

KILLINEY BEACH ENVIRONMENTAL ASSESSMENT

REGIONAL DISTRICT OF CENTRAL OKANAGAN
SUBDIVISION ENVIRONMENTAL ASSESSMENT SERVICES

Prepared For:

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1.0 INTRODUCTION

Ecoscape Environmental Consultants Ltd. (Ecoscape) was retained by the Regional District of Central Okanagan (RDCO) to complete an overview environmental assessment of the Killiney Beach Subdivision (Killiney Beach). The purpose of the assessment was to refine the existing Aquatic Ecosystem and Terrestrial Development Permit (DP) areas, using a combination of publically available inventory data and field work to confirm the presence/absence of watercourses and other important habitat areas.

Killiney Beach is located on the northwest side of Okanagan Lake approximately 45 km from downtown Kelowna (Figure 1). The roughly 224 hectare subdivision straddles Westside Road and has approximately 483 parcels. Historically, Killiney Beach was mostly occupied by summer occupants, but more recently residents live there year-around.

1.1 Background

Development within Killiney Beach is guided by the Rural Westside Official Community Plan (OCP) (RDCO 2010). Aquatic Ecosystem DP areas were designated for the protection of watercourses, including streams, ponds, springs, wetlands, and lakes. The DP areas were established by the identification of possible watercourse locations using provincial Terrain Resource Inventory Mapping (TRIM) data, Sensitive Ecosystem Inventory (SEI) data and Sensitive Habitat and Inventory Mapping (SHIM) field surveys. Because the DP areas are meant as a flagging tool, all sites that could potentially contain watercourses were included. No field inspections and feature verification were carried during the 2010 OCP development as it was intended as a desktop exercise. The OCP then relied on Qualified Environmental Professionals (QEPs) to affirm the presence or non-presence of an actual watercourse.

The OCP set out to establish policy around defining riparian leavestrips, which included methods outlined in the provincial Riparian Areas Regulation (RAR). A leavestrip occurs adjacent to a watercourse and is intended to be left in a natural condition and untouched by development. If previously damaged, the leavestrip is to be restored or enhanced (RDCO 2010). The OCP clearly establishes leavestrip areas for creeks and wetlands that are fish bearing or connected by surface flows to fish bearing watercourses, as no less than 15 m measured from bank full width. The leavestrip for Okanagan Lake is also clearly defined based on shoreline sensitivity; ranging from 15 to 30 m. These leavestrip areas established by the OCP often times are more conservative than that set forth by the province.

Terrestrial DP areas were established based on the presence of Coniferous Woodland, Broadleaf Woodland, Grassland, Sparsely Vegetated, and Mature Forest Ecosystems identified through SEI (RDCO 2010). In Terrestrial DP areas, a development permit



must be approved prior to land alteration or subdivision. Figure 1 depicts the existing Aquatic Ecosystem and Terrestrial DP areas within Killiney Beach.

1.2 Project Objectives

RDCO planning staff have identified inefficiencies and challenges with the more conservative nature of existing Aquatic Ecosystem and Terrestrial DP areas that were identified in the OCP (RDCO 2010). For example, there are many DP areas that are flagged as Aquatic Ecosystem that do not actually have watercourses. This results in wasted time and money for both property owners and RDCO staff. This broad scale subdivision environmental assessment sets out to accomplish the following:

- Clarify the locations of aquatic features and determine whether they actually exist (e.g., Are the identified TRIM lines actually streams?);
- Recommend leavestrip setbacks from watercourses;
- Confirm the applicability of the Riparian Areas Regulation (RAR);
- Clarify if the ecosystem attributes that resulted in areas flagged as Terrestrial DP areas exist, or have been previously lost to development;
- Verify SEI classifications to ensure that data used for flagging DP Areas is accurate;
- Provide generic and site specific mitigation measures;
- Identify and refine areas where the DP areas are inaccurate; and
- Provide recommendations for how to use the EA information for new development proposals.

2.0 ENVIRONMENTAL ASSESSMENT

The following sections present the methods and results of the Killiney Beach environmental assessment. Field work was conducted by Kyle Hawes, R.P.Bio. and Mary Ann Olson-Russello, R.P.Bio., Senior Natural Resource Biologists with Ecoscape, with support from Gisele Rehe, Planning Assistant with RDCO. Field investigations were conducted on November 13th, 16th, 2015 and January 21st, 2016. Mapping deliverables and GIS analysis was completed by Rachel Plewes, M.Sc. of Ecoscape.



2.1 Methods

To achieve the project objectives, the following methods were undertaken:

2.1.1 Fieldwork

- Field work was focused in areas where the existing Aquatic Ecosystem and Terrestrial DP areas are located.
- Field maps were developed that conveyed terrestrial ecosystem mapping (TEM) polygons (Haney and Iverson 2009), watercourse location information (TRIM, SHIM, wetlands) (Patterson *et al.* 2014), and existing Aquatic Ecosystem and Terrestrial DP areas.
- Background data files were also loaded into a hand held GPS for use in the field.
- Because private property access was not granted for this project, the full lengths of watercourses were not investigated. Rather, watercourse presence was determined by stopping at all locations where possible watercourses intersected roadways or public lands. At each intersection (pinpointed using the background file in the GPS), evidence of watercourse presence was investigated. Indicators of a watercourse included presence of standing or flowing water and presence of a defined channel (with or without water). The presence of broadleaf vegetation was also a good indication of the potential for a watercourse, but did not necessarily translate into a definitive surface water feature. If a watercourse was not encountered, it was crossed-off the field map at each road crossing.
- If a watercourse was encountered, its connection (i.e. by surface water flow) with Okanagan Lake or another fish-bearing watercourse was verified. In some cases, segments of a single watercourse were connected and hence are RAR applicable, while other segments of the same watercourse had discontinuous channel development and no direct surface water connection with Okanagan Lake. There were other instances where the extent of a watercourse was different than what was previously mapped. These feature changes were picked up using the GPS. The watercourse was then redrawn and the database was updated.
- Terrestrial features were also noted. These included confirmation of TEM classifications such as structural stage, levels of disturbance (e.g. weeds or changes to landscape since latest airphoto) and critical habitat features. Discrepancies in Terrestrial DP areas and SEI classifications were also noted in several cases and were marked as needing further investigation.



2.1.2 Data Processing

- Information collected in the field was incorporated into a GIS interface by either updating existing databases or redrawing features to more accurately reflect what was encountered on the ground. For example, the non-existent watercourses were removed from the database and updates to existing watercourse alignments were made.
- Where necessary, TEM classifications were updated and polygon boundaries redrawn.
- The revised TEM data was used to conduct an environmental sensitivity analysis (ESA), to refine development permit areas, and to develop relevant recommendations.
- Rather than cutting polygons at the subdivision study area extent, all TEM polygons that intersected the boundary were kept and mapping outputs intentionally showed the adjacent areas beyond the subdivision. The larger output area provides better ecological context with insights into viable wildlife movement corridors within and beyond the subdivision and it better addresses cumulative effects and provides information that may be valuable in the future, especially if residential development extends beyond the existing subdivision boundary.

2.1.3 Environmental Sensitivity Analysis

- The ESA was completed for each delineated TEM polygon that intersects the Killiney Beach study area. Professional judgment was used to evaluate ecosystem polygons based on criteria including: provincial Conservation Data Center (CDC) status (i.e., Red or Blue listed), rare and endangered species occurrence potential, landscape condition (i.e., connectivity, fragmentation), successional status, regional rarity, critical and specialized habitat features, fragility, and relative biodiversity. A summary of defining criteria for each ESA rating is shown in Table 1.



Table 1. Summary of defining criteria used in the Environmental Sensitivity Analysis.

ESA Value	Defining Criteria
Very High (ESA 1)	Red or Blue listed intact woodland ecosystems of mature forest (structural stage 6), open water features (pond, marsh, etc.), and intact sparsely vegetated ecosystems (e.g. rocky bluff and rock outcrop ecosystems)
High (ESA 2)	Red or Blue listed intact woodland ecosystems with predominantly young forest (structural stage 5)
Moderate (ESA 3)	Recently modified woodland ecosystems (structural stage 3 or 4), or ecosystems with anthropogenic disturbance (rural, cultivated orchards and fields)
Low (ESA 4)	Anthropogenic disturbance with little or no possibility for recovery or rehabilitation (e.g. hardscaped areas such as parking lots)

- Ecosystem polygons were ranked using RDCO's ESA Stratification Criteria that was developed in part by the Environmental Advisory Commission, and is described below. Guidelines for the retention, mitigation, and compensation of ESAs is presented in Section 5.0:
 - I. Very High (ESA 1): ESA 1's contain rare physical features, plants and animals or are ecologically functioning natural systems. Various types of habitat will qualify on the basis of sensitivity, vulnerability, connectivity and biodiversity. All wetlands, high value foreshore, locally/regionally rare plant communities, animals and habitats will be considered as Very High. Areas given this rating are considered the highest priority for protection of ecosystem function and values and should be left undisturbed. Avoidance and conservation of Very High ESA designations should be the primary objective.
 - II. High (ESA 2): ESA 2's contain physical features, plants, animals and habitat characteristics which contribute toward the overall diversity and contiguous nature of the surrounding natural features. These will include Sensitive Ecosystems (SEI) as refined according to the ESA stratification criteria at the appropriate scale for the site. These may also include areas used to buffer ecological functions of Very High ecosystems. An area given this rank is of only slightly lower priority for protection of ecosystem function and values. Therefore, clear rationale and criteria for distinction between Very High and High values shall be provided.
 - III. Moderate (ESA 3): ESA 3's contain important features or remnant stands/sites with ecological value that are not identified in the Sensitive Ecosystems Inventory as refined according to the ESA stratification criteria at the appropriate scale for the site and are not locally/regionally



rare. The moderate ESA still contributes to the diversity and connectivity of the landscape, and may contain natural habitats, and some features of interest (e.g. tree patches, rock outcroppings, drainages and corridors).

- IV. Low (ESA 4): ESA 4's polygons contribute little or no value to the overall diversity of vegetation, soils, and terrain and wildlife characteristics of the area. These areas have generally experienced anthropogenic disturbances (e.g. a driveway or other approved land clearing but does not include land cleared for agriculture) with little or no possibility for recovery or rehabilitation.

2.1.4 Riparian Setback Determination

- Riparian setbacks or leavestrips were recommended for all identified watercourses.
- In addition, RAR setbacks were determined for all RAR applicable watercourses using the detailed assessment method (BC MOE 2006a). The RAR setbacks for creeks and springs were generated using bankfull width data collected during SHIM. If bankfull width information was not available, then a 1-m default width was used. For Okanagan Lake, the setbacks were generated off of the approximate high water level (343 m contour).
- Okanagan Lake setbacks were specified in the OCP (RDCO 2010) and were based on relative habitat use/value with respect to Kokanee. Accordingly, setbacks ranged from 15 – 30 m.

2.2 Ecosystem Classification

Killiney Beach occurs within the Okanagan Very Dry Hot Interior Douglas-fir Variant (IDF_h1) biogeoclimatic zone, which is defined by the Biogeoclimatic Ecosystem Classification (BEC) program (Lloyd *et al.* 1990). Areas of the IDF zone are generally warm and dry, with long growing seasons and periodic droughts.

