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POST-WILDFIRE ENVIRONMENTAL AND HAZARDOUS CONDITIONS ASSESSMENT OF THE NORTH WESTSIDE ROAD AREA

Dated:	February 23, 2022
Presented To:	Regional District of Central Okanagan
Attention:	Brittany Nichols, Environmental Planner
CGL Project # 21-0115	EOC #A21-674
Document Control:	Version Rev. 1 (corrected civic and legal property addresses for 3 properties)

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Executive Summary

With funding from Emergency Management BC (EMBC), the Regional District of the Central Okanagan (RDCO) Emergency Operation Center (EOC) retained Clarke Geoscience Ltd. (CGL) to complete a *Post-Wildfire Environmental and Hazardous Conditions Assessment* of the Killiney Beach and Estamont Areas on North Westside Road.

Study Objective and Scope of Work

The objective of the assessment was to document health and safety issues for selected damaged properties and to identify applicable environmental policies and regulations for recovery or rebuilding affected structures on these affected properties.

The scope of work was to complete property-specific assessments for thirty-four (34) properties directly impacted by the 2021 White Rock Lake Wildfire, and which are near sensitive aquatic environments (i.e., Okanagan Lake foreshore, streams, springs, or mapped watercourses). The assessment also comments on post-wildfire impacts to the general area since the anticipated effects extend beyond these properties.

The method of assessment follows that which is outlined in *Post-Wildfire Natural Hazards Risk Analysis in British Columbia*, Land Management Handbook No. 69 (2015).

Post-Wildfire Natural Hazards - Background

Post-wildfire natural hazards are associated with hydrologic and geomorphologic processes including:

- **Hydrologic Hazards** – such as flooding, debris floods, and sediment-laden floods. These processes are associated with the loss of vegetation, and potential development of water repellent soils, due to wildfire within the contributing upslope catchment area.
- **Geomorphic Hazards** – such as landslides, debris flows, and soil erosion. Hillslope stability impacts are associated with the loss of vegetation, exposed mineral soils, and thermal expansion of rocks, due to wildfire.

The above-listed hazards are governed by climate, which is variable and difficult to predict. Wildfire-related impacts will be the greatest within areas that experienced a moderate to high level of vegetation burn severity, and within the first 5 years. Within the short-term, hydrologic and geomorphic hazards are most likely to be associated with spring snow melt rates, rain-on-snow events, and short-duration high-intensity rainfall events.

Summary of Results

Post-wildfire impacts in the Killiney Beach area are most likely to be associated with changes in hydrology on small tributary streams originating from the slopes above the subdivision. The assessment has interpreted that many streams above the subdivision lose water by infiltration into pervious sand and gravel deposits that are generally situated upslope of the subdivision. When passing through the subdivision, the resultant stream flows are much smaller and, as a result, are sometimes diverted and contained within ditches, pipes, and culverts. These downstream conveyances are therefore vulnerable to post-wildfire increases in runoff.

Post-wildfire impacts in the Estamont area are likely to be associated with changes in hydrology affecting small streams that flow into the area and include localized effects of high severity burn on soil stability. In the Estamont area, properties below Westside Road are located within a zone of groundwater emergence. Increased discharge from spring sources and increased groundwater levels may negatively impact slope stability in these zones.

Property-specific report cards have been developed to document field observations, hazard conditions, and recommendations for risk mitigation measures and identify the need for additional review or further assessment work. These report cards are provided in Appendix C.

Recovery Process

Property owners experiencing loss will need to navigate a rebuilding process that meets current Provincial regulations and local government bylaws.

Overall, the results indicate that most (20 of the 34) of the assessed properties will require further assessment prior to obtaining either a Development Permit or Building Permit. Seven out of 34 properties appear low risk, and 7 properties were undeveloped at the time of the wildfire.

Summary of Recommended Mitigation Measures

For properties that have identified hazards, and for all properties situated along mapped or observed water courses, recommended mitigation measures to reduce risk are provided. These include short term measures to be implemented prior to the upcoming (spring 2022) freshet, and longer-term measures to be considered part of the recovery process.

<u>Short-Term Measures (prior to spring freshet):</u>

- **Public Awareness** – All levels of government need to ensure that residents are made aware of the potential for unusually high runoff conditions in the spring. As this is weather-dependent, residents should be provided information on how to prepare for potential flooding and landslides, and how to recognize hazardous conditions. Flows may be higher than normal on existing watercourses, and areas of groundwater springs and seepages may be wetter than usual. In addition, there is a potential for sediment-laden runoff from burned slopes to affect roads and properties (regardless of whether there is a pre-existing watercourse nearby).
- **Prepare for Increased Runoff** - Property owners should inspect ditches and culverts on their property to ensure they are clear of sediment and debris. Public roads should have increased levels of inspection and maintenance by the MOTI roads contractor. Clear and free passage through all drainage structures and conveyances should be ensured.
- **Protection** - Flood preparation activities may include relocating valuable assets or installing temporary protective measures such as sandbags.

<u>Long-Term Measures to reduce risk and to be considered part of the recovery process:</u>

- **Reduce potential for soil erosion** - Property owners should consider seeding and revegetating burned slopes and restoring riparian vegetation along foreshore areas. In addition to seeding and planting, locally sourced wood fiber mulch or coarse woody debris scattered across the slope would help protect exposed soil surfaces, reduce rainfall impact, and help retain seed.

- **Further soils/geotechnical assessment** - For select properties with observed slope instability, or where retaining walls have become destabilized, a soils/geotechnical (slope stability/geohazard) assessment should be considered as part of the rebuild process.
- **Further groundwater (hydrogeology) assessment** - For properties located within zones of groundwater emergence, a groundwater assessment should be conducted to ensure drainage through the site is maintained.
- **Further hydrology assessment** - It is noted that even if structures (e.g., culverts and drainage channels) are clear they may not be adequately sized to accommodate an increased post-wildfire runoff. Where there are concerns, culverts should be reviewed to ensure adequate sizing. Further hydrology assessment, completed in conjunction with expanded Sensitive Habitat Inventory and Mapping (SHIM), as indicated below, would further characterize stream channel connectivity through the developed area, and would help identify opportunities to restore natural drainage patterns where it was previously disrupted.
- **Expand and improve watercourse (SHIM) mapping** - More detailed assessment of the upstream watercourses to refine and expand the SHIM-mapping is recommended. This would include a ground-based traverse of stream channels upstream and through the developed area to review areas of instability, blockages, debris flow initiation potential, connectivity, etc.

Next Steps for Recovery

Fire resulted in devastating losses in the area, with many burned residences and/or accessory structures. In the process of rebuilding, all levels of government need to assist owners in navigating the rebuilding and the regulatory approval processes. The Province and the RDCO will be challenged where burned structures were previously approved under different regulations and will no longer meet the current environmental standards. For these properties, the recovery process will require additional assessment work, and in some cases, variances to Provincial regulations and RDCO bylaws may be requested.

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1. Introduction

Clarke Geoscience Ltd. (CGL) was retained by the Regional District of the Central Okanagan (RDCO) to complete a Post-Wildfire Environmental and Hazardous Conditions Assessment of the Killiney Beach and Estamont Areas on North Westside Road (Figure 1.1).

The scope of work for this assessment was defined in a letter proposal to RDCO (dated October 22, 2021). The services provided by Clarke Geoscience Ltd. are subject to the General Conditions and Limitations provided in Appendix A.

1.1 Project Background and Objectives

The White Rock Lake Wildfire (Fire K61884) was first reported on July 13, 2021. Between mid-July to mid-September, when the fire was finally deemed under control, the Wildfire of Note burned a total area of 83 342 ha (833 km^2). The fire affected areas within the Salmon River watershed to the west, the Whiteman Creek, Naswhito Creek and Equesis Creek watersheds and Monte Lake area to the north, and the Killiney Beach area to the south, all the way east to Okanagan Lake in some places.

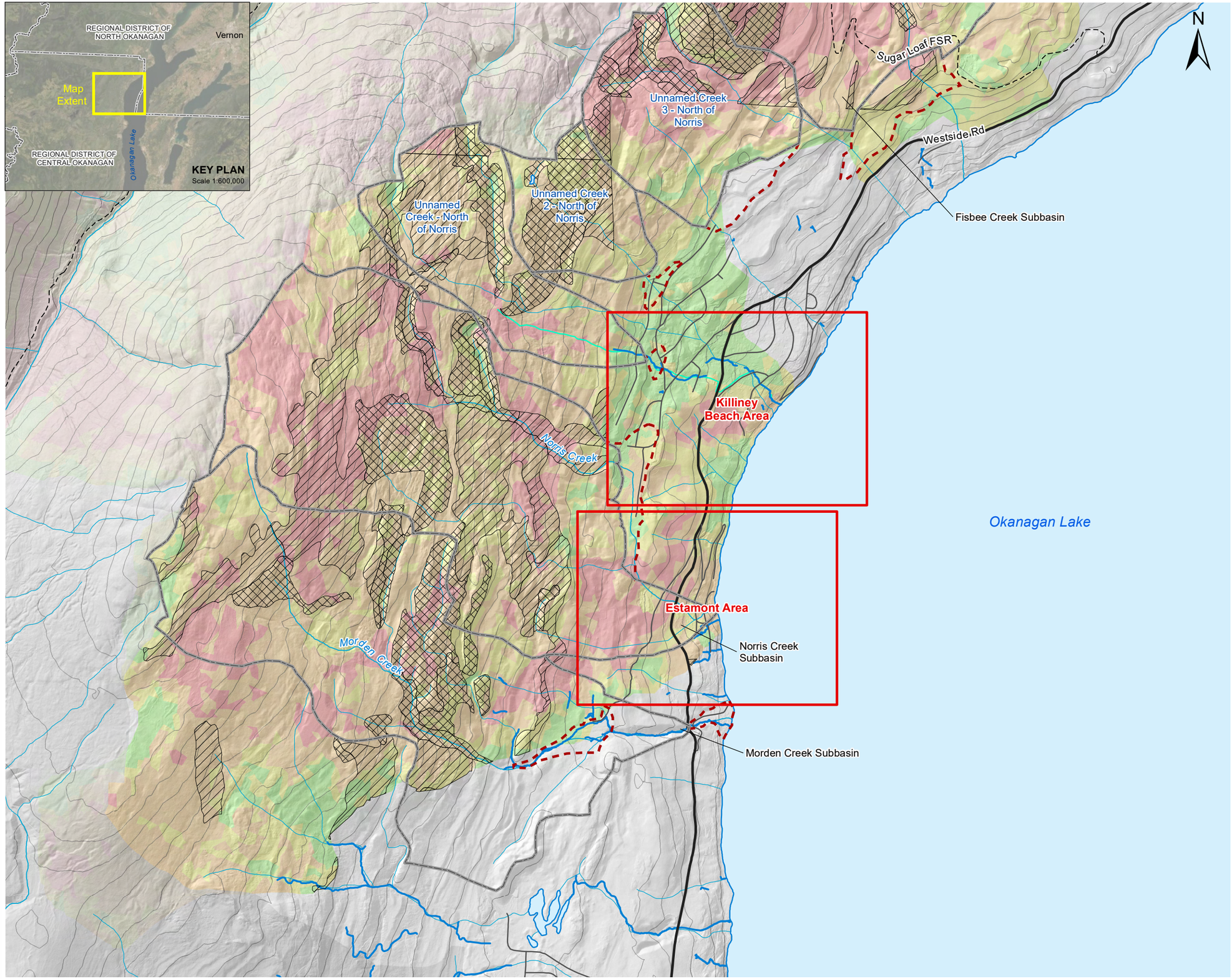
Approximately 75 homes were lost within the RDCO jurisdiction, concentrated mainly within the Killiney Beach and Estamont areas along the Westside Road.

The objectives of the Environmental and Hazardous Conditions Assessment were to document health and safety issues for 34 properties that were damaged during the 2021 White Rock Lake Wildfire. In addition, the Assessment will identify applicable environmental policies and regulations for recovery or rebuilding affected structures on these affected properties.

1.2 Scope of Work

The scope of work for this assignment was to complete assessments for 34 affected properties. Thirteen (13) properties are in the Killiney Beach Area (see Figure 1.2), along Hodges Road, Killarney Place, Westside Road, and Udell Road. Twenty-one (21) properties are in the Estamont Area (see Figure 1.3) along Beachwood Road and Nerie Road.

The affected properties were identified by RDCO due to their proximity to Okanagan Lake or tributary streams. Although other properties in the RDCO area were impacted by the wildfire, these select properties will require additional attention pertaining to the recovery process.



LEGEND

- Sub-basin Catchment Boundary
- Interpreted Fan Area
- Elevation Contour (20m Interval)
- Watercourse (Source: RDCO-SHIM)
- Interpreted Watercourse
- Watercourse (Source: BC Fresh Water Atlas)

Road Type (Source: BC Digital Roads Atlas)

- Arterial
- Local
- Resource

Burn Severity (Source: BC Data Catalogue)

- High
- Medium
- Low
- Unburned
- Unknown

Terrain Stability Class (Source: BC Terrain Stability Mapping TSM)

- IV - Potentially Unstable
- V - Unstable

300 150 0 300 600
metres

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **LOCATION OF STUDY AREA**

Scale: 1:25,000 | NAD 1983 UTM Zone 11 U | Figure No. 1.1

Project No: 21-0115 | Date: January 22, 2022

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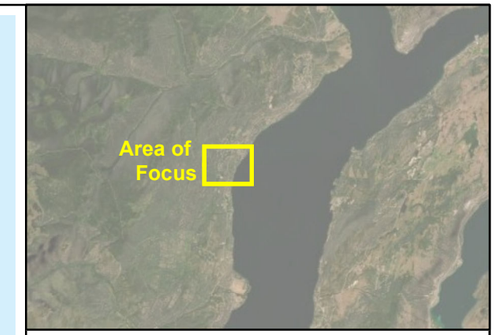

LEGEND

- Property Parcel (Source: RDCO)
- Subject Property

Burn Severity (Source: BC Data Catalogue)

- High
- Medium
- Low
- Unburned
- Unknown
- Landslide
- Watercourse (Source: RDCO-SHIM)
- Watercourse (Field Observed)
- Watercourse (Source: BC Fresh Water Atlas)
- Natural Spring (Source: RDCO-SHIM)
- Water Rights Licenses - Water Supply Intake (Source: BC Water Resources Atlas)
- Water Intake Line (Source: BC Water Resources Atlas)
- Culvert (RDCO-SHIM)
- Culvert (MOTI) (Entrance-Driveway)
- Culvert (MOTI) (Roadway)
- Culvert (Field Observed)
- Elevation Contour (5m Interval)

N

60 30 0 60 120
metres

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **KILLINEY BEACH AREA**

Scale: 1:6,000 | NAD 1983 UTM Zone 11 U | Figure No. 1.2

Project No: 21-0115 | Date: January 28, 2022

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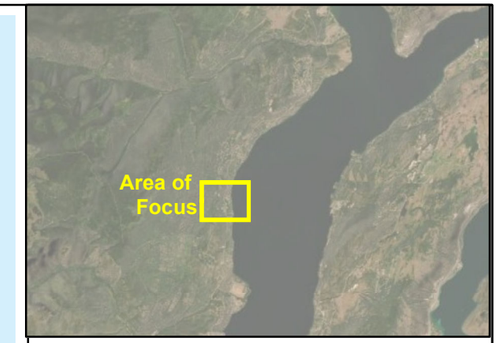

LEGEND

- Property Parcel (Source: RDCO)
- Subject Property

Burn Severity (Source: BC Data Catalogue)

- High
- Medium
- Low
- Unburned
- Unknown
- Landslide
- Watercourse (Source: RDCO-SHIM)
- Watercourse (Source: BC Fresh Water Atlas)
- Natural Spring (Source: RDCO-SHIM)
- Water Rights Licenses - Water Supply Intake (Source: BC Water Resources Atlas)
- Water Intake Line (Source: BC Water Resources Atlas)
- Culvert (MOTI) (Entrance-Driveway)
- Culvert (MOTI) (Roadway)
- Culvert (RDCO-SHIMI)
- Elevation Contour (5m Interval)

N

60 30 0 60 120
metres

Client:
REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)

Project:
ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA

Title:
ESTAMONT AREA

Scale: 1:6,000 NAD 1983 UTM Zone 11 U

Figure No. 1.3

Project No: 21-0115 Date: January 28, 2022

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2. Study Methods

2.1 Study Tasks

The study methods and approach were comprised of the following tasks:

- **Task 1: Preparation for site work, including background information and mapping review.**

  In advance of completing the field work, CGL met with RDCO to review the list of affected properties and gather pertinent information on each site. Background information was reviewed to characterize area topography, terrain, bedrock, and hydrology. Sensitive Habitat Inventory and Mapping (SHIM) and Foreshore Inventory and Mapping (FIM) provided valuable information on identified water courses and habitat quality in the study area.

- **Task 2: Visual ground-based assessment of the slopes, creek banks, and foreshore within the identified project areas.**

  A field assessment was completed on two days in November 2021 by J. Clarke, of Clarke Geoscience Ltd. accompanied by a field assistant. Photos and field notes were collected using a tablet on georeferenced maps using the Avenza mapping app.

  Hazardous conditions that existed prior to the 2021 wildfire were difficult to distinguish. Therefore, the report addresses present conditions and recommendations for stabilization and/or mitigation.

- **Task 3: Identify and document health and safety issues and complete hazard and risk assessment.**

  The hazard and risk assessment approach are described in Section 2.2, below. RDCO was immediately informed of any high-risk sites identified during the field assessments and were provided recommendations for mitigation.

- **Task 4: Prepare a summary (Phase 1 and Phase 2) report**.

  Phase 1 of the report includes a description of the environmental and hazardous conditions within the study area.

  Study results, based on a visual inspection of each property and surrounding area, are summarized in the form of a “property report card”. The report card summarizes site conditions and further identifies potential environmental hazards. A qualitative level of risk to the identified elements at risk is assigned. Conceptual-level recommendations for impact mitigation are provided with a focus on high-risk sites. Photos and a post-fire orthophoto image are provided for each affected property. Property report cards indicate where further, more detailed assessment and/or detailed engineering design is required.

  Phase 2 of the report includes a summary of applicable environmental regulation and policies that will require consideration as part of the recovery plan. We provide an overview-level opinion on whether variances will be required for the recovery and rebuilding process.

2.2 Hazard and Partial Risk Assessment Approach

Post-wildfire hazards identified during the field assessment are defined as "a potentially hazardous situation or event that has the potential to affect an Element at Risk". The post-wildfire risk assessment approach follows that which is outlined in Post-Wildfire Natural Hazards Risk Analysis in British Columbia, Land Management Handbook No. 69 (Hope et al., 2015). We have adopted a qualitative partial risk assessment and a detailed description of the risk assessment methodology is provided in Appendix B. The results provide a means to identify and prioritize sites for mitigative measures.

In summary, partial risk[1] is defined as the probability of a specific hazardous event affecting an element at risk, and it can be expressed as:

$$P(HA) = P(H) \times P(S{:}H)$$

where:

$P(HA)$ is the partial risk

$P(H)$ is the likelihood of a hazardous event occurring (i.e., the hazard)

$P(S{:}H)$ is the spatial likelihood that the hazardous event will reach the element at risk (i.e., the potential exposure to the hazard)

Qualitative ratings (i.e., low, moderate, and high) are used to describe hazard levels and the spatial likelihood level. These ratings, and the criteria used to assign each rating, are defined in Appendix B (Tables B1 and B2). The hazard and spatial likelihood ratings are combined in a matrix (see Table 2.1 below) to determine partial risk.

Table 2-1: Qualitative Partial Risk Matrix

Partial Risk P(HA): the probability that a specific hazard will occur and the probability of it impacting a site occupied by a specific Element at Risk (ie., P(HA) = P(H) x P(S:H)		**P(S:H) – the probability (likelihood) that the specific hazard will reach or otherwise affect the site occupied by an Element at Risk, assuming the event occurs.**		
		High	Moderate	Low
P(H) – the annual probability (likelihood) of occurrence of a specific hazard (i.e., landslide, debris flow, sediment-laden flood)	High	Very High	High	Moderate
	Moderate	High	Moderate	Low
	Low	Moderate	Low	Very Low

[1] "Partial Risk" analysis differs from "Total Risk" analysis as it does not estimate the damages that may occur because of an impact (i.e., the vulnerability). Partial risk assumes that any encounter is undesirable.

The outcome of the partial risk evaluation, above, is an assigned risk level. Five possible outcomes, or risk levels, expressed as VH, H, M, L and VL, are described in Table 2.2. These risk levels broadly assume a threshold level of acceptability or tolerance. This level of tolerance is completely dependent upon regulatory requirements or the perspective of the end user. Assigned risk levels provide a relative risk rating, which can be used to prioritize sites and each level has associated management implications for risk mitigation that are described.

Table 2-2: Risk Levels Defined

Risk Level	Description	Management Implications
Very High (VH)	Risk is unacceptable within the short-term, before the next flood season (Spring 2022).	Risk reduction is required. A plan to reduce risk should be developed as soon as feasible and implemented prior to the next flood season.
High (H)	Risk is unacceptable within the short to medium-term (3-5 years).	A plan to reduce risk should be developed as soon as feasible and implemented within a reasonable time frame.
Moderate (M)	Risk may be tolerable. More detailed review may be required.	Reduce to low where reasonably practicable.
Low (L)	Risk is acceptable and tolerable but there is a remote possibility of effects.	Monitor for changing conditions, as resources permit.
Very Low (VL)	Risk is acceptable and tolerable.	No further assessment or risk reduction is required.

3. Study Area Characteristics

3.1 Physiography, Hydrology and Geomorphology

The project study area is located on the west side of Okanagan Lake and is situated approximately 34 km north of the William R. Bennett bridge and ~5 km north of Fintry Provincial Park (see Figure 1.1).

Slopes above the study area have an east aspect and have an overall relief of ~1000m, rising from the shores of Okanagan Lake to ~1500m elevation. The height of land is defined as a low ridge separating South Whiteman Creek (aka “South Fork”) from the study area slopes. Slopes above the study area are relatively undeveloped, with historical selective logging but not by more recent industrial forest harvest methods (i.e., clearcutting). All residential development is situated below ~600 m elevation.

The slopes have a benched topography characterized by bedrock-controlled lineaments oriented roughly parallel to the slope. Slopes are moderate (35-50%), with short steep sections of bedrock, steepening below Westside Road and above Okanagan Lake. Bedrock bluffs are separated by thin, till-mantled benches. Below ~600m elevation and above Westside Road, a significantly wider bench is indicative of an ice-contact kame terrace

deposit. The terrace is comprised of sands, gravels and boulders and is relatively thick (>10m). Below Westside Road, the terrace deposits slope steeply down to Okanagan Lake.

