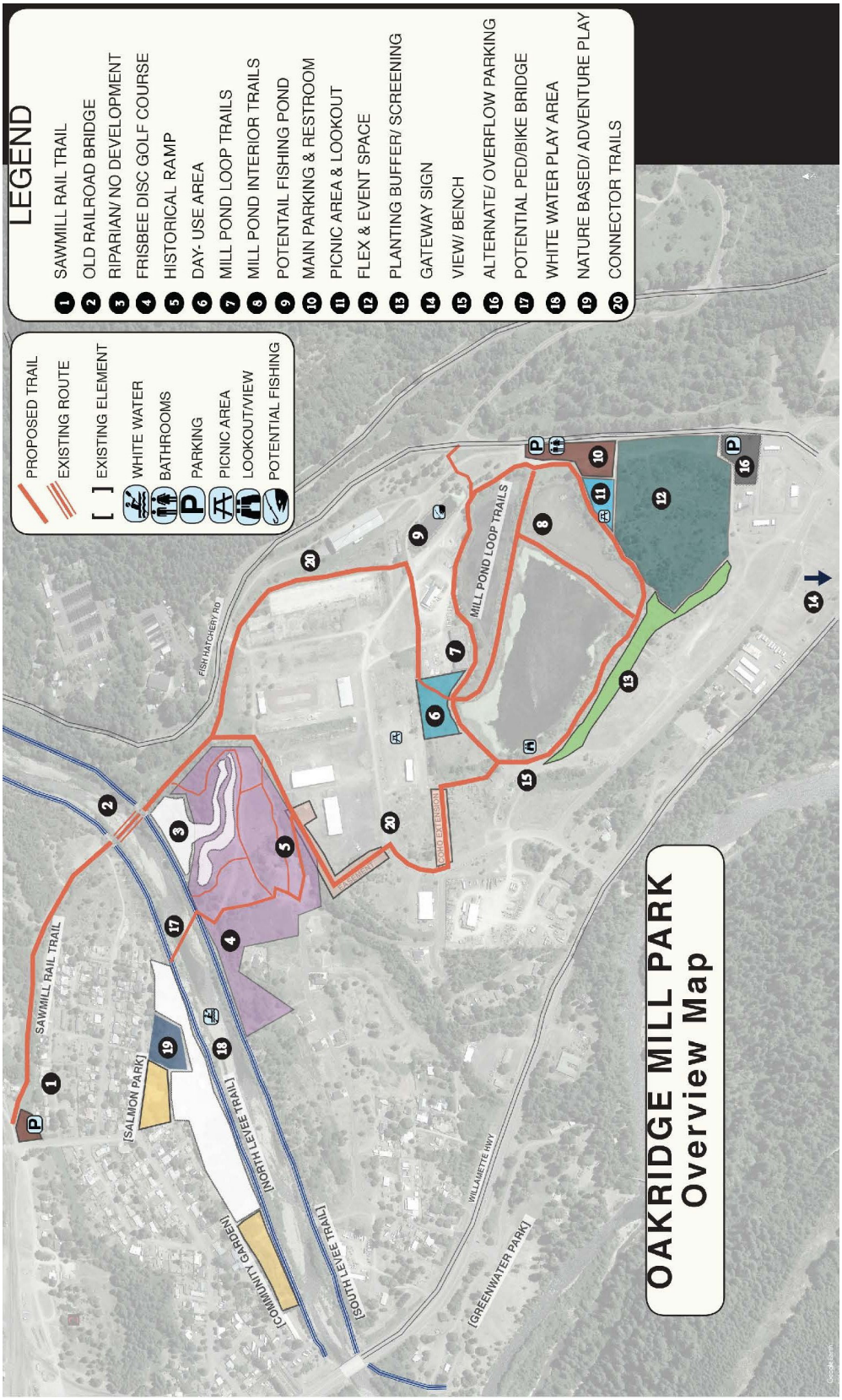


FIG. 4

Oakridge Mill Park Overview Map

City of Oakridge 2019

Assessment Findings

Visibility Impacts

Results of the visibility analysis for the residential, commercial, and recreational areas of Oakridge are displayed in Figures 5 through 7, respectively. Areas of visibility of the proposed quarry for each of the aforementioned land-use types include:

- **Residential:** Almost all the City of Oakridge residential areas are anticipated to be able to see the area of the proposed quarry. This occurs to a lesser extent in the northeastern portion of the city, where many of the parcels can only view one to two of the analysis points, and some of the northernmost parcels cannot see any. Most of the remaining residents can see three of the four analysis points.
- **Commercial:** Almost all the business districts of Oakridge are within view of the proposed quarry site, though they have varying degrees of visibility. The entire Central Business District and the majority of the Mixed-Use District can view one to two of the viewpoints, while the entire Highway Commercial District can view three of the four viewpoints.
- **Recreational:** The entirety of Oakridge's park system and open river spaces are within view of the proposed quarry site, with the western half of this system viewing three of the four viewpoints, and the closer, eastern portion of parks (including the Oakridge Mill Park) viewing only one to two of the viewpoints.

Visibility points are shown on the figures as teal dots. Colors of the visibility assessment range from no color, where none of the dots can be seen, to white, where one dot can be seen, to orange, where two or three dots can be seen, and finally to red, where all the dots can be seen.

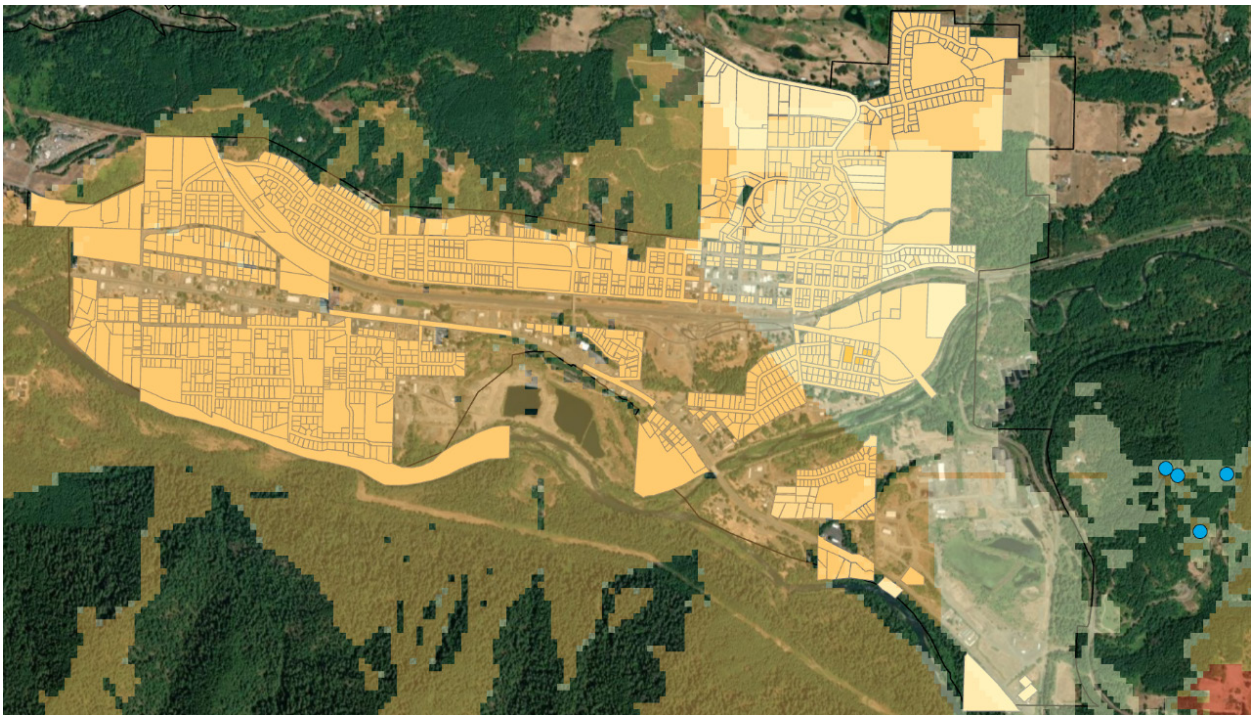


FIG. 5

Quarry Visibility from Residential Properties

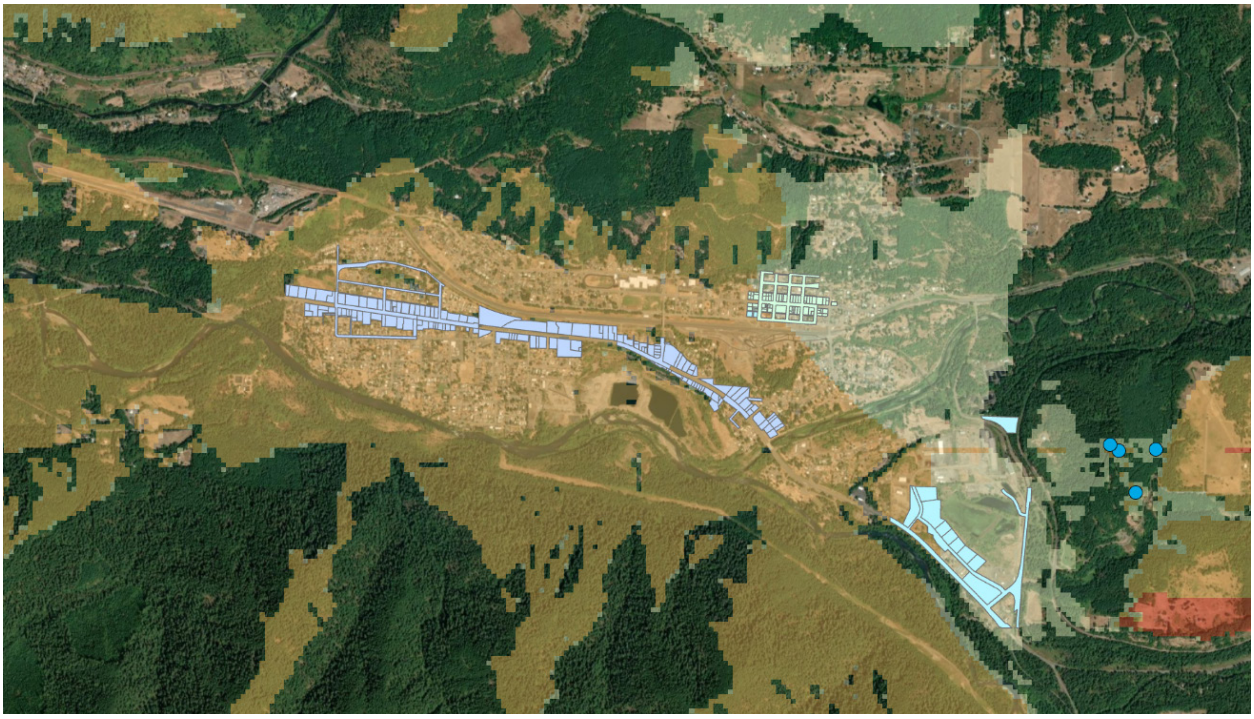


FIG. 6

Quarry Visibility from Commercial Properties

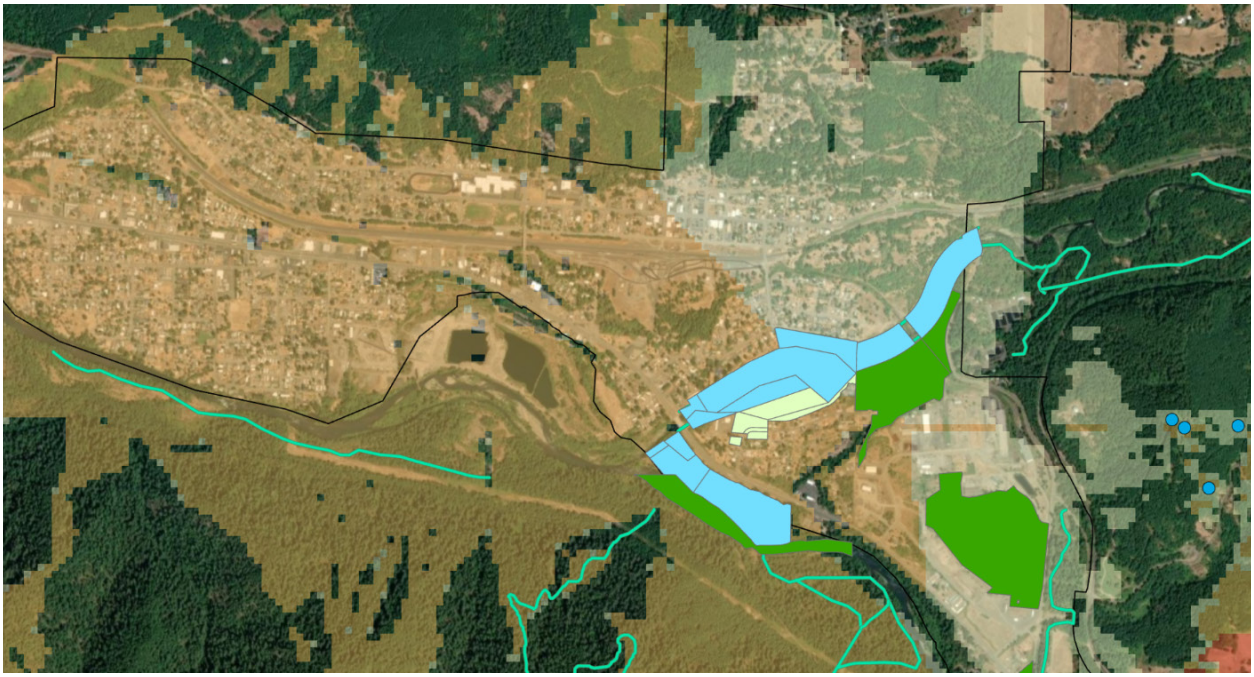


FIG. 7

Quarry Visibility from Recreational Properties

Proximity Analysis

Figures 8 through 10 illustrate residential, commercial, and recreational lands within the City of Oakridge that are in direct proximity to the proposed quarry. The buffer zones illustrate proximities of 1,500, 2,000, 2,500, and 3,000 feet. Land use types falling within these boundaries include:

- **Residential:** A limited number of low-density residential properties are located within 2,500 feet of the proposed quarry. Additionally, a limited number of rural residential properties are in proximity of the quarry up to 1,500 feet.
- **Commercial:** The entire mixed-use district of Oakridge falls within 2,500 feet of the proposed quarry, extending as close as 200 feet. There is also a single rural commercial parcel within 1,500 feet of the proposed quarry.
- **Recreational:** Three of Oakridge's parks, a portion of open river space, as well as limited portions of five recreational trails fall within 3,000 feet of the proposed quarry. Two of these parks and three of the recreational trails come as close as 500 feet from the quarry boundary. Of particular note, the planned location of the Oakridge Mill Park is almost entirely within 1,500 feet of the proposed quarry site.