Polygons within and surrounding Killiney Beach represent distinct habitat types based on vegetation cover and by adapting the nomenclature and site series used by TEM. Killiney Beach was divided into 45 polygons representing twelve (12) distinct ecosystems. Figure 2 shows a spatial distribution of the TEM polygons and Table 2 summarizes the ecosystem codes, site series, and provincial status.



Table 2. Ecosystem communities occurring in and around the Killiney Beach Subdivision.

Ecosystem Code	Site Series	Site Series Name	Provincial Status ¹
CD	00	Black cottonwood/Douglas-fir - Snowberry - Red-osier dogwood	Red
CF	-	Cultivated Field	-
CO	-	Cultivated Orchard	-
DP	01	Douglas-fir/Ponderosa pine - Pinegrass	Blue
DS	07	Douglas-fir/Ponderosa pine - Snowberry - Spirea	Red
DW	03	Douglas-fir - Ponderosa pine – Bluebunch wheatgrass – Pinegrass	Blue
FO	00	Douglas-fir/Ponderosa pine - Saskatoon - Mock orange	Red
RW	-	Rural	-
RZ	-	Road Surface	-
SD	08	Hybrid white spruce – Douglas-fir – Douglas maple – Dogwood	Red
SO	00	Trembling Aspen - Mock orange	Red
SP	06	Douglas-fir/Ponderosa pine - Snowberry - Pinegrass	Blue

¹ Source: <http://www.env.gov.bc.ca/cdc/>

Blue: Of special concern. **Red:** Endangered or threatened.

Killiney Beach contains numerous Red and Blue listed communities, highlighting the rare ecosystems that characterize the area. The listed communities were generally associated with coniferous and mixed woodland and sparsely vegetated sites.

2.3 Terrestrial Community Types

For the purpose of reporting, Killiney Beach has been divided into two broad terrestrial ecosystem community types, coniferous woodland and sparsely vegetated. The Killiney Beach area is generally characterized by an expanse of mature and young coniferous forest and has a few pockets of sparsely vegetated communities.

2.3.1 Coniferous Woodland



Coniferous woodland communities that extend across Killiney Beach include the following ecosystem codes as outlined in Table 2: DP, DS, DW, SD and SP. Tree cover is generally dominated by interior Douglas-fir (*Pseudotsuga menziesii* var. *glauca*), with lesser amounts of ponderosa pine (*Pinus ponderosa*).



The understories are generally well-developed with a diverse mix of shrubs and herbaceous vegetation. Typical shrubs associated with these woodland ecosystems in drier, warmer aspect areas include common juniper (*Juniperus communis*), snowbrush (*Ceanothus velutinus*), mock orange (*Philadelphus lewisii*), soopolallie (*Shepherdia canadensis*), spreading dogbane (*Apocynum androsaemifolium*), oceanspray (*Holodiscus discolor*), and kinnikinnick (*Arctostaphylos uva-ursi*). In cooler, more moist areas dominant shrubs include birch-leaved spirea (*Spiraea betulifolia*), Nootka rose (*Rosa nutkana*), Douglas maple (*Acer glabrum*), mountain alder (*Alnus incana*), Pacific willow (*Salix lucida*), and red raspberry (*Rubus idaeus*). Common woodland grasses and herbs include pinegrass (*Calamagrostis rubescens*), fescues (*Festuca* sp.), bluebunch wheatgrass (*Pseudoroegneria spicata*), arrowleaf balsamroot (*Balsamorhiza sagittata*), round-leaved alumroot (*Heuchera cylindrical*), aster (*Aster* sp.), daisy (*Erigeron* sp.), hawkweed (*Hieracium* sp.), wild strawberry (*Fragaria virginiana*), pussytoes (*Antennaria* sp.), rockcress (*Arabis* sp.), tarragon (*Artemisia dracunculus*), and woodsia fern (*Woodsia oregana*).

2.3.2 Sparsely Vegetated Areas

Sparsely vegetated communities (Table 2: FO and SO) are typically associated with rock outcrop, cliff, talus and other dry, steep, or warm aspect sites (i.e., south and/or west facing) that receive little moisture and have shallow, well-drained soils. Tree cover is generally sparse with occasional veteran fir and pine, and shrub cover is similarly sparse. Shrubs include Saskatoon, shrubby penstemon (*Penstemon fruticosus*), mock orange, pasture sage and juniper. Herbs are mainly comprised of ground cover mosses and lichens, including cladonia (*Cladonia* spp.) and compact selaginella (*Selaginella densa*) associated with the exposed bedrock and shallow soils, with scattered pussytoes (*Antennaria* sp.), buckwheat, balsamroot, alumroot, lupine, and bunchgrasses.

There are only two TEM polygons that have components of sparsely vegetated communities; they are located near the western boundary of the study area but neither site could be accessed during the field investigations.

2.4 Aquatic Ecosystems

CD is the only ecosystem that is typically associated with aquatic features that was identified within the TEM data (discussed below in Section 2.4.1), however there are other critical aquatic ecosystems within or adjacent to Killiney Beach that include Okanagan Lake, Norris Creek and several identified seepages/springs. Each are discussed in the following sections.



2.4.1 Broadleaf Woodland

Broadleaf woodland (Table 2: CD) can be found in areas with abundant water either from seepages, shallow ground water or surface water. The CD community is found along the foreshore of Okanagan Lake, but also occurs as a narrow band along the Norris Creek corridor and in locations supported by shallow groundwater and springs. These areas tend to be dominated by vegetation that



require or are adapted to higher soil moistures with periodic saturation and inundation. Tree cover in these areas typically includes black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) with occasional water birch and western redcedar (*Thuja plicata*). Riparian shrubs include red-osier dogwood (*Cornus stolonifera*) and willow (*Salix* spp.).

During the SHIM fieldwork, six areas that were classified as broadleaf forest were also documented (Figure 5). One example is a fairly extensive pocket of trembling aspen (pictured) that borders a cultivated field just beyond the northern edge of the study area (occurs within polygon 2839; Figure 2). A spring occurs adjacent to this feature to the southwest at the end of Keithley Road.

2.4.2 Okanagan Lake

Killiney Beach occurs along Okanagan Lake Foreshore Inventory and Mapping (FIM) Segments 183, 184 and 185, which were described as a gravel shore type with single family and park land use with high levels (>40%) of impact. Only approximately 5 to 15% of the segments remain in a natural state (Schleppe 2010). The area has steep slopes (20-60%) and the shore types were described as gravel with a moderate littoral zone width (10-50 m) (Schleppe 2010). Substrates were described as approximately 70% gravel, 20% cobble and 10% boulder. The riparian area has mature coniferous forest with moderate (10-50%) shrub and abundant (>50%) tree cover.

Moorages along segments classified as single family occur at densities of approximately 20 per km, while there were two documented moorages within the 488-m park segment (Schleppe 2010). These segment descriptions are generally consistent with the current state of Killiney Beach.



Kokanee (*Oncorhynchus nerka*) are the fish species of primary concern with respect to shoreline development and aquatic habitat alteration along Okanagan Lake, and the substrates along the Killiney Beach shoreline include angular cobble that are preferred by shore spawning kokanee. A review of Kokanee shore spawning zones for Okanagan Lake (MFLNRO 2015)¹, revealed that Killiney Beach is located within a Kokanee Yellow Zone. Approximately 75% of the Killiney Beach shoreline is designated a Yellow Zone. The provincial Yellow Zone designation represents moderate to high value habitat that is required for the long term maintenance and recovery of kokanee (BC MOE 2009). Yellow zones were identified as locations where spawning aggregations of 50 or fewer fish were observed in recent years (2001-2008) or where documented historic spawning activities with aggregations of less than 1000 fish were recorded.

The Aquatic Habitat Index (AHI) current and potential ratings for segments along Killiney Beach are Moderate/High and High (Schleppe 2010). In addition to providing Kokanee shore spawning habitat, substrates adjacent to Killiney Beach provide suitable spawning, foraging and general living habitat for a number of other fish species. Table 3 provides a list of native and non-native fish species documented to occur in Okanagan Lake.

¹ Ministry of Forests Lands and Natural Resource Operations (MFLNRO) – 2015 Kokanee shore spawning enumeration data.



Table 3. Species of fish found in Okanagan Lake (BC MFLNRO 2015)

Common Name	Scientific Name
Eastern Brook Trout	<i>Salvelinus fontinalis</i>
Burbot	<i>Lota lota</i>
Carp	<i>Cyprinus carpio</i>
Chiselmouth	<i>Acrocheilus alutaceus</i>
Cutthroat Trout	<i>Oncorhynchus clarki lewisi</i>
Kokanee	<i>Oncorhynchus nerka</i>
Lake Trout	<i>Salvelinus namaycush</i>
Lake Whitefish	<i>Coregonus clupeaformis</i>
Largescale Sucker	<i>Catostomus macrocheilus</i>
Leopard Dace	<i>Rhinichthys falcatus</i>
Longnose Dace	<i>Rhinichthys cataractae</i>
Longnose Sucker	<i>Catostomus catostomus</i>
Mountain Whitefish	<i>Prosopium williamsoni</i>
Northern Pikeminnow	<i>Ptychocheilus oregonensis</i>
Peamouth Chub	<i>Mylocheilus caurinus</i>
Prickly Sculpin	<i>Cottus asper</i>
Pumpkinseed	<i>Lepomis gibbosus</i>
Pygmy Whitefish	<i>Prosopium coulteri</i>
Rainbow Trout	<i>Oncorhynchus mykiss</i>
Redside Shiner	<i>Richardsonius balteatus</i>
Slimy Sculpin	<i>Cottus cognatus</i>
Yellow Perch	<i>Perca flavescens</i>

2.4.3 Norris Creek

Norris Creek is the only creek system that occurs within Killiney Beach. It originates near the western study area boundary and flows downslope towards Okanagan Lake. Norris Creek has persistent surface flows in some segments with bankfull widths of up to 2 m. In other segments, flows are seasonal (ephemeral) and the channel is more poorly defined to discontinuous. At the upper limits of the Killiney Beach area the creek flows downslope through a defined channel and gully for about 700 m where it then infiltrates to the ground. A new creek segment then starts approximately 150 m north of where the upper segment ended (going to ground). The beginning of the second segment is ephemeral and there are areas where there is no defined channel. The lower segment of the creek reemerges just upslope of Killarney way and follows a narrow defined channel to Okanagan Lake.



2.4.4 Springs

Several springs, including Norris, Cornish, Hall and other unnamed springs occur within the Killiney Beach area. The springs range from natural seepages with well-developed riparian vegetation to highly modified features, having been ditched or piped between residential and accessory structures and roads. Some of the more natural seepages and springs support pockets of cattail (*Typha latifolia*) and Baltic rush (*Juncus balticus*), and several of the unknown springs located north of the study area have sizable broadleaf forest ecosystems associated with them. The natural springs with well-established broadleaf communities are rare, have high wildlife and biodiversity value, and are of conservation concern.

2.5 Rare and Endangered Plants

The British Columbia CDC was queried for potential occurrences of rare plants that may occur within Killiney Beach. The search distribution was refined using the following criteria: Okanagan Ministry of Environment Region, Regional District of Central Okanagan, interior Douglas-fir Biogeoclimatic Zone, and agriculture, forest, riparian, spring and rock/sparsely vegetated, habitat types. The resulting list includes twelve (12) potentially occurring rare vascular plant species (Table 4). The CDC does not list element occurrences of rare plants within the vicinity of Killiney Beach, however they still may occur there.