The bedrock topography and local physiography strongly control the hydrology and pattern of stream channels in the study area. In many cases, it is observed that the Provincial mapping (BC Freshwater Atlas) is not accurate and does not reflect the actual flow pattern. Provincial mapping is derived from the 1:20 000 scale topographic mapping and sometimes requires field confirmation.

3.2 Watercourse Mapping

The RDCO has previously completed field-based mapping of watercourses flowing through the developed portion of the study area. This mapping, referred to as Sensitive Habitat Inventory and Mapping (SHIM) was completed in 2006 and 2007. It is a standardized method of collecting information that aims at mapping aquatic habitats and their associated riparian areas and terrestrial habitats. The mapping process also documents modifications such as culverts, ditches, riprap armour, berms, and dikes.

Similar field-based mapping of the foreshore areas along Okanagan Lake has also been completed. This shoreline mapping, referred to as Foreshore Inventory and Mapping (FIM), was initiated in 2004 on Okanagan Lake by the RDCO and was repeated in 2009 and 2016. The mapping includes data on broad land use, shore morphology, lakebed substrates, riparian condition, and describes shoreline modifications such as docks, retaining walls, and groynes.

Based on available SHIM mapping, LiDAR data, terrain interpretation, and observations in the field, it is interpreted that the kame terrace located between 500-600 m elevation forms a zone of watercourse infiltration. Within this zone, many streams go subsurface and do not appear to convey surface water flow through that zone. In many cases, provincially mapped stream crossings at road locations were not observed. Further downslope, on the slopes located below Westside Road, the streams reemerge as springs, forming a zone of groundwater discharge.

3.3 Landslides and Slope Stability

Terrain stability mapping available from the Province (DataBC) is shown on Figure 1.1. The mapping indicates that there are areas of potentially unstable and unstable terrain across the bedrock-controlled slopes at mid-slope elevations within the study area. Field observations indicate that geomorphological processes are more active on the steeper slopes below Westside Road. These include small-scale landslides, surface erosion, channelization, and some incised stream channels exhibiting rapid runoff (but not debris flow activity).

Geomorphological processes, such as landslides and debris flows, are driven by hydrology and surface water runoff and are strongly influenced by topography and the stratigraphic sequence of soils. Two landslides were observed on the downslope side of Westside Road (indicated on Figures 1.2 and 1.3):

1. Landslide North of Ewings Landing off Westside Rd. – occurred between 2009 and 2018[2], and was likely associated with altered drainage, as there is a roadway culvert and nearby groundwater springs.

[2] Based on comparative review of readily available (RDCO) orthophotos.

2. Landslide North of Elliot Road off Westside Rd. – occurred between 2014 and 2018[3], and was also likely associated with altered drainage. At the time of the slide, there was no roadway culvert at Killarney Way, so overflow from a pond (at 9344 N Westside Rd) continued almost 850 m down the roadside ditch before crossing Westside Rd to the landslide site.

These examples illustrate the potential consequences of intercepted or diverted drainage, whether it is surface runoff or groundwater flow. These examples also illustrate the difficulty and uncertainty associated with predicting impacts. Therefore, all drainage routes and pathways are important, and maintaining a natural drainage pattern will help reduce the potential for impacts.

3.4 Vegetation Burn Severity

Vegetation burn severity is based on the Burned Area Reflectance Classification (BARC) and mapping of the White Rock Lake Wildfire was completed by the Province of BC. Vegetation burn severity refers to the effects of fire on the forest canopy and the understory and the mapping provides an indication of where the hydrologic and geomorphologic impacts are likely to occur.

Vegetation burn severity is mapped and classified as follows (after Curran et al., 2006) and is shown on Figure 1.1:

- High (red areas) – trees are blackened and dead, needles consumed and understory consumed;
- Moderate (orange areas) – trees are burned and dead, needles remain and understory mostly burned;
- Low (yellow areas) – canopy and trunks partially burned, understory lightly or patchily burned.

Loss of forest cover by wildfire has similar hydrologic effect as forest harvesting, with the compounding issue that wildfire also has an impact on soils. Soil burn severity is a relative measure describing the wildfire effect on soil conditions, namely the hydrologic function, or character, of soils. Within areas assigned a high soil burn severity the forest floor is consumed, and the mineral soil has altered porosity and structure. Such soils are highly likely to develop hydrophobicity, or water repellency. This is a characteristic of burned soils that increases the amount/likelihood of overland runoff during rain events.

For the purposes of this assessment, vegetation burn severity is used as a surrogate for soil burn severity. Thus, areas mapped as a high vegetation burn severity, are assumed to have a high soil burn severity.

3.5 Elements at Risk

Elements at risk are defined as the population, building or engineering works, utilities, infrastructure, and environmental features in the area potentially affected by the hazards being assessed (Wise et al., 2004). For this study the elements at risk include:

[3] Based on comparative review of readily available (RDCO) orthophotos.

- Public and private property.
- Public infrastructure (e.g., Ministry of Transportation and Infrastructure public roads including Westside Road, Community Water systems, electrical and telecommunication utility systems)
- Okanagan Lake, with a focus on high habitat value and Kokanee shore spawning areas as identified by FIM mapping.
- Drinking water quality (e.g., Killiney Community Water Supply and Intake Protection Zone, Westshore Estates Community Water Supply and Intake Protection Zone, the Estamont Community Water Supply (a private water system), and numerous domestic water intakes).
- Tributary Streams (named and unnamed) including Norris Creek and Buchanan Spring, for example, as identified by SHIM mapping.

4. Post-Wildfire Natural Hazard Assessment (Phase 1 Results)

4.1 Post-Wildfire Natural Hazards - Background

Post-wildfire natural hazards considered for this assessment are the hydrologic and geomorphologic processes that are most affected by the effects of wildfire. Post-wildfire natural hazards may include, but are not necessarily limited to, the following:

- **Hydrologic Hazards - flooding, debris floods, and sediment-laden floods** are hydrologic processes associated with the loss of vegetation due to wildfire within the contributing upslope catchment area. Effects include:
  - Faster runoff and greater volume of runoff due to the loss of interception and transpiration by vegetation, by the reduced infiltration into fire-affected soils.
  - Sediment-bulking of a stream occurs with increasing sediment inputs from tributaries, side slopes, or within-channel mobilization.
  - In snow-dominated watersheds, wildfire results in greater snow accumulation, earlier onset of snow melt, and increased rates of snow melt.
  - Post-wildfire peak flows may be orders of magnitude higher.
  - Post-fire hydrologic response will be faster in smaller catchment areas due to the short time of runoff concentration and synchronization of runoff.
  - In the developed study area, hydrologic effects will be most apparent in downslope areas along watercourses at road crossings (culverts) and connecting ditches along roadways.
- **Geomorphic Hazards - landslides, debris flows, and soil erosion** are hillslope stability processes associated with the loss of vegetation due to wildfire along slopes within the study area. Effects include:

- Accelerated soil erosion due to exposed mineral soils and damaged root systems.
- Thermal expansion of rocks due to intense heating may destabilize exposed bedrock bluffs or may destabilize retaining walls.
- In the study area, stability impacts will be most apparent on steep (>60%) slopes.
- Burned trees that remain standing are a potential safety hazard, and when the trees fall, they may destabilize the slope and expose soils to erosion.

By-products from the burning of the property and infrastructure may include, ash, heavy metals, and other substances. There is a potential for the release of contaminated substances associated with damaged septic tanks, heating oil storage tanks or other household fixtures. Although a detailed environmental impact assessment is considered outside the scope of this assessment, where burned properties are on slopes that are directly connected to Okanagan Lake, the spatial likelihood for impact is higher. Slopes and tributary streams that enter the lake within the water supply Intake Protection Zone[4] are of particular interest.

Upslope hazards associated with larger-scale processes at the catchment-scale are not specifically addressed in this study but are addressed by work undertaken on behalf of the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (MFLNRORD) – BC Wildfire Branch (Clarke Geoscience Ltd., 2022). The results of the MFLNRORD study were incorporated into, and complement, this assessment.

4.2 Hazard Assessment Results

A key indicator of the likelihood for post-wildfire natural hazards is the percentage area burned, and the percentage burned at high vegetation (and soil) burn severity. The larger-scale assessment of the White Rock Lake Fire was completed for the MFLNRORD Post-Wildfire Natural Hazard Risk Assessment (Clarke Geoscience Ltd., 2022) and is utilized for this assessment. Small catchment areas above the North Westside Road area were extensively burned; the percentage area burned was 73% in Morden Creek, and was greater than 90% in Norris Creek, Fisbee Creek, and in several unnamed tributary catchments. In three of the catchments, the percentage burned at high severity was greater than 30%, representing a high peak flow hazard scenario. (Clarke Geoscience Ltd., 2022).

For this assessment, properties are organized into two areas: the Killiney Beach area (Figure 1.2) and the Estamont Area (Figure 1.3). General characteristics and hazard assessment results are provided for each area, below. Hazard assessment results for individual properties are provided in Report Cards that are included in Appendix C.

4.2.1 Killiney Beach Area

The Killiney Beach area (see Figure 1.2) is a subdivision comprised of approximately 300 properties situated both above and below Westside Road. The White Rock Lake wildfire burned an extensive (greater than 95%) proportion of the area upslope of the Killiney Beach subdivision. Of this, 31% of the Norris Creek catchment

[4] Intake Protection Zone delineated by Foreshore Inventory and Mapping (FIM) extends approx. 1 km from the intake location (RDCO, 2016)

upslope of the subdivision burned at high burn severity. Although much of the developed subdivision area was unburned, the fire extended downslope to the south end of Killarney Place and Hodges Road.

Post-wildfire effects in this area are most likely to be associated with changes in hydrology on small tributary streams originating from the slopes above the subdivision. As discussed in Section 3, many streams lose water by infiltration into the pervious sand and gravel deposits at ~600m elevation, situated just upslope of the subdivision. Because flows on the small tributaries have been historically very small, downslope conveyances such as ditches and culverts may be undersized and unable to accommodate flow increases.

Watercourses mapped by the RDCO in the Killiney Beach area are shown on Figure 1.2. The field-based SHIM mapping illustrates the stream channel discontinuity and historic diversions through the subdivision.

The property-specific assessments indicate that four out of the thirteen assessed properties in the Killiney Beach area have a high- to very high-risk level associated with the proximity to a watercourse. The watercourse is mapped and identified as Norris Creek by RDCO-SHIM but is more likely to be an unnamed tributary.

Norris Creek is a somewhat discontinuous water course and only the “blue line” derived from the RDCO SHIM mapping is considered reliable. Where the water course originates upstream is unclear and it is suspected that during the course of subdivision development, the stream has been altered and/or diverted from its natural course.

Because of the moderate to high hazard level associated with post-wildfire hydrologic effects and the close proximity to the water course (high spatial likelihood of impact), the risk is determined to be high to very high. The downstream property at 9294 Hodges Road has an elevated hazard (i.e., high) and risk (i.e., very high) because of observed soil slumping and instability along the stream channel (see Figure 4.1, photos). For these identified properties, increased peak flow runoff from the slopes above may result in a hazardous condition with the potential to cause damages to property and/or infrastructure.

Vulnerable Culvert at Udell Road

Unstable slopes along Watercourse (9294 Hodges Rd)

Figure 4-1: Vulnerable Culvert and Unstable Slopes in the Killiney Beach area

At the time of the site visit, two high hazard sites were also identified in the Killiney Beach Area. These include:

1. A fireguard crossing on Norris Creek, located south of the Killiney Beach area and accessed off the end of Winchester Road. Logs placed in the channel to facilitate fire suppression efforts through the area constitute a hydrologic hazard that may potentially impact properties downslope (see Figure 4.2, photo). The site conditions were communicated to staff at the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (Shuswap Okanagan Forest District office) for rehabilitation. It is recommended that the logs within the channel be removed and the fill material along the banks be pulled back to a stable angle.

Figure 4-2: Woody Debris within Channel at Fireguard Crossing on Norris Creek

2. A trail crossing on Norris Creek, just upstream of the fire guard crossing described above (see Figure 4.3, photo). Instability along the channel and trail fill slopes likely pre-date the wildfire, but now present a risk to downslope properties if the channel experiences increased runoff. The trail crossing location appears to be associated with a domestic water intake site (RDCO) that is no longer in use. Conditions at this site were communicated to RDCO staff.

Figure 4-3: Unstable Fills at Trail Crossing on Norris Creek

4.2.2 Estamont Area

The catchments upslope of the Estamont area are not well defined but include the Norris Creek catchment, the Morden Creek catchment, and areas in between. The wildfire burned between 73% and 98% of the upslope area, with 15% to 31% at a high burn severity (see Figure 1.1). Areas of high severity burn extended down from the slopes above Attenborough Road, across Westside Road, all the way down to Okanagan Lake affecting properties along Elliot Road, Nerie Road, and Beachwood Road. In some places, the fire affected moderate to steep slopes, exposing mineral soils and altering soil structure.

Post-wildfire effects in the area are likely to be associated with changes in hydrology affecting small streams that flow into the area, and also include localized effects on soil stability. Properties below Westside Road, particularly in the Nerie Road area, are located within a zone of groundwater emergence (e.g., Buchannan Spring and Lawrence Spring). Potential post-fire hydrologic effects may include increased discharge from spring sources and increased groundwater levels that may impact slope stability in these zones.

The property-specific assessments indicate that seven of the twenty-one assessed properties in the Beachwood Road area have a high-risk level associated with the potential for soil erosion or shallow landslides on moderate to steep slopes.

Severely burned steep slopes above and below Beachwood Road appeared to have observed soil slumping, small scale instability, and had exposed mineral soils considered to have a high potential for soil erosion (see Figure 4.4, photos). There is a high likelihood that sediment would reach Beachwood Road, the downslope properties, and Okanagan Lake. At the time of the assessment, a privately retained landscape contractor was clearing burned trees from the slopes along three properties and was intending to plant and seed the area. Further recommendations for the area are provided in Section 6 of this report.

Small landslide above Beachwood Rd

Burned (and recently cleared) slopes below Beachwood Rd

Burned slopes below Beachwood Rd

Exposed mineral soils above Beachwood Rd subject to soil erosion and shallow landslide

Figure 4-4: Photos of Severe Burn along Beachwood Rd (Estamont Area)

In addition to the slopes in the Beachwood Road area, severely burned slopes along Attenborough Road were identified as high hazard. Where trees and tap roots were completely burned, large voids were observed within the road fill. This appeared to have led to some observable destabilization. Due to public safety concerns, it is recommended that the road be inspected and signed for cautious use until road fill instability is reviewed and addressed.

Two of the twenty-one assessed properties in the Nerie Road area have a high-risk level associated with groundwater seepage and the potential for geotechnical instability. A small watercourse identified as Buchanan Spring emerges from a zone of groundwater emergence above 104 Elliott Road, then flows through a culvert under Nerie Road (see Figure 4.5, photos). Runoff is conveyed by pipe through downslope properties before emerging within and between 23 Nerie Road and 25 Nerie Road. It is unclear whether culverts and pipes in the area can accommodate increases in groundwater discharge. Soil and groundwater effects in the general area may result in a hazardous condition with the potential to cause damages to property and/or infrastructure.

Partly obstructed culvert under Nerie Rd

Culvert outlet to buried pipe at 25 Nerie Rd

Figure 4-5: Potentially Vulnerable Culverts along Buchanan Spring along Nerie Rd (Estamont Area)

4.2.3 Property Inspection Reports

Property inspection reports are presented in Appendix C. For each property, there is a report card documenting observed site conditions, selected photographs, and a post-fire orthophoto (from RDCO).

4.2.4 Risk Assessment Summary

The risk assessment results are summarized in Table 4.1, below. The results indicate that there are:

- Two properties rated Very High risk;
- Eleven properties rated High risk;
- Five properties rated Moderate risk;
- Ten properties rated Low risk; and,
- Six properties rated Very Low risk.

Mitigation measures and considerations for further assessment are recommended for the High and Very High risk properties. This will form part of the Recovery Assessment (Part 2 of this assessment).

Table 4-1: Summary of Risk Assessment Results

Civic Address	Hazard Level	Spatial Likelihood Level	Risk Level
9344 N Westside Rd	H	H	VH
654 Udell Rd	M	H	H
9325 Keithley Rd	M	H	H
9304 Hodges Rd	M	M	M
9294 Hodges Rd	H	H	VH
9284 Hodges Rd	M	L	L
55 Killarney Pl	M	L	L
57 Killarney Pl	M	L	L
58 Killarney Pl	L	L	VL
66 Killarney Pl	L	L	VL
75 Killarney Pl	L	L	VL
81 Killarney Pl	M	L	L
90 Killarney Pl	M	L	L
43 Beachwood Rd	M	H	H
67 Beachwood Rd	M	H	H
73 Beachwood Rd	M	H	H
79 Beachwood Rd	M	H	H
85 Beachwood Rd	M	H	H
91 Beachwood Rd	M	H	H

Civic Address	Hazard Level	Spatial Likelihood Level	Risk Level
95 Beachwood Rd	M	H	H
2 Nerie Rd	M	M	M
7 Nerie Rd	M	L	L
11 Nerie Rd	M	L	L
13 Nerie Rd	M	L	L
17 Nerie Rd	L	L	VL
19 Nerie Rd	L	L	VL
21 Nerie Rd	L	L	VL
23 Nerie Rd	H	M	H
25 Nerie Rd	H	M	H
31 Nerie Rd	M	M	M
37 Nerie Rd	M	M	M
104 Elliot Rd	M	M	M
8700 N Westside Rd	L	M	L
8715 N Westside Rd	L	M	L

5. Recovery Assessment (Phase 2 Results)

5.1 Background

Property owners experiencing a total (more than 75%) loss of their structure(s) will need to navigate a rebuilding process that meets current local government bylaws and provincial regulations. To facilitate recovery efforts, the relevant policy and regulatory requirements of provincial and local government agencies are identified on the Property Inspection Reports for each assessed property. This information will help to identify properties that will require Development Permit applications and whether rebuilding on the site may require additional review or assessment work, and whether variances may be required.

Relevant regulations and policies identified for the properties include:

- BC Riparian Areas Protection Regulation (BC RAPR)
- RDCO Aquatic, Terrestrial, Hillside, and Wildfire Interface Development Permit Areas as outlined in the Rural Westside Official Community Plan Bylaw No. 1274
- RDCO Floodplain Regulations outlined in Zoning Bylaw No. 871
- Federal Fisheries Act
- BC Water Sustainability Act (Section 11) for works in and about a stream
- BC Land Act for private moorage

Floodplain elevation and setback distances from streams and lakes are established by the Province of BC and RDCO has corresponding floodplain regulations in Zoning Bylaw 871. The regulations state minimum construction elevations and setback distances as follows:

- Flood Construction Levels:
  - 343.66 metres (1,127.49 ft.) Geodetic Survey of Canada datum for land adjacent to Okanagan Lake
  - 1.5 metres (4.9 ft.) above the natural boundary of any other watercourse
- Floodplain setbacks:
  - 15.0 metres (49.2 ft.) from the natural boundary of Okanagan Lake
  - 15.0 metres (49.2 ft.) from the natural boundary of any other nearby watercourse

5.2 Summary of Results

For each affected property included in the assessment, the site inspection included a visual estimation of the presence of structures within 15m of the natural boundary of Okanagan Lake, or within 15m of a mapped water course. Example structures include primary residence, boathouse, or storage shed. In some cases, it was difficult to tell what had burned because demolition and site clearing had already taken place.

Pre- and post-wildfire orthoimagery was reviewed to help distinguish features that were lost. Post-fire orthophotos are included with each property report (Appendix C). The orthophotos highlight the 343 m elevation, which corresponds to the target full pool level of Okanagan Lake + 0.5 m. The photos also indicate the 15 m setback and 30 m setback distance from this elevation. For permitting purposes, however, both the riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

For properties that have lost structures within 30 m of the natural boundary Okanagan Lake, or within 15 m of a mapped water course, the recovery process to rebuild structures may require further assessment. For these properties, environmental assessments and flood hazard review may be required. Where required setbacks cannot be met, a variance will be required.

Table 5.1 lists properties that lost structures within the estimated setback distance. The assessment results indicate that 20 of 34 properties will likely require further assessment, or a variance. Seven out of 34 properties appear to meet setback requirements, and 7 properties were undeveloped at the time of the wildfire.

Table 5-1: Properties with Burned Structures within the Estimated 15 m Setback Distance

Civic Address	Burned Structures within a 15m Setback
9344 Westside Road	yes, <15 m to watercourse
654 Udell Rd	yes, <15 m to watercourse
9325 Keithley Rd	vacant
9304 Hodges Road	yes, <15 m to watercourse
9294 Hodges Road	vacant
9284 Hodges Road	vacant
55 Killarney Pl	yes, boat house <15 m to Lake
57 Killarney Pl	yes, <15 m to Lake
58 Killarney Pl	yes, <15 m to Lake
66 Killarney Pl	yes, <15 m to Lake
75 Killarney Pl	yes, <15 m to Lake
81 Killarney Pl	yes, <15 m to Lake
90 Killarney Pl	no, <15m to lake
43 Beachwood Rd	yes, <15 m to Lake
67 Beachwood Rd	no, >15 m to Lake
73 Beachwood Rd	yes, <15 m to Lake
79 Beachwood Rd	vacant
85 Beachwood Rd	vacant
91 Beachwood Rd	no, >15 m to Lake
95 Beachwood Rd	yes, <15 m to Lake
2 Nerie Rd	no, >15 m to Lake
7 Nerie Rd	no, >15 m to Lake
11 Nerie Rd	yes, boat house <15 m to Lake
13 Nerie Rd	yes, boat house <15 m to Lake
17 Nerie Rd	no, >15m to Lake
19 Nerie Rd	yes, boat house <15m to Lake
21 Nerie Rd	yes, boat house <15m to Lake
23 Nerie Rd	yes, boat house <15 m to Lake
25 Nerie Rd	no, >15 m to Lake
31 Nerie Rd	no, >15 m to Lake
37 Nerie Rd	no, >15 m to Lake
104 Elliot Rd	yes, <15 m to watercourse
8700 N Westside Rd	vacant
8715 N Westside Rd	vacant

6. Conclusions and Recommendations

6.1 Summary of Post-Wildfire Impacts in the Study Area

Post-wildfire impacts to thirty-four properties in the North Westside Road area of RDCO were assessed. Wildfire resulted in the loss of vegetation along with its hydrologic function to retain soil moisture, intercept rainfall, transpire and absorb groundwater. Intense heat altered mineral soil properties and fractured rock, resulting in soil and rock instability.