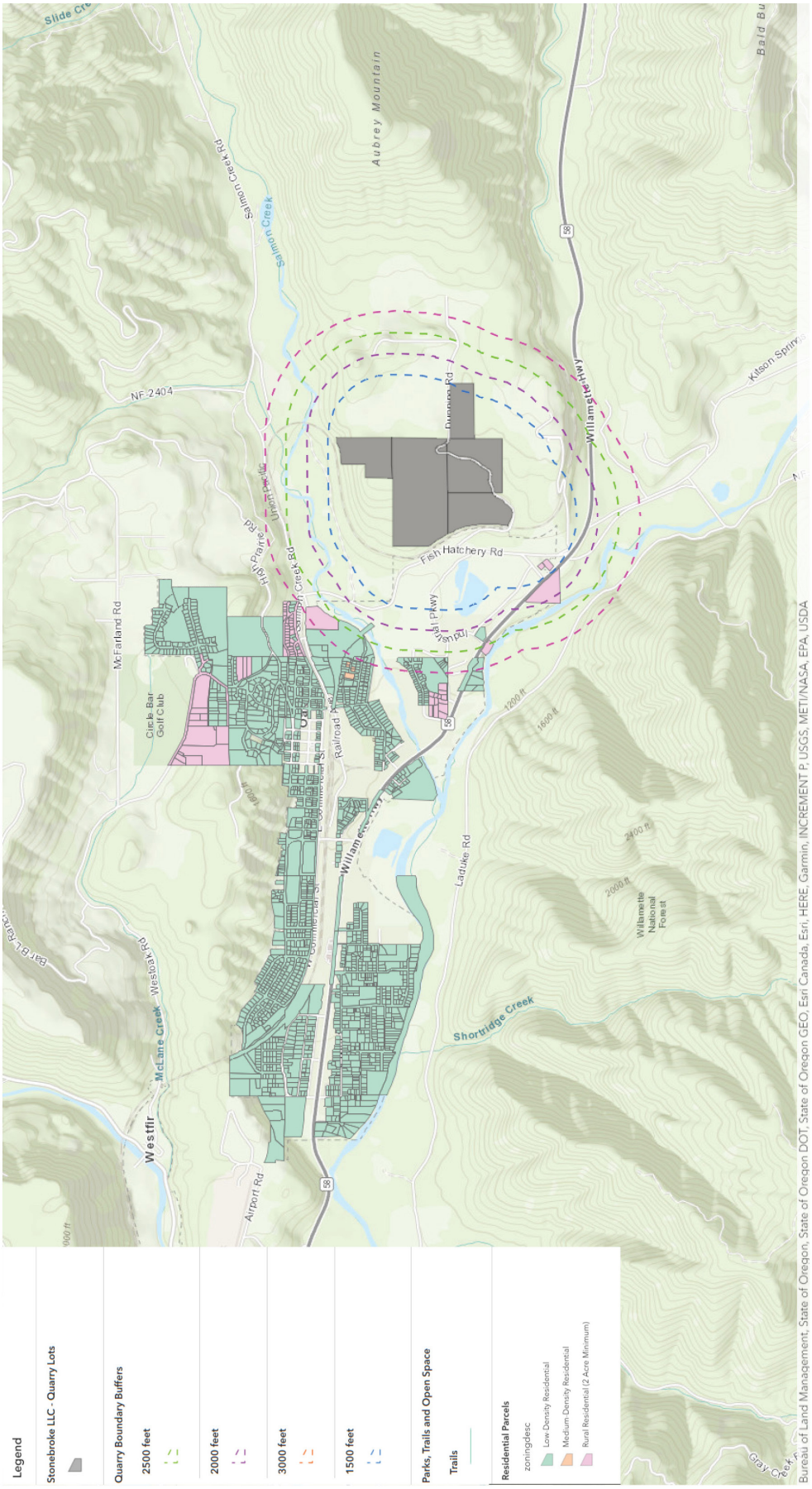
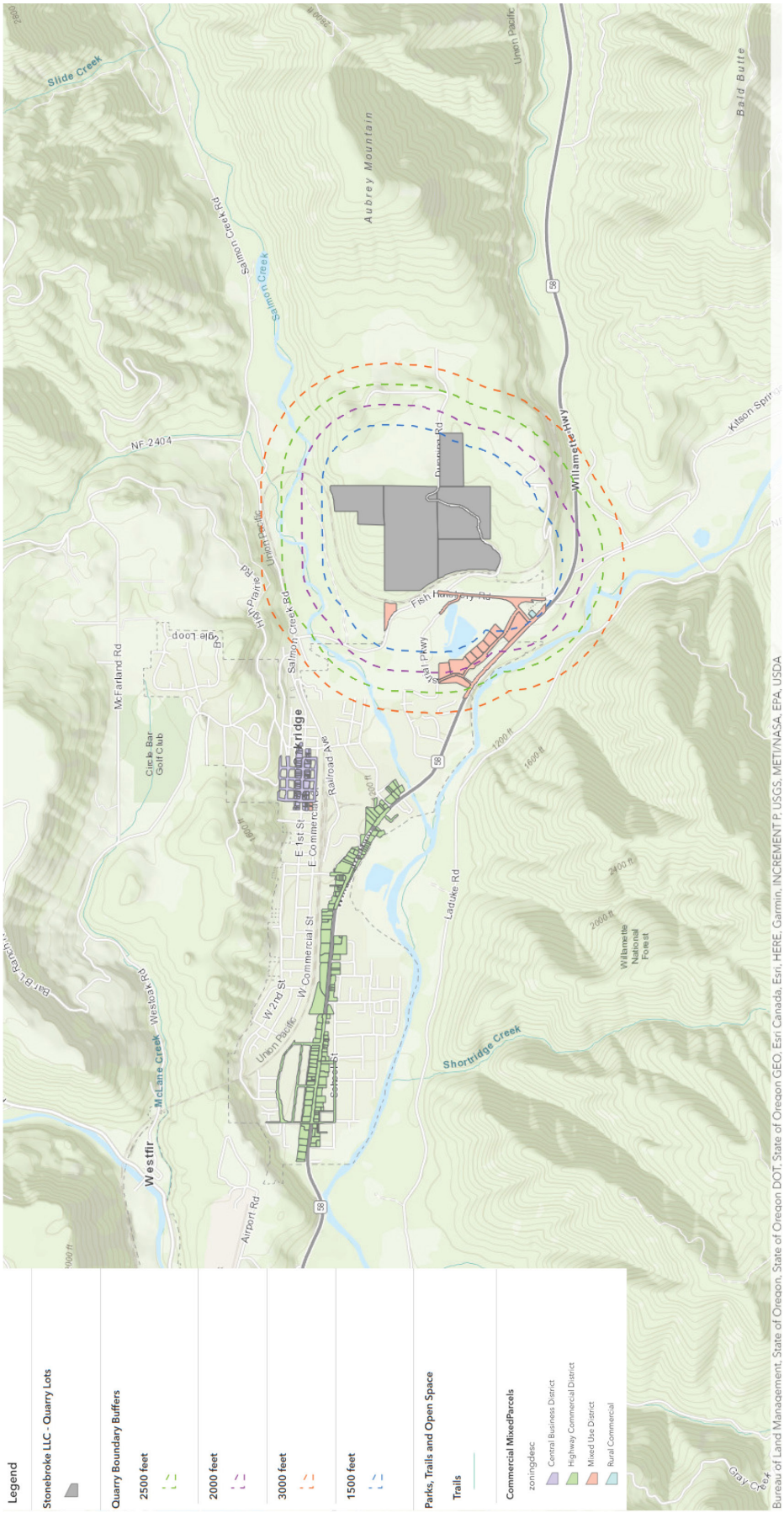


FIG. 8

Quarry Proximity to Residential Properties

FIG. 9

Quarry Proximity to Commercial Properties



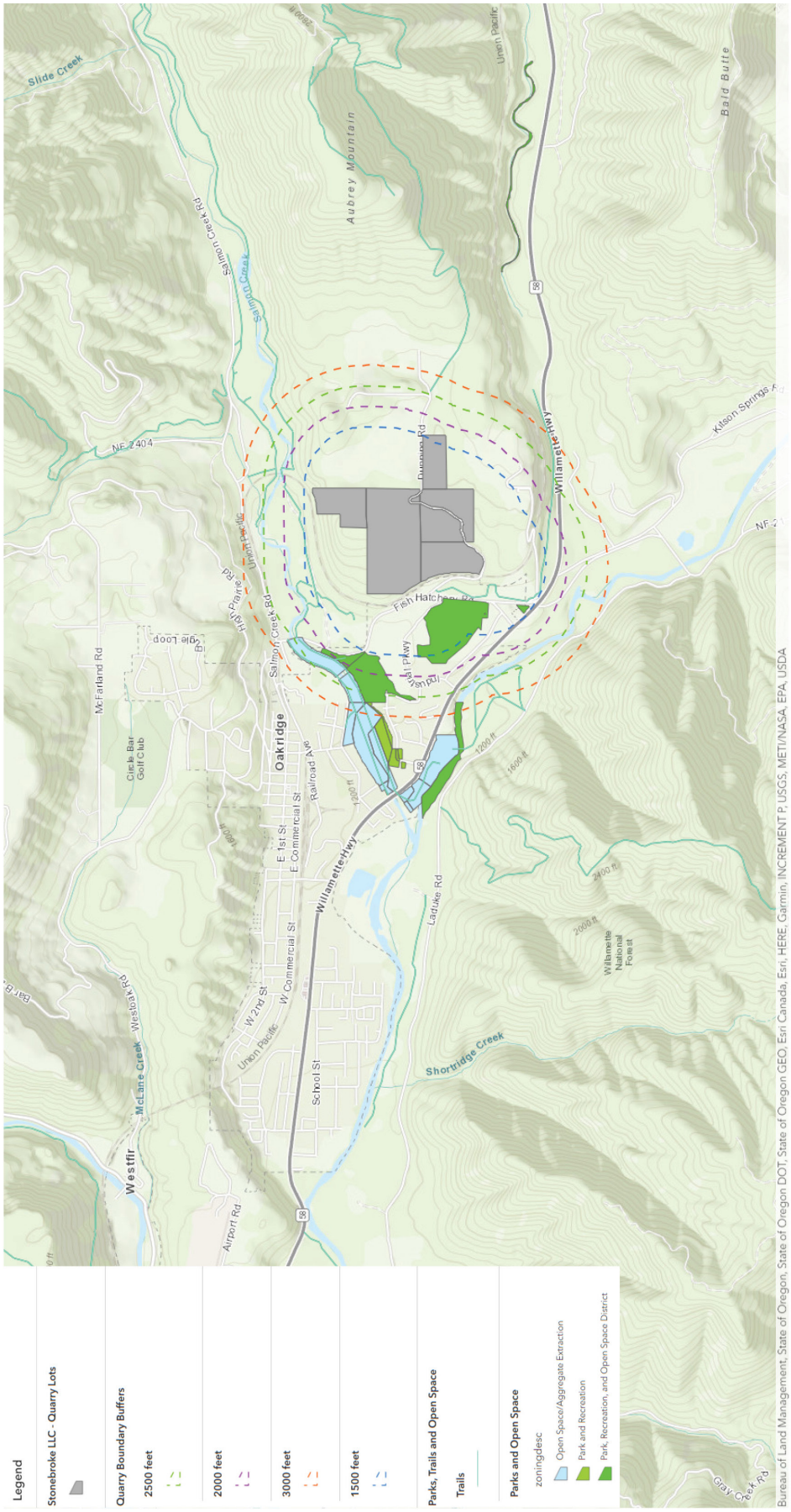


FIG. 10

Quarry Proximity to Recreational Properties

Proximity analysis examining the building footprints of existing structures near the proposed quarry is displayed in Figure 11. As identified using Google Earth (Google Earth 2023), existing buildings within the 1,500- and 2,000- foot buffer areas include:

- Aubrey Mountain Airstrip
- Willamette Fish Hatchery
- Old Mill Disc Golf Course
- City of Oakridge Public Works
- Multiple Private Residential Properties, including Rural Farms
- Multiple Industrial Commercial Buildings