Table 4. Summary of rare and endangered plants with the potential to occur within Killiney Beach.		
Common Name	Scientific Name	Provincial Status ¹
blunt-sepaed starwort	<i>Stellaria obtusa</i>	Blue
cup clover	<i>Trifolium cyathiferum</i>	Red
false-pimpernel	<i>Lindernia dubia</i> var. <i>anagallidea</i>	Blue
giant helleborine	<i>Epipactis gigantea</i>	Blue
near navarretia	<i>Navarretia propinqua</i>	Red
northern linanthus	<i>Leptosiphon septentrionalis</i>	Blue
obscure cryptantha	<i>Cryptantha ambigua</i>	Blue
oniongrass	<i>Melica bulbosa</i>	Blue
peach-leaf willow	<i>Salix amygdaloides</i>	Red
red-rooted cyperus	<i>Cyperus erythrorhizos</i>	Red
scalegod	<i>Idahoa scapigera</i>	Blue
short-flowered monkey-flower	<i>Mimulus breviflorus</i>	Blue

¹ Source: <http://www.env.gov.bc.ca/cdc/>

Blue: Of special concern. Red: Endangered or threatened.



2.6 Wildlife Species At Risk

Species at risk were identified in the context of provincial and national ranking systems. The provincial ranking system applies to species that have been assessed by the CDC. The national ranking system applies to species that have been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The CDC was queried for potential occurrences of at risk wildlife with the potential to occur within Killiney Beach (Table 5). The search distribution was refined using the following criteria: Okanagan Ministry of Environment Region, Regional District of Central Okanagan, Interior Douglas-fir Biogeoclimatic Zone, and agriculture, forest, riparian, springs and rock/sparsely vegetated.

Killiney Beach contains an assemblage of woodland, riparian, and sparsely vegetated communities which provide cover and refuge for a range of wildlife. Mature trees and snags provide nesting, roosting, and foraging habitat for cavity nesting species such as Lewis's Woodpecker, and Western Screech-owl (Fenger *et al.* 2006). The



CDC reports an occurrence of American Badger (#74373) that was last sighted in 2012 which overlaps Killiney Beach.

Table 5. Summary of species at risk with the potential to occur within Killiney Beach.

Species Group	Common Name	Scientific Name	Provincial Status ¹	COSEWIC Listing ²
Amphibians	Great Basin spadefoot*	<i>Spea intermontana</i>	Blue	Threatened
	western toad*	<i>Anaxyrus boreas</i>	Blue	Special Concern
Birds	American bittern	<i>Botaurus lentiginosus</i>	Blue	-
	California Gull	<i>Larus californicus</i>	Blue	-
	canyon wren	<i>Catherpes mexicanus</i>	Blue	Not At Risk
	barn swallow*	<i>Hirundo rustica</i>	Blue	Threatened
	black swift	<i>Cypseloides niger</i>	Blue	Endangered
	burrowing owl	<i>Athene cunicularia</i>	Red	Endangered
	flamulated owl*	<i>Otus flammeolus</i>	Blue	Special Concern
	great blue heron*	<i>Ardea herodias herodias</i>	Blue	-
	horned lark	<i>Eremophila alpestris merrilli</i>	Blue	Special Concern
	lark sparrow	<i>Chondestes grammacus</i>	Blue	-
	Lewis's woodpecker*	<i>Melanerpes lewis</i>	Blue	Threatened
	olive-sided flycatcher*	<i>Contopus cooperi</i>	Blue	Threatened
	short-eared owl	<i>Asio flammeus</i>	Blue	Special Concern
	Swainson's hawk	<i>Buteo swainsoni</i>	Red	-



Species Group	Common Name	Scientific Name	Provincial Status ¹	COSEWIC Listing ²
	western screech-owl	<i>Megascops kennicottii macfarlanei</i>	Red	Threatened
	white-throated swift	<i>Aeronautes saxatalis</i>	Blue	Special Concern
	yellow-breasted chat	<i>Icteria virens</i>	Red	Endangered
Invertebrates	black gloss	<i>Zonitoides nitidus</i>	Blue	-
	common sootywing	<i>Pholisora catullus</i>	Blue	-
	Emma's dancer	<i>Argia emma</i>	Blue	-
	immaculate green hairstreak	<i>Callophrys affinis</i>	Blue	-
	lilac-bordered copper	<i>Lycaena nivalis</i>	Blue	-
	magnum mantleslug	<i>Magnipelta mycophaga</i>	Blue	Special Concern
	monarch	<i>Danaus plexippus</i>	Blue	Special Concern
	Nevada skipper	<i>Hesperia nevada</i>	Blue	-
	pale jumping-slug	<i>Hemphillia camelus</i>	Blue	-
	silky vallonina	<i>Vallonia cyclophorella</i>	Blue	-
	vivid dancer	<i>Argia vivida</i>	Blue	Special Concern
Mammals	American badger	<i>Taxidea taxus</i>	Red	Endangered
	Bighorn sheep*	<i>Ovis Canadensis</i>	Blue	-
	Fisher*	<i>Pekania pennant</i>	Blue	-
	fringed myotis	<i>Myotis thysanodes</i>	Blue	Data Deficient
	grizzly bear	<i>Ursus arctos</i>	Blue	Special Concern
	Northern bog lemming	<i>Synaptomys borealis artemisiae</i>	Blue	-
	Nuttall's cottontail	<i>Sylvilagus nuttallii</i>	Blue	Special Concern
	Preble's shrew	<i>Sorex preblei</i>	Red	-
	spotted bat	<i>Euderma maculatum</i>	Blue	Special Concern
	Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	Blue	-
	western harvest mouse	<i>Reithrodontomys megalotis</i>	Blue	Special Concern
	western small-footed myotis	<i>Myotis ciliolabrum</i>	Blue	-
	white-tailed jackrabbit	<i>Lepus townsendii</i>	Blue	-
	wolverine	<i>Gulo gulo luscus</i>	Blue	Special Concern
Reptiles	Great Basin gopher snake*	<i>Pituophis catenifer deserticola</i>	Blue	Threatened
	painted turtle – intermountain- rocky Mountain population*	<i>Chondestes grammacus</i>	Blue	-
	western rattlesnake	<i>Crotalus oreganus</i>	Blue	Threatened
	western skink*	<i>Plestiodon skiltonianus</i>	Blue	Special Concern
	western yellow-bellied racer*	<i>Coluber constrictor mormon</i>	Blue	Threatened

¹ Source: <http://www.env.gov.bc.ca/cdc/>

Yellow: Not considered at risk. **Blue:** Of special concern. **Red:** Endangered or threatened.

² Source: <http://www.cosewic.gc.ca/>

Threatened: A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern: A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Not at Risk: A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

Endangered: A wildlife species facing imminent extirpation or extinction.

Data Deficient : A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction.

*have a higher likelihood of occurring in Killiney Beach Subdivision



3.0 ENVIRONMENTAL IMPACT ASSESSMENT

There is a central core of higher density development within Killiney Beach that extends along the northeastern study area boundary and spans south to the proximity of Norris Creek. The lots within this core area are smaller in size and have been highly modified. Larger lot sizes and less disturbance occurs along the western and southern periphery of the study area. Within these areas, mature forest communities that are red and blue-listed remain relatively intact and are in good condition. They are ecologically functional and provide valuable wildlife habitat for a variety of native species, including those that are rare and endangered.

The northwest side of Okanagan Lake surrounding Killiney Beach provides critical range for mule deer and California bighorn sheep. Wildlife movement through the subdivision and adjacent areas likely follows the higher sensitivity polygons shown in Figure 3. North/south movement corridors occur along the western study area boundary and within the neighbourhood core where Very High polygons provide a connection, albeit fragmented, through Killiney Beach. East/west movement to and from Okanagan Lake is probable along portions of the Norris Creek corridor.

Environmental effects documented within Killiney Beach include incremental loss of riparian vegetation and habitats, the modification of watercourses, the loss of wildlife movement corridors due to the expansion of road networks and increased development, and the loss of mature forest and rare ecosystems that are critical for the survival of rare and endangered wildlife. Existing watercourses (springs and Norris Creek) in developed areas have been modified with the use of culverts, ditches and pipes, and in several cases broadleaf riparian ecosystems have been cleared. Native understories have been replaced with horticultural plants and turf, and weeds ubiquitously occur with land modification.

These impacts at the subdivision level can seem insignificant, but when considered cumulatively across the Okanagan Valley, they become more tangible and problematic. It is expected that the desire to live and recreate in Killiney Beach will increase with improved access through ongoing upgrades of Westside Road. As development expands, further loss of natural habitat is anticipated. Recreational pressures on the lakefront of Okanagan Lake will also increase, especially with the upscaling of residences and gentrification of summer homes.






4.0 FINDINGS AND RECOMMENDATIONS

4.1 Environmentally Sensitive Areas

The Environmental Sensitivity Analysis (ESA) followed the methods outlined in Section 2.1.3. Figure 3 depicts the results of the ESA and Table 6 shows the breakdown of values by area (ha) and relative extents of coverage within the Killiney Beach study area. The ESA indicated that the majority of Killiney Beach has a Moderate (54%) rating. A grouping of Very High and High rated polygons are located within the southern and western portions of the subdivision. These areas represent contiguous, intact mature and young coniferous woodland.



Table 6. Percent composition of ESAs that intersect the Killiney Beach subdivision (224 ha).

ESA Value	ESA Area (ha)	Percent of Area (%)
 <p>Very High (ESA 1) Mature mixed woodland and riparian communities</p>	47.51	21
 <p>High (ESA 2) Mature coniferous woodland with rural influence</p>	54.92	25
 <p>Moderate (ESA 3) Perforated/fragmented rural properties and cultivated orchard</p>	121.73	54
Low (ESA 4)	0	0



4.2 Recommended Changes to Development Permit Areas

The Aquatic Ecosystem DP areas were refined by only including field confirmed watercourses and broadleaf forest and riparian features that were mapped during the SHIM assessment. The bank full width of each confirmed watercourse was buffered by 30 m to form the edge of the Aquatic Ecosystem DP areas. In cases where bank full width data was not available, a 1 m channel width was assumed and subsequently buffered. The mapped extent of broadleaf forest (Figure 5-0), and areas within 30 m of the Okanagan Lake were also included to form the updated Aquatic Ecosystem DP area.

The Terrestrial DP areas were refined by incorporating Very High and High rated polygons from the ESA. Originally, terrestrial DP areas were developed using SEI data, but because there were classification errors within some of the polygons of interest, refined ESA values were used instead of SEI data. In cases where there was overlap between Aquatic and Terrestrial DP areas, Aquatic Ecosystem superseded that of Terrestrial. In some cases this resulted in small fragments of overhanging Terrestrial DP areas. Professional judgement was used to eliminate non-essential DP areas. Figure 4 depicts the recommended changes to the Aquatic Ecosystem and Terrestrial DP areas.

Field review and verification reduced the extents of Aquatic Ecosystem DP areas, while resulting in a small increase in Terrestrial DP areas. There are approximately 230 parcels that overlap with the two DP areas, compared with almost 290 parcels that overlapped previously.