The post-wildfire impacts are associated with hydrologic changes and constitute hazards such as flooding, debris floods, and sediment-laden flooding. Post-wildfire impacts associated with slope stability constitute hazards such as landslide, debris flow, and soil erosion. All associated hazards have the potential to impact property, infrastructure, or the environment (i.e., Okanagan Lake foreshore, streams, springs, or other mapped water courses).

6.2 Recommended Mitigation Measures

For properties that have identified hydrologic hazards, and for all properties situated along mapped or observed water courses, recommended mitigation measures to reduce risk are provided. Recommendations provided here overlap and further expand upon those provided in the MFLNRORD Post-Wildfire Natural Hazard Risk Assessment report.

Recommendations, presented below, include short term measures to be implemented prior to the upcoming (spring 2022) freshet, and longer-term measures to be considered part of the recovery process.

<u>Short-Term Measures (prior to spring freshet):</u>

- **Public Awareness** - The RDCO should ensure that residents are made aware of the potential for unusually high runoff conditions in the spring. As this is weather-dependent, residents should be provided information on how to prepare for potential flooding and landslides and how to recognize hazardous conditions. Flows may be higher than normal on existing watercourses and areas of groundwater springs and seepages may be wetter than usual. In addition, there is a potential for sediment-laden runoff from burned slopes (regardless of whether there is a pre-existing watercourse nearby).
- **Prepare for Increased Runoff** - Property owners should inspect ditches and culverts on their property to ensure they are clear of sediment and debris. Public roads should have increased levels of inspection and maintenance by the MOTI roads contractor. Clear and free passage through all drainage structures and conveyances should be ensured and fail-safe measures taken should the structures become overwhelmed.
- **Protection** - Flood preparation activities may include relocating valuable assets, or installing temporary protective measures such as sandbags.

Long-Term Measures to reduce risk and to be considered part of the recovery process:

- **Reduce potential for soil erosion** - Property owners should consider seeding and revegetating burned slopes and restoring riparian vegetation along foreshore areas. In addition to seeding and planting, locally sourced wood fiber mulch or coarse woody debris scattered across the slope would help protect exposed soil surfaces, reduce rainfall impact, and help retain seed.
- **Further soils/geotechnical assessments** - For select properties with observed slope instability or where retaining walls have become destabilized, as part of the rebuild process conduct soils/geotechnical (slope stability/geohazard) assessments.
- **Further groundwater (hydrogeology) assessments** - For properties located within zones of groundwater emergence, conduct groundwater assessments to ensure drainage through the site is maintained.
- **Further hydrology assessments** - It should be noted that even if structures (e.g., culverts and drainage channels) are clear they may not be adequately sized to accommodate an increased post-wildfire runoff. Where there are concerns, culverts should be reviewed to ensure adequate sizing, and mitigation efforts in cases of potential overtopping applied. Further hydrology assessment, completed in conjunction with expanded Sensitive Habitat Inventory and Mapping (SHIM) mapping, as indicated below, would further characterize stream channel connectivity and would help identify opportunities to restore natural drainage patterns where previously disrupted.
- **Expand and improve watercourse (SHIM) mapping** - More detailed assessment of the upstream watercourses to refine and expand the SHIM-mapping is recommended. This would include ground-based traverse of stream channels upstream and through the developed area to review instability, blockages, debris flow initiation potential, connectivity, etc.

6.3 Next Steps for Recovery

Fire resulted in devastating losses in the area, with many burned residences and/or accessory structures. In the process of rebuilding, all levels of government need to assist owners in navigating the rebuilding and the regulatory approval processes. The Province and the RDCO will be challenged where burned structures were previously approved under different regulations and will no longer meet the current environmental standards. For these properties, the recovery process will require additional assessment work, and in some cases, variances to Provincial regulations and RDCO bylaws may be requested.

7. Closure and Limitations

This report has been prepared exclusively for the use of the Regional District of Central Okanagan. The assessment has been carried out in accordance with generally accepted practice. Professional judgment has been applied in the interpretations provided in this report. No other warranty is made, either expressed or implied.

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Appendix A General Conditions and Limitations

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GENERAL CONDITIONS AND LIMITATIONS OF THE REPORT

1.0 **Standards of Care:**

In the performance of professional services, CGL has used the degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession practicing in the same or similar localities, based on the current state of practice. Professional judgement has been applied in developing the conclusions and/or recommendations provided in the report. No other warranty, expressed or implied, is provided.

2.0 **Use of Report:**

The information developed for this report is intended for the sole use of the CLIENT. Any use of this information by any third party unless authorized in writing by CGL is at the sole risk of the user. The contents of the report are subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of CGL.

Reference must be made to the whole of the report to fully understand suggestions, recommendations and opinions expressed herein. We are not responsible for use by any party of portions of the report without reference to the whole report.

The CLIENT shall be responsible for reporting the results of any investigation to the relevant regulatory agency if such reporting is required, and the CLIENT acknowledges that CGL may be required by law to disclose information to regulatory agencies and hereby consents to such disclosure.

3.0 **Site Conditions and Interpretation of the Report:**

Site conditions (e.g., soil, rock, and groundwater) may vary from those encountered at the locations where surface exposures exist or where observed by CGL and that the data, interpretations, and recommendations of CGL are based solely on the information available. Classification and identification of soils, rocks, geological units, and terrain are based on investigations performed in accordance with commonly accepted methods and systems employed in professional geotechnical practice. There is no warranty expressed or implied by CGL, that any investigation can fully delineate all subsurface features and terrain characteristics.

4.0 **Limitations:**

The interpretations and conclusions of this report are based on the observed site conditions at the time of the assessment, and on the basis of information provided. We rely in good faith on the representations, information and instructions provided. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contain in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of any persons providing such information. CGL accepts no responsibility for the accuracy or reliability of information provided by third parties other than the CLIENT.

The report is not applicable, nor are the results transferrable, to any other sites. It is a condition of this report that CGL be notified of any changes to site conditions and be provided with an opportunity to review or revise the recommendations within this report.

5.0 **Environmental and Regulatory Issues:**

Unless expressly agree to in the Terms of Engagement agreement, CGL is not responsible for identifying, considering, or addressing environmental or regulatory issues associated with the project.

6.0 **Liability:**

CGL carries professional liability insurance, and this coverage applies to the services provided. To the fullest extent permitted by law, the total liability of CGL, its directors, employees, and subconsultants, for any and all injuries, claims, losses, expenses, or damages whatsoever arising out of or in any way relating to the Project, the Site, or this Report from any cause or causes including but not limited to the negligence, errors, omissions, strict liability, breach of contract, or breach of warranty of CGL, its directors, employees, and subconsultants shall not exceed the coverage amount available at the time of the Claim.

The CLIENT will indemnify and hold harmless CGL from third party Claims that exceed the available coverage amount.

Appendix B Partial Risk Assessment Methodology

Appendix B - Partial Risk Assessment Methodology

The following describes the risk assessment methodology and provides definitions of the technical terms used. The approach is adopted from, and described in more detail in, Land Management Handbook No. 56 (Wise et al., 2004) and is the recommended approach for post-wildfire risk assessment described in Land Management Handbook No. 69 (Hope et al., 2015).

The term "partial risk" refers to the probability of a specific hazardous event affecting an element at risk. Partial risk analysis differs from a Total Risk analysis as it does not estimate the damages that may occur because of an impact (i.e., vulnerability). Partial risk assumes that any encounter is undesirable.

Partial risk is expressed as:

$$P(HA) = P(H) \times P(S{:}H) \times P(\text{T:S})$$

where:

$P(HA)$ is the partial risk;
$P(H)$ is the likelihood of a hazardous event occurring;
$P(S{:}H)$ is the spatial likelihood that the hazardous event will reach the element at risk;
$P(\text{T:S})$ is the temporal likelihood that the element at risk will be at the site if the hazard event occurs.

For fixed or stationary structures such as buildings and roads, the temporal probability [P(T:S)] is equal to 1 and the above equation is reduced to:

$$P(HA) = P(H) \times P(S{:}H)$$

Partial Risk = **Hazard** (likelihood of a hazardous event) x **Spatial Likelihood** (likelihood that event reaches and otherwise affects the Element at Risk)

Each component of risk is defined, and the interpretive assessment criteria are described below.

Hazard P(H) – is defined as a process that has the potential to damage, harm, or cause other adverse effects to human health, property, the environment, or other things of value (CSA, 1997). With respect to the post-wildfire risk assessment work, hazards may include **flooding, debris flood, landslides, soil erosion, debris flow, sediment-laden flood, or other natural geological processes**.

Hazard levels that pertain to specific hazardous events associated with post-wildfire effects are expressed in qualitative, or relative, terms and according to the criteria defined in the Table B1 below.

Table B1: Hazard Levels (Likelihood of a Post-Wildfire Hazardous Event) and Criteria Defined

Hazard Level P(H)	Qualitative Description	Hazard Criteria
High	An event is very likely to occur or will occur in the near future (within 5 years).	• A large proportion (>40%) of the upslope catchment area is burned and >20% at high burn severity. • Severe burn extends along long lengths of riparian forest. • There is observable evidence of recent or past instability or impact (i.e., 2017/2018 flood events). • There are geomorphic indicators of instability.
Moderate	An event is not likely but possible in the short term (within 5 years).	• Proportion of upslope catchment area burned is less than 40% but greater than 20%, and less than 20% burned at high burn severity. • Limited degree of burn affecting the riparian forest. • There is potentially unstable terrain, characterized as having moderately steep to steep (45->60%) slopes with no observable instability. • Areas show historic geomorphic indicators of instability but have not been directly impacted by recent flood events.
Low	An event is unlikely to occur within the short term.	• A smaller proportion of the upslope catchment is burned (<20%). • There are no geomorphic indicators of instability or impacts by recent past events. • Terrain is generally stable with no observable instability and moderate slopes (<60%)

Spatial Likelihood P(S:H) – is defined as the likelihood that post-wildfire hazardous event reaches and otherwise affects the Element at Risk. For the partial risk assessment there is no estimate of potential damages, only that an encounter is assumed to be undesirable.

Relative levels of spatial likelihood are expressed in qualitative, or relative, terms. These levels as the associated criteria for assigning these levels at a particular site is defined in the Table B2 below.

Table B2: Spatial Likelihood Levels (Likelihood that a Post-Wildfire Event Reaches an Element at Risk) and Criteria Defined

Spatial Likelihood Level	Description	Criteria
High	The Element at Risk is likely to be impacted or otherwise affected by the hazard, should the hazard occur.	• The Element at Risk is located within the zone of potential runout or zone of impact of the hazard being evaluated. • For flood/debris flood, the site is situated within an area of previous flood impact, or within an area interpreted to be immediately vulnerable based on interpreted process and field indicators of previous events. • Active fan area.
Moderate	The Element at Risk may potentially be impacted or otherwise affects by the hazard, should be hazard occur.	• The Element at Risk is located outside the zone of impact but within an area of potential impact based on topography and process. • This would include the potentially difficult to predict effects of an avulsion event resulting from a debris jam. • Inactive fan area but within zone of avulsion or erosion.
Low	The Element at Risk is unlikely to be affected by the hazard being evaluated.	• The Element at Risk is located at the distal end of the runout zone or outside the zone of influence of the hazard being evaluated. • Inactive fan area.

Elements at Risk – are defined as the population, building or engineering works, utilities, and infrastructure features in the area potentially affected by the hazards being assessed. Environmental features, such as fish and fish habitat and water quality are not considered for this study.

Elements at risk identified within the study area include:

- Residences, structures, dwellings on private property;
- Infrastructure, utilities, engineering works;
- Transportation routes necessary for emergency access (i.e., Westside Road) and associated bridges/culverts.

Partial risk P(HA) - is defined as the likelihood of a hazardous event, such as a flood, debris flood, debris flow, or landslide event, reaching or otherwise affecting an element at risk, AND causing an impact to that element. Risk may be evaluated quantitatively using probabilities, or, as in the case for this assessment, qualitatively using relative ratings and a risk matrix (see Table B3).

Table B3: Qualitative Risk Matrix for Partial Risk Assessment

Partial Risk P(HA): the probability that a specific hazard will occur and the probability of it impacting a site occupied by a specific Element at Risk (i.e., P(HA) = P(H) x P(S:H)		**P(S:H) – the probability (likelihood) that the specific hazard will reach or otherwise affect the site occupied by an Element at Risk, assuming the event occurs.**		
		High	**Moderate**	**Low**
P(H) – the annual probability (likelihood) of occurrence of a specific hazard (i.e. landslide, debris flow, sediment-laden flood)	**High**	Very High	High	Moderate
	Moderate	High	Moderate	Low
	Low	Moderate	Low	Very Low

The outcome of the partial risk evaluation, above, is an assigned risk level. Five possible outcomes, or risk levels, are described in Table B4. These risk levels broadly assume some threshold level of acceptability or tolerance. This is completely dependent upon regulatory requirements or the perspective of the end user. Assigned risk levels provide a relative risk rating, which can be used to prioritize sites and each level has associated management implications for risk mitigation that are described in Table B4.

Table B4: Risk Levels Defined

Risk Level	**Description**	**Management Implications**
Very High	Risk is unacceptable within the short-term (before next flood season).	Risk reduction is required. A plan to reduce risk should be developed as soon as feasible and implemented prior to the next flood season.
High	Risk is unacceptable within the short to medium-term (3-5 years).	A plan to reduce risk should be developed as soon as feasible and implemented within a reasonable time frame.
Moderate	Risk may be tolerable. More detailed review may be required.	Reduce to low where reasonably practicable
Low	Risk is acceptable and tolerable but there is a remote possibility of effects.	Monitor for changing conditions, as resources permit.
Very Low	Risk is acceptable and tolerable.	No further assessment or risk reduction is required

Appendix C Property Inspection Reports

Appendix C – Property Inspection Reports

Table of Contents

Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	9344 Westside Rd.	Date of Inspection:	11/19/2021
PID:	009-498-346	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Killiney Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Stream (Norris Creek)
Structures Lost:	All (dwelling)
Observed Site Conditions:	Terraced lot above Westside Rd, low rock retaining walls. Upslope of property there is a small pond impounded by 0.6 m high constructed berm at top of driveway, outlet stream flows along north edge of property to Westside Rd ditch, then under driveway through partly obstructed driveway culvert to the south. Flows south to a cross drain culvert under Westside Road onto Killarney Way ditch.
Soils:	Sandy cobble and gravel
Slopes:	15-40%
Groundwater Observations:	Constructed pond at top of lot. No seepage noted elsewhere.
Foreshore Conditions:	N/A
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Status of stream channel and corresponding setback to be determined.
Wildfire Effects Upslope/Upstream:	Scattered burn through residential area upslope. Upslope catchment area (Unnamed Ck N of Norris) 95% burn (10% H burn severity).

Hazards Noted:	Potential that increased runoff to the pond could exceed storage capacity and flows could impact property and downstream roads (Westside Rd and Killarney Way).	
Spatial Likelihood:	High potential for hydrologic impact to property, to Westside Road and downslope properties.	
Hazard Level: HIGH	Spatial Likelihood: HIGH	Risk Level: VERY HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term (pre-freshet): Ensure full clearance of driveway culvert and ditch along Westside Road. Monitor and be prepared to respond to overflow and/or blockage.
	Long term: Complete hydrotechnical engineering assessment of berm and hydrology assessment of pond and outlet structures. Consider options to restore natural drainage.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of driveway entrance at 9344 Westside Road, stream flows south through culvert under driveway

Photo 2: View of stream that flows along the north property boundary of 9344 Westside Rd.

Photo 3: View of berm surrounding small pond located just upslope of 9344 Westside Rd.

Photo 4: View of small pond located upslope of 9344 Westside Road. Water level controlled by elevation of outlet.

LEGEND

- Property Parcel
- Subject Property

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **9344 WESTSIDE ROAD**

5 2.5 0 5 10 metres

Scale: 1:500 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	654 Udell Rd.	Date of Inspection:	11/19/2021
PID:	008-010-111	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Killiney Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Stream (Norris Creek)
Structures Lost:	All
Observed Site Conditions:	Terraced and sloped lot, seepage was noted from slope cuts and overland runoff was directed from the stream across the lot to ditch. Stream flows along south property line to a 550 mm CSP under Udell Rd.
Soils:	Sandy cobble
Slopes:	40-55%, stream 15-20%
Groundwater Observations:	Seepage noted from slope cuts. Bottom part of the lot appears to be seasonally wet.
Foreshore Conditions:	N/A
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Setbacks from stream to be determined.
Wildfire Effects Upslope/Upstream:	Mixed forest and residential area upslope, are was moderately burned.

Hazards Noted:	Seepage issues and potential for high flows to exceed channel and culvert capacity on Udell Rd.	
Spatial Likelihood:	High potential for hydrologic impact to Udell Rd and downslope properties.	
Hazard Level: MODERATE	Spatial Likelihood: HIGH	Risk Level: HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term (pre-freshet): Ensure full clearance of driveway culvert and ditch along Udell Road and culvert under Udell Road. Monitor and be prepared to respond to overflow and/or blockage.
	Long term: Consider groundwater seepage assessment and soils/geotechnical assessment for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of driveway entrance at 654 Udell Rd, culvert under driveway visible

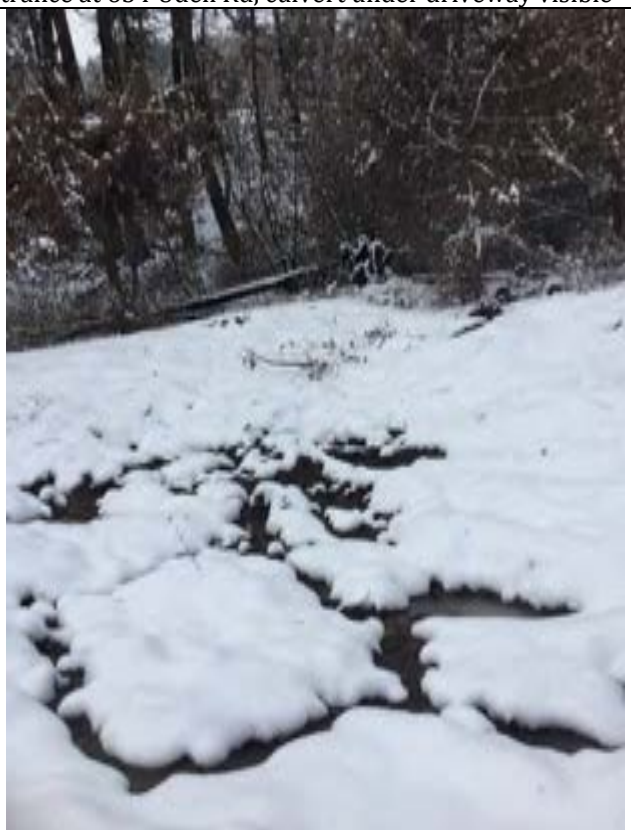

Photo 2: View of seepage across property and view towards stream (Norris Creek) in background along south property line.

Photo 3: View of stream that flows along the south property boundary of 654 Udell Rd to culvert under Udell Rd..

LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **654 UDELL ROAD**

5 2.5 0 5 10
metres

Scale: 1:500 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	9325 Keithley Rd.	Date of Inspection:	11/19/2021
PID:	008-010-102	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Killiney Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Stream (Norris Creek)
Structures Lost:	Vacant
Observed Site Conditions:	Lot is located on the corner of Udell Rd and Keithley Rd, with the stream flowing along the north property boundary. Lot is moderately sloped. The stream channel is fairly well confined within a moderately sloped gully.
Soils:	Sandy cobble
Slopes:	40-55%, stream 15-20%
Groundwater Observations:	No seepage noted a time of site visit. There is potential for seepage along the north side of the lot along the stream.
Foreshore Conditions:	N/A
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Setback from stream to be determined.
Wildfire Effects Upslope/Upstream:	Mixed forest, residential area upslope. Moderate burn severity.

Hazards Noted:	Potential for high flows to exceed channel and culvert capacity at Keithley Rd (upslope) and Udell Rd (downslope).	
Spatial Likelihood:	High potential for hydrologic impact to roads and downslope properties.	
Hazard Level: MODERATE	Spatial Likelihood: HIGH	Risk Level: HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term (pre-freshet): Ensure full clearance of culvert under Udell Road. Monitor and be prepared to respond to overflow and/or blockage.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View downstream along stream that flows along north boundary of 9325 Keithley Rd, from culvert under Keithley Rd.

LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **9325 KEITHLEY ROAD**

5 2.5 0 5 10 metres

Scale: 1:500 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	9304 Hodges Rd.	Date of Inspection:	11/19/2021
PID:	009-418-610	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Killiney Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Stream (Norris Creek), Okanagan Lake and Killiney Intake Protection Zone
Structures Lost:	Residence and Garage
Observed Site Conditions:	Property is located upslope from Hodges Rd. Driveway access through sandstone bedrock to garage area, residence site is located on bench upslope. Stream along south boundary is not well confined at top of property and there is evidence of slumping within the channel. There is potential for overtopping along left bank.
Soils:	Silty Sand, fill and bedrock
Slopes:	40% up, 70% down
Groundwater Observations:	Potential for seepage along the steeper parts of the slope and at slope cuts.
Foreshore Conditions:	N/A
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Setback from stream to be confirmed; >1.5m for residence
Wildfire Effects Upslope/Upstream:	Slopes above experienced moderate vegetation burn severity, some organic material remains on the ground surface.

Hazards Noted:	Moderate potential for surface erosion of exposed soils due to moderate to steep slopes. Potential for stream flow impacts if channel loses confinement due to instability.	
Spatial Likelihood:	Moderate potential for sediment delivery to lower slopes and to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: MODERATE	Risk Level: MODERATE

Recommended Recovery Response and Considerations for Future Development:	Short term (pre-freshet): Ensure full clearance of driveway culvert and ditch along Hodges Road and culvert under Hodges Road. Monitor and be prepared to respond to overflow and/or blockage.
	Long term: Consider groundwater seepage assessment and soils/geotechnical assessment for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of driveway access from Hodges Road (at 9304 Hodges Rd)

Photo 2: View towards upper part of lot from driveway at 9304 Hodges Rd.

Photo 3: View of water course (Norris Creek) along south boundary of 9304 Hodges Rd.

LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **9304 HODGES ROAD**

5 2.5 0 5 10 metres

Scale: 1:500 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	9294 Hodges Rd.	Date of Inspection:	11/19/2021
PID:	009-418-628	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Killiney Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Stream (Norris Creek), Okanagan Lake and Killiney Intake Protection Zone
Structures Lost:	Vacant
Observed Site Conditions:	Flat bench and access right of way along bottom of slope. Lot is steeply sloped above the foreshore area. Stream flows through property and is, at times, not well confined in channel. Some slumping is noted upslope of foreshore. Stream flows through culvert under driveway access.
Soils:	Silty sand
Slopes:	60% upslope
Groundwater Observations:	Seepage wthin the property was observed.
Foreshore Conditions:	N/A
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Status of stream and corresponding setback to be determined.
Wildfire Effects Upslope/Upstream:	Moderate vegetation burn severity. Some trees and shrubs are only partly burned.

Hazards Noted:	Slumping and slope instability noted along the channel on steep (60%) slopes above the foreshore. The culvert inlet appears partly obscured by vegetation and partly infilled with sediment. There is the potential for further instability.	
Spatial Likelihood:	High potential for sediment delivery to Okanagan Lake.	
Hazard Level: HIGH	Spatial Likelihood: HIGH	Risk Level: VERY HIGH

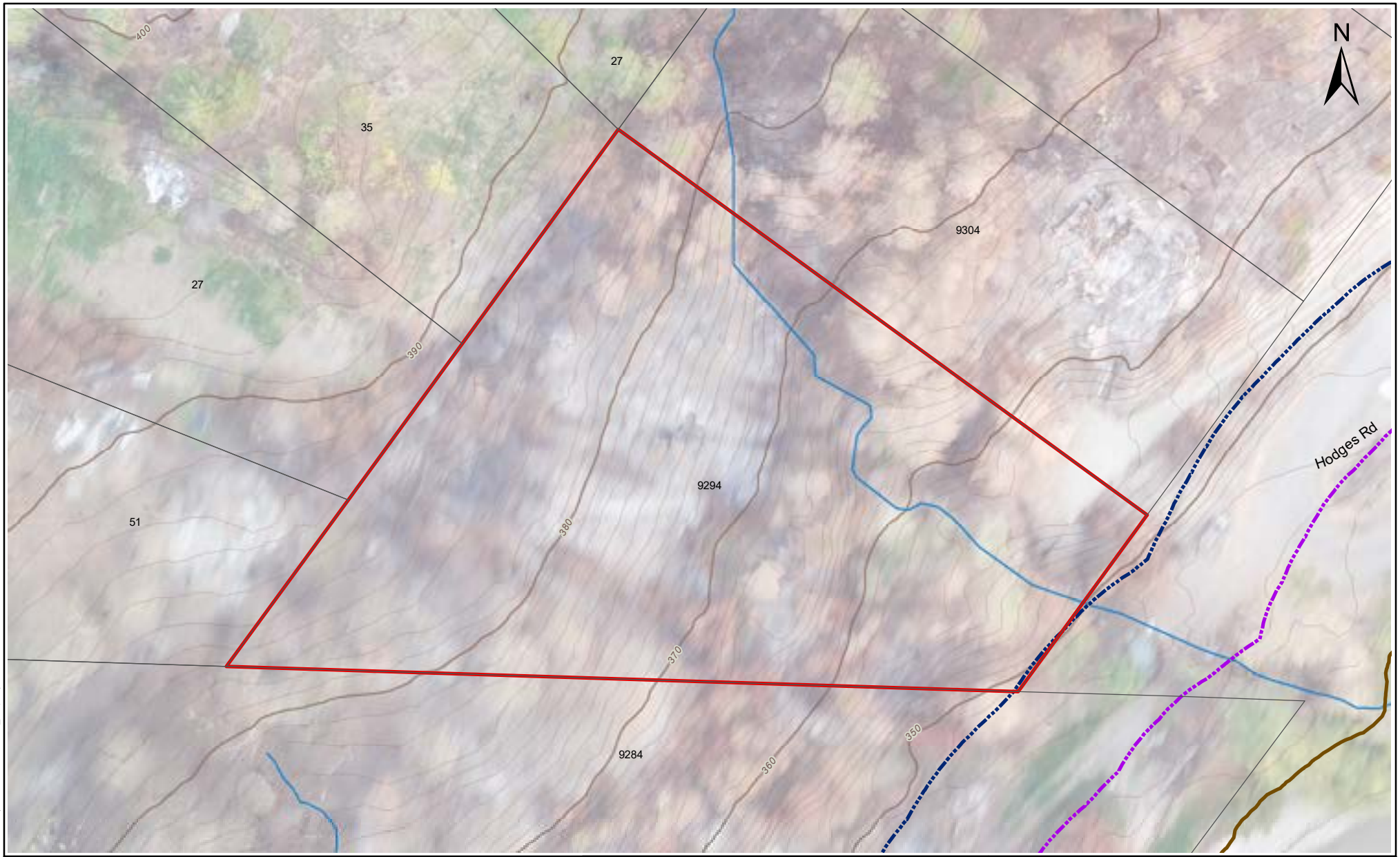
Recommended Recovery Response and Considerations for Future Development:	Short term (pre-freshet): Ensure full clearance of culvert under Hodges Road. Monitor and be prepared to respond to overflow and/or blockage.
	Long term: Consider groundwater seepage assessment and soils/geotechnical assessment for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View upslope from driveway access right of way at 9294 Hodges Rd.

Photo 2: View of partly obstructed culvert inlet under driveway access (Norris Creek) below 9294 Hodges Rd.

Photo 3: Unstable slopes observed along watercourse within 9294 Hodges Rd.



LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **9294 HODGES ROAD**

6 3 0 6 12 metres

Scale: 1:600 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	9284 Hodges Rd.	Date of Inspection:	11/19/2021
PID:	003-475-417	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Killiney Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake and Killiney Intake Protection Zone
Structures Lost:	Vacant
Observed Site Conditions:	Steeply sloped lot accessible from driveway access along toe of slope (from end of Hodges Road) and from a switchbacking trail from the top of the lot. Displaced mature trees suggests potentially unstable terrain.
Soils:	Silty sand
Slopes:	80% upslope
Groundwater Observations:	There is a mapped spring within the lot.
Foreshore Conditions:	Series of low wood and rock walls along foreshore in disrepair, concrete apron and boat ramp along foreshore.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	~10 m setback from lake to burned retaining wall (1.8 m high); no dwelling on property.
Wildfire Effects Upslope/Upstream:	Moderate vegetation burn severity on steep, potentially unstable slopes.

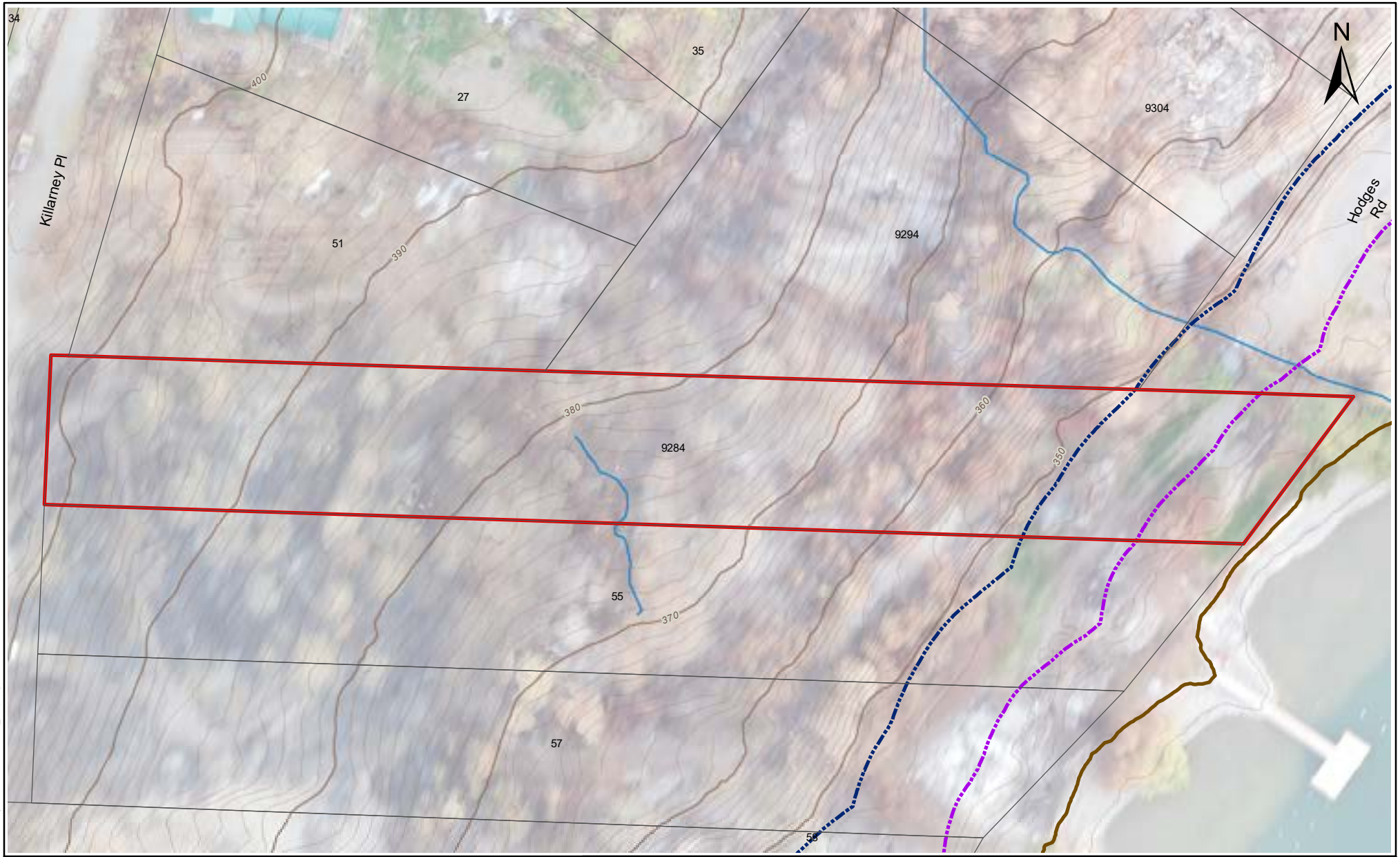
Hazards Noted:	Potentially unstable slopes above the foreshore area.	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: LOW	Risk Level: LOW

Recommended Recovery Response and Considerations for Future Development:	
	Long term: Consider soils/geotechnical assessment for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View upslope from driveway access right of way at 9284 Hodges Rd.

Photo 2: View of concrete apron along foreshore, with wood retaining wall in background of photo at 9284 Hodges Rd.



LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **9284 HODGES ROAD**

8.5 4.25 0 8.5 17
metres

Scale: 1:800 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	55 Killarney Pl.	Date of Inspection:	11/19/2021
PID:	003-475-433	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Killiney Spring (License C036508)
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lale and Killiney Intake Protection Zone
Structures Lost:	All, including boat house or storage shed located along foreshore.
Observed Site Conditions:	Steep (60-80%), narrow lot with some development along a narrow flat area located along the foreshore.
Soils:	Silty sand
Slopes:	60-80%
Groundwater Observations:	There is a mapped spring on the adjacent lot with potential seepage towards the property.
Foreshore Conditions:	Dock ok, 1.8 m retaining wall is burned, 0.3 m high mortar rock wall along HWM partly damaged. Riparian vegetation burned.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	10 to 12.5 m setback from lake to retaining wall; > 1.5m setback to dwelling site; <15m to boat house site.
Wildfire Effects Upslope/Upstream:	Moderately steep to steep lot upslope of foreshore, driveway trail switchbacks upslope. Area was burned at moderate burn severity.

Hazards Noted:	Potential slope instability above the foreshore area.	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: LOW	Risk Level: LOW

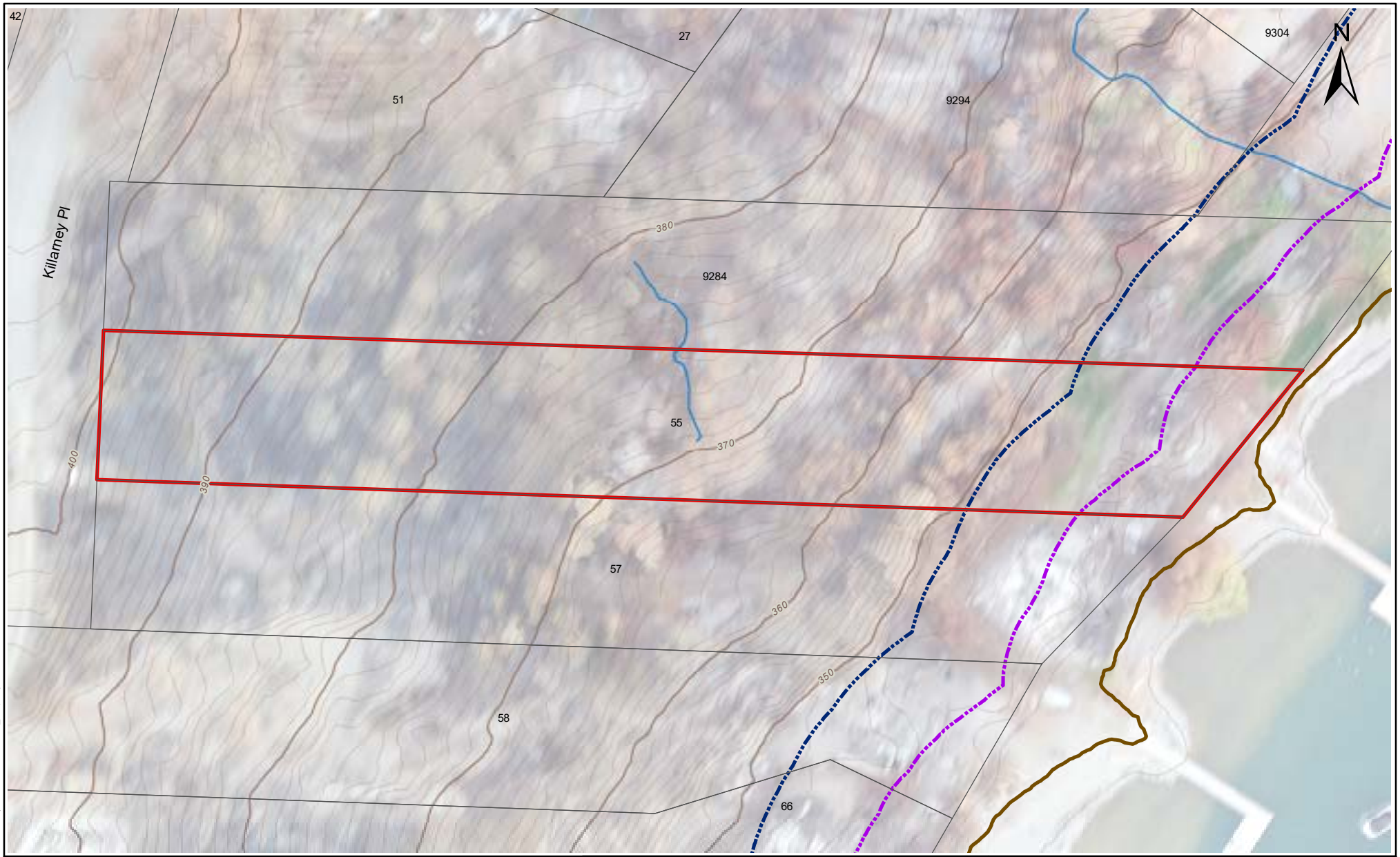
Recommended Recovery Response and Considerations for Future Development:	
	Long term: Consider soils/geotechnical assessment for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View upslope of foreshore area from the lake, concrete retaining wall and burned wood retaining wall

Photo 2: Close up view of burned wood retaining wall at 55 Killarney Pl.

Photo 3: View of steep slopes above foreshore area at 55 Killarney Pl.



LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **55 KILLARNEY PLACE**

8.5 4.25 0 8.5 17
metres

Scale: 1:800 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	57 Killarney Pl.	Date of Inspection:	11/19/2021
PID:	003-475-468	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Killiney Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake and Killiney Intake Protection Zone
Structures Lost:	All
Observed Site Conditions:	Structure was located at bottom of slope, slopes above are moderately steep to steep (40%- 60%). Access drive switchbacks from top but doesn't look heavily used. There is evidence that runoff from the road may have led to some destabilization of trail fillslopes and a cobble-supported wall along the toe of the slope may be destabilized.
Soils:	Silty sand
Slopes:	40-60%, surface runoff intercepted at driveway.
Groundwater Observations:	No seepage observed.
Foreshore Conditions:	Mostly natural cobbles along foreshore. There is low rock wall and narrow stairs approaching the beach area.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est 12.5 m setback from low wall to foundation, need to confirm setback requirements.
Wildfire Effects Upslope/Upstream:	Moderate vegetation burn severity on slopes above foreshore area.

Hazards Noted:	Potential slope instability above the foreshore area and along access trail. Potentially unstable rock retaining wall along toe of slope. Several storage drums noted on property.	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: LOW	Risk Level: LOW

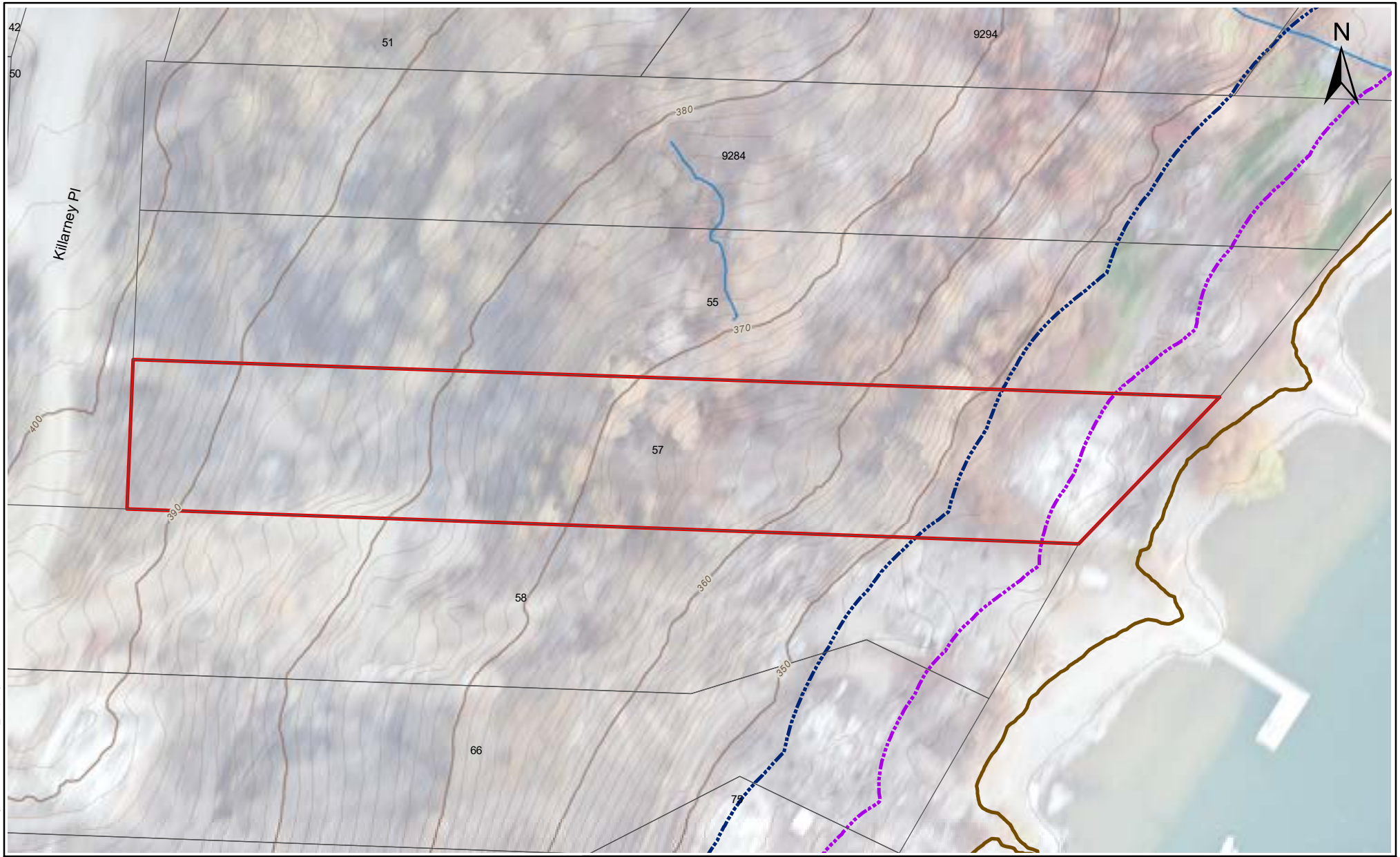
Recommended Recovery Response and Considerations for Future Development:	
	Long term: Consider soils/geotechnical assessment and drainage plan along access driveway for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View upslope of foreshore area and low rock wall from the lake

Photo 2: View of slope above foreshore area with rock retaining wall and driveway access trail above.

Photo 3: View of discarded drums on slope of 57 Killarney Pl.



LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **57 KILLARNEY PLACE**

8.5 4.25 0 8.5 17
metres

Scale: 1:800 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	58 Killarney Pl.	Date of Inspection:	11/19/2021
PID:	006-117-953	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Okanagan Lake (License C070456)
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake and Killiney Intake Protection Zone
Structures Lost:	All
Observed Site Conditions:	Long, narrow lot extends from foreshore area upslope. Gently sloped 18% foreshore area and steep slopes above. Driveway access trail switchbacks up the slope from above. There are some steep exposed trail cuts but no indication of instability. There is a section of concrete block retaining wall along the toe of the slope.
Soils:	Silty sand
Slopes:	15% along foreshore
Groundwater Observations:	No seepage observed.
Foreshore Conditions:	Low stepped cobble walls and some natural banks, gravel sand beach
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Setback from lake to be confirmed.
Wildfire Effects Upslope/Upstream:	Moderate vegetation burn severity. Steep slopes but no significant signs of instability. Possible interception and concentration of runoff along the driveway access trail.