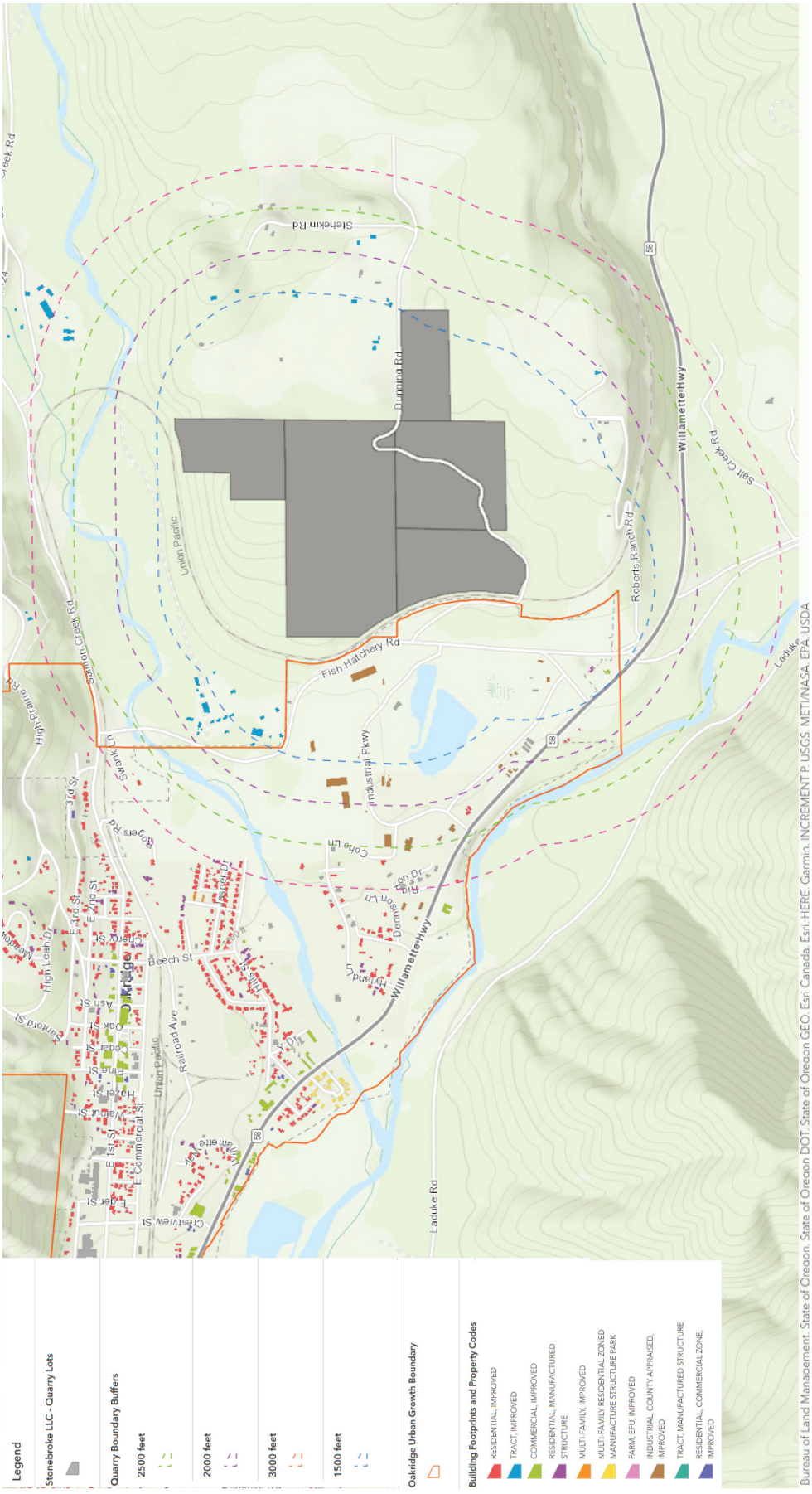


FIG. 11

Quarry Proximity to Existing Structures

In consideration of land uses beyond the City of Oakridge's urban growth boundary, a proximity analysis examined the land use types bordering the quarry, which are in Block Group 1 (Figure 12). County land use types identified include Rural Residential, Impacted Forest, and Exclusive Farm Use, meaning there is land use potential for people to both live and work within 1,500 feet of the proposed quarry. The property value and quality of life on these properties will almost certainly be impacted by the presence of the proposed quarry, however the population density in this area is significantly less than in the rest of Oakridge, and much of this area is currently undeveloped.

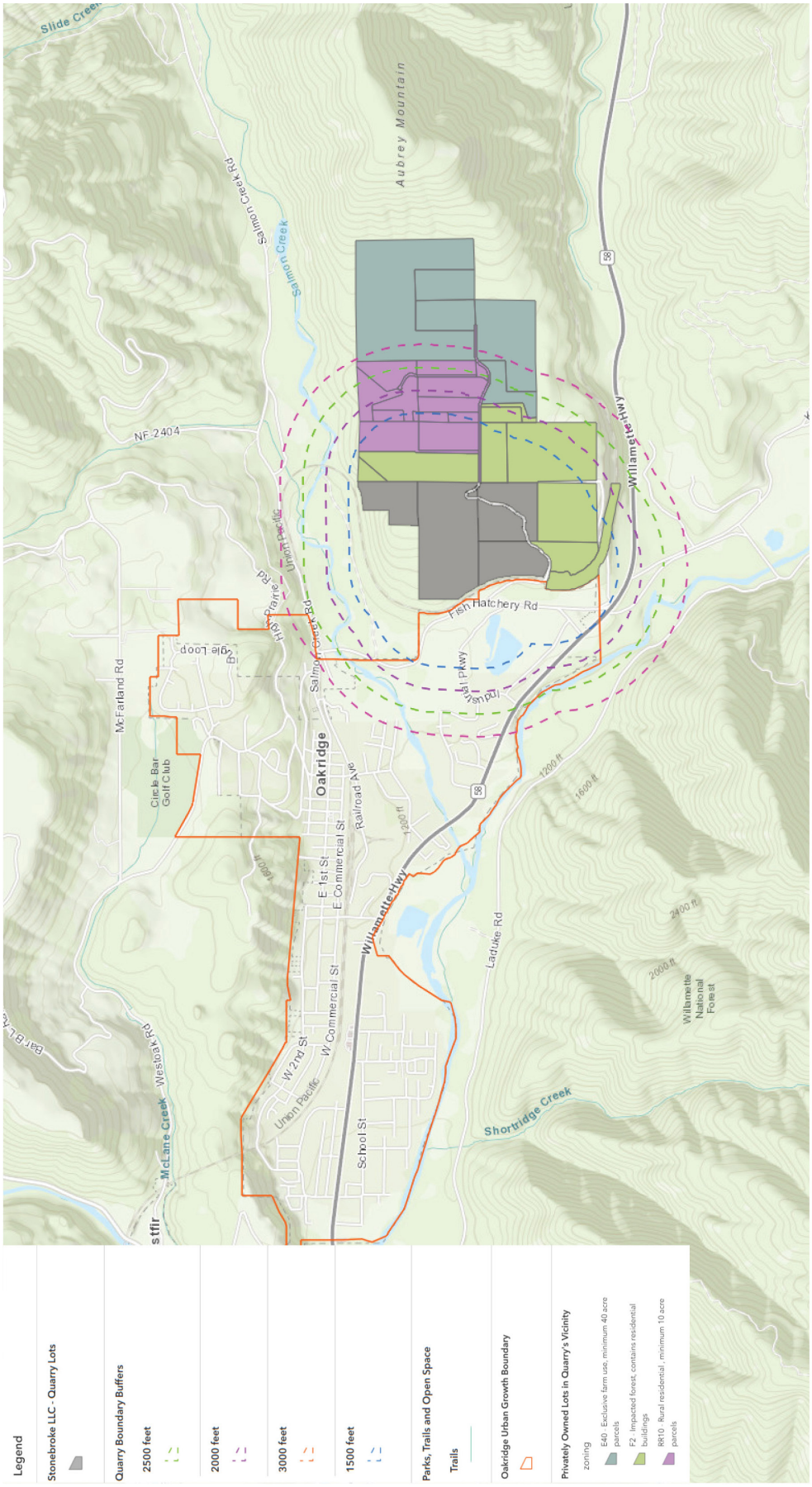


FIG. 12

Quarry Proximity to Privately Owned Rural Properties

AIR QUALITY IMPACTS

The City of Oakridge sits at the bottom of a valley where stagnant air and pressure inversions can trap airborne particulates. This makes Oakridge especially vulnerable to airborne pollutants, such as smoke from wildfires. Since 1988, wildfires have burned almost 20,000 acres within 11 miles of Oakridge, creating a significant seasonal air quality issue within the city and surrounding area (Figure 13; Oakridge Air, 2019). In 2019, the United States Environmental Protection Agency (US EPA) granted the communities of Oakridge and Westfir $4.9 million for air quality improvement projects and awarded an additional $2.7 million in 2022 (Oakridge Air, 2019). Improving the air quality of the city and the surrounding area is an ongoing mission of Oakridge.

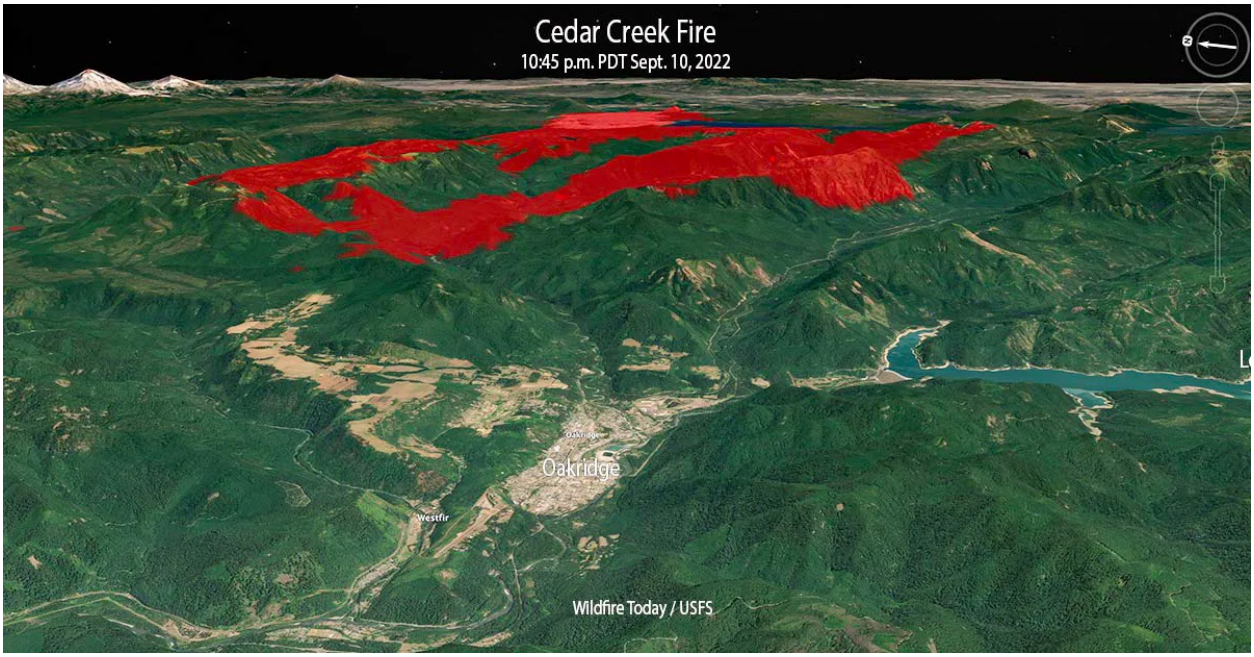


FIG. 13

022 Cedar Creek Fire Extent

Gabbert 2022

The current average annual air quality in the City of Oakridge, as reported through public-source Purple Air monitors (Purple Air 2025), is displayed in Figure 14. Air quality varies across the city, with the worst air quality observed in the residential area far to the west of the development. Though this might indicate that the air quality surrounding the proposed quarry is better than in most of the city, the number of data sensors in this area was extremely limited, which may skew these findings.

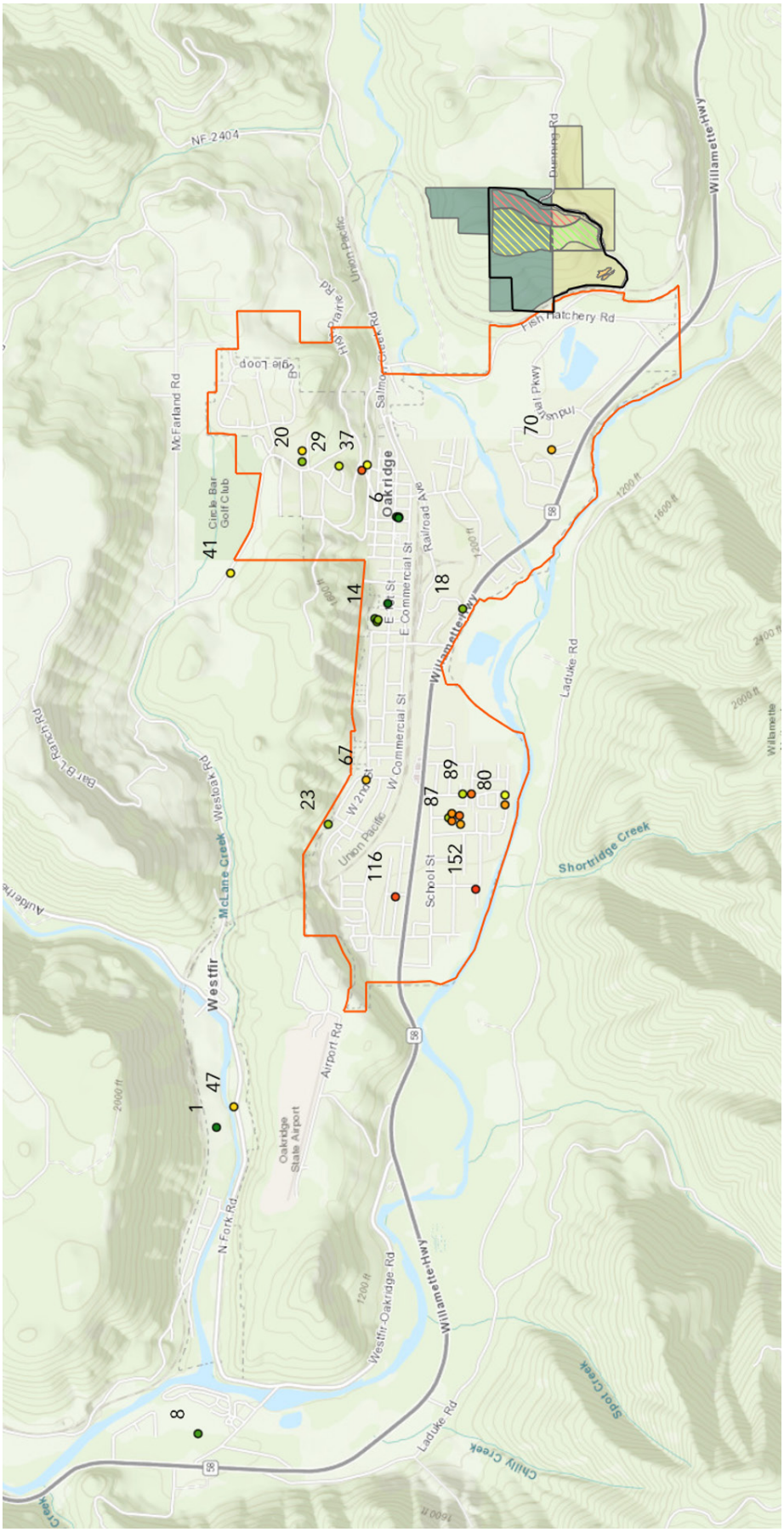


FIG. 14

Average Oakridge Air Quality for Fine Particulate Matter ($PM_{2.5}$) from February 2024 through February 2025

Assessment Strategy

Mining operations have the potential to produce dust particles in the crushing, hauling, and explosion processes. If uncontrolled, these dust particles may spread through the air, creating an air quality hazard. The size of the dust particles produced varies, with finer particles presenting higher health risks. Dust particle sizes can range from particle matter greater than 10 micrometers (referred to as PM) which is non-inhalable, particle matter approximately 10 micrometers (PM_{10}), which are inhalable coarse particles such as smoke and dust, and fine 2.5 micrometer particles ($PM_{2.5}$), which may travel into the bloodstream if inhaled and pose the greatest health risk (USEPA 2024).