4.3 Watercourse Setbacks and Policy

Figures 5-0 through 5-10 depict the watercourses present within Killiney Beach, as well as pertinent riparian setbacks. Riparian Area Regulation setbacks were determined for all watercourses that are applicable under the RAR and Recommended Setbacks / No Build Areas are shown for all identified watercourses.

It was not within the project scope to prescribe specific setbacks for individual lots. Instead a 15 m setback was recommended for all watercourses. This blanket setback was chosen for two reasons: First, the fieldwork confirmed that a smaller setback of less than 15 m was not sufficient for all properties. As an example, a reduced setback (e.g. 10 m) along the upper portion of Norris Creek, was not large enough to prevent development from encroaching below the top of bank of a gully that surrounds the creek. Second, the 15 m setback is consistent with the Rural Westside OCP, which has clearly established leavestrip areas for creeks and wetlands that are fish bearing or connected by surface flows to fish bearing watercourses, as no less than 15 m measured from bank full width (RDCO 2010).



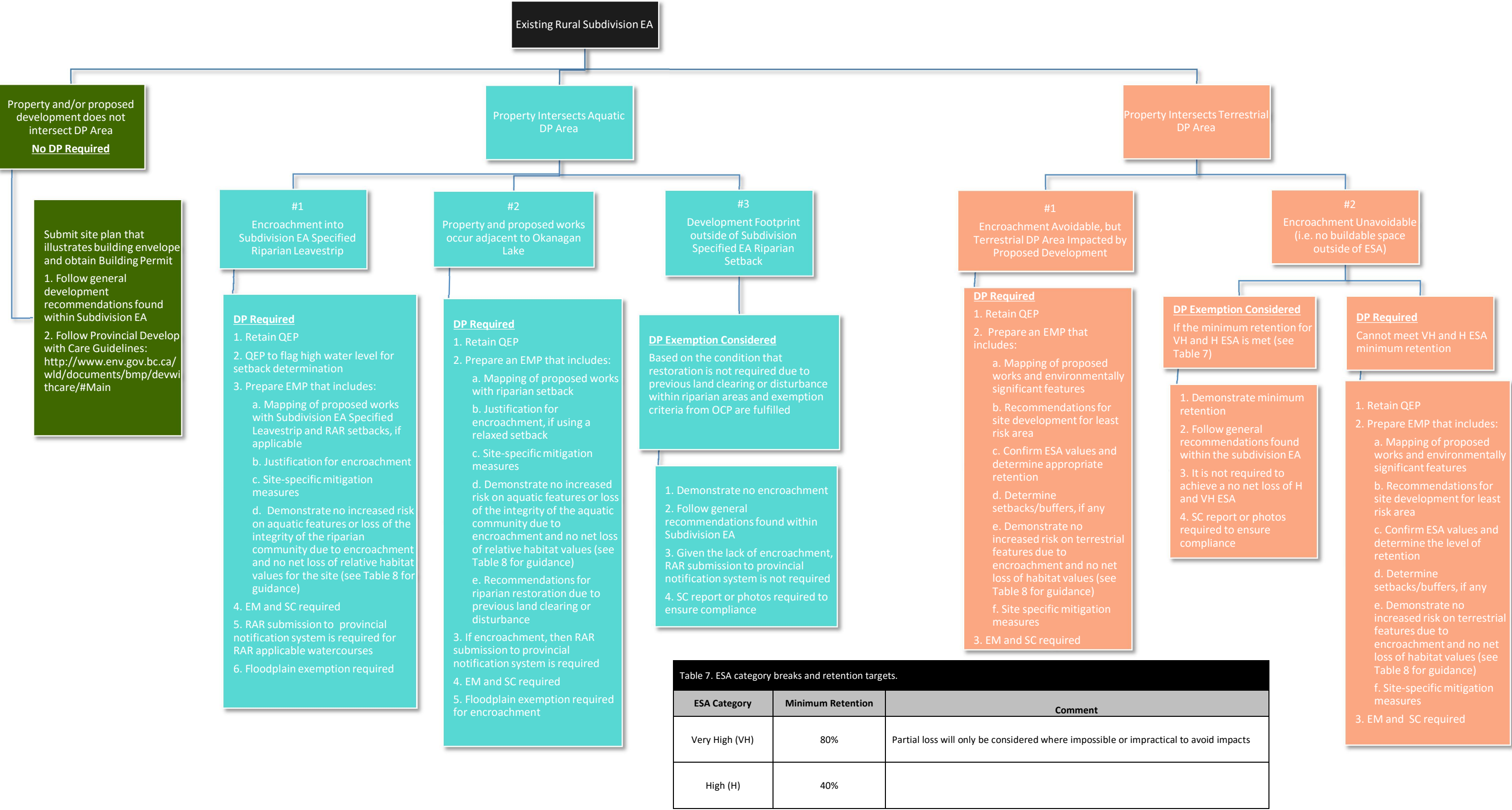
Despite the 15 m blanket setback, its acknowledged that for watercourses that are confined by a narrow channel or for seepages where there is no channel, a 15 m setback can be excessive, especially if the setback results in sterilization of the lot. For this reason, the 15 m setback can be reduced through a more detailed site specific assessment by a Qualified Environmental Professional (QEP). If there is desire to encroach, then a QEP will need to determine the most appropriate setback and provide justification for the possible relaxation.

4.4 Environmental Permitting of Future Development

This overview EA for Killiney Beach is meant to streamline the environmental permitting requirements for future development within the subdivision. Figure 6 depicts a flow chart that outlines several permitting paths dependent on a) if the proposed development is located within or outside of Aquatic and Terrestrial DP areas, and b) whether the development encroaches into recommended setbacks or is located within High and Very High ESAs.



Figure 6. Implementation Plan for Future Development in Killiney Beach.



¹ DP – development permit; EA – environmental assessment; EMP – environmental management plan; EM – Environmental Monitor; ESAs – environmentally sensitive areas; QEP – Qualified Environmental Professional; OCP – official community plan; SC – substantial completion report prepared by the EM/QEP that confirms the development extents and mitigation, effectively protected the integrity of the specified setback area and completion of proposed works were fulfilled as planned.

² RAR submission to the provincial notification system is required for all RAR applicable watercourses (those connected by surface flow to a fish bearing waterbody), when the proposed development encroaches into the Subdivision EA specified riparian leavestrip. If the proposed development stays outside of the leavestrip, then a RAR upload is not required, even if the property occurs within 30 metres of a RAR applicable watercourse. RDCO will not issue a DP until the RAR assessment has been accepted by the Province.

³The minimum retention of ESA categories (Table 7), is only relevant to determine if a DP exemption may be considered. If the proponent seeks to develop an area that results in reduced area retention from the minimum range, then a QEP will assess the site at a finer spatial scale and determine the relative position that the site occupies in the ESA spectrum, to rationalize a reduced retention area. Areas of the highest value within each category will have greater overall area retention targets to help ensure that development planning takes the relative value into consideration and each polygon has a limit to development (refer to Table 8 for guidance to determine no net loss).

The guiding principles of Avoid, Mitigate, and Enhance apply to proposed development in environmentally sensitive areas (i.e. High and Very High ESAs and within the recommended riparian setbacks). The principles are generally described as follows.

1. **Avoid:** Development proposals should seek to avoid areas of High and Very High environmental sensitivity (ESA 1 and ESA 2).
2. **Mitigate:** If circumstances prevent avoidance of development within an environmentally sensitive area, proven mitigation measures must ensure the least possible amount of environmental damage during development.
3. **Enhance:** Habitat and ecosystem enhancement consists of improvements to the remaining natural or sensitive areas found on the property to ensure ecological integrity and function is maintained and/or improved. Enhancement should be site-specific and prescribed to increase the relative habitat value of the site. Examples of enhancement include large woody debris placement, invasive plant management, inclusion of bird boxes to increase cavity nesting opportunities, planting of native species within disturbed areas and an overall increase in structural heterogeneity and biodiversity potential.

Table 8 provides a relative habitat value rating for natural ecosystems and for anthropogenic features. It is provided as guidance for one way to objectively achieve a no net loss of habitat value or increased risk on aquatic and terrestrial features due to encroachment. When encroachment is proposed, the relative habitat value of a property could be determined before and after development. If the value is reduced due to encroachment, then enhancement of the remaining natural ecosystems should be undertaken to improve the environmental conditions on site and to achieve a no net loss in relative habitat value.



Table 8. Relative habitat value ratings for discreet vegetation types (communities) and anthropogenic features occurring in the RDCO Northwest Side.

Group	Qualifier	Comment	Relative Habitat Value
Wetland	1-3 veg forms	low structural heterogeneity	0.8
	4-6 veg forms	moderate structural heterogeneity	0.9
	≥7 veg forms	high structural heterogeneity	1
Treed Coniferous	Structural Stage 4	relatively eve-aged pole sapling	0.5
	Structural Stage 5	low relative structural heterogeneity	0.6
	Structural Stage 6	moderate relative structural heterogeneity	0.8
	Structural Stage 6-7	high relative structural heterogeneity	0.9
Tall Shrub	Natural	low flood, seepage areas, riparian thickets, etc.	0.7
Treed Riparian/Broadleaf	Natural	black cottonwood stands	1
Grassland	Natural		0.9
Building	Urban/Rural		0
Road	Urban/Rural	paved or gravel	0
Retaining Wall	Urban/Rural		0
Trail/Path	Rural	semi-pervious	0.1
Exposed Soil	Disturbed		0.1
Shoreline Armouring	Modified	e.g. rip rap	0.2
Turf	Urban/Rural	grass/herb lawns - mowed	0.1
Landscape - Shrub	Urban/Rural	non-native horticultural varieties/landscaping	0.2
Treed - Landscape	Urban/Rural	native understory strata generally absent and consisting of turf and landscaping	0.5
Beach	Disturbed	groomed recreational swimming beach	0.2
Pasture/Field	Agriculture		0.3
Row Crops	Agriculture		0.2
Orchard	Agriculture		0.4
Shoreline Armouring/Bioenginerring	Urban/Rural	rock with large woody debris	0.4

Relative Habitat Value considers biodiversity and production



4.5 Specific Recommendations by Watercourse

Table 9-1. Recommendations pertaining to Killiney Beach watercourses: Okanagan Lake.