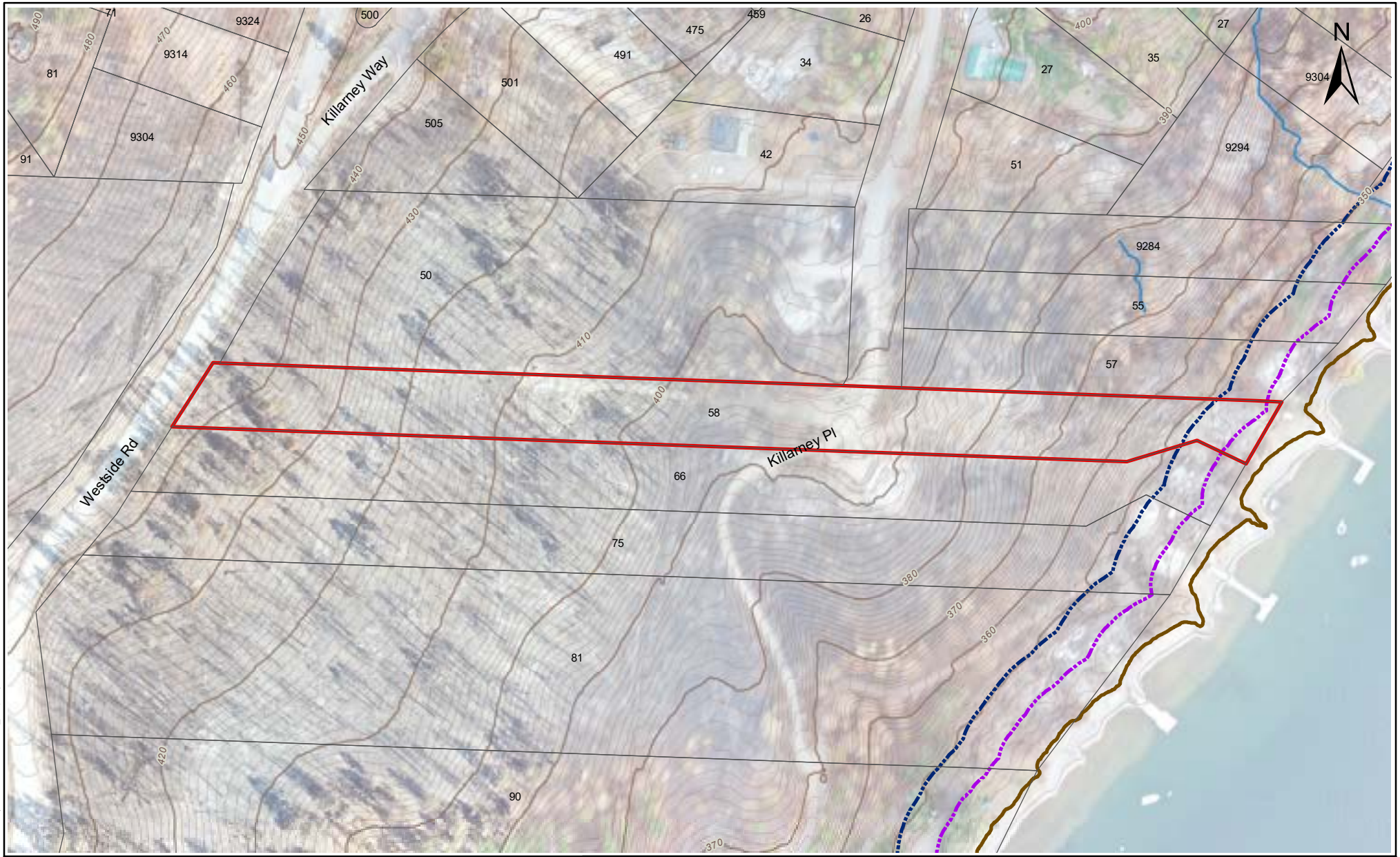
Hazards Noted:	None. Potential for runoff concentration and diversion along the driveway access trail.	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake.	
Hazard Level: LOW	Spatial Likelihood: LOW	Risk Level: VERY LOW

Recommended Recovery Response and Considerations for Future Development:	
	Long term: Consider soils/geotechnical assessment along access driveway for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of stepped rock walls from the foreshore at 58 Killarney Pl

Photo 2: View of slope above foreshore area with block retaining wall along toe of slope



LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **58 KILLARNEY PLACE**

20 10 0 20 40
metres

Scale: 1:2,000 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	66 Killarney Pl.	Date of Inspection:	11/19/2021
PID:	006-117-961	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Okanagan Lake (License C047274)
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake and Killiney Intake Protection Zone
Structures Lost:	All
Observed Site Conditions:	Long narrow lot extends from gently sloped foreshore area to steeper slopes above. Lower area had structures.
Soils:	Silty sand
Slopes:	15% lower area,
Groundwater Observations:	No seepage observed.
Foreshore Conditions:	Dock burned, some disturbance along foreshore associated with the fire
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Setback from lake to be confirmed.
Wildfire Effects Upslope/Upstream:	Moderate vegetation burn severity. No signs of slope instability.

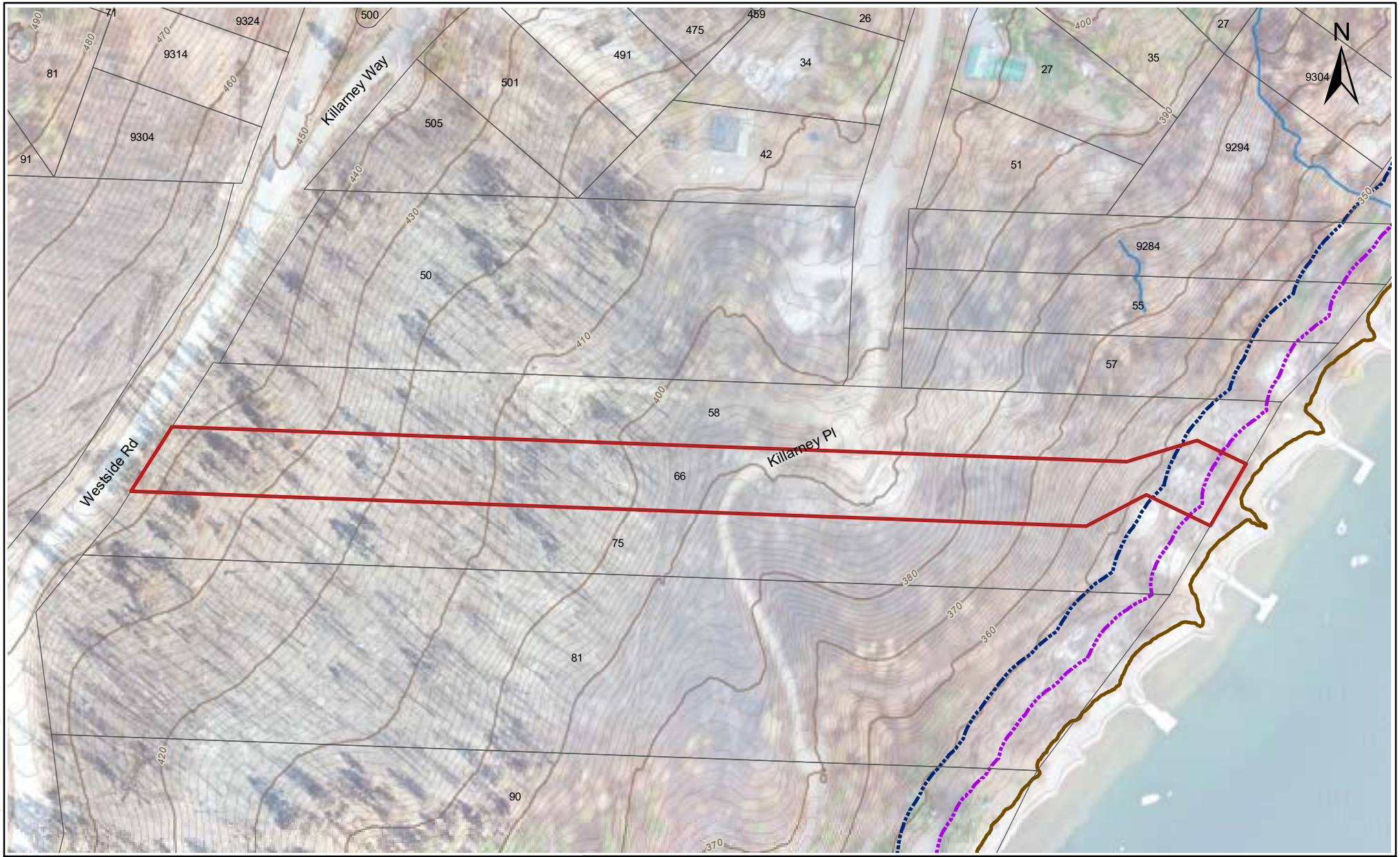
Hazards Noted:	None. Potential for runoff concentration and diversion along the driveway access trail.	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake.	
Hazard Level: LOW	Spatial Likelihood: LOW	Risk Level: VERY LOW

Recommended Recovery Response and Considerations for Future Development:	
	Long term: Consider soils/geotechnical assessment along access driveway for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View towards Okanagan Lake 66 Killarney Pl.

Photo 2: View of slope above foreshore area at 66 Killarney Pl.



LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **66 KILLARNEY PLACE**

20 10 0 20 40
metres

Scale: 1:2,000 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	75 Killarney Pl.	Date of Inspection:	11/19/2021
PID:	006-117-970	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Okanagan Lake (License C062132)
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake and Killiney Intake Protection Zone
Structures Lost:	All, possibly a lake side storage shed
Observed Site Conditions:	Long narrow lot with low gradient bench along the foreshore area and a moderate to steeply sloped upper lot.
Soils:	silty sand
Slopes:	40-50%
Groundwater Observations:	No seepage observed.
Foreshore Conditions:	Dock ok, fairly natural foreshore structure, cobbles and boulders in loose stacks, burned riparian vegetation
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Setback from lake to be confirmed.
Wildfire Effects Upslope/Upstream:	Moderate vegetation burn intensity. No indications of instability along upper slopes.

Hazards Noted:	None. Potential for runoff concentration and diversion along the driveway access trail.	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake.	
Hazard Level: LOW	Spatial Likelihood: LOW	Risk Level: VERY LOW

Recommended Recovery Response and Considerations for Future Development:	
	Long term: Consider drainage plan for driveway access.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of foreshore area towards slope at 75 Killarney Pl.

Photo 2: View of slope above foreshore area at 75 Killarney Pl.

LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **75 KILLARNEY PLACE**

20 10 0 20 40
metres

Scale: 1:2,000 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	81 Killarney Pl.	Date of Inspection:	11/19/2021
PID:	010-988-262	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	Killiney Spring (License F066274)
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake and Killiney Intake Protection Zone
Structures Lost:	All
Observed Site Conditions:	Wide and long lot that extends from foreshore area upslope. There is series of terraces along the bottom part of the slope. All structures, including dock, were lost. There are some trails constructed on the upper slopes with exposed soil cuts. There is a low mortar rock wall along toe of slope.
Soils:	Sand
Slopes:	60% upslope
Groundwater Observations:	No observed seepage but there is evidence of overland flow and sediment transport in a small gully located along the lower slope.
Foreshore Conditions:	Some sections of foreshore are natural but other parts appear to have been built up, some wildfire disturbance to rocks and soils.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Setback from lake to be confirmed.
Wildfire Effects Upslope/Upstream:	Moderate to high burn severity upslope, noted root burn holes.

Hazards Noted:	Potential sediment input from slopes and trail above. Limited soil disturbance.	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: LOW	Risk Level: LOW

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above.
	Long term: Consider geotechnical assessment and drainage plan for access trail.

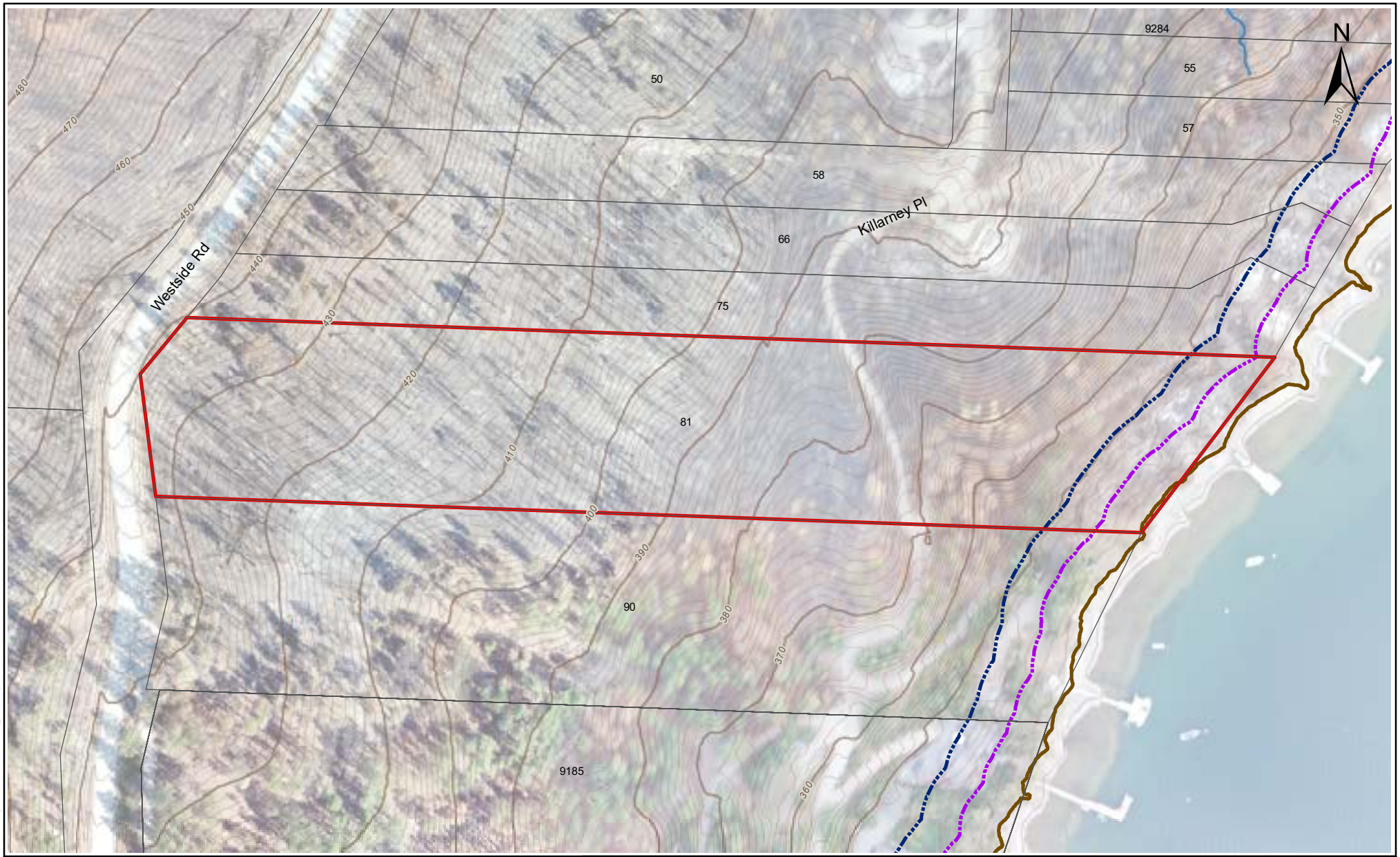
* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of foreshore area at 81 Killarney Pl.

Photo 2: View of slope above foreshore area at 81 Killarney Pl.

Photo 3: View of slope above foreshore area at 81 Killarney Pl.

Photo 4: Small gully located on 81 Killarney Pl, with evidence of sediment transport through burned area



LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **81 KILLARNEY PLACE**

20 10 0 20 40
metres

Scale: 1:2,000 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	90 Killarney Pl	Date of Inspection:	1/19/2022
PID:	006-750-460	Author:	J. Clarke, P.Geo.
RDCO Area:	Killiney Beach		

Domestic water supply source:	
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake, mapped stream not visible, no SHIM
Structures Lost:	None
Observed Site Conditions:	Long, narrow lot extends from Westside Rd down to lake. There is a shallow gully on the north side of the lot with some sediment transport apparent. Unpaved (shared) road access off end of Killarney Pl switchbacks down to lakefront cottages. Access road has ravelling cutslopes. Two small dwellings at lake front while rest of property is undeveloped. Wildfire affected slopes above lake.
Soils:	Sandy gravel and cobble.
Slopes:	Moderate (55%) slopes above lake, convex slopes with low-gradient sections. Severe burn severity in areas with exposed mineral soils and burned trees.
Groundwater Observations:	No observed seepage.
Foreshore Conditions:	Two small cottages on piled wood foundations at the lakeshore. No damages to building apparent. No dock. Beach area relatively natural.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Current cabins <15 m setback from lake; elevation to be confirmed.
Wildfire Effects Upslope/Upstream:	Mod to severe burn severity, burned gully shows recent sediment transport but very limited runout at toe of slope. Fire affected catchment areas upslope.

Hazards Noted:	Potential runoff effects, sediment-laden runoff along gully and runoff and soil erosion on moderately sloped areas upslope.	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake	
Hazard Level: MODERATE	Spatial Likelihood: LOW	Risk Level: LOW

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above.
	Long term: Consider geotechnical assessment and drainage plan for access trail.

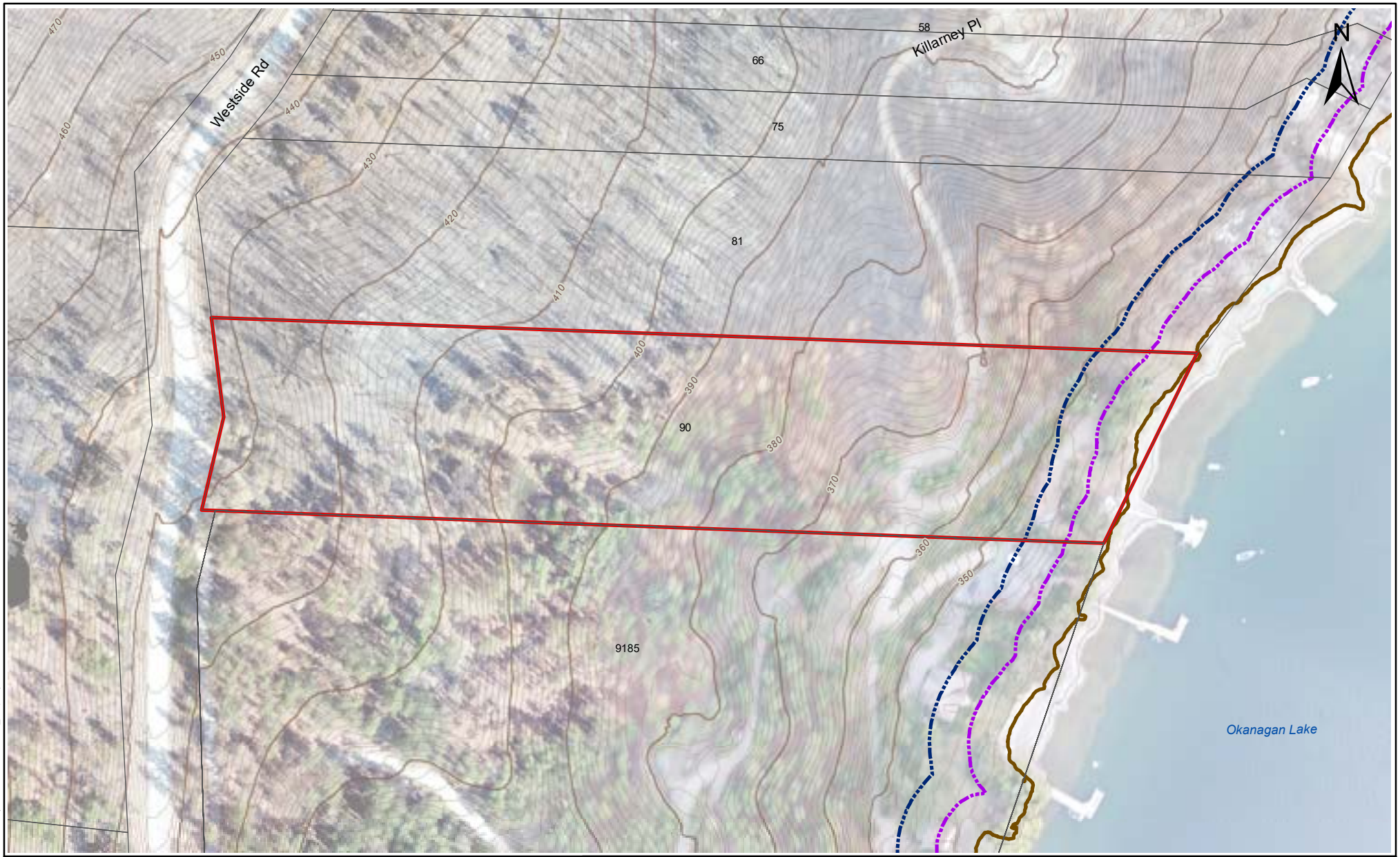
* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of foreshore area at 90 Killarney Pl. Note two small dwellings along foreshore area.

Photo 2: View of foreshore area at 90 Killarney Pl.

Photo 3: View of small gully situated along property line (from 81 Killarney Pl.) showing recent sediment transport through burned area

Photo 4: Unpaved access trail switchbacks off end of Killarney Pl. Minor ravelling cutslopes and minor erosion along trail surface.



LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **90 KILLARNEY PLACE**

20 10 0 20 40
metres

Scale: 1:2,000 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	43 Beachwood Rd	Date of Inspection:	11/5/2021
PID:	009-715-690	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	No licensed intake
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	Residence
Observed Site Conditions:	All structures lost, low (1.20 m) rock wall fronting lake in front of residence, turf and beach gravels along foreshore, no retaining wall. Lot is bisected twice by Beachwood Rd. Upper lot has a level area but slopes steeply to road.
Soils:	Sandy gravel
Slopes:	14% lower lot; 70% middle lot
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Some recent mechanical disturbance from clearing work but otherwise intact.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	~5 m from wooden edging along turf to foundation. Fill placement would be likely be required. Setback and elevation from lake to be confirmed.
Wildfire Effects Upslope/Upstream:	Vegetation burn severity is moderate, small green shoots visible. Middle lot is steep with exposed mineral soils, signs of surface erosion.

Hazards Noted:	Observed soil erosion and shallow soil slump/landslide.	
Spatial Likelihood:	Potential sediment delivery to Beachwood Rd and downslope properties.	
Hazard Level: MODERATE	Spatial Likelihood: HIGH	Risk Level: HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above. Maintain ditches along Beachwood Road.
	Long term: Consider restoration plan for burned slopes.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of 43 Beachwood from Okanagan Lake

Photo 2: View upslope from lower part of Beachwood Rd.

LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **43 BEACHWOOD ROAD**

6 3 0 6 12
metres

Scale: 1:600 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 31, 2022

Clarke Geoscience Ltd.