StoneBroke LLC included a plan of Best Management Practices that will be adopted to limit the spread of any particulate matter associated with crushing, hauling, and explosive operations. Notably, water will be used for dust suppression during all operations that may produce fine-grained particulates that could become airborne.

In the interest of extreme caution, an air quality assessment was completed to examine the air quality impact from mining operations that may occur if these best management dust suppression practices were not followed. A simplified version of the Gaussian Plume Equation was used to estimate the maximum particulate matter spread during various proposed quarrying operations:

$$S = 0.1 * v * \sqrt{(Q)}$$

Where:

- *S = Horizontal spread distance*
- *v = Wind speed*
- *Q = Particle release rate*

The estimated daily and yearly dust production rates (Tables 2 and 3, respectively) provided by StoneBroke LLC were used to determine the impact of each activity (Old Hazeldell Quarry, LLC 2023). Wind speeds used in the modeling equation varied from 5 to 7mph based on historical average wind speeds for Oakridge, Oregon (Weather Spark 2025).

Emission Sources	PM (tons/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)
Total Erosion	**0.01**	**0.01**	**0.00**
Aggregate Stockpiles	0.01	0.01	0.00
Total Crushing	**5.00**	**2.50**	**0.15**
Rock Crusher	5.00	2.50	0.15
Total Loading and Unloading	**0.75**	**0.25**	**0.04**
Loading (Truck) from Pit to Haul Truck	0.19	0.07	0.01
Loading (Truck) from Pit to Haul Truck	0.19	0.07	0.01
Unloading from Crusher/Screener to Stockpiles	0.19	0.07	0.01
Unloading from Haul Truck to Crusher Feeder	0.19	0.07	0.01
Total Quarrying	**0.13**	**0.10**	**0.02**
Drilling/Blasting	0.13	0.10	0.02
Total Unpaved Road Travel	**4.41**	**1.12**	**0.11**
Total Emissions	**10.29**	**4.00**	**0.32**

TABLE 2

Anticipated Total Annual Particulate Emissions of Proposed Mining Activities

Emission Sources	PM (lbs/day)	PM_{10} (lbs/day)	$PM_{2.5}$ (lbs/day)
Total Crushing	27.40	13.70	0.82
Total Loading and Unloading	4.11	1.37	0.22
Total Quarrying	0.71	0.55	0.11
Total Unpaved Road Travel	24.16	6.14	0.60
Total Emissions	**56.38**	**21.75**	**1.75**

TABLE 3

Anticipated Total Daily Particulate Emissions of Proposed Mining Activities (Calculated from Annual Estimates Provided in Table 2).

Assessment Findings

The horizontal spread for various dust particle sizes without dust suppression are displayed on Table 4 and Figures 15 through 18. The largest amount of dust produced and thus the furthest spread of dust is anticipated to be from the crusher area and from driving on unpaved roads. Hazardous PM_{10} and $PM_{2.5}$ dust from the crusher area is anticipated to travel up to 306 and 73.9 feet, respectively, just over the bounds of the quarry, briefly overlapping with the road. Hazardous PM_{10} and $PM_{2.5}$ dust from the unpaved roads is anticipated to travel up to 102.3 and 11.7 feet, respectively, beyond the quarry and road along the entire southwestern corner of the quarry site.

These estimates, along with the estimates for dust produced by quarrying and loading, are based on the outline of the area planned for that specific activity. Due to this fact, the dust spread estimation for the quarrying activities appears significant, assuming the bounds of the entire quarry will be mined, which is not necessarily true. Additionally, this area has the lowest amount of hazardous dust spread (60.6 and 27.4 feet for PM_{10} and $PM_{2.5}$, respectively) is only anticipated to interact with the highway if mining activities are completed up to within 50 feet of the edge of the proposed quarry site.

Additionally, it should be noted that the Gaussian Plume Equation method for estimating particulate spread is purely empirical and does not consider many site-specific factors that may influence the spread of dust. For example, it does not consider that the Hazeldell Quarry site is in an area with varying elevations and wind speeds that may impact the dispersion of airborne particulate matter. If additional air quality impact analysis is desired, further modeling should consider:

- Weather information, including wind speed, wind direction, and precipitation;
- Specific terrain/land use data; and
- Particulate dampening/management practices.

Emission Source	Horizontal Spread (feet)					
	PM		PM_{10}		$PM_{2.5}$	
	5mph	7mph	5mph	7mph	5mph	7mph
Crushing	309	433	218	306	53	74
Loading and Unloading	121	170	73	102	8	12
Quarrying	53	74	43	61	20	27
Unpaved Road Travel	291	406	144	202	46	64

TABLE 4

Estimated Spread of Particulate Matter from Quarrying Activities

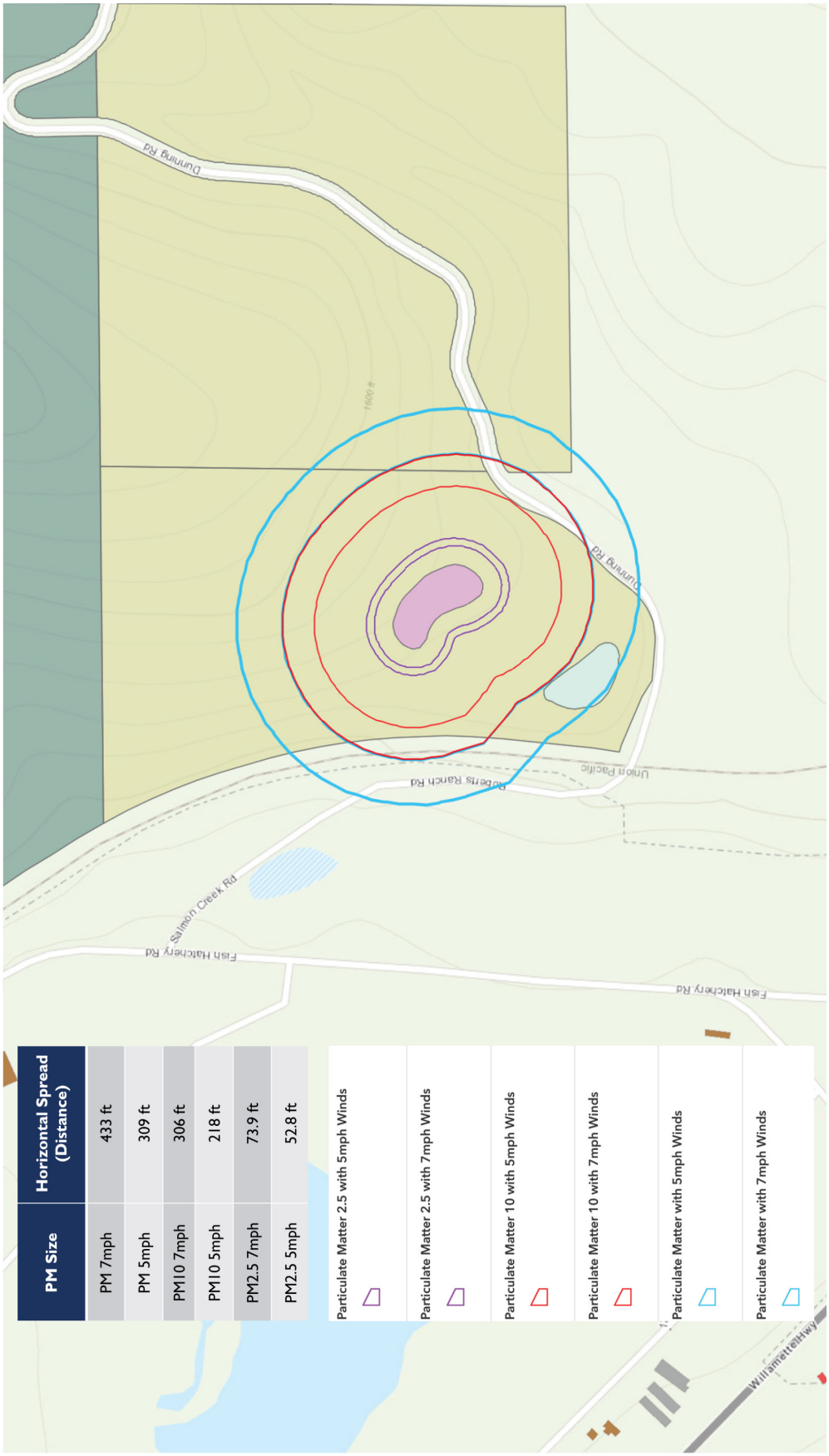
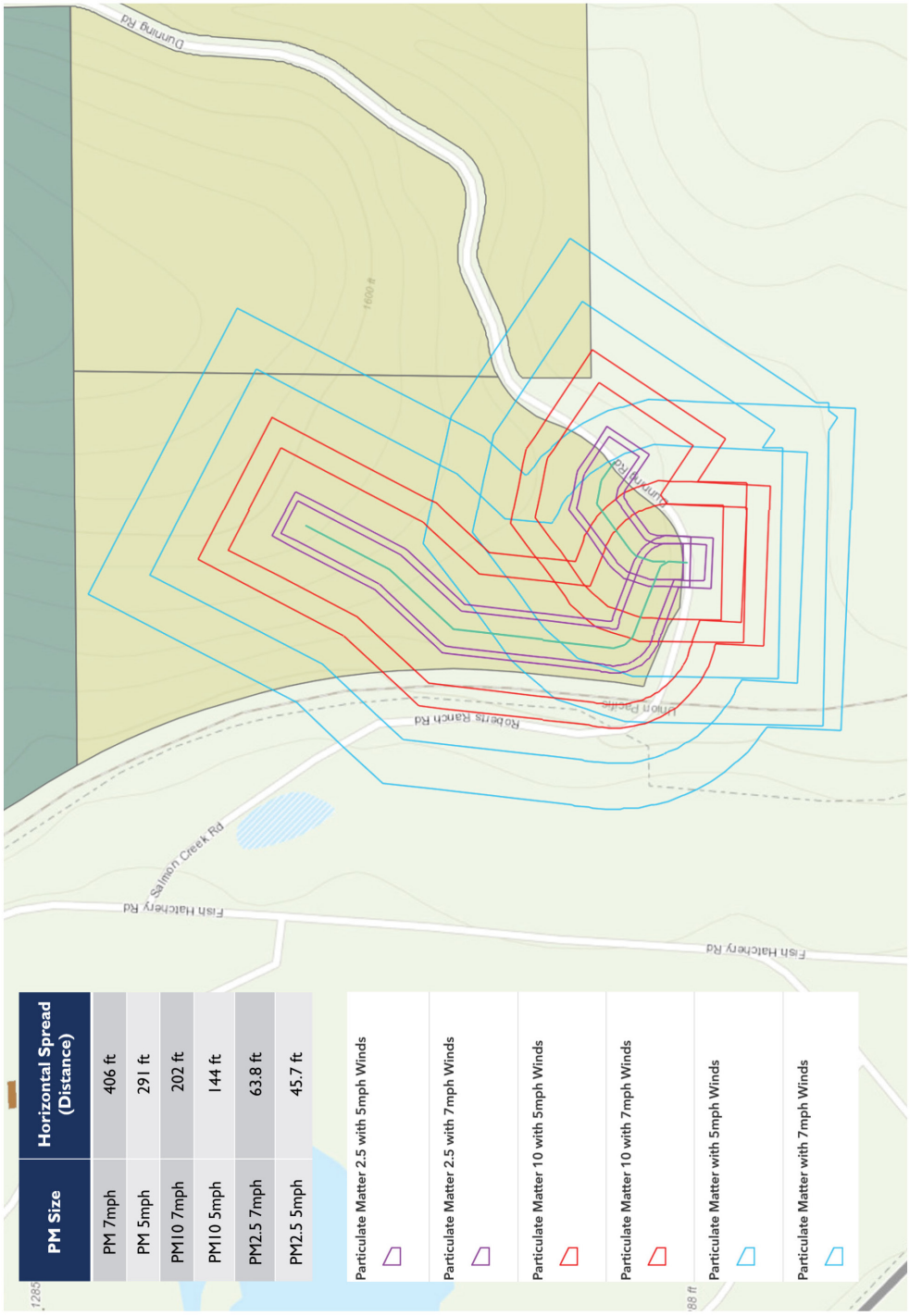