Watercourse Name:	Okanagan Lake
Corresponding Figure Number:	5-0
RAR Applicable:	Yes
RAR Setback (metres), if applicable:	15
Recommended Setback / No Build Zone (metres):	15
Representative Photos:	 <p>Example of lakefront home within Killiney Beach.</p>
<p>Discussion, Recommendations and Specific Mitigation Measures:</p> <p>Lakefront properties within Killiney Beach occur along a Yellow shoreline sensitivity zone that is identified in the Rural Westside OCP (RDCO 2010). The leavestrip for yellow zones is 15 m from the Okanagan Lake high water level. This setback is consistent with RAR, as large woody debris and litterfall apply to all Killiney Beach lakefront properties (Figure 5-0). The RAR shade setback (30 m due south) is not applicable.</p> <p>The Yellow sensitivity zone identified in the OCP was created in part based on the number of documented spawning kokanee and the kokanee zones developed for Okanagan Lake. Yellow kokanee zones, which are located along the Killiney Beach shoreline, represent moderate to high value habitat that is required for the long term maintenance and recovery of kokanee. Yellow zones were identified as locations where spawning aggregations of 50 or fewer fish were observed in recent years (2001-2008) or where documented historic spawning activities with aggregations of less than 1000 fish were recorded. Historic kokanee spawning numbers are shown along Killiney Beach in Figure 5-0.</p> <p>Riparian setbacks for Okanagan Lake, being 15 m as defined by the OCP and RAR are consistent along the entire Killiney Beach lakefront. Despite the defined setbacks, there are numerous recreational and residential structures that substantially encroach. Most of these structures are likely grandfathered, but the precedent for constructing homes close to the Okanagan Lake high water level has been set. Many environmental infractions were also noted and include: placement of concrete below the high water level, beach grooming and importation of sand, nonconforming dock structures and patios, private boat launches and roadways below the high water level, constructed groins and riparian vegetation removal.</p> <p>Lakefront Killiney Beach residents would benefit from a stewardship program that details Best Practices for Waterfront Living. Specific regulations pertinent to lakefront properties are included within Section 4.6.3 Development Based Recommendations and Mitigation.</p>	



Table 9-2. Recommendations pertaining to Killiney Beach watercourses: Cornish Spring.



Watercourse Name:	Cornish Spring
Corresponding Figure Number:	5-1
RAR Applicable:	No
RAR Setback (metres), if applicable:	-
Recommended Setback / No Build Zone (metres):	15
Representative Photos:	 <p>Riparian vegetation associated with Cornish Spring.</p>  <p>Structure associated with water extraction.</p>
<p>Discussion, Recommendations and Specific Mitigation Measures:</p> <p>Cornish Spring flows for about 33 m and extends across 9284 Hodges Road and 55 Kilarney Place, two largely undeveloped lakefront properties. The water goes to ground at the toe of slope approximately 75 m from the high water level of Okanagan Lake, and therefore is not RAR applicable. Cornish Spring was delineated during the Northwest Side SHIM assessment; a bank full width was defined as 1.2 m. The SHIM also noted that riparian vegetation clearing had occurred. The recommended 15 m setback / no build zone could potentially be reduced, but would require a more detailed assessment by a QEP. When future development is proposed, restoration works in the form of native riparian planting within the setback should be undertaken to offset previous clearing.</p>	

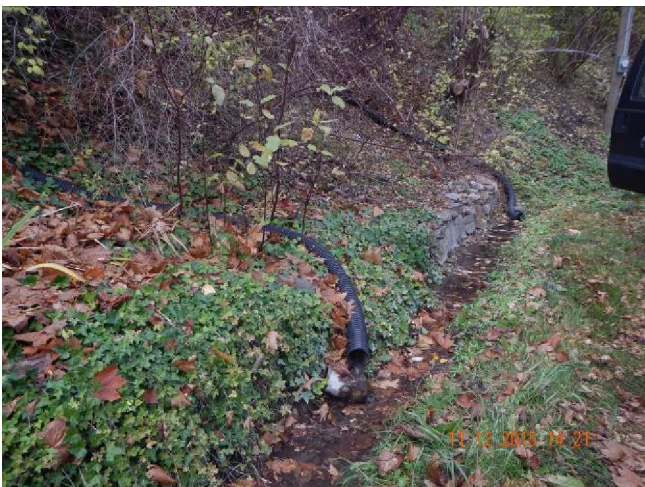

Table 9-3. Recommendations pertaining to Killiney Beach watercourses: Hall Spring.	
Watercourse Name:	Hall Spring
Corresponding Figure Number:	5-2
RAR Applicable:	Yes
RAR Setback (metres), if applicable:	10
Recommended Setback / No Build Zone (metres):	15
Representative Photos:	 <p>Hall Spring upslope of the access road.</p>  <p>Hall Spring piped around accessory buildings.</p>
<p>Discussion, Recommendations and Specific Mitigation Measures: Hall Spring originates upslope of a narrow, dirt access road for several lakefront homes/cottages. The spring has been piped beneath the road and between accessory buildings on a lakefront property, prior to flowing into Okanagan Lake. Existing residential structures occur well within the riparian setbacks. The SHIM data indicates that there was overland flow with no defined channel. A bank full width of 0.69 m was recorded. SHIM photos confirm the spring was piped at the time of assessment. Ideally, where possible, the pipes would be removed and the water allowed to naturally flow, with the establishment of surrounding riparian vegetation.</p>	



Table 9-4. Recommendations pertaining to Killiney Beach watercourses: Killiney Spring 1.

Watercourse Name:	Killiney Spring 1
Corresponding Figure Number:	5-3
RAR Applicable:	Yes, lower portion only
RAR Setback (metres), if applicable:	10
Recommended Setback / No Build Zone (metres):	15
Representative Photos:	 <p>Beginning of the upper segment of Killiney Spring 1</p>  <p>Shows the seepage and filamentous green algae adjacent to Okanagan Lake</p>
Discussion, Recommendations and Specific Mitigation Measures: <p>Both segments of Killiney Spring 1 occur within a single undeveloped waterfront property (9475 Kilkenny Place). The upper portion of Killiney Spring 1 was identified during SHIM and was reaffirmed during this assessment. The upper spring has surface flow for approximately 10 m, without a defined channel prior to disappearing to ground. Flows reemerge near the toe of slope adjacent to Okanagan Lake that was not previously documented in the SHIM. Pooling and filamentous green algae were documented in some areas, prior to discharging into Okanagan Lake.</p>	





The lower seepage occurs within the 15 m setback of Okanagan Lake and therefore is not likely to be targeted for residential development. A dense riparian thicket dominated by willow, red-osier dogwood and Nootka rose along with some weedy species occurs over the seepage area. Future foreshore access development (trail or tram) should avoid this wet area and native vegetation within the 15 m setback of Okanagan Lake should not be removed. The adjacent properties on both sides of this undeveloped lot have been highly modified with structures well within the Okanagan Lake setback, and thus there may be a desire to do something similar on this property.

The 15 m recommended setback / no build zone on the upper segment of Killiney Spring 1 could likely be reduced with little impact to the spring. A QEP should be engaged to provide and justify a reduced setback and to ensure the continuance of surface and groundwater flows.



Table 9-5. Recommendations pertaining to Killiney Beach watercourses: Norris Creek.

Watercourse Name:	Norris Creek
Corresponding Figure Number:	5-4 through 5-7
RAR Applicable:	Yes, lower segment only (see Figure 5-7)
RAR Setback (metres), if applicable:	10
Recommended Setback / No Build Zone (metres):	15
Representative Photos:	 <p>A non RAR applicable segment of Norris Creek where the top of bank sits greater than 10 m back from the bank full width (Figure 5-4; between Winchester Road and Keithley Road).</p>  <p>Norris Creek immediately upstream of the recently developed pond (Figure 5-4; below Lester Road).</p>





Recently developed / expanded pond (Figure 5-5).



Norris Creek below the pond where it has been ditched to prevent property damage (Figure 5-5).



Culvert at Westside Road where Norris Creek flows intermittently and a channel is not well defined.

Discussion, Recommendations and Specific Mitigation Measures:

All properties that intersect Norris Creek were not investigated. Rather, conditions adjacent to roads were noted. Norris Creek originates near the western study area boundary. In this area downstream to Udell Road, Norris Creek forms a gully that requires a setback greater than 10 m to prevent development from encroaching below the top of bank (Figure 5-4). Between Udell and Lester Roads, a gully was not apparent, so a 10 m setback is likely more justifiable for this non-RAR segment of the watercourse.

Below Lester Road, an approximately 600 m² pond was encountered near where the SHIM data showed Norris Creek going to ground. The pond had recently established, as ponderosa pine and other non-hydrophilic vegetation were underwater in the centre of the pond. Through conversation with the property owner downslope of the pond, it was understood that the pond had been present for about 2 years. Below the pond, a ditch has been constructed to contain the overflowing water and to prevent damage to personal property. The water then flows downslope, sheeting over ground into a ditch along Westside Road, where it eventually goes to ground. Based on these observations, it is thought that changes in the upper watershed (above the study area) maybe the cause of increased and more persistent flows (e.g. drainage alteration/flow diversion).

Figure 5-5 shows the proximity of Norris Creek below the pond. The flow is ditched prior to naturally flowing downslope across an undeveloped property to the north. This area is fairly steep and the routing of Norris Creek across this property results in the need for several assessments (geotechnical, environmental) at the time of development. Driveway construction across the steep slope may be of concern due to the presence of this flowing water. The creek then reaches the ditch along Westside Road. Riparian setbacks from this ditch could be considerably relaxed from 15 m to 2 to 5 m, as is typical for a 'ditch' under the RAR.

Figure 5-6 shows the next segment of Norris Creek. The creek channel above Westside Road is poorly and intermittent and discontinuously defined. A culvert extends beneath Westside Road, but there was no evidence of a channel immediately downslope of Westside Road where a driveway has been constructed. This segment of Norris Creek was included as a precaution, based on observed flows and channel character further upslope.

Figure 5-7 shows the last segment of Norris Creek that flows into Okanagan Lake and is RAR applicable. Flows in this area are also intermittent; however a channel was well defined in some locations.

The blanket 15 m recommended setback / no build zone could likely be reduced with little impact to the creek on some properties where the creek is confined to a narrow channel. However, on other properties, where there is significant down cutting through a gully, development should be set back from the top of bank. A QEP should be engaged to provide and justify a reduced setback where appropriate.



Table 9-6. Recommendations pertaining to Killiney Beach watercourses: Norris Spring.



Watercourse Name:	Norris Spring
Corresponding Figure Number:	5-8
RAR Applicable:	No
RAR Setback (metres), if applicable:	-
Recommended Setback / No Build Zone (metres):	15
Representative Photos:	 <p>Looking west at Norris Spring adjacent to Udell Road showing a moisture receiving community dominated by red-osier dogwood. Water was flowing during the January 21, 2016 field survey.</p>  <p>Looking east at Norris Spring upslope of Udell Road</p>
Discussion, Recommendations and Specific Mitigation Measures: <p>The information pertaining to Norris Spring is approximate, as access for SHIM fieldwork was not granted by the landowner. Therefore the watercourse alignment and presence of a broadleaf forest was estimated using airphoto interpretation. Because of this, it is recommended that a more detailed environmental assessment be undertaken prior to future development of Lot 68 (684 Udell Road) to define the spatial extents of the watercourse and associated riparian communities.</p>	






Table 9-7. Recommendations pertaining to Killiney Beach watercourses: Unnamed Spring.	
Watercourse Name:	Unnamed Spring (at the end of Keithley Road)
Corresponding Figure Number:	5-9
RAR Applicable:	No
RAR Setback (metres), if applicable:	-
Recommended Setback / No Build Zone (metres):	15
Representative Photos:	 <p>Broadleaf vegetation that occurs downslope of the spring</p>
<p>Discussion, Recommendations and Specific Mitigation Measures:</p> <p>The unnamed spring occurs at the north end of Keithley Road and consists of seepage originating from a hillslope. A broadleaf forest ecosystem community has established downslope of the spring, and occurs on the edge of a larger broadleaf forest polygon (consisting primarily of trembling aspen) that was mapped during SHIM (Figure 5-0; occurring along the northern study area boundary).</p> <p>The spring occurs on a residential lot with existing rural landuse. The seepage and shallow groundwater is important in maintaining the broadleaf forest community down slope and therefore efforts should be made to maintain the feature and drainage characteristics. Having said this, the blanket 15 m recommended setback / no build zone could likely be reduced with little impact to the spring. A QEP should be engaged to provide and justify a reduced setback.</p>	



Table 9-8. Recommendations pertaining to Killiney Beach watercourses: Unnamed Spring.