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	67 Beachwood Rd	Date of Inspection:	11/5/2021
PID:	004-450-132	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	No licensed intake
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	Accessory dwelling or garage, boat house with concrete ramp to the lake.
Observed Site Conditions:	Dwelling damaged and accessory structures lost. Developed part of lot lies below lower Beachwood Rd. Lot is bisected twice by road. Upper part of lot is steep.
Soils:	Sands and gravel
Slopes:	20% lower lot; 70% middle lot
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Concrete retaining wall (~1.05 m high), concrete boat ramp, wooden piled dock (ok), gravel and turf, series of lock block retaining walls terrace to road grade.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15m setback from lake to garage; >1.5 m elevation to garage. To be confirmed.
Wildfire Effects Upslope/Upstream:	Burned open forest, trees removed, mineral soil exposed, steep slopes, ravelling disturbed soils observed.

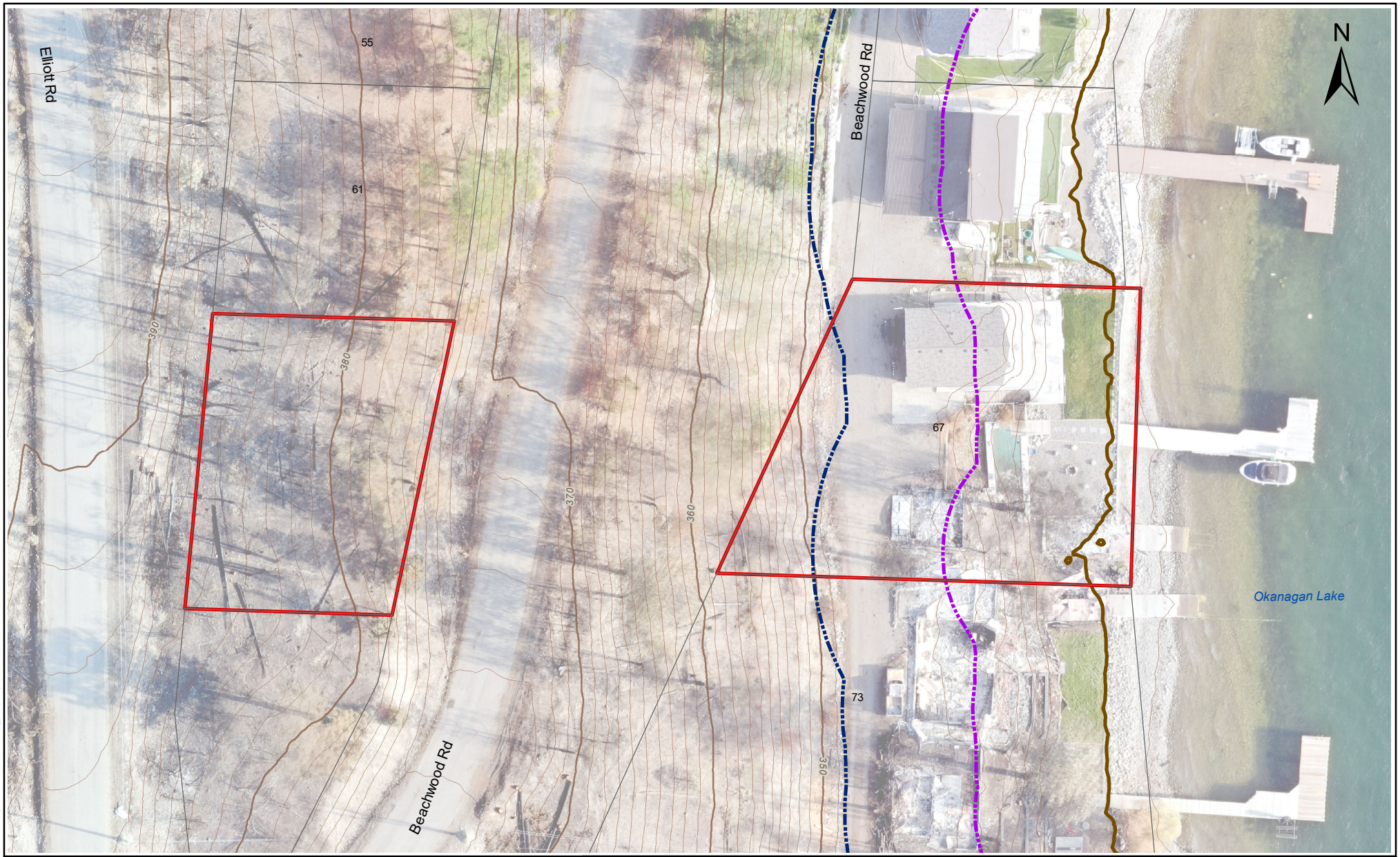
Hazards Noted:	Observed soil erosion and shallow soil slump/landslide.	
Spatial Likelihood:	Potential sediment delivery to Beachwood Rd and downslope properties.	
Hazard Level: MODERATE	Spatial Likelihood: HIGH	Risk Level: HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above. Maintain ditches along Beachwood Road.
	Long term: Consider restoration plan for burned slopes.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of 67 Beachwood from Okanagan Lake

Photo 2: View upslope from lower part of Beachwood Rd.



LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **67 BEACHWOOD ROAD**

6 3 0 6 12
metres

Scale: 1:600 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 31, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	73 Beachwood Rd	Date of Inspection:	11/5/2021
PID:	004-450-141	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	No licensed intake
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	All including residence, garage and boat house
Observed Site Conditions:	Terraced yard fronting lake including low (0.5m) landscape block wall along foreshore, turf, mature trees burned, garage beside house with concrete retaining wall. Lot is bisected by Beachwood Rd.
Soils:	Sandy gravel, fill
Slopes:	15% average; short 50% slope up to house site, 70% slope above
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Small boathouse and concrete boat ramp to lake, low block wall (0.5m high) fronting cobble and gravel beach, turf and landscaping to house, wooden piled dock ok.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. ~13.2 m setback from lake to house, >1.5m elevation. To be confirmed.
Wildfire Effects Upslope/Upstream:	Burned and cleared upslope, 70% slope above lot, exposed sands and gravels, shallow soil ravelling observed.

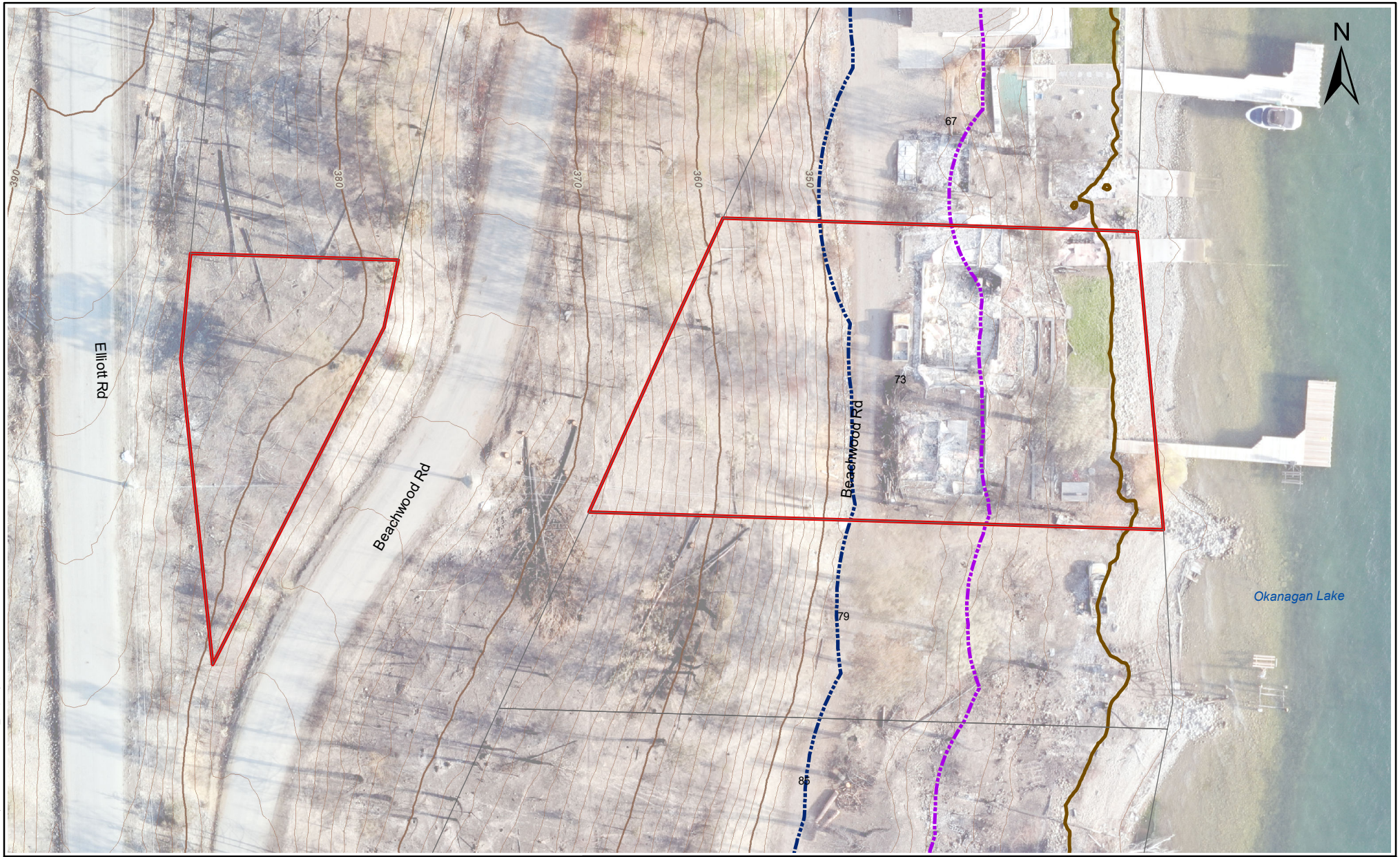
Hazards Noted:	Observed soil erosion and shallow soil slump/landslide.	
Spatial Likelihood:	Potential sediment delivery to Beachwood Rd and downslope properties.	
Hazard Level: MODERATE	Spatial Likelihood: HIGH	Risk Level: HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above. Maintain ditches along Beachwood Road.
	Long term: Consider restoration plan for burned slopes.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of 73 Beachwood from Okanagan Lake

Photo 2: View upslope from lower part of Beachwood Rd.



LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **73 BEACHWOOD ROAD**

6 3 0 6 12
metres

Scale: 1:600 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 31, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	79 Beachwood Rd	Date of Inspection:	11/5/2021
PID:	009-715-932	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Okanagan Lake (License C109115)
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	Vacant lot, wooden dock with wood piles burned
Observed Site Conditions:	All veg burned, exposed soils, no built structures other than dock.
Soils:	Sandy gravel
Slopes:	5% along bottom, 15% avg to lower road, 56% above Beachwood
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Two rock groynes along north and south property lines, no retaining walls or structures along foreshore.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	N/A. Setback from lake to be confirmed for future development.
Wildfire Effects Upslope/Upstream:	Burned, short steep slope then benches at top, 65%, exposed sandy gravel soils, soil instability upslope of lower Beachwood Rd.

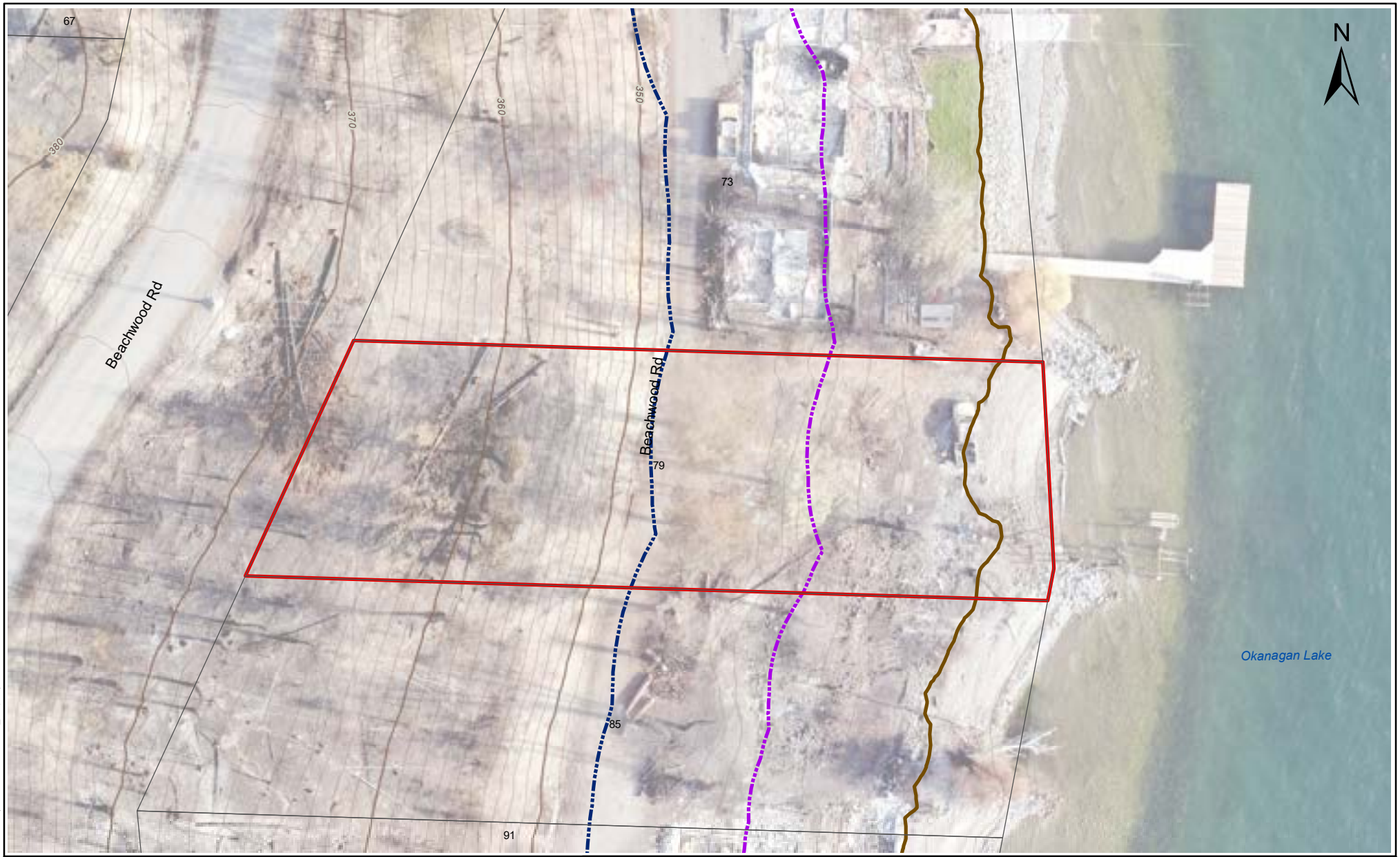
Hazards Noted:	Observed soil erosion and shallow soil slump/landslide.	
Spatial Likelihood:	Potential sediment delivery to Beachwood Rd and downslope properties.	
Hazard Level: MODERATE	Spatial Likelihood: HIGH	Risk Level: VERY HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above. Maintain ditches along Beachwood Road.
	Long term: Consider restoration plan for burned slopes.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of 79 Beachwood towards Okanagan Lake

Photo 2: View upslope from lower part of Beachwood Rd.



LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **79 BEACHWOOD ROAD**

5 2.5 0 5 10 metres

Scale: 1:500 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	85 Beachwood Rd	Date of Inspection:	11/5/2021
PID:	009-715-967	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	No licensed intake
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	Possibly storage sheds, accessory structures.
Observed Site Conditions:	Lot is bisected by Beachwood Rd twice, with lower gradient portion fronting the lake and steeply sloped above the lower road. High level of burn severity, soil disturbance and exposed cobble soils were observed.
Soils:	Exposed gravel, cobbles, small boulders
Slopes:	18%, slightly benched, 60% slope above road
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	No retaining walls, fairly natural beach gravels, one willow tree burned, rock groynes along property lines.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	N/A. Setback from lake to be confirmed for future development.
Wildfire Effects Upslope/Upstream:	Burned, steep slopes above, 60% slope, 2:1 cutslope above Beachwood exposes sandy gravel soils. Observed shallow soil instability upslope of Beachwood.

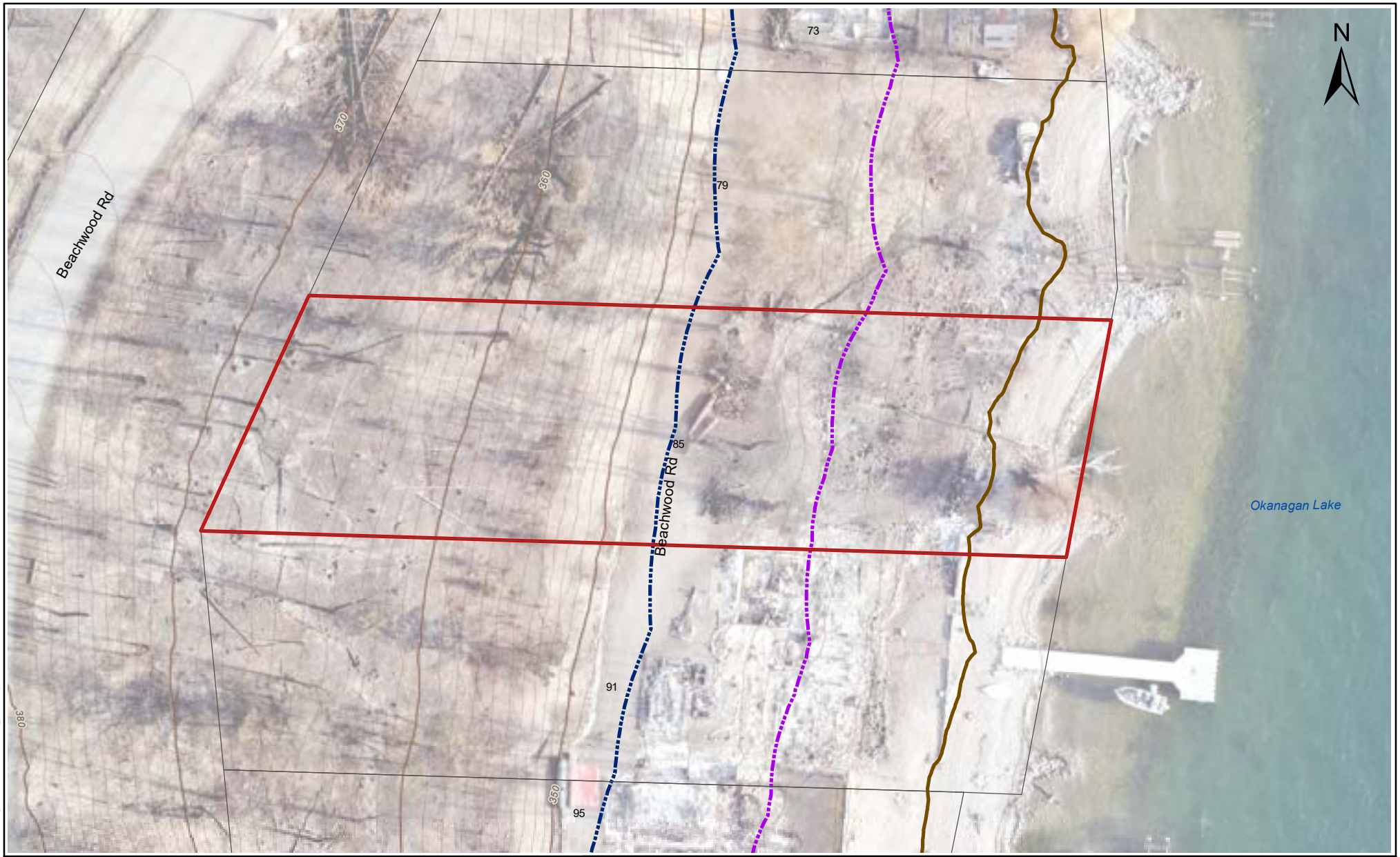
Hazards Noted:	Observed soil erosion and shallow soil slump/landslide.	
Spatial Likelihood:	Potential sediment delivery to Beachwood Rd and downslope properties.	
Hazard Level: MODERATE	Spatial Likelihood: HIGH	Risk Level: HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above. Maintain ditches along Beachwood Road.
	Long term: Consider restoration plan for burned slopes.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of 85 Beachwood from Okanagan Lake

Photo 2: View upslope from lower part of Beachwood Rd.



LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **85 BEACHWOOD ROAD**

5 2.5 0 5 10 metres

Scale: 1:500 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	91 Beachwood Rd	Date of Inspection:	11/5/2021
PID:	009-715-991	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	No licensed intake
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	Residence
Observed Site Conditions:	Lot is bisected by Beachwood Road, terraced low rock walls front the lake.
Soils:	Sandy gravel
Slopes:	15% avg slope from lower Beachwood, 50% upslope
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Disturbed, low (0.5 m) rock wall at HWM in poor condition, upper rock walls in poor condition, landscape features and retaining walls are damaged.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake; est. > 1.5m elevation. To be confirmed.
Wildfire Effects Upslope/Upstream:	High burn severity, all vegetation lost, exposed and unstable soils, 50% slope, burned log retaining structures, potentially unstable soils.