FIG. 15

Maximum Estimated Particle Spread for Crushing

FIG. 16

Maximum Estimated Particle Spread for Unpaved Road Travel



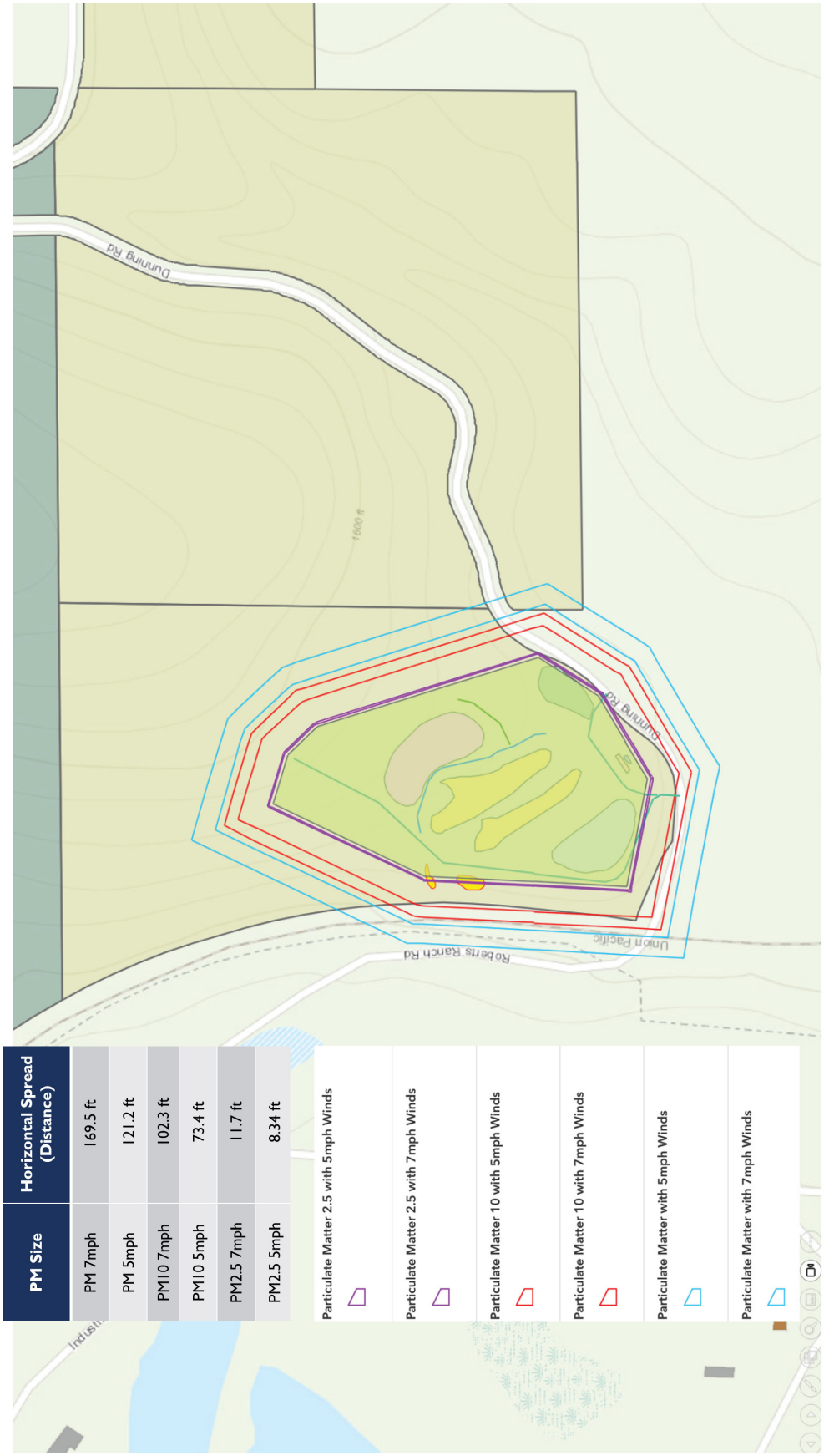
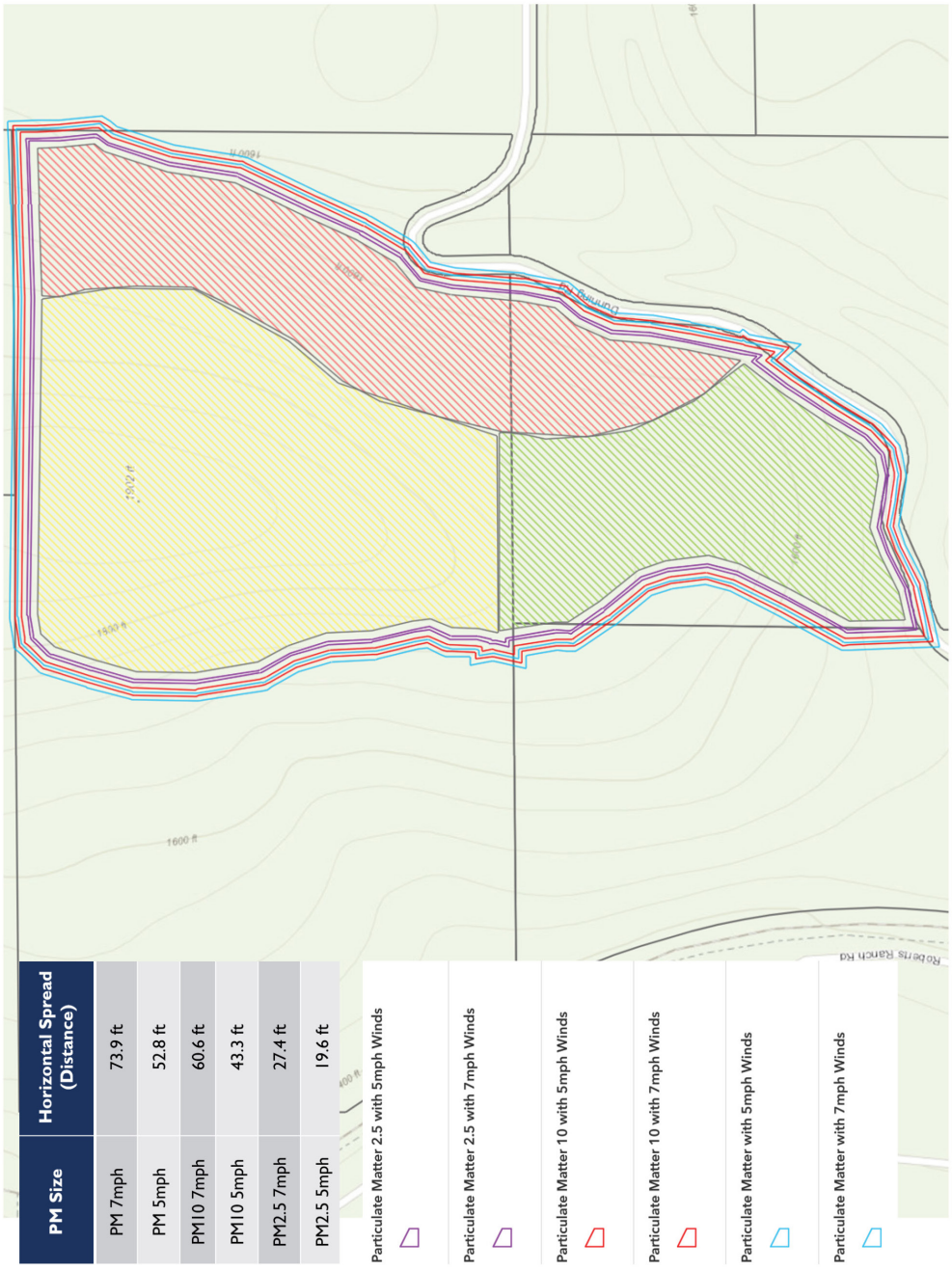


FIG. 17

Maximum Estimated Particle Spread for Loading and Unloading

FIG. 18

Maximum Estimated Particle Spread for Quarrying



NOISE IMPACTS

Assessment Strategy

The primary source of noise disturbance listed in the StoneBroke LLC 2023 quarry application includes their use of Ammonium Nitrate-Fuel Oil (ANFO) explosives (Old Hazeldell Quarry, LLC 2023). ANFO explosives vary in sound depending on the amount of material used, however based on review of typically published ranges, it was assumed that the ANFO explosives used at the proposed quarry would range in volume from 130 to 150 decibels (dB). The impact of the noise produced by the explosives was completed using the Inverse Square Law:

$$\Delta L = 20 * \log\left(\frac{R_2}{R_1}\right)$$

Where:

- *L = Difference in sound pressure between to points (dB)*
- *R_1 = Distance from the noise source to point 1 (feet)*
- *R_2 = Distance from the noise source to point 2 (feet)*

The distance was calculated assuming that the explosives were experienced at full volume from one foot away. This modeling process did not take into consideration site-specific factors, such as changes in topography or the local climate (e.g. wind and precipitation), or mitigation strategies such as sound berms planned for use during the quarry operations. If a more specific noise analysis is desired in the future, it should be completed considering these factors.

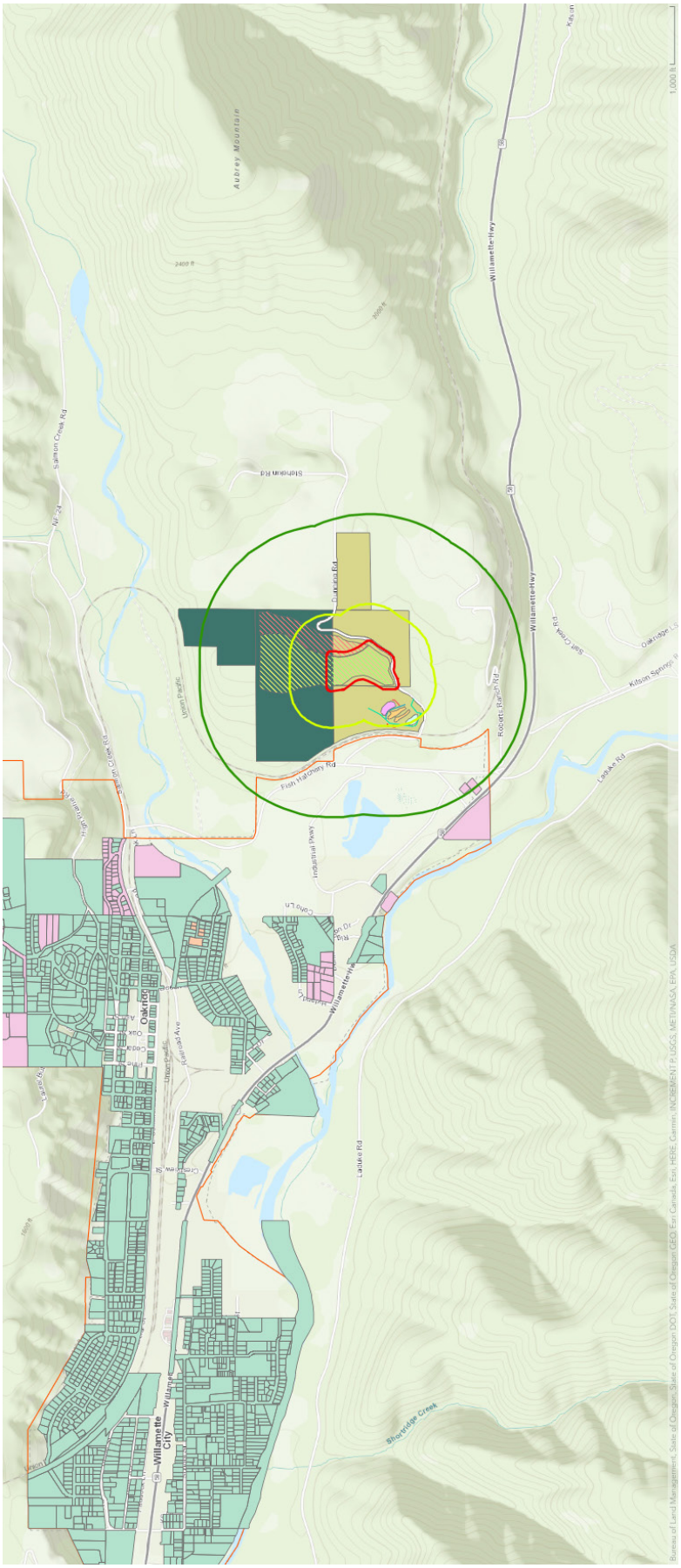
Assessment Findings

Phase 1 of the mining will occur first and is anticipated to have a similar level of explosive use as the rest of the mining phases. Modeling of noise propagation was only completed for Phase 1 as it is generally representative of the other mining phases and is located closer to potentially affected residential properties. The concentric rings presented in Figure 19 illustrate the noise propagation anticipated during Phase 1 of the mining operation. Sound levels of 70, 80, and 100 dB are shown in green, yellow, and red, respectively. These sound levels are similar to a motorcycle, police siren, and a vacuum cleaner (Figure 20; MDHearing 2024).

Based on the map, some of the loudest noises may be heard at a few residential properties to the southeast, however these will only be heard at about 70 dB, approximately as loud as vacuum cleaner. The danger and tolerability of these noise levels are heavily impacted by how frequently and how long they occur, neither of which was included in the 2023 quarry application (Old Hazeldell Quarry, LLC 2023).