Watercourse Name:	Unnamed Springs (north of the Killiney Beach study area)
Corresponding Figure Number:	5-10
RAR Applicable:	No
RAR Setback (metres), if applicable:	-
Recommended Setback / No Build Zone (metres):	15
Representative Photos:	 <p>Wet area due to the western most spring</p>  <p>Mature broadleaf forest that has established around the springs</p>





Eastern most spring is used to water livestock

Discussion, Recommendations and Specific Mitigation Measures:

There are two Unnamed Springs that are located north of the study area just upslope of an agricultural field on 9742 Westside Road (Figures 5-0 and 5-10). A fairly extensive intact, mature broadleaf forest has established around these springs. However, there is evidence of recent disturbance within the dense canopy due to the construction of a fence line. The eastern most spring is also used to water livestock.

A blanket 15 m setback is shown for each of these springs (Figure 5-10), however maintaining the full extent of the broadleaf forest is recommended. Ideally, there will be no further encroachment into the defined aquatic DP area in this location.



4.6 Development Based Recommendations and Mitigation

Mitigation measures and Best Management Practices (BMPs) to minimize environmental impacts that are often associated with residential development are summarized below.

4.6.1 General Mitigation Measures

- Prior to any disturbance, sensitive environmental features (watercourses / ESAs) should be clearly defined by a QEP and subsequently surveyed by a qualified land surveyor such that site plans incorporate these features designated for protection. Following the survey, the setback boundary and development footprint must be delineated prior to construction using brightly coloured snow fence.
- In the event that land and/or natural vegetation is disturbed or damaged beyond the limits of disturbance, these areas should be restored and/or replanted with plant material indigenous to the area under the direction of the EM.
- The release of fine sediments, construction debris or other substances deleterious to the terrestrial environment or to aquatic habitats (e.g., gasoline) must be prevented at all times during construction activities.
- Ensure that onsite machinery is in good operating condition, clean and free of leaks, excess oil, or grease.
- Spill containment kits appropriate for the number of machines onsite must be kept readily available in case of the accidental release of a deleterious substance to the environment. Any spills of a toxic substance of reportable quantities must be immediately reported to the Provincial Emergency Program 24 hour hotline at 1-800-663-3456. The spill kit must be appropriate for addressing spills of hydrocarbons in waterbodies.
- Wherever possible, trees with high wildlife value, such as veteran trees and large snags, should be conserved. Hazardous trees with wildlife value within the vicinity of the construction works should be assessed by a certified Wildlife/Danger Trees Assessor to determine levels of risk. Alternatives to falling wildlife trees may include topping or other modifications to improve safety while retaining habitat value.
- Existing native trees that occur within the riparian setbacks of identified watercourses or Okanagan Lake should be retained to maintain existing



ecological values. Tree removal within a riparian setback, if deemed to be hazardous, will trigger the provincial tree replacement criteria, provided below.

Table 10. Tree replacement criteria

Trees to be removed	Replacement/Compensation tree requirements	
Diameter at Breast Height	Quantity	Size (min. height)
DBH < 151 mm	2	1.5 m (or 4 shrubs)
152 mm-304 mm	3	1.5 m
305 mm-456 mm	4	2.0 m
457 mm-609 mm	6	2.0 m
610 mm-914 mm	8	2.0 m
DBH > 914 mm	individual approval	individual criteria

Source: Department of Fisheries and Oceans Canada (2006)
Ministry of Environment Lands and Parks (1996)

- Prior to the removal or limbing of trees during the avian nesting season (April 1 – July 31), a nest survey to ensure there are no active nests must be undertaken by a QEP.
- If active nests are found within the clearing limits, a buffer will be established around the nest until such time that the environmental monitor can determine that the nest has become inactive. The size of the buffer will depend on the species and nature of the surrounding habitat. Buffer sizes will generally follow provincial BMP guidelines or other accepted protocols (e.g., Environment Canada). In general, a minimum 20 m buffer will be established around songbird nests or other non-sensitive (i.e., not at risk) species.

4.6.2 Invasive Plant Management

- Prevention of the spread of invasive plant species can be achieved by limiting disturbance to soils and native vegetation. Clearing limits should be conservative. All disturbed areas must be restored with native plantings or grass seeding. Grass seed must be Canada Agricultural Grade #1 to minimize weed seed counts. The grass seed mix used must be appropriate for the site conditions. Fodder species such as clover and alfalfa should not be included in the mixture.
- In accordance with the Regional Noxious Weed Control Bylaw (#179) weed infestations should be identified and controlled by property owners with regular manual removal of weeds (e.g., mowing, pulling). The use of pesticides/herbicides must be avoided when in proximity to watercourses.



4.6.3 Lake Front Properties

- No works can occur below the 343 m elevation of Okanagan Lake without having a Provincial Water Act Section 9 Notification/Approval application submitted, approved, and in the possession of the property owner and contractor prior to any instream works. Dredging or placement of fill below the lake high water level must not occur at any time.
- Fueling or vehicle maintenance must not occur within 30 m of the high water level of Okanagan Lake.
- No beach grooming, addition of sand, removal of cobbles/boulders, or removal of riparian vegetation should occur at any time.
- Demolition and construction materials must not be stored on the beach over native substrates to avoid compaction.

4.6.4 Erosion and Sediment Control

- Erosion and sediment control are particularly important when construction works occur adjacent to watercourses (e.g. Okanagan Lake, streams). Mitigation measures are generally based upon provincial BMPs and other specifications and include the following principles:
 - Construction works should be conducted during periods of low flow with little forecasted precipitation;
 - Works should be suspended during periods of heavy rain.
 - Natural drainage patterns should be maintained;
 - Existing native vegetation should be retained;
 - Stormwater and surface runoff should be directed away from exposed soils within the construction area;
 - Sediment-laden water should not be directed to any surface water feature, wetland, or other drainage system, including municipal storm sewer;
 - Slopes should be stabilized as soon as possible;
 - Other erosion and sediment control measures (described below) should be implemented, inspected, maintained, and/or replaced as required to provide appropriate mitigation.
- The Okanagan Lake shoreline adjacent to Killiney Beach has the potential to support kokanee spawning. It is imperative that sediment laden water does not flow down slope into Okanagan Lake foreshore areas.
- Surface flows should be directed away from the construction site to avoid the degradation of water quality. If flows cannot be directed offsite and surface



waters become turbid from flowing over exposed soils, the sediment-laden waters should be conveyed to a sediment trap or sump located at a low point of the construction site, but outside any riparian setbacks. The trap or sump should be of sufficient capacity to collect waters and allow for infiltration and settling of fine materials prior to discharge.

- Other erosion control measures may include: slope drains and interceptor ditches, grass seeding, rock, mulch, and tarps. Sediment control measures that may be employed include check dams, erosion control fabrics and logs, sumps and sediment traps, and rip-rap. Hay bales and straw are not desirable mitigation measures based on the potential to disperse non-native and invasive plant seeds.
- Silt fence will be installed along the construction limits between the construction area and sensitive terrestrial or aquatic environments. The silt fence should mitigate the risks associated with surface runoff and sediment transport and provide a visual barrier delineating the disturbance boundary. Fencing will be staked into the ground and trenched a minimum of 10 cm to prevent flow underneath the fence, as per the manufacturer's specifications.
- Silt fencing will be monitored on a daily basis and any damages or areas where the integrity and function of the fencing has been compromised will be repaired or replaced immediately. Silt fence must remain in place until the completion of the project. Once construction is finalized, sediment and erosion control measures must be promptly removed and properly disposed. Other equivalent sediment and erosion control measures may include check dams (e.g., rock or sand bag) to slow flows along drainage channels and ditchlines, sumps, or other settling areas for turbid waters.
- The release of silt, sediment, sediment-laden water, or any other deleterious substances into any ditch, watercourse, or storm sewer system must be prevented at all times. The recommendations for sediment and erosion control outlined in the Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck *et al.* 1992) should be used for reference.
- Exposed soils along slopes must be stabilized and covered using coconut matting, geotextile fabric, poly sheeting, tarps, or other suitable materials to reduce the potential for erosion resulting from rainfall, snowmelt, seepage, or other unexpected causes.
- Excess materials, overburden, and other cut and fill materials should not be stockpiled or deposited over steep slopes, over areas of shallow soils and sparsely vegetated ecosystems, or within 30 m of a watercourse, except within designated fill placement areas or as directed by an environmental monitor. Excavated fill should be stockpiled on tarps in order to minimize impacts to the



riparian area. Stockpiles should be covered with poly sheeting or tarps or surrounded with silt fencing to prevent sediment from being conveyed down slope to watercourses, particularly during rain events. Material not required for backfill must be transported offsite and disposed of appropriately.

- Adjacent roadways to construction sites must be kept clean and free of fine materials. Sediment accumulation upon the road surfaces must be removed (i.e., swept or scraped) and disposed of appropriately.
- Sediments, debris, concrete, concrete fines, or wash water associated with pouring of the concrete must not come into contact with watercourses or be discharged within 30 m of a watercourse. Equipment and tools used for concrete works must be washed offsite away from any watercourses and the concrete cast must remain inside sealed formed structures until cured.
- Cuts and fills with site grading and disturbance within the development footprint must be minimized, in order to limit the exposure of groundwater.

4.6.5 Air Quality and Greenhouse Gas Reduction

Dust control can be achieved by reducing the spatial extents and amount of time that soils are exposed to construction activities. Reducing traffic speed and volume can also reduce dust concerns. Surface and air movement of smoke and dust during project activities can be mitigated through preventive measures and design criteria.

- Exposed soils should be watered as required to suppress dust. Sediment-laden runoff water must not be conveyed to adjacent drainages/watercourses. Oil and other petroleum products should not be used for dust suppression. Alternative dust suppressants must be approved by the EM prior to application.
- Idle time of construction equipment and contractor vehicles should be kept to a minimum to reduce the release of greenhouse gases. The contractor should inform and educate employees and sub-contractors on the importance of minimizing idling time and develop guidelines to direct the practice of reducing unnecessary idling.
- Alternate energy sources should be considered during development of the site, such as solar panels and ground source heating and cooling. Other options for greenhouse gas reducing features include rainwater recycling systems, landscaping with native species, and utilizing water efficient products.



4.6.6 Operational

- Pools and hot tubs must not be discharged into adjacent watercourses. Alternatively, pool water must be dechlorinated, prior to a slow release to a vegetated area in order to avoid the potential for surface runoff entering adjacent watercourses.
- Personal items (e.g. vehicles, equipment, etc.) should not be stored within the riparian setback.



4.7 Best Management Practices and Guidelines

A variety of BMPs and Guideline documents have been released by regulatory bodies that pertain to land development within British Columbia. Details found within these documents provide information that supplements what is presented here, and these documents should be consulted throughout future construction works. The following table provides a list of BMPs and guidelines, as well as their respective applicability to works that may be proposed in the future.