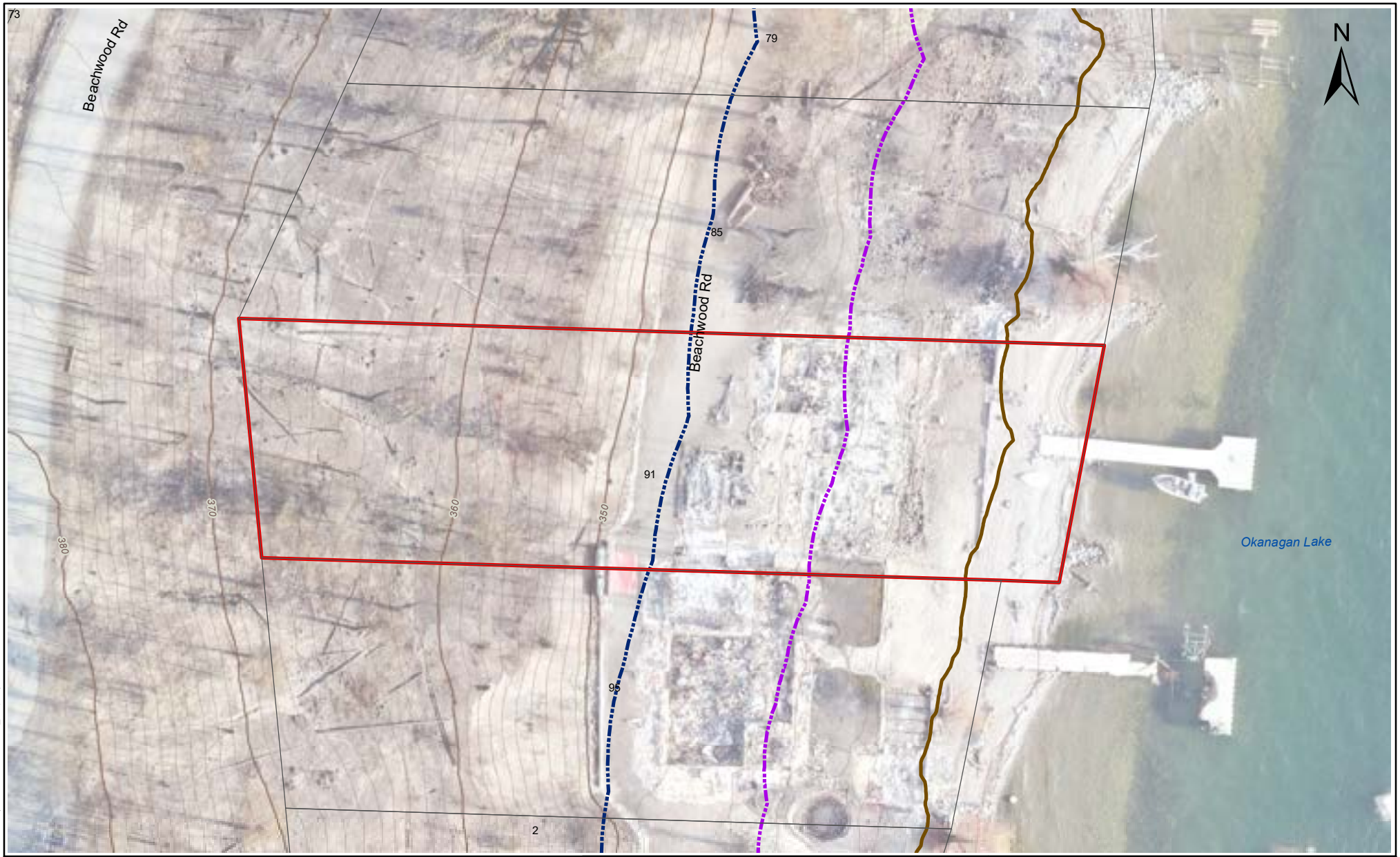
Hazards Noted:	Observed soil erosion and shallow soil slump/landslide. Recent planting and seeding reduces hazard.	
Spatial Likelihood:	Potential sediment delivery to Beachwood Rd and downslope properties.	
Hazard Level: MODERATE	Spatial Likelihood: HIGH	Risk Level: HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above. Maintain ditches along Beachwood Road.
	Long term: Consider soils/geotechnical assessment for burned slopes. (planting completed in late fall 2021)

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of 91 Beachwood from Okanagan Lake

Photo 2: View upslope from lower part of Beachwood Rd.



LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **91 BEACHWOOD ROAD**

5 2.5 0 5 10 metres

Scale: 1:500 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	95 Beachwood Rd	Date of Inspection:	11/5/2021
PID:	004-741-897	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Okanagan Lake (License C130589)
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	All
Observed Site Conditions:	Terraced yard to lake, all structures and vegetation lost. Lot is bisected by Beachwood Road, with steep slopes above lower road.
Soils:	Sandy
Slopes:	15% avg gradient, comprised of mortared rock walls 1.4 & 1.6 m setback 4.8 m from low wall, 12 m to next wall (0.9 m high)
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Section of low (0.9 m) rock wall at HWM is damaged, remainder is sand, dock on piles is badly damaged, some debris at lakeshore, willow badly burned
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. ~15 m setback from lake; Est. > 1.5m elevation. To be confirmed.
Wildfire Effects Upslope/Upstream:	High burn severity, exposed soils, potentially unstable, 2.5 m concrete retaining wall at toe of slope, 60% slope, sandy gravels, Cutslope

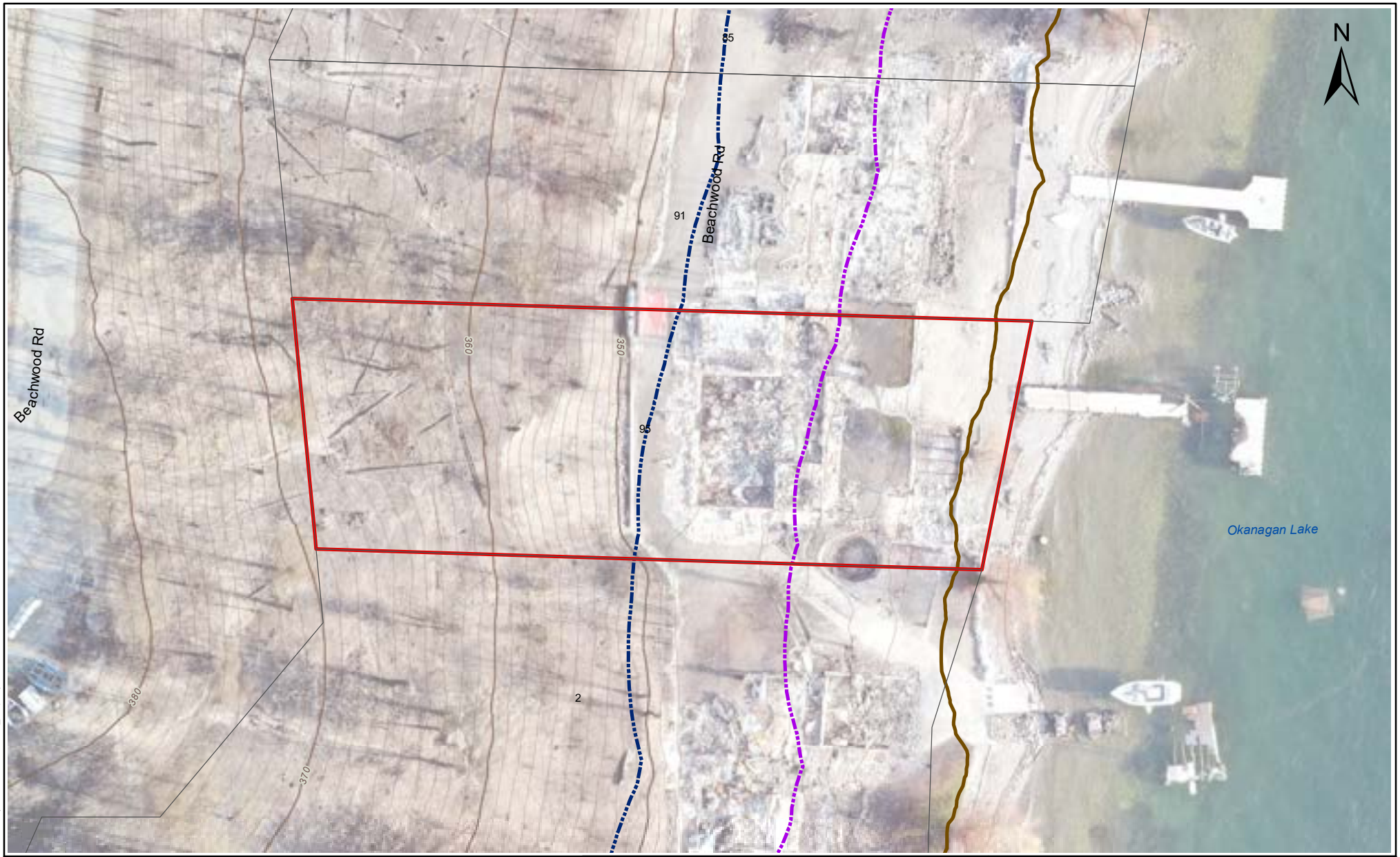
Hazards Noted:	Observed soil erosion and shallow soil slump/landslide. Rcokwall potentially unstable. Recent planting and seeding reduces hazard.	
Spatial Likelihood:	Potential sediment delivery to Beachwood Rd and downslope properties.	
Hazard Level: MODERATE	Spatial Likelihood: HIGH	Risk Level: HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above. Maintain ditches along Beachwood Road.
	Long term: Consider soils/geotechnical assessment for burned slopes. (planting completed in late fall 2021)

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of 95 Beachwood from Okanagan Lake

Photo 2: View upslope from lower part of Beachwood Rd.



LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **95 BEACHWOOD ROAD**

5 2.5 0 5 10
metres

Scale: 1:500 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	2 Nerie Rd.	Date of Inspection:	11/5/2021
PID:	001-744-313	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	All
Observed Site Conditions:	Access from the end of Beachwood, steep slopes above then moderate to lake. Lot is adjacent to public beach access (also location of water system well and pump house)
Soils:	Sandy gravel with cobbles
Slopes:	5% at lake; 50-60% upslope from lower part of lot.
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Multiple retaining walls, 0.6 m concrete section, concrete boat ramp to lake, then section of 0.5 m high mortared rock wall (damaged), dock structure with rock-filled pilings is heavily damaged.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake to residence; est. >1.5m elevation. To be confirmed.
Wildfire Effects Upslope/Upstream:	Severely burned, no vegetation or surface organics, steep slopes, 1-1.5m high lock block wall in poor condition. Cutslope ~2 m high above lot.

Hazards Noted:	Potential for upslope soil erosion and shallow soil slump/landslide. Destabilized retaining walls.	
Spatial Likelihood:	Potential sediment delivery to lower slopes, moderate potential for sediment delivery to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: MODERATE	Risk Level: MODERATE

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above.
	Long term: Consider soils/geotechnical assessment for burned slopes. (planting completed in late fall 2021)

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View towards lake at 2 Nerie Rd.

Photo 2: View of foreshore area at 2 Nerie Rd. with concrete retaining wall.

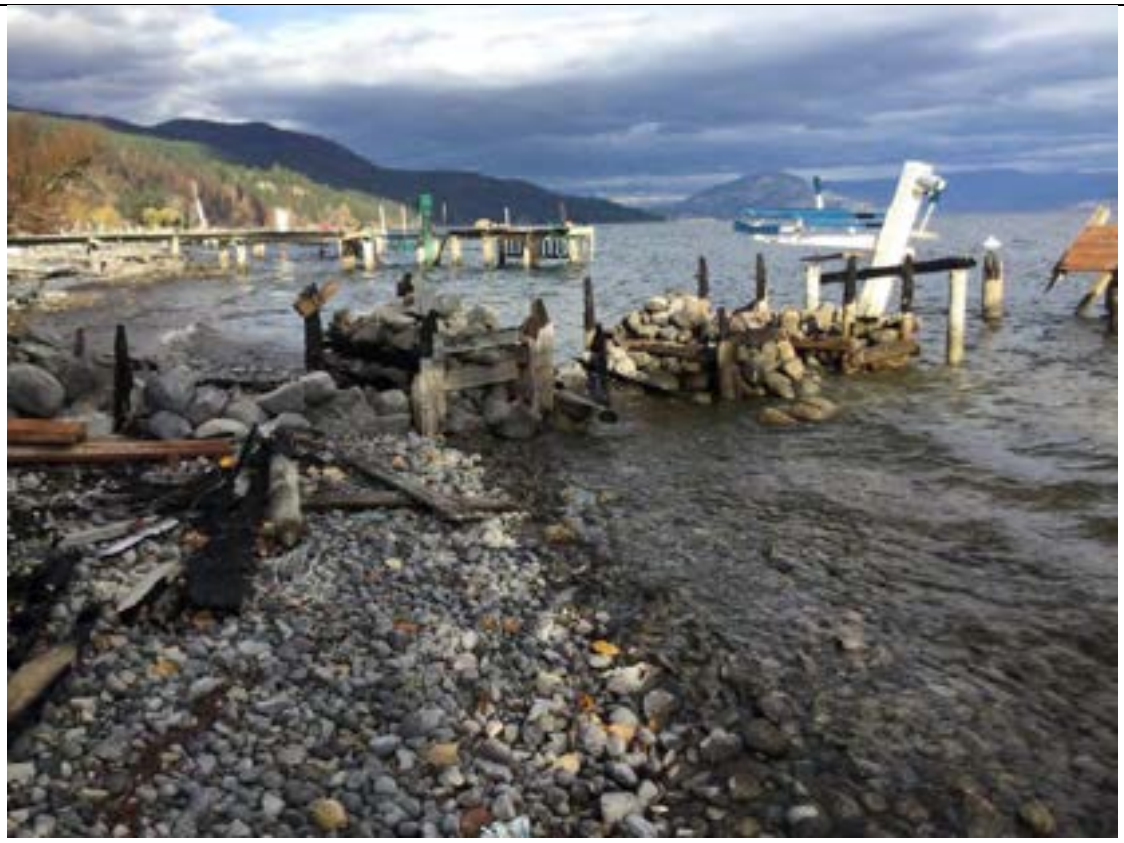

Photo 3: View of damaged dock with rock filled piling at 2 Nerie Rd.

Photo 4: View of retaining wall and slope above lower property at 2 Nerie Rd.

LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **2 NERIE ROAD**

6 3 0 6 12 metres

Scale: 1:600 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	7 Nerie Rd.	Date of Inspection:	11/5/2021
PID:	007-889-950	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	All
Observed Site Conditions:	Sloped lot with several low retaining wall structures.
Soils:	Sandy gravel, fill
Slopes:	10% to lake, short steep (70%) slope below Nerie Road to lot.
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Mix of natural cobbles and low (<0.5 m) cobble mortar wall, dock ok. Noted disturbance along foreshore area associated with demolition and clean up efforts.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake to residence; est. >1.5m elevation. To be confirmed.
Wildfire Effects Upslope/Upstream:	Slopes above Nerie Road are burned.

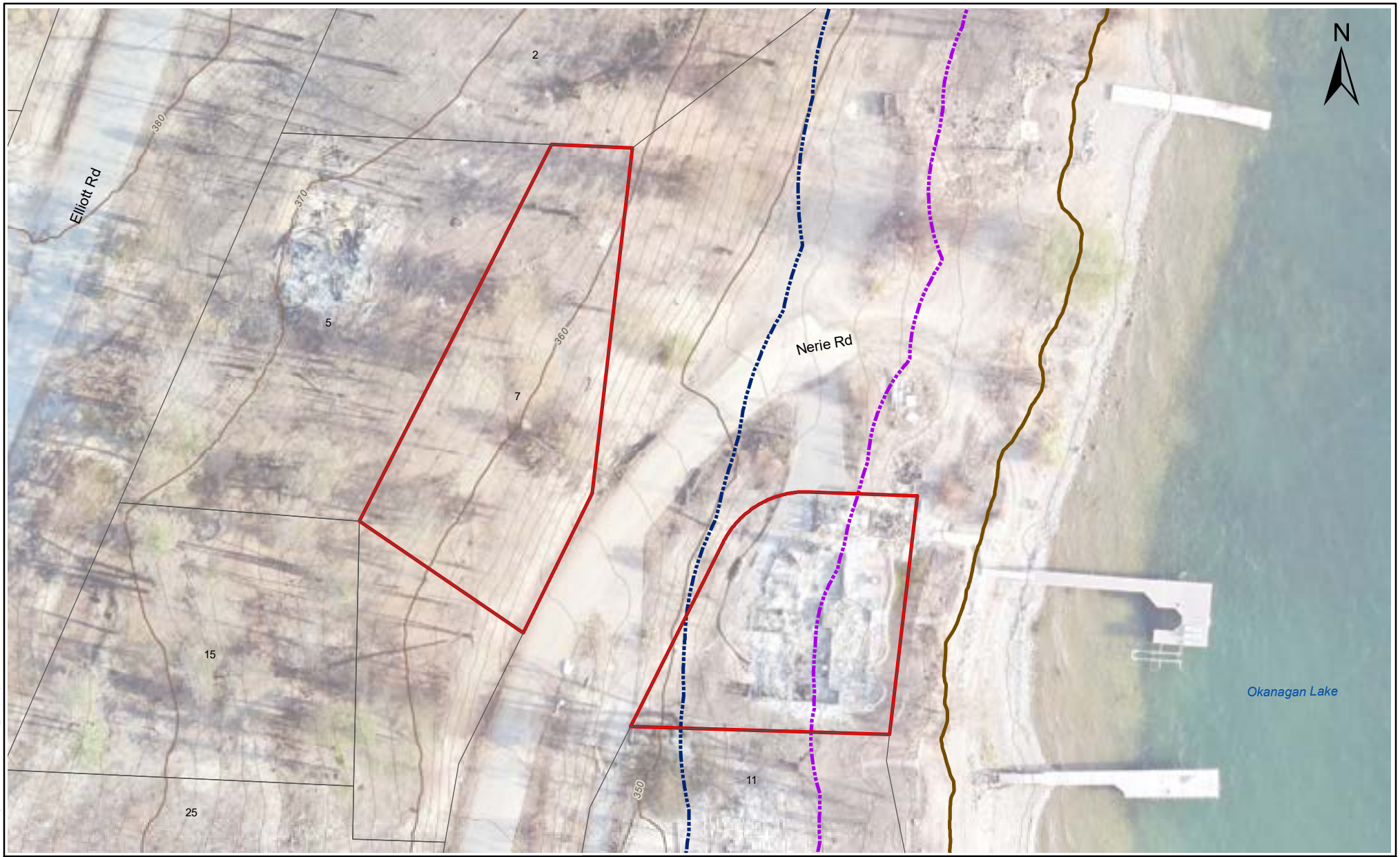
Hazards Noted:	Potential for upslope soil erosion.	
Spatial Likelihood:	Low potential for sediment delivery to lower slopes and to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: LOW	Risk Level: LOW

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of foreshore area at 7 Nerie Rd.

Photo 2: View from foreshore area at 7 Nerie Rd. with low mortared rock wall.



LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **7 NERIE ROAD**

6 3 0 6 12 metres

Scale: 1:600 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	11 Nerie Rd.	Date of Inspection:	11/5/2021
PID:	007-889-968	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community System (check)
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	All, including boat house
Observed Site Conditions:	Lot is situated below Nerie Road, driveway access, gently sloping landscaped lot, burned trees will need removal. There is a concrete boat ramp to the lake from a burned boat house.
Soils:	Sandy gravels
Slopes:	15% avg.
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Dock partly burned, concrete boat launch to boat house, mostly natural otherwise
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake to residence; est. >1.5m elevation. To be confirmed.
Wildfire Effects Upslope/Upstream:	Slopes above Nerie Road are burned.

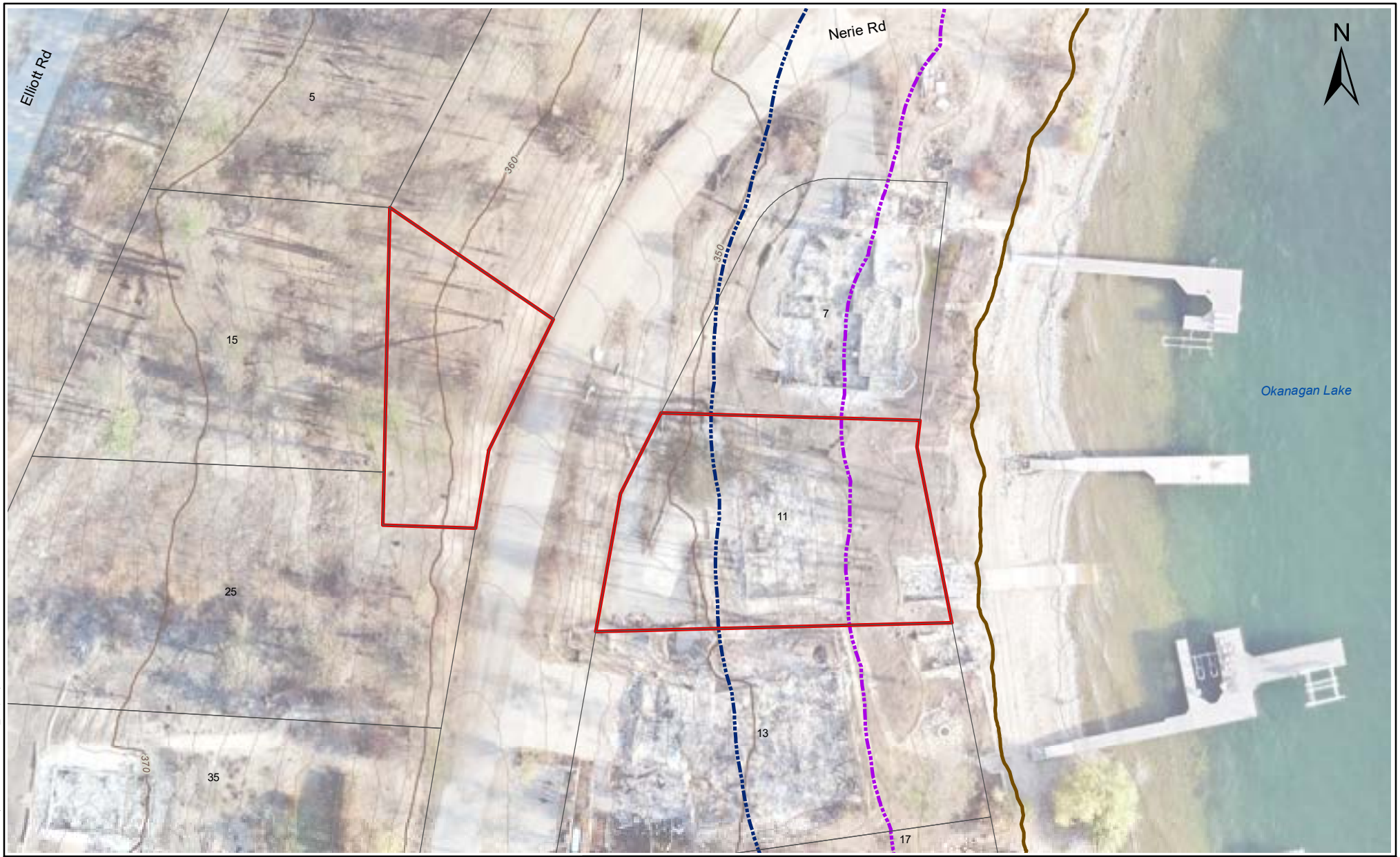
Hazards Noted:	Potential for upslope soil erosion.	
Spatial Likelihood:	Low potential for sediment delivery to lower slopes and to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: LOW	Risk Level: LOW

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of foreshore area at 11 Nerie Rd.