FIG. 19

Estimated Propagation of Explosive Noise



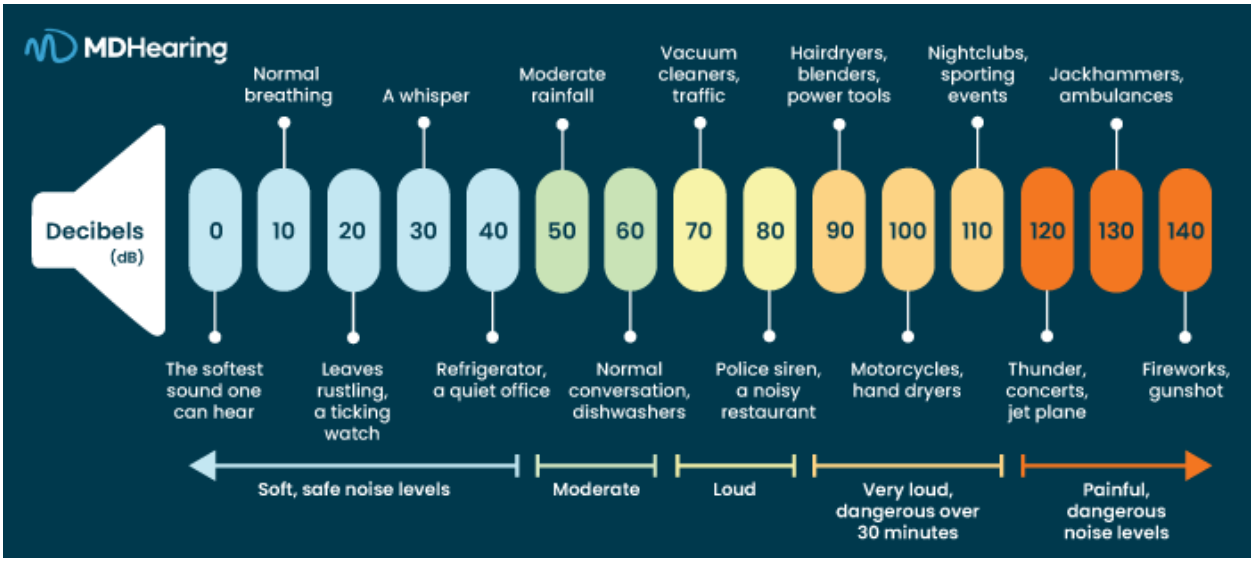


FIG. 20

Decibel Rating of Common Noises

MDHearing 2024

HYDROLOGIC IMPACTS

One of the primary concerns of Oakridge citizens regarding the proposed quarry is the potential for the rivers and lakes near the site to become contaminated, either due to the increased overland flow from water used for dust suppression, or through over-pumping of groundwater that might impact the current pattern of groundwater flow.

Soils beneath the proposed quarry consist primarily of low permeability bedrock, resulting in a poorly established groundwater table within the butte underlying the site. Because of this, it is difficult to develop monitoring wells within the immediate vicinity of the proposed quarry. StoneBroke LLC completed a series of investigatory borings at the site, identifying groundwater levels ranging from approximately 37.1 to 49.6 feet below ground surface. It was concluded that the groundwater encountered was contained within joints and fractures within the bedrock and appeared to be replenished primarily by surface infiltration. One vibrating wire piezometer was installed in one of the exploratory borings (CB-4) at a depth of approximately 137.9 feet below ground surface to allow for future groundwater level monitoring below the site (Old Hazeldell Quarry 2023). This type of monitoring location allows for continuous measurement of depth to groundwater readings; however it does not provide any ability to test groundwater quality, which is a prime concern of many Oakridge residents. Additionally, one monitoring location does not provide enough data to determine the direction of groundwater travel from the site, which is another important step when monitoring groundwater systems.

Any potential water contamination emanating from the quarry would most likely be caused by stormwater drainage passing through the site, eventually traveling to mix with river water and the underlying alluvial aquifers from which Oakridge draws its water supply. Concerns regarding how the presence of the proposed quarry might impact the water quality in the rivers include:

- Stormwater runoff from the proposed quarry flowing through stockpiles of mined aggregate and transporting:
  - Toxins (i.e. heavy metals)
  - Excessive fines (i.e. rock dust) that may increase the turbidity of the rivers
- Stormwater runoff from the historic landfill which may contain landfill leachate.

During the site investigation, no heavy metals were identified in the aggregates beneath the site that the proposed quarry would mine and stockpile (Carsley 2023). Additionally, the proposed quarry plans to implement standard best management practices (BMPs) to prevent stormwater at the site from flowing through the gravel stockpiles or over the historic landfill. These BMPs include the construction of a stormwater berm uphill from these areas, as well as a berm downgradient from the crusher area (Figure 21). Built to a height of 15 to 25 feet, these berms will also help isolate sound from mining activities at the sight. Based on the planned presence of these berms, as well as the lack of heavy metals in the mined aggregate, it is not anticipated that the mining activities of the proposed quarry would directly impact the water quality of the stormwater draining to the rivers.

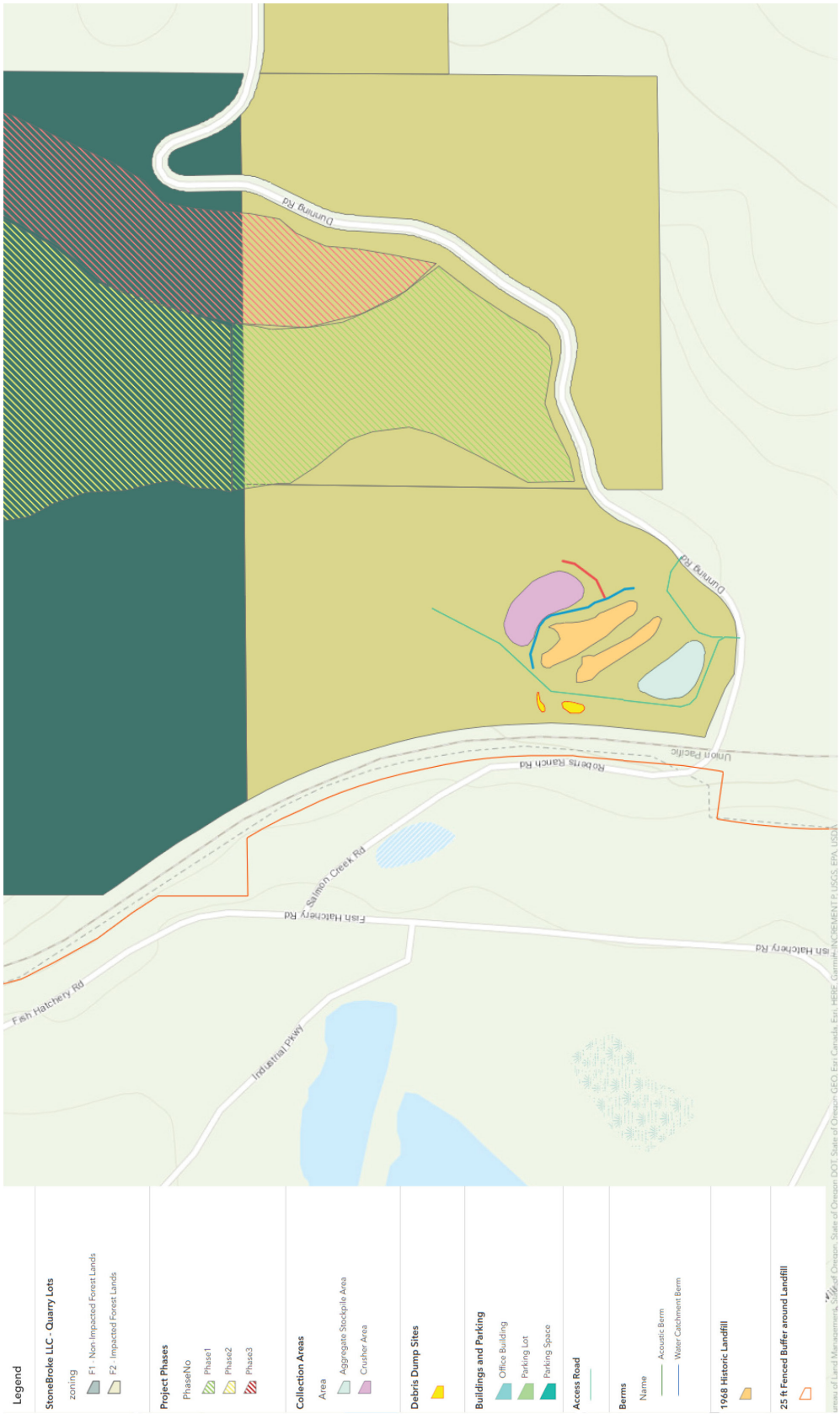


FIG. 21

Proposed Placement of Diversion Berms

There is a potential, however, that leachate from the historic landfill could mix with stormwater flowing over the landfill, eventually draining into the river. There is currently no evidence that the landfill contains hazardous material, however no environmental investigation has been completed to confirm if this is true. In 2016, ODEQ recommended that an environmental investigation of the landfill be completed, and a groundwater monitoring system be established downgradient of the landfill to identify if any potential contaminants are flowing into the river (ODEQ 2016). Any contaminants that may flow from the historic landfill were not placed there by the proposed quarry. However, vibrations from gravel crushing operations of the quarry have a potential to shift soils within the landfill, increasing the likelihood of exposed debris that may mix with stormwater flowing over the landfill, thus increasing the potential for additional leachate to travel to the river.

Assessment Strategy

Assessment of potential groundwater impacts from the proposed quarry, or the presence of the landfill, were limited based on the data available. The assessment included an evaluation of where public and private wells in the vicinity of the quarry draw their water, and the potential for stormwater drainage from the quarry and historic landfill to flow into the water that supplies these aquifers.

Assessment Findings

Private Water Supply

StoneBroke LLC identified three types of wells that are within the vicinity of the proposed quarry: lowland, highland, and midland wells (Figure 22). These wells were sorted based on the groundwater elevation of the aquifers from which they draw water (Old Hazeldell Quarry, LLC 2023).

- **Lowland Wells:** Estimated static groundwater elevations at lowland wells range from 1,159 to 1,294 feet above mean sea level. These wells are predominantly shallow wells, and are located primarily near Salmon Creek and the Willamette River. These wells do not rely on the quarry area as a source of groundwater but rather rely on alluvial aquifers and their connection to major streams. These wells will not be impacted unless there are contaminants that get directly into the stream system.
- **Highland Wells:** Highland wells are the highest of the geological areas. These wells have very low flow and are very deep wells indicating that the aquifers they are drawing from are localized around where they are screened. Estimated groundwater elevations at these wells range from 1,444 to 1,749 feet above mean sea level. Similar to lowland wells, the highland wells do not rely on the quarry as a source for groundwater and have very little chance of being impacted by the quarries activities.
- **Midland Wells:** Midland wells have high flow rates and are quite shallow, with estimated static groundwater elevations ranging from 1,540 to 1,680 feet above mean sea level. Based on the StoneBroke LLC 2020 application, there is still some uncertainty about where these wells draw their water. Because of how shallow these wells are, there is some likelihood that overland and groundwater flow from the quarry could seep into the water supply where they pull from.

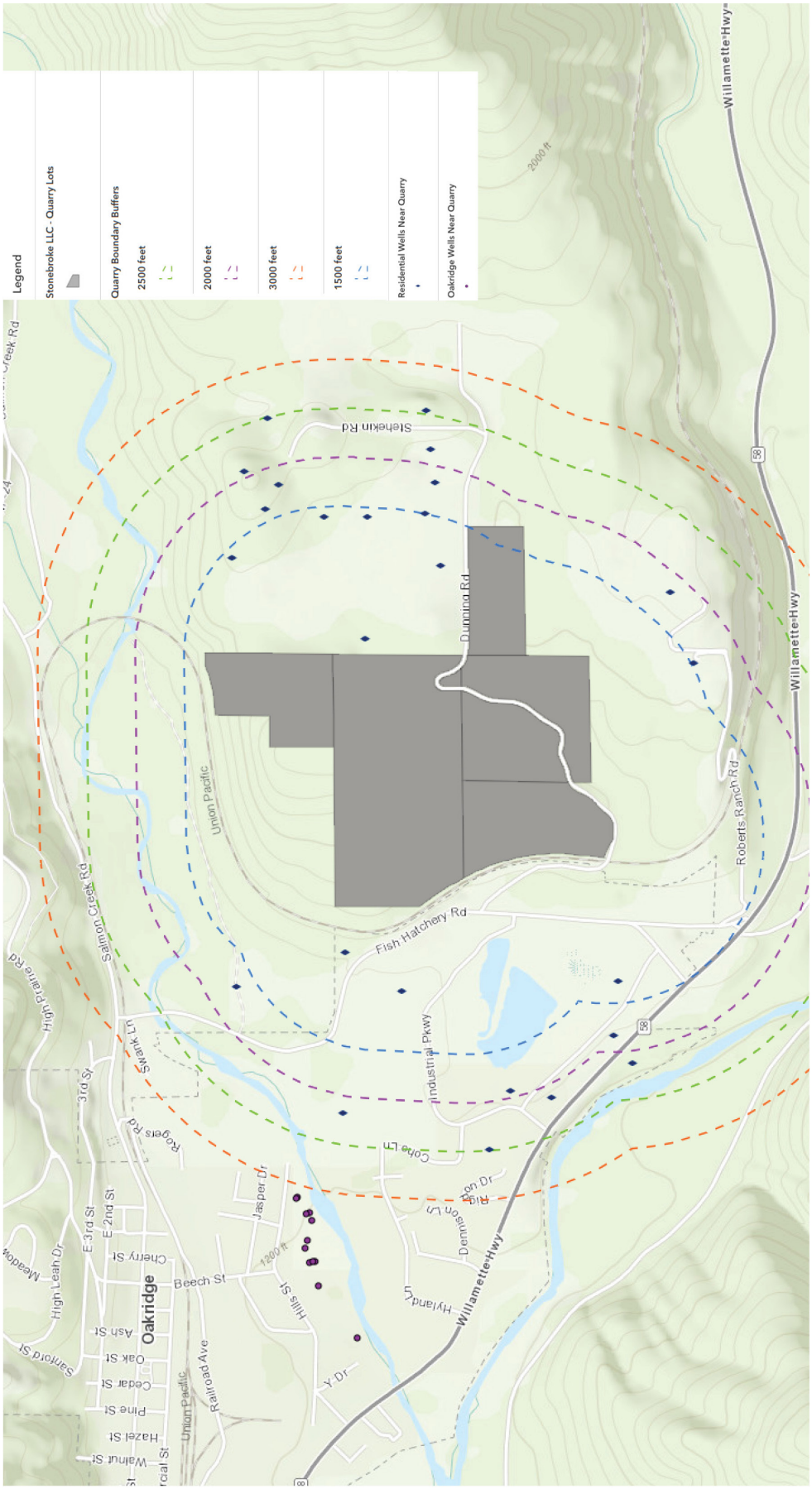


FIG. 22

Private Wells Near the Quarry

Public Supply

Potable water for the City of Oakridge is supplied by five wells located in the alluvial aquifer underlying Salmon Creek (Figure 23). The alluvial aquifers along Salmon Creek and the Middle Fork of the Willamette River also supply water to several of the private lowland wells surrounding the Oakridge city limits. These alluvial aquifers are fed by the water in the rivers that flow over them - both water flowing from upstream, as well as rain that falls onto the surrounding hillsides and drains into the rivers. If either of these water sources were to become contaminated - either by the upstream river water or stormwater flowing down the hillside - there is potential for the alluvial aquifer, and thus the water supply for the City of Oakridge and some of the private residential wells, to become contaminated as well. Figure 23 displays travel times provided by the City of Oakridge depicting how long it would take a single drop of water to enter the alluvial aquifer and be drawn up by the City of Oakridge wells, and thus Oakridge's water system.