Table 11. Summary of BMPs and guidelines that are applicable to development in the Okanagan.		
BMP or Guideline	Target Species Group and/or Habitat Feature	Applicability
Rural Westside OCP (RDCO 2010)	Terrestrial and Aquatic DP areas	Overarching guideline for development in Killiney Beach.
Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia. (BC MOE 2014a)	Regionally Sensitive Species Terrestrial Aquatic Riparian	This document is applicable because it comprises any form of land development.
Best Management Practices for Lakeshore Stabilization (BC MOE 2006b)	Aquatic Riparian	This BMP is highly applicable to many of the lots within Killiney Beach that are on steep slopes adjacent to riparian features. In several cases, steep slopes are accompanied by seepage, which increases the risk of releasing sediment and non-point source pollution into Okanagan Lake.
Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck et al. 1992)	Aquatic	This BMP is highly applicable to lots adjacent to riparian features.
Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (BC MOE 2013)	Raptors	Terrestrial ecosystems comprised of mature coniferous and mixed woodlands make this BMP applicable.
Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia (BC MOE 2014b)	Amphibians and Reptiles	Ecosystems comprised of aquatic habitats, rocky outcrops and forested areas make this BMP applicable.
Best Management Practices for Hazard Tree and Non-Hazard Tree Limbing, Topping or Removal (BC MOE 2006c)	Terrestrial Aquatic	This BMP is applicable for tree removal.



4.8 Environmental Monitoring

An Environmental Monitor (EM) should be retained to monitor residential construction within DP areas in order to document compliance with best management practices, mitigation measures, and other recommendations and to provide guidance for implementation of operational best practices (e.g., erosion and sediment control) during construction. The EM will be an appropriately qualified environmental professional authorized to halt construction activities should an incident arise that is causing undue harm (unforeseen or from lack of due care) to terrestrial, aquatic or riparian ecosystems. In the event that greater disturbance occurs due to unforeseen circumstances, the EM will recommend further measures to protect/restore the natural integrity of the site. Typical monitoring schedules are provided below:

- A pre-construction meeting should be held between the EM and the contractor(s) undertaking the work to ensure a common understanding of the mitigation measures and best practices required for the project.
- Construction activities should be monitored on a monthly basis and more regularly during high risk activities (e.g. concrete pours, large material excavations) until the completion of the project.
- Regular monitoring reports will be submitted to the primary contractor, property owner, and relevant regulators. Once construction is complete a substantial completion site visit and report will be undertaken by the EM.

5.0 OTHER CONSIDERATIONS

The following are recommended measures that could be undertaken to better inform the Aquatic Ecosystem DP areas and to reduce overall development impacts.

- An additional SHIM survey of Norris Creek should be undertaken, as both the watercourse location and flow extents have changed since the 2002 survey.
- Most lots within Killiney Beach have a moderate environmental sensitivity due to anthropogenic influence of adjacent roads and/or development. This includes previously developed lots and those that have yet to be developed. Undeveloped lots remain natural in character and consist of rare coniferous ecosystems. Because of their reduced sensitivity, development within moderate areas does not trigger a DP. Landowners should retain as much forest canopy as possible, and clear cutting of lots should be highly discouraged. By retaining trees, the rural form and character of the subdivision is preserved, smaller groupings of trees act as stepping stones of remnant habitat for wildlife and the rare woodland ecosystems are not entirely lost within the subdivision.

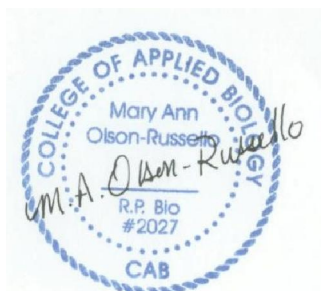


6.0 CLOSURE

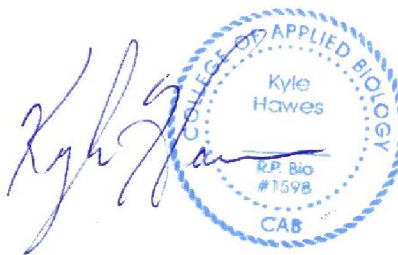
This report has been prepared for the RDCO and considers the existing site conditions of the Killiney Beach neighbourhood area with respect to terrestrial and aquatic ecosystems and intrinsic ecological values. Ecoscape has prepared this report with the understanding that all available information on the past, present, and proposed conditions of the site have been disclosed. RDCO has acknowledged that in order for Ecoscape to properly provide the professional service, Ecoscape is relying upon full disclosure and accuracy of this information.

If you have any questions or comments, please contact the undersigned at your convenience.

Respectfully Submitted
ECOSCAPE ENVIRONMENTAL
CONSULTANTS LTD.



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Attachments: References
 Figures



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FIGURES



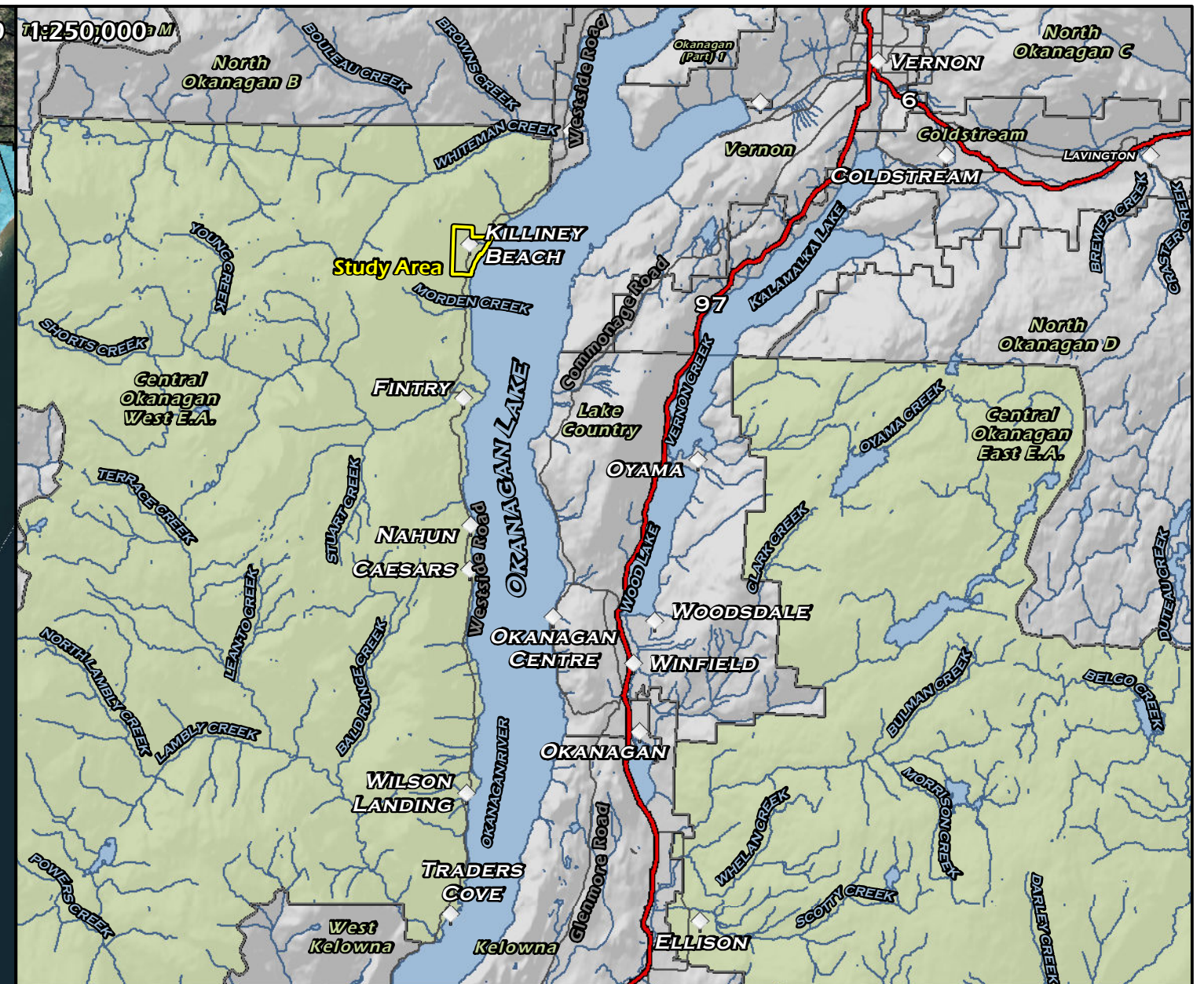


FIGURE 1: KILLINEY BEACH

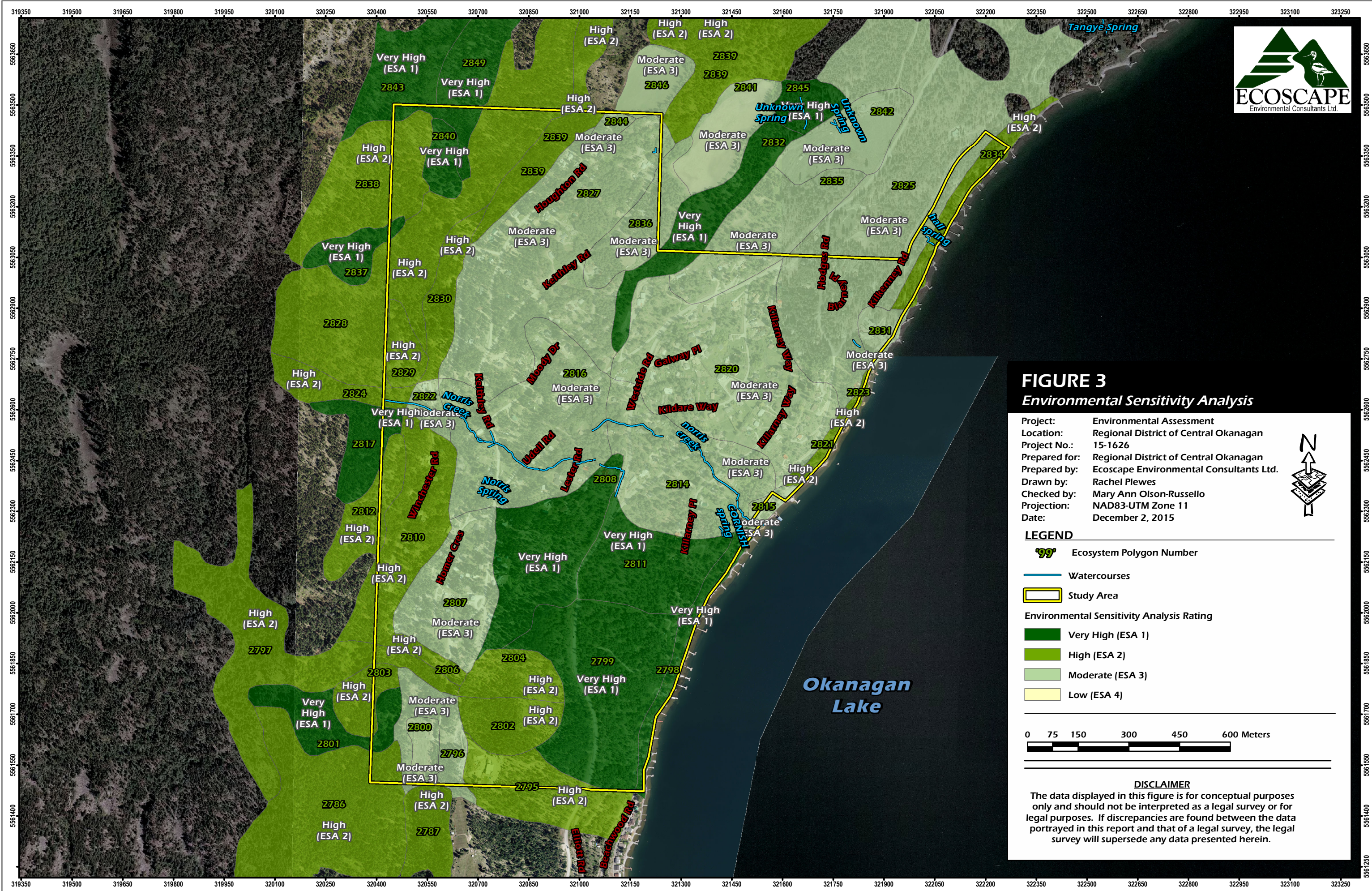
Site Location and Existing Aquatic with Terrestrial Development Permit Areas