Photo 2: View from foreshore area at 11 Nerie Rd. with concrete boat ramp and burned boat house



LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **11 NERIE ROAD**

6 3 0 6 12 metres

Scale: 1:600 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	13 Nerie Rd.	Date of Inspection:	11/5/2021
PID:	004-200-161	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	All, including boat house
Observed Site Conditions:	Terraced lot, with rock retaining walls at house and retaining wall along foreshore. Boat house along foreshore lost.
Soils:	Sandy gravels
Slopes:	15% to base of wall
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Retaining wall along foreshore (0.8 m high), boat house burned, no ramp, dock ok
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. ~15 m setback from lake to residence; est. >1.5m elevation. To be confirmed.
Wildfire Effects Upslope/Upstream:	Slopes above the lot have been severely burned.

Hazards Noted:	Potential for upslope soil erosion.	
Spatial Likelihood:	Low potential for sediment delivery to lower slopes and to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: LOW	Risk Level: LOW

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of foreshore area at 13 Nerie Rd.

Photo 2: View from foreshore area at 13 Nerie Rd. with retaining wall and burned boat house

LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **13 NERIE ROAD**

5 2.5 0 5 10 metres

Scale: 1:500 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	17 Nerie Rd.	Date of Inspection:	1/19/2022
PID:	007-889-984	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	None, foreshore damage but dwelling ok.
Observed Site Conditions:	Terraced lot from dwelling to lake. Turf yard areas separated by sloped landscaped sections. Low concrete retaining wall along foreshore. Trees in yard are burned.
Soils:	No exposed soils, sandy gravel and cobble.
Slopes:	25% average slope to the lake, no exposed soils and no erosion apparent
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Relatively natural shoreline, cobble gravel and rock, 0.8m high concrete wall with steps to beach, dock is not damaged.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake to residence; est. >1.5m elevation. No foreshore structures. To be confirmed.
Wildfire Effects Upslope/Upstream:	Residence is unburned. Vegetation damage on property. Burned catchment area upslope.

Hazards Noted:	None	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake	
Hazard Level: LOW	Spatial Likelihood: LOW	Risk Level: VERY LOW

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above.
	Long term: Consider riparian vegetation restoration to improve foreshore condition.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View upslope from foreshore area at 17 Nerie Rd.

Photo 2: View of retaining wall along foreshore area at 17 Nerie Rd.

LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **17 NERIE ROAD**

5 2.5 0 5 10 metres

Scale: 1:500 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	19 Nerie Rd.	Date of Inspection:	1/19/2022
PID:	007-889-992	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	Boat house. Dwelling not burned.
Observed Site Conditions:	Sloping lot from dwelling to lake. Grassy and shrubs along slope between house and lake. Only boat house was lost due to fire.
Soils:	No exposed soils, sandy gravel and cobble.
Slopes:	20-25% average slope to the lake, no exposed soils and no erosion apparent
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Concrete boat ramp, boat house (burned), paving stone patio area supported by low log retaining wall, dock damaged but recently repaired.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake to residence; est. >1.5m elevation. Boat house <15m setback. To be confirmed.
Wildfire Effects Upslope/Upstream:	Residence is unburned. Vegetation damage on property. Burned catchment area upslope.

Hazards Noted:	None	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake	
Hazard Level: LOW	Spatial Likelihood: LOW	Risk Level: VERY LOW

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above.
	Long term: Consider riparian vegetation restoration to improve foreshore condition.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View upslope from foreshore area at 19 Nerie Rd. Note concrete boat ramp and burned boat house.

Photo 2: View of foreshore area at 19 Nerie Rd. End of dock is repaired.

LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **19 NERIE ROAD**

6 3 0 6 12 metres

Scale: 1:600 | NAD 1983 UTM Zone 11 U | Figure No. -

Project No: 21-0115 | Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	21 Nerie Rd.	Date of Inspection:	1/19/2022
PID:	007-890-001	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	Boat house. Dwelling not burned.
Observed Site Conditions:	Sloping lot from dwelling to lake. Grassy and shrubs along slope between house and lake. Only boat house was lost due to fire.
Soils:	No exposed soils, sandy gravel and cobble.
Slopes:	25-30% average slope to the lake, no exposed soils and no erosion apparent
Groundwater Observations:	No seepage noted.
Foreshore Conditions:	Concrete boat ramp, boat house (burned), concrete retaining wall (1m high) along foreshore. One large willow tree at lake edge (damaged), burned trees and shrubs on property.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake to residence; est. >1.5m elevation. Boat house <15m setback. To be confirmed.
Wildfire Effects Upslope/Upstream:	Residence is unburned. Vegetation damage on property. Burned catchment area upslope.

Hazards Noted:	None	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake	
Hazard Level: LOW	Spatial Likelihood: LOW	Risk Level: VERY LOW

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and associated soil erosion from slopes above.
	Long term: Consider riparian vegetation restoration to improve foreshore condition.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View upslope from foreshore area at 21 Nerie Rd. Note concrete retaining wall, boat ramp and burned boat house.

Photo 2: View of foreshore area at 21 Nerie Rd. Note retaining wall and damaged end of shared dock.

LEGEND

- Property Parcel
- Subject Property
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **21 NERIE ROAD**

6 3 0 6 12 metres

Scale: 1:600 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	23 Nerie Rd.	Date of Inspection:	11/5/2021
PID:	007-890-010	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake and stream-fed stream
Structures Lost:	All, including boat house
Observed Site Conditions:	Steep lot heavily burned. Substantial disturbance and debris along foreshore. Cutslope along toe of slope retained by stacked tires that have burned.
Soils:	Fill, silty sand
Slopes:	25-35%
Groundwater Observations:	Seepage noted along the toe of the slope and there is a small watercourse flowing in a channel along the south property line. Source is from a spring-fed stream (Buchanan Spring) that flows under Nerie Road through culvert then into a pipe (at driveway for 25 Nerie).
Foreshore Conditions:	Heavy damage to all structures, boat house, two concrete ramps to water, sections of log retaining structures (height ~1 m), some willow trees remaining.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake to residence; est. >1.5m elevation. Boat house <15m setback. To be confirmed.
Wildfire Effects Upslope/Upstream:	Terraced developed residential area, short slopes and terraced lots, scattered partial burn areas immediately upslope.

Hazards Noted:	Disturbed soils and seepage create potential for instability and soil erosion. Piped stream flow and drainage across mid-slope area.	
Spatial Likelihood:	Potential sediment delivery to lower property, moderate potential for sediment delivery to Okanagan Lake.	
Hazard Level: HIGH	Spatial Likelihood: MODERATE	Risk Level: HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and groundwater seepage.
	Long term: Sediment and erosion control measures are recommended. Measures to manage onsite drainage may be needed. Consider geotechnical assessment for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of foreshore area at 23 Nerie Rd.

Photo 2: View of log retaining wall along foreshore at 23 Nerie Rd.

Photo 3: View of slope above foreshore area with burned garage and burned tire retaining wall

Photo 4: Small spring-fed stream flowing along south property line at 23 Nerie Rd.

LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **23 NERIE ROAD**

5 2.5 0 5 10
metres

Scale: 1:500 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	25 Nerie Rd.	Date of Inspection:	11/5/2021
PID:	005-720-273	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake and Buchanan Spring (spring-fed stream) flowing through culvert at Nerie Road and directed through lot by pipe
Structures Lost:	All, residence located at top of slope, dock was also damaged.
Observed Site Conditions:	High level of ground disturbance, driveway access ok. Concrete retaining walls and paving stones create switchback path to lake (highly disturbed).
Soils:	Fills, granular, sandy gravel
Slopes:	50-55% slopes to the lake, burned and destabilized, , exposed soils and erosion apparent
Groundwater Observations:	Spring-fed stream (Buchanan Spring) flows under Nerie Road through culvert then into a pipe (at driveway for 25 Nerie). Flow is contained in culvert through lot to 23 Nerie Rd.
Foreshore Conditions:	Relatively natural shoreline, cobble gravel and rock, wood dock on wood piles is badly damaged
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake to residence; est. >1.5m elevation. Setback from piped stream to be confirmed.
Wildfire Effects Upslope/Upstream:	Terraced developed residential area, short slopes and terraced lots, scattered partial burn areas immediately upslope.

Hazards Noted:	Mineral soils are exposed and subject to erosion and shallow destabilization.	
Spatial Likelihood:	Potential sediment delivery to lower property, moderate potential for sediment delivery to Okanagan Lake.	
Hazard Level: HIGH	Spatial Likelihood: MODERATE	Risk Level: HIGH

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and groundwater seepage.
	Long term: Sediment and erosion control measures are recommended. Measures to manage onsite drainage may be needed. Consider geotechnical assessment for future development.

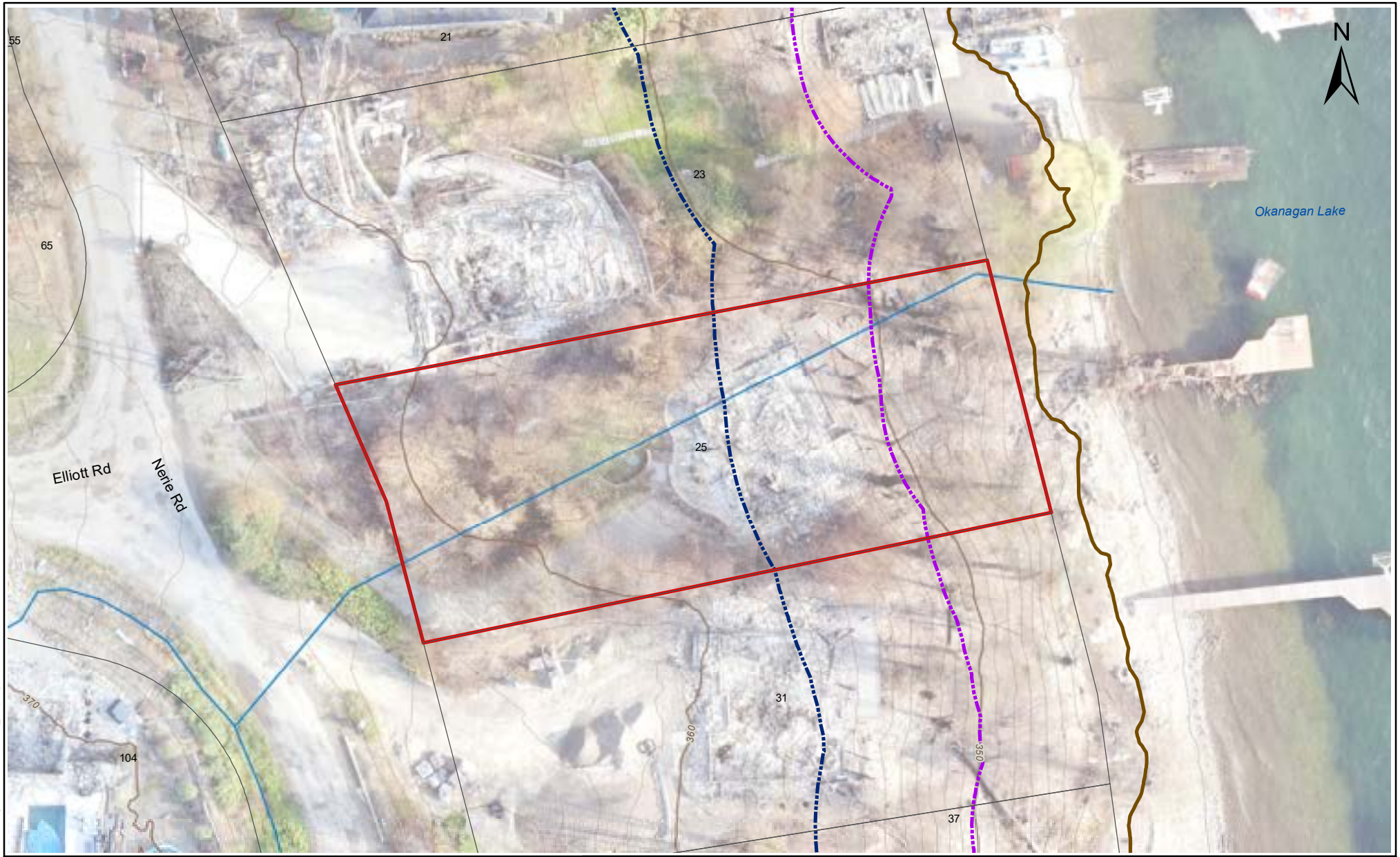
* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View downslope towards lake at 25 Nerie Rd

Photo 2: View upslope from toe of slope at foreshore at 25 Nerie Rd.

Photo 3: View of foreshore area at 25 Nerie Rd.

Photo 4: View upslope from upper part of lot towards Nerie Rd at 25 Nerie Rd.



LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **25 NERIE ROAD**

5 2.5 0 5 10
metres

Scale: 1:500 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	31 Nerie Rd.	Date of Inspection:	11/5/2021
PID:	007-890-028	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	All, residence currently under construction
Observed Site Conditions:	Under construction, site is cleared and graded at top accessing Nerie Road. There is a steeper slope from the top of the lot down to the lake. There is no development along the foreshore.
Soils:	Silty sand and gravel
Slopes:	10% down from rd to house, ~60% slope above foreshore
Groundwater Observations:	Seepage through Nerie Rd and overland flow noted at top of lot. Flow associated with Buchanan Spring.
Foreshore Conditions:	No development, relatively natural foreshore area.
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake to residence; est. >1.5m elevation. To be confirmed.
Wildfire Effects Upslope/Upstream:	Terraced developed residential area, short slopes and terraced lots, scattered partial burn areas immediately upslope.

Hazards Noted:	Disturbed soils and seepage create potential for instability and soil erosion. Piped stream flow and drainage across mid-slope area.	
Spatial Likelihood:	Potential sediment delivery to lower property, moderate potential for sediment delivery to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: MODERATE	Risk Level: MODERATE

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and groundwater seepage.
	Long term: Sediment and erosion control measures are recommended. Measures to manage onsite drainage may be needed. Consider geotechnical assessment for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View downslope towards lake at 31 Nerie Rd (new build under construction)

Photo 2: View of overland flow along upper part of 31 Nerie Rd.

LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **31 NERIE ROAD**

5 2.5 0 5 10 metres

Scale: 1:500 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	37 Nerie Rd.	Date of Inspection:	11/5/2021
PID:	007-890-036	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake and seepage stream
Structures Lost:	All
Observed Site Conditions:	Burned, steep lot, exposed soils. Overland flow of seepage through lot.
Soils:	Clayey Silt and sand with gravel, high erosion potential
Slopes:	15% top, 60% bottom, steep and disturbed soils, small stream flows down property line, high pot for erosion and instability
Groundwater Observations:	Seepage through Nerie Rd noted and directed under driveway through culvert. Overland flow across top of lot along north property line. Flow associated with Buchanan Spring.
Foreshore Conditions:	Low landscape wall along toe of slope, low rock lines along beach, dock is damaged, otherwise no built structures
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Est. >15 m setback from lake to residence; est. >1.5m elevation. Setbacks from unmapped watercourse to be confirmed.
Wildfire Effects Upslope/Upstream:	Terraced developed residential area, short slopes and terraced lots, scattered partial burn areas immediately upslope.

Hazards Noted:	Disturbed soils and seepage create potential for instability and soil erosion. Piped stream flow and drainage across mid-slope area.	
Spatial Likelihood:	Potential sediment delivery to lower property, moderate potential for sediment delivery to Okanagan Lake.	
Hazard Level: MODERATE	Spatial Likelihood: MODERATE	Risk Level: MODERATE

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and groundwater seepage.
	Long term: Sediment and erosion control measures are recommended. Measures to manage onsite drainage may be needed. Consider geotechnical assessment for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of upper part of lot at 37 Nerie Rd, culvert outlet and stream flow in foreground

Photo 2: View of foreshore area at 37 Nerie Rd.

LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **37 NERIE ROAD**

5 2.5 0 5 10
metres

Scale: 1:500 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	104 Elliot Rd.	Date of Inspection:	11/5/2021
PID:	007-890-150	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont		

Domestic water supply source:	Estamont Community Water System
Nearest Waterbody (lake or stream) Element at Risk:	Buchanan Spring (spring-fed stream)
Structures Lost:	All, dwelling, garage, swimming pool.
Observed Site Conditions:	Lot slopes down to Nerie Rd. House located on terraced area. Landscaping around home. Two white PVC pipes are visible along the cutslope below property along Nerie Rd. There is a small driveway culvert conveying ditch flow along Elliot Rd.
Soils:	Sandy gravel
Slopes:	70% cutslope to Nerie Rd downslope, avg 20% grade across lot
Groundwater Observations:	Buchanan Spring (spring-fed stream) flows along south property line, converges with piped seepage and ditch drainage to the northeast corner of lot before flowing through culvert under Nerie Rd.
Foreshore Conditions:	N/A
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	Setbacks from watercourse need to be determined.
Wildfire Effects Upslope/Upstream:	Terraced developed residential area, short slopes and terraced lots, scattered partial burn areas immediately upslope.

Hazards Noted:	Hydrologic and drainage hazards associated with nearby water course, seepage, and ditch/culvert capacity.	
Spatial Likelihood:	Property may potentially be impacted by drainage hazard.	
Hazard Level: MODERATE	Spatial Likelihood: MODERATE	Risk Level: MODERATE

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff and groundwater seepage. Maintain clear passage for flow through driveway culvert, roadside ditches, and culvert under Nerie Road.
	Long term: Consider groundwater assessment for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of corner property at 104 Elliot Rd towards ditchline and culvert across Nerie Rd. Noted, two white PVC drain pipes along cutslope.

Photo 2: View of spring-fed stream along south property line at 104 Elliot Rd.

LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **104 ELLIOT ROAD**

4 2 0 4 8 metres

Scale: 1:400 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	8700 N Westside Road	Date of Inspection:	1/19/2022
PID:	006-732-267	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont (TBC)		

Domestic water supply source:	N/A
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	None, vacant lot
Observed Site Conditions:	Gentle to moderate sloped shrubby area, historically cleared but currently undeveloped. Affected by wildfire (low to moderate severity).
Soils:	Sandy gravel. Snow cover limits visibility.
Slopes:	20-25% slopes, straight slopes, no gullies or ridges. Slopes drain to roadside ditch along Westside Road. 400 mm CSP culvert under road is mostly clear but some sediment infill at inlet.
Groundwater Observations:	Licensed spring within property. Potential seepage through lot towards Westside Road. Seepage is intercepted by roadside ditch and directed to a culvert, which flows to a gully (part of Lawrence Spring).
Foreshore Conditions:	N/A
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	N/A. No mapped watercourses.
Wildfire Effects Upslope/Upstream:	Low to moderate burn severity, loss of shrub vegetation. Catchment upslope, including Attenborough Road, is burned.

Hazards Noted:	Potential overland flow runoff.	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake. Moderate potential for Westside Road.	
Hazard Level: LOW	Spatial Likelihood: MODERATE	Risk Level: LOW

Recommended Recovery Response and Considerations for Future Development:	Short term: Be prepared for higher than usual runoff from slopes above. Ensure clear passage through Westside Road culvert.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View upslope to 8700 N Westside Rd

Photo 2: View of downslope side of road across from 8700 N Westside Rd at culvert crossing

Photo 3: Partly obscured inlet of ~400 mm culvert at 8700 N Westside Rd.

LEGEND

- Property Parcel
- Subject Property

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **8700N WESTSIDE ROAD**

10 5 0 10 20
metres

Scale: 1:1,250 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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Regional District of Central Okanagan
Post-Wildfire Environmental / Hazardous Conditions Assessment
Property Inspection Report

Civic Address:	8715 N Westside Road	Date of Inspection:	1/19/2022
PID:	005-836-379	Author:	J. Clarke, P.Geo.
RDCO Area:	Estamont (TBC)		

Domestic water supply source:	N/A
Nearest Waterbody (lake or stream) Element at Risk:	Okanagan Lake
Structures Lost:	None, vacant lot
Observed Site Conditions:	Lot wraps around #8705 Westside Rd (unburned) and is currently vacant. The lot includes a level building site on the north side of the lot. The western and southern portions of the lot are moderately sloped (up to 45%). The south end of the lot is part of a gully and is the outfall from a CSP culvert under Westside Road. The gully area is vegetated (partially burned)
Soils:	Sandy gravel. Possible seepage area in gully on south side of lot.
Slopes:	Level lot at top with moderate (45%) slopes to the west and south into a gully. Drainage originates from a 400 mm CSP culvert under Westside Road.
Groundwater Observations:	Potential seepage through south part of lot below Westside Road. Potential for seepage along toe of slope towards Okanagan Lake (source area for several springs in the area).
Foreshore Conditions:	N/A
Setback Distance & Elevation from HWM* or Top of Bank (SHIM):	N/A. No mapped watercourses.
Wildfire Effects Upslope/Upstream:	Low to moderate burn severity, loss and fire damage to trees and shrubs in gully at south side of lot. Catchment upslope is burned.

Hazards Noted:	Potential runoff effects, including surface runoff to culvert/gully and subsurface seepage increases along south side of lot. Potential for surface erosion on moderate slopes.	
Spatial Likelihood:	Low potential for sediment delivery to Okanagan Lake. Moderate potential for downslope properties.	
Hazard Level: LOW	Spatial Likelihood: MODERATE	Risk Level: LOW

Recommended Recovery Response and Considerations for Future Development:	Long term: Consider groundwater assessment and soils/geotechnical assessment for future development.

* HWM was visually identified in field and defined by 343m elevation on maps, distance is approximate and subject to confirmation by survey

Photo 1: View of slopes along south side of 8715 N Westside Rd.

Photo 2: View downslope towards Okanagan Lake from 8715 N Westside Rd.

Photo 3: View of level area at top of 8715 N Westside Rd.

Photo 4: View of culvert outlet on Westside Road, draining into gully south of 8715 N Westside Rd.

LEGEND

- Property Parcel
- Subject Property
- Watercourse (Source: RDCO)
- 343m Elevation - Highest Target Lake Level + 0.5m (approx. High Water Elevation of Okanagan Lake)
- 15 m Setback Distance (from 343m elevation)
- 30 m Setback Distance (from 343m elevation)

Maps are provided for information only. For permitting purposes, both riparian and floodplain setbacks are to be measured from the natural boundary and confirmed by a legal land survey.

Orthoimagery obtained from RDCO (acquisition date: Sept. 10, 2021).

Client: **REGIONAL DISTRICT OF CENTRAL OKANAGAN (RDCO)**

Project: **ENVIRONMENTAL/HAZARDOUS CONDITIONS ASSESSMENT - NORTH WESTSIDE ROAD AREA**

Title: **8715 WESTSIDE ROAD**

10 5 0 10 20 metres

Scale: 1:1,250 NAD 1983 UTM Zone 11 U

Figure No. -

Project No: 21-0115 Date: January 28, 2022

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