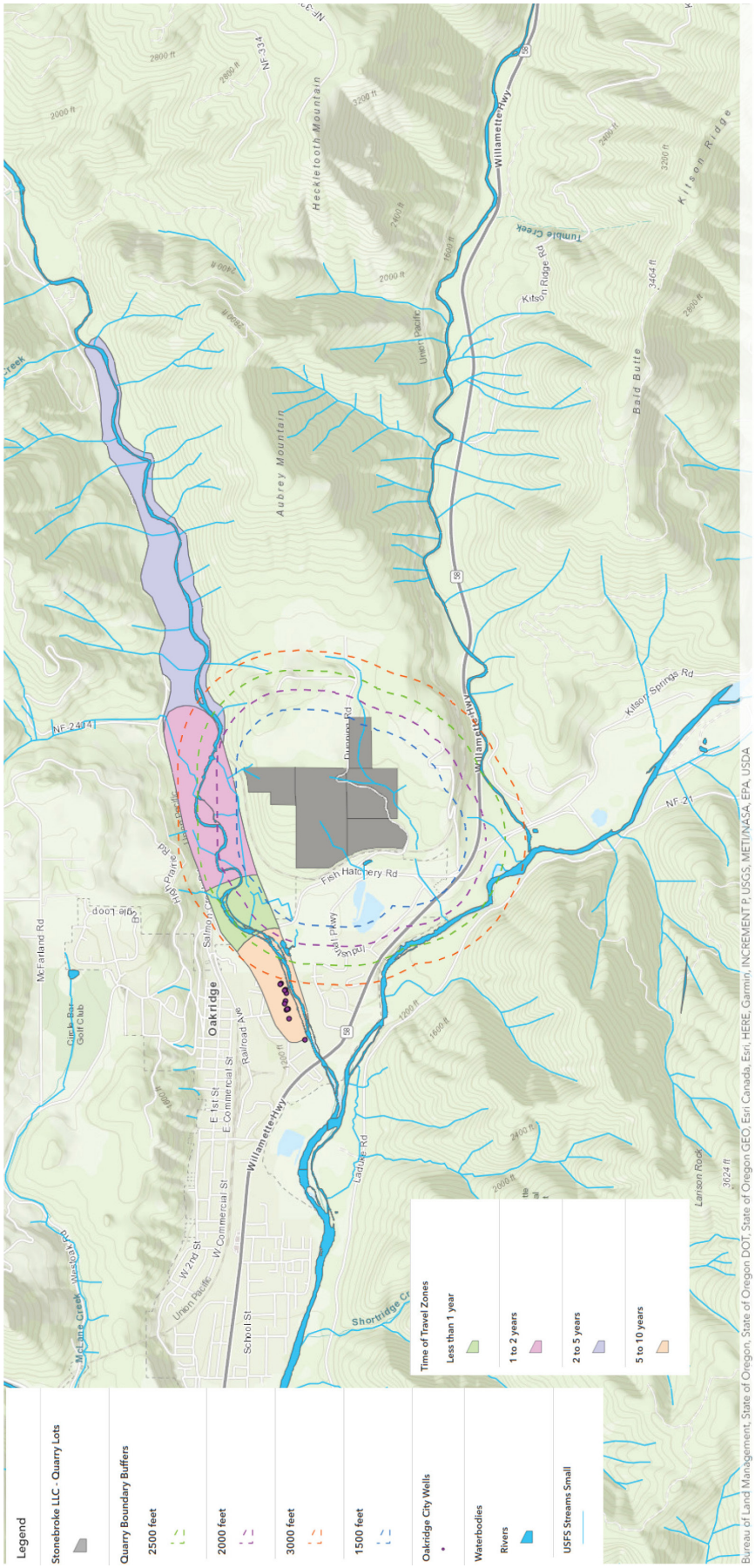


FIG. 23

City of Oakridge Public Water Supply Wells, Time of Travel Zones

A watershed drainage analysis of the quarry area was completed using the ArcGIS Pro hydrology toolset and DEM files from both the City of Oakridge and USGS (Figure 24). The DEM file from the City of Oakridge appeared to be corrupted, unfortunately, and produced clearly erroneous drainage pathways. For this reason, the final analysis was completed using the USGS DEM file, which unfortunately was not granular enough to make any useful, conclusive findings. Though the authors were successful in modeling that stormwater from the quarry site would flow into the Salmon River, the model lacked any substantive detail to clearly show how stormwater drainage from the historic landfill or crusher area would flow. Further analysis using a refined and corrected DEM file is required if this information is desired. This drainage system should be overlain with the travel time areas provided by the City of Oakridge (Figure 23) to determine how soon any changes to water quality created by the presence of the proposed quarry might be observed.

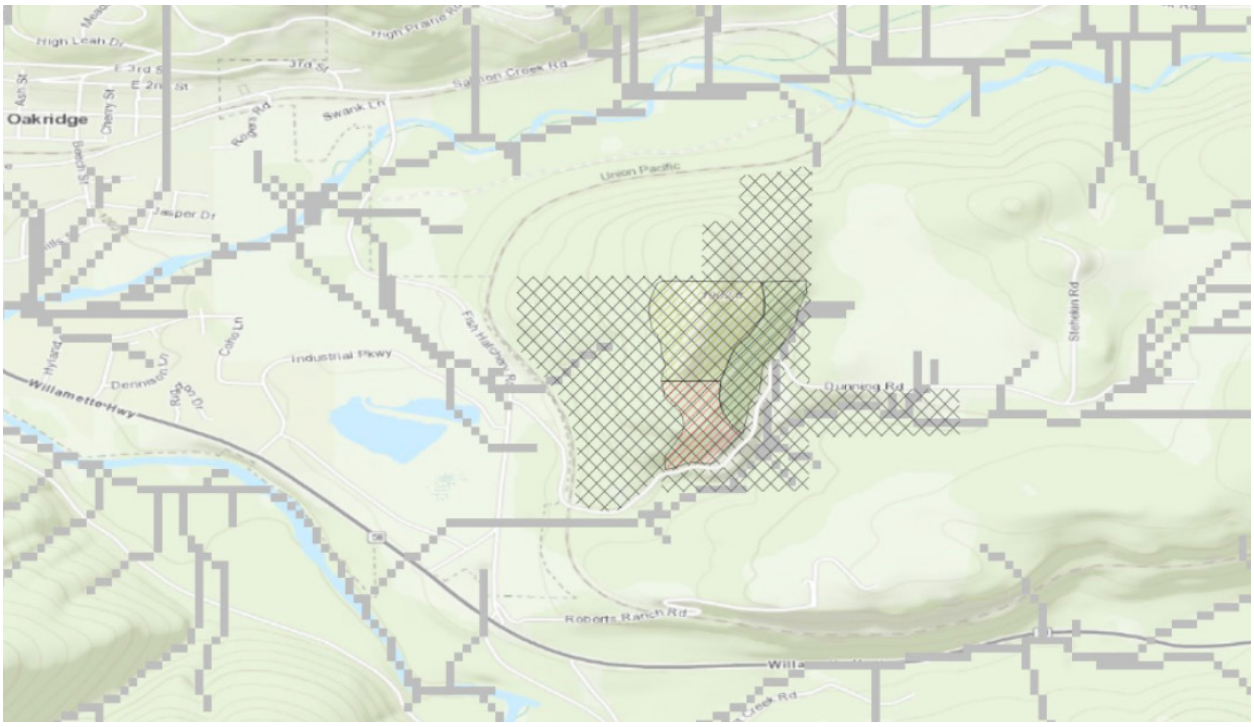


FIG. 24

Estimated Surface Drainage Pathways

ECOLOGICAL IMPACTS

Assessment Strategy

Assessment of the proposed TV Butte Quarry ecological impacts was driven primarily by the Oregon Department of Fish and Wildlife's (ODFW) Oregon Conservation Strategy. "It provides a shared set of priorities for addressing Oregon's conservation needs.
The Conservation Strategy brings together the best available scientific information and presents a menu of recommended voluntary actions and tools for all Oregonians to define their own conservation role. The goals of the Conservation Strategy are to maintain healthy fish and wildlife populations by maintaining and restoring functioning habitats, preventing declines of at-risk species, and reversing declines in these resources where possible" (ODFW 2016).

Strategy habitats, priority wildlife connectivity areas (ODFW 2016), and strategy species sited in the Oakridge area are all displayed on Figure 25 (iNaturalist 2025). Urged by public concern, sightings of Elk have also been added to this map (iNaturalist 2025).

Assessment Findings

Elk observations on iNaturalist have been recorded along the western edge of the proposed quarry site and within 3,000 feet of the eastern boundary (iNaturalist 2025). Based on the Oregon Conservation Strategy's habitat corridors, it can be assumed that human planned state-wide migration pathways for these elk would not be directly affected by the construction of the quarry, however based on their current presence within the immediate vicinity of the quarry, the territories they currently are accustomed to visiting would be directly affected.

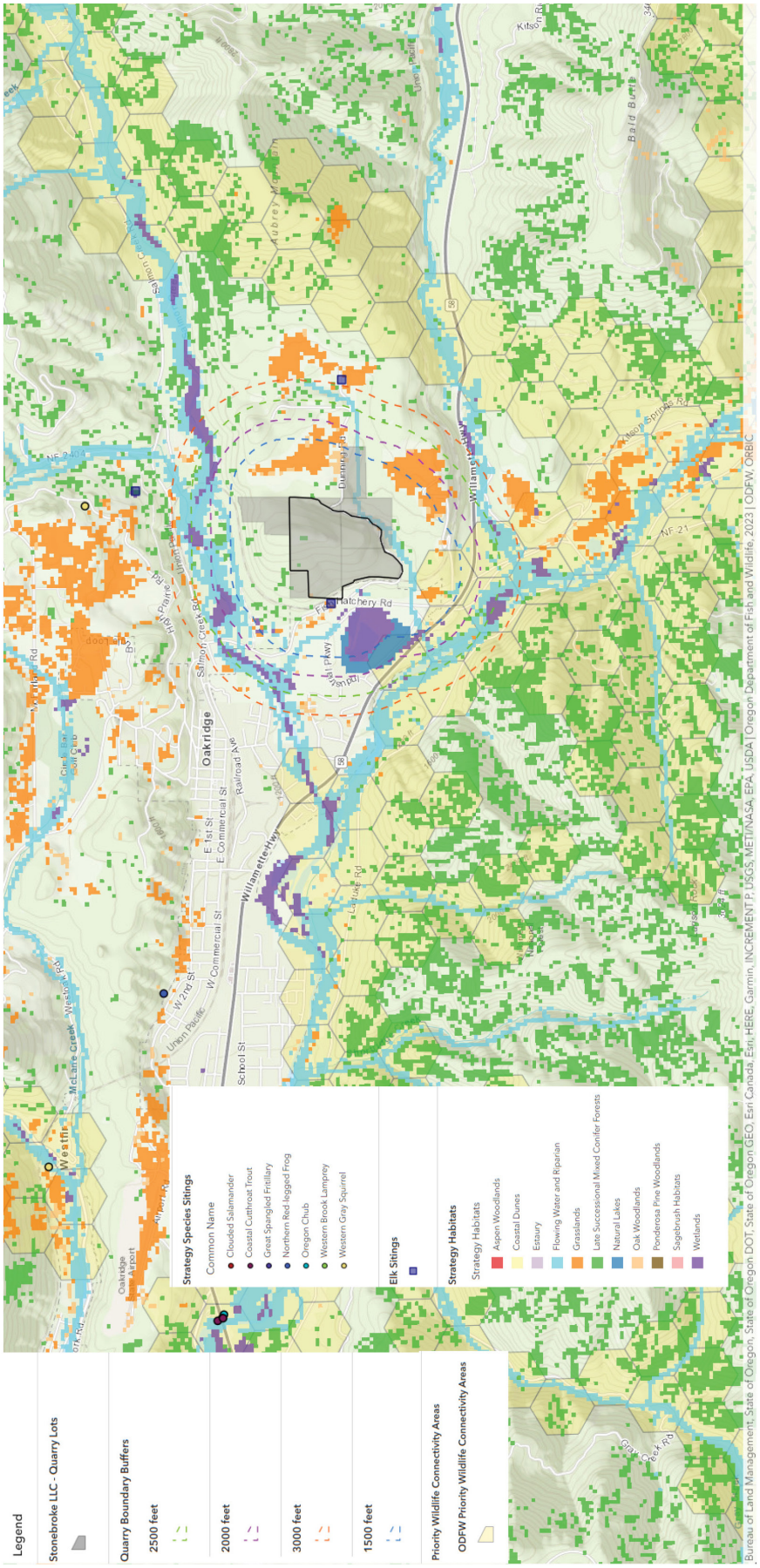
The nearest sighting of strategy species around the site include Western Gray Squirrel one mile to the north, Northern Red-legged Frog two miles to the west, and Coastal Cutthroat Trout 2.5 miles to the south. Based on these distances, the risk of disturbance to known strategy species in the area is low. It should be noted however that sightings of strategy species are limited based on access and public engagement with iNaturalist, and the absence of a species sighting does not mean that a species is not present in the area.

Strategy habitats surrounding and within the proposed quarry include late successional mixed conifer forests, grasslands, oak woodlands, riparian corridors, wetlands, and natural lakes. Development of the proposed quarry is anticipated to directly disrupt only a small portion of strategy habitat, including a combined one acre of late successional conifer forest. None of the priority wildlife connectivity areas pass through the quarry area.

There are, however, 95 acres of strategy habitat within 1,500 feet of the proposed quarry, and the nearest wildlife connectivity area is 400 feet from the southern border of the proposed quarry. Based on how near these areas are to the bounds of the quarry, they should be considered and included in any sound and stormwater management plans proposed to protect the surrounding environment.

FIG. 25

Ecological Map



NATURAL DISASTERS

Assessment Strategy

Natural disasters considered in relationship to the proposed quarry location include:

- Floods, which could spread gravel and dust into the river if they entered the quarry;
- Earthquakes, which may be triggered by the use of underground explosives depending on local geology; and
- Landslides, which could be triggered by vegetation removal, poor slope management, heavy equipment use, and gravel stockpiling.

Historical flood and geologic data provided by the Federal Emergency Management Agency (FEMA 2024) and the Oregon Department of Geology and Mineral Industries (DOGAMI 2024a and 2024b), respectively, are illustrated on the Hazard Map (Figure 26).

Assessment Findings

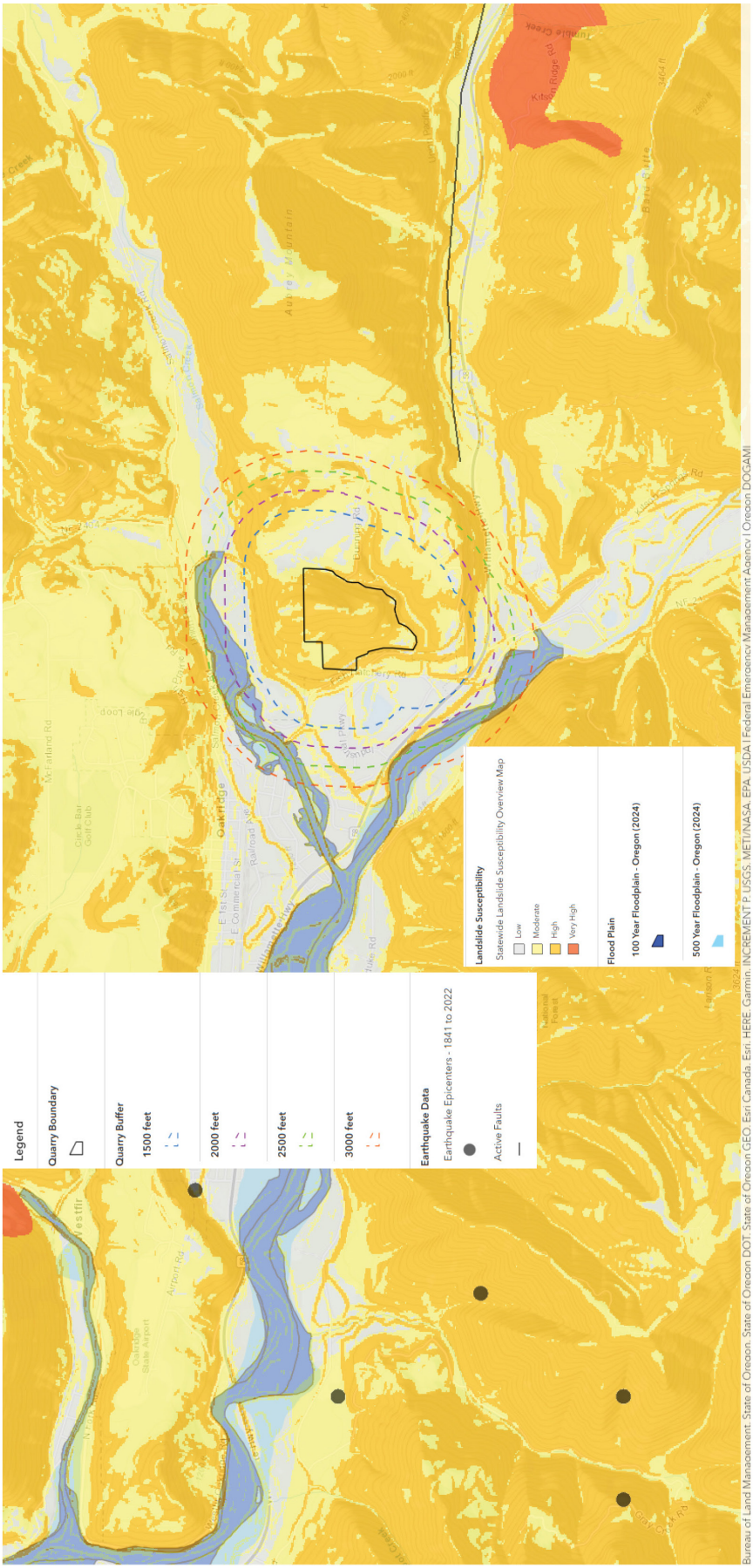
All examined natural disaster risk factors are displayed on Figure 26. The site is located approximately 150 feet above the 100 and 500-year flood plains (FEMA 2024) and has a very low risk of flooding. Though there is a fault within 0.75 miles of the proposed quarry boundary, no earthquakes have been observed along this fault since at least 1841. Instead, all the local earthquakes observed since 1841 have occurred towards the west of the site, with the nearest epicenter being more recently observed over 2.5 miles to the west (Oregon DOGAMI 2024a). Based on the historical data, there is a low risk that mining activities at the quarry would trigger an earthquake.

Under the current conditions of the site, DOGAMI has characterized soils in the area as highly susceptible to moderately susceptible to landslides (~80% and ~15% of the quarry area, respectively; Oregon DOGAMI 2024b). This categorization is based on broad data sets considering site topography, geology, and proximity to mapped existing landslides, however it is not site-specific and cannot be used to predict where a landslide will occur. Site-specific investigations found that the proposed quarry is predominantly underlain by competent bedrock, including Little Butte Volcanics and Intrusive Andesite, ideal for gravel mining (GSI Water Solutions, Inc. 2016). This means that landslides that may occur at the site would most likely be within shallow soils only. The DOGAMI landslide susceptibility categorizations, however, warrant their consideration during mining activities, and a potential bearing capacity assessment and/or slope stability assessment to ensure the use of heavy machinery, gravel stockpiling, and use of explosives will not trigger a landslide.

No stability information was identified regarding the on-site landfill. Landfills are prone to settlement and are notoriously unstable, particularly when they are located on steep slopes, compose large areas of a hillside, or are subject to potentially destabilizing forces such as repeated vibrations. Due to the nature of the on-site landfills as being shallow trenches, it is not anticipated that there is a high potential for a landfill landslide to occur. The crusher placement within 25 feet of the landfill, however, warrants potential investigation into the stability of the landfill considering the additional vibrations from crushing activity, explosives, and heavy machinery.

FIG. 26

Natural Disaster Hazard Map



Recommendations

Due to the limitations of time, data quality, student skill in ArcGIS Pro, and experience with outside software programs, this is not intended to represent a professionally completed EIA. To further study the potential impacts of the proposed quarry, student recommendations are written in order of priority.

1. **Soil and Water Sampling:** Evaluate the current impact of the landfill prior to any mining operations.
2. **Contamination and Risk Mapping:** If contamination is identified in the soil and water samples, map potential spread of contaminants and establish a monitoring plan.
3. **Hydrology Modeling:** Update overland flow analysis using a more detailed DEM file; model groundwater flow through the existing quarry; include the 5,000 gal/day that will be used for dust suppression.
4. **Soil Erosion and Sediment Transport Modeling:** Revise Universal Soil Loss Equation (RUSLE) and Sediment Yield Models to predict soil erosion to identify areas where sedimentation might affect rivers and reservoirs.
5. **Public Communication of Monitoring Results:** Establish a method to communicate monitoring results of air, sound, stormwater, and groundwater.
6. **Groundwater Monitoring Network:** Establish a network of groundwater wells to monitor potential contamination spread.
7. **Air Dispersion Modeling:** Update air dispersion dust modeling using more accurate information about the anticipated spread, considering the effects of hourly/daily changes in atmosphere and weather, as well as the combined impacts of wildfire smoke during fire season. The air quality modeling presented in this report considers average air quality values only. It is recommended that future modeling be completed considering both peak air quality values and maximum spread.

During the course of study, students interviewed Professor Qusheng Jin, an expert in contaminant remediation and geochemical and bio-geochemical modeling. Professor Jin reiterated the importance of understanding the landfill's history and potential contamination issues. He hypothesized that due to its age and the historical landfill practices at the time of its operation, the landfill likely already poses some environmental risk, regardless of the presence of the proposed quarry. Following on the recommendations from ODEQ (ODEQ 2016), Professor Jin recommended completing additional sampling at the site, including:

- Stormwater runoff quality;
- Groundwater quality from seeps below the landfill; and
- Infiltration Rate/Hydraulic Conductivity of the soils.

These results could be used to inform a more complete understanding of the risks posed by the historic landfill to the City of Oakridge's water supply, with or without the presence of the proposed quarry.

Conclusion

The City of Oakridge's primary interest in assessing the potential impacts of the proposed quarry included assessment of:

- **Community Health & Assets:** Health risks associated with silica dust, air pollutants, and noise exposure in nearby residential and recreational areas.
- **Water Contamination:** Map the quarry's proximity to the abandoned landfill and assess contamination risk into Salmon Creek and local aquifers.
- **Wildlife Disruption:** Map the quarry's proximity to wildlife habitats.

The analyses completed by the students were informed by both the City of Oakridge's initial objectives, and standard Environmental Impact Assessment strategies. The findings of these preliminary assessments include:

SOCIAL IMPACTS

The entirety of the City of Oakridge will likely be able to at least partially see changes in the landscape created by the proposed quarry. Views will most heavily be impacted in the southern, central, and western residential neighborhoods, the Highway Commercial District, the central river parks, and on recreational trails south of town. Though less impacted by changes to their views, the commercial Mixed-Use District and the Oakridge Mill Park may all be affected by falling within 2,000 feet of the quarry.

AIR QUALITY IMPACTS

The only significant air pollutant anticipated from quarry operations is fine particulate matter from the quarrying, crushing, and loading of gravel, as well as truck traffic on unpaved roads. Based on the estimated particulate production rates provided by Stonebroke LLC, average windspeeds in the area, and the assumption of no dust suppression used, it is estimated that dust may travel up to 330 feet from the site, crossing over the highway in the southwest corner of the site. The spread of particulate matter is the worst from truck traffic on unpaved roads. These findings are biased high, as Stonebroke LLC is planning to use dust suppression methods to reduce the spread of particulate matter from the site.

NOISE IMPACTS

Noises produced from quarrying activities include the use of explosives and heavy machinery. Based on the anticipated use of ANFO explosives, it is estimated that the eastern portion of the commercial Mixed-Use District, two eastern residential properties, and majority of Mill Park will be able to hear the explosives at approximately 70 dB, about as loud as a vacuum. The frequency of explosive use was not published by StoneBroke LLC, so it is unknown how often such noises would be heard in these areas. These findings are biased high, as they do not consider the impacts of any of the planned sound berms or natural topography.

HYDROLOGIC IMPACTS

There are no significant chemical impacts to stormwater runoff or groundwater quality that are anticipated from quarrying activities. It is unknown if the historic landfill contains contaminants that might impact stormwater or leachate flowing from the historic landfill, which has the potential to flow from TV Butte, eventually draining into Salmon Creek, and potentially impacting the quality of the river and the alluvial aquifer from which the City of Oakridge draws its water supply. Additionally, there is potential

for overland and groundwater flow from the site to impact Midland residential wells. To ensure mining activities are not presenting a potential hazard to their surroundings, it is common practice to establish a monitoring network to monitor the quality of surface and groundwater flowing from the site. If data is published in a publicly available format, this could aid in establishing a confident relationship between the public and Stonebroke LLC, if development of the quarry were to move forward. The analysis completed in this report was insufficient to determine how water from the landfill area will drain, but it is an important factor to consider when establishing a monitoring network for the site.

ECOLOGICAL IMPACTS

There are no sightings of strategy species within 3,000 feet of the proposed quarry. Two recorded elk sightings occurred within 3,000 feet of the quarry boundary, which is an important note to the community of Oakridge. Wildlife connectivity areas extend to within 400 feet of the quarry boundary and may be functioning as prime elk migratory corridors. Only one acre of strategy habitat would be directly disturbed by the proposed quarry, however approximately 95 acres of strategy habitat are present within 1,500 feet of the quarry.

NATURAL DISASTERS

Natural disasters considered included floods, earthquakes, and landslides. It is not anticipated that the quarry will have any interaction with flooding in the area. The quarry is in a high to moderately susceptible landslide area, which may warrant a slope stability assessment to ensure the site grading and material storage methods do not trigger a local landslide, particularly one which might interact with the historic landfill. Though the quarrying activities are not anticipated to trigger an earthquake, the site is in a seismic area, which increases the likelihood of a potential landslide.

Based on the evaluations completed in this report, the greatest impacts to the Oakridge community anticipated from the presence of the proposed quarry include:

- Changes to views of the landscape which could be seen from all areas of the city;
- Potential noise disturbances, as loud as a vacuum, which could be heard in the Mill River Park area;
- Disturbance of an existing elk grazing site, though not to prime migratory corridors;
- Potential localized landslides which impact the historic landfill and potentially result in new or increased impacted drainage from the historic landfill area (this latter statement is not supported with modeling or sample results).

Further assessment by qualified professionals is recommended to consider the severity of the potential impacts listed above. Additionally, the authors wish to note that sampling of the historic landfill area and establishment of a surface and groundwater monitoring program would aid in building trust between Stonebroke LLC and the Oakridge community.

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