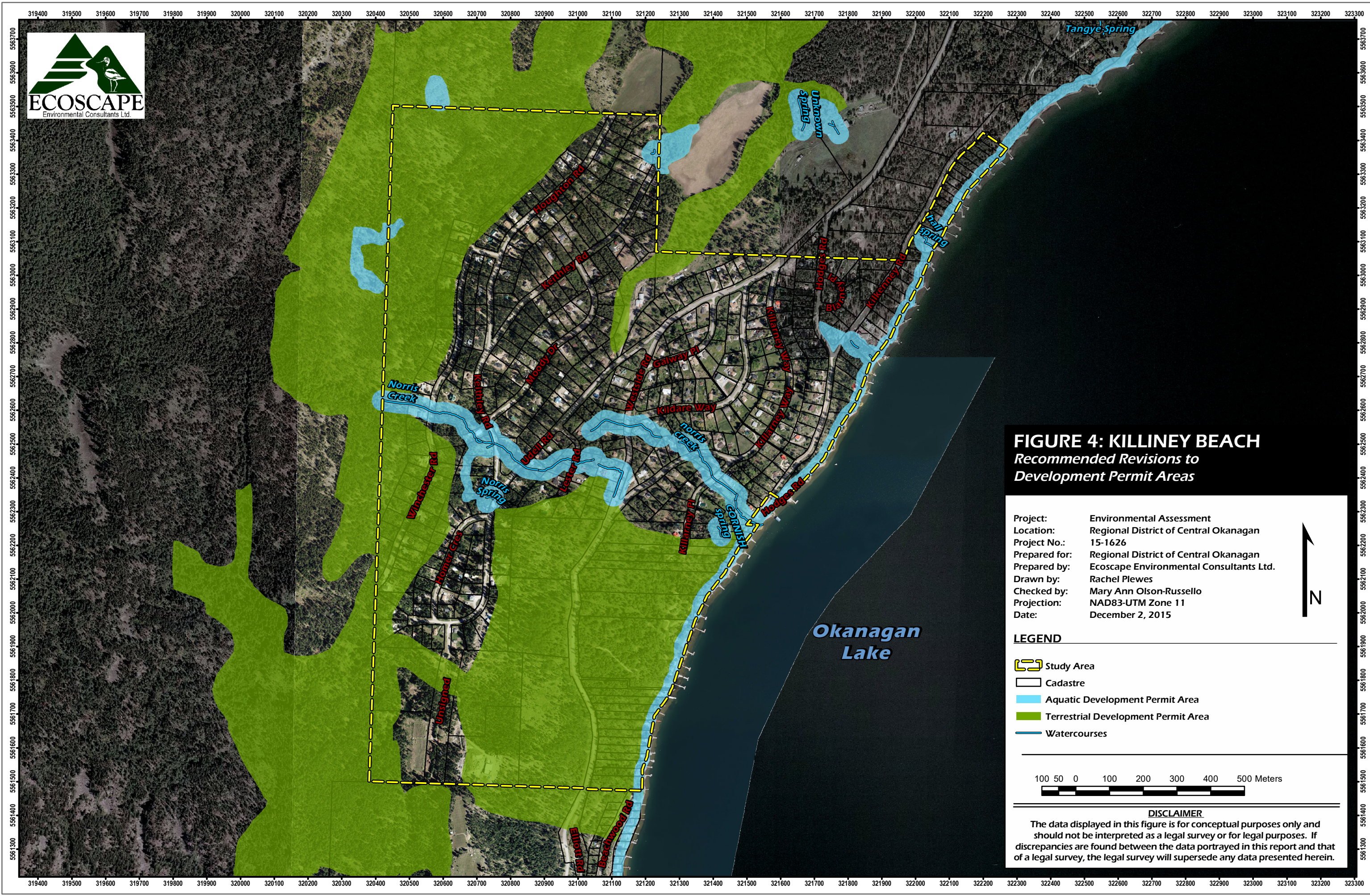
Project: Environmental Assessment
 Location: Regional District of Central Okanagan
 Project No.: 15-1626
 Prepared for: Regional District of Central Okanagan
 Prepared by: Ecoscape Environmental Consultants Ltd.
 Drawn by: Rachel Plewes
 Checked by: Mary Ann Olson-Russello
 Projection: NAD83-UTM Zone 11
 Date: December 2, 2015



LEGEND

- | | | |
|--------------------|--|--------------|
| Study Area | Cadastre | SHIM Stream |
| Places | Regional District Central Okanagan | TRIM Streams |
| Major Highway | Lake | |
| Major Roads | Existing Aquatic Development Permit Area | |
| Municipal Boundary | Existing Terrestrial Development Permit Area | |





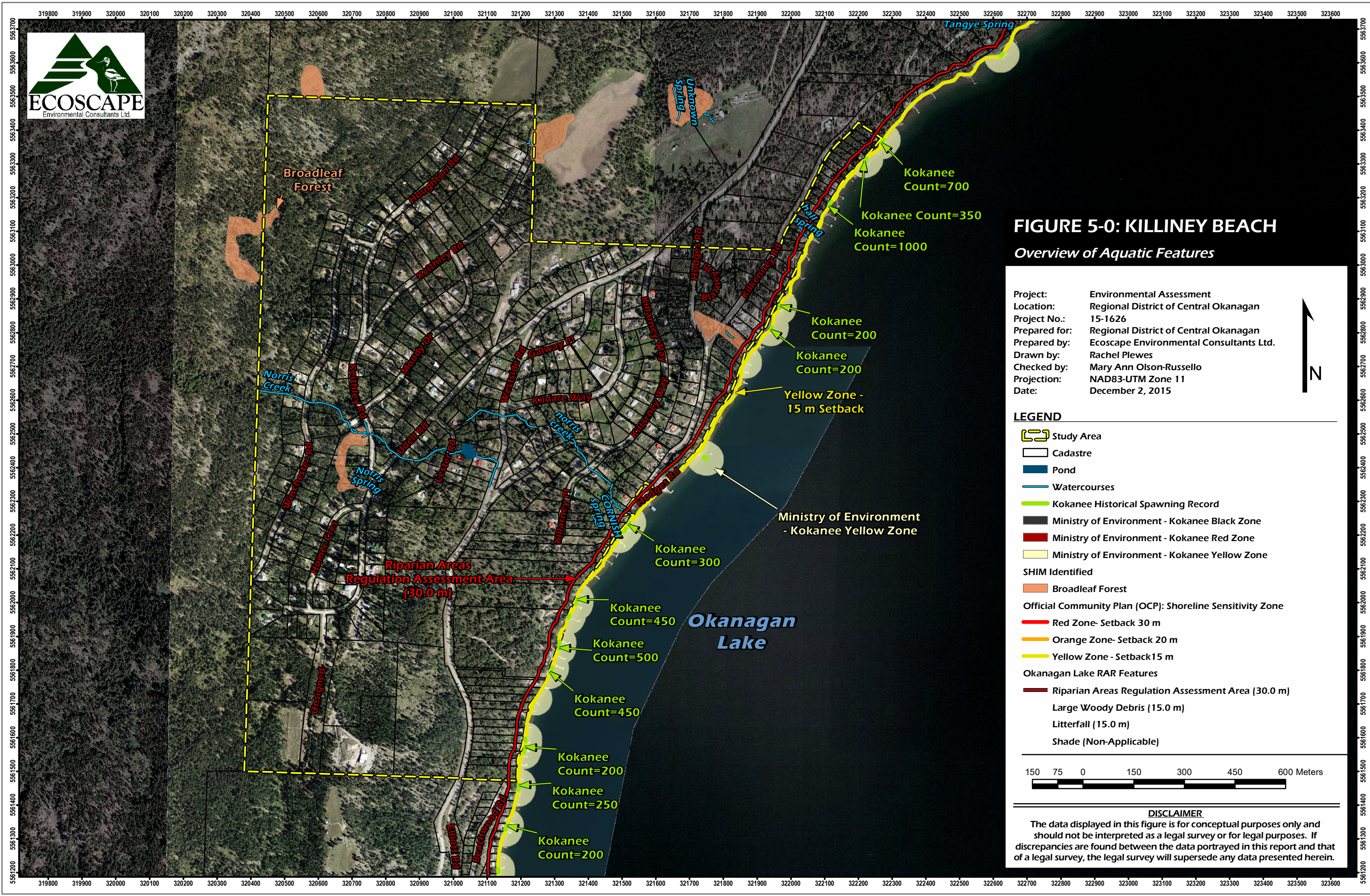


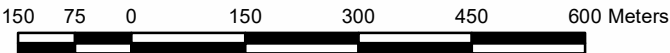
FIGURE 5-0: KILLINEY BEACH

Overview of Aquatic Features

Project: Environmental Assessment
Location: Regional District of Central Okanagan
Project No.: 15-1626
Prepared for: Regional District of Central Okanagan
Prepared by: Ecoscape Environmental Consultants Ltd.
Drawn by: Rachel Plewes
Checked by: Mary Ann Olson-Russello
Projection: NAD83-UTM Zone 11
Date: December 2, 2015

LEGEND

- Study Area
- Cadastre
- Pond
- Watercourses
- Kokanee Historical Spawning Record
- Ministry of Environment - Kokanee Black Zone
- Ministry of Environment - Kokanee Red Zone
- Ministry of Environment - Kokanee Yellow Zone
- SHIM Identified
- Broadleaf Forest
- Official Community Plan (OCP): Shoreline Sensitivity Zone
- Red Zone- Setback 30 m
- Orange Zone- Setback 20 m
- Yellow Zone - Setback 15 m
- Okanagan Lake RAR Features
- Riparian Areas Regulation Assessment Area (30.0 m)
- Large Woody Debris (15.0 m)
- Litterfall (15.0 m)
- Shade (Non-Applicable)



DISCLAIMER

The data displayed in this figure is for conceptual purposes only and should not be interpreted as a legal survey or for legal purposes. If discrepancies are found between the data portrayed in this report and that of a legal survey, the legal survey will supersede any data presented herein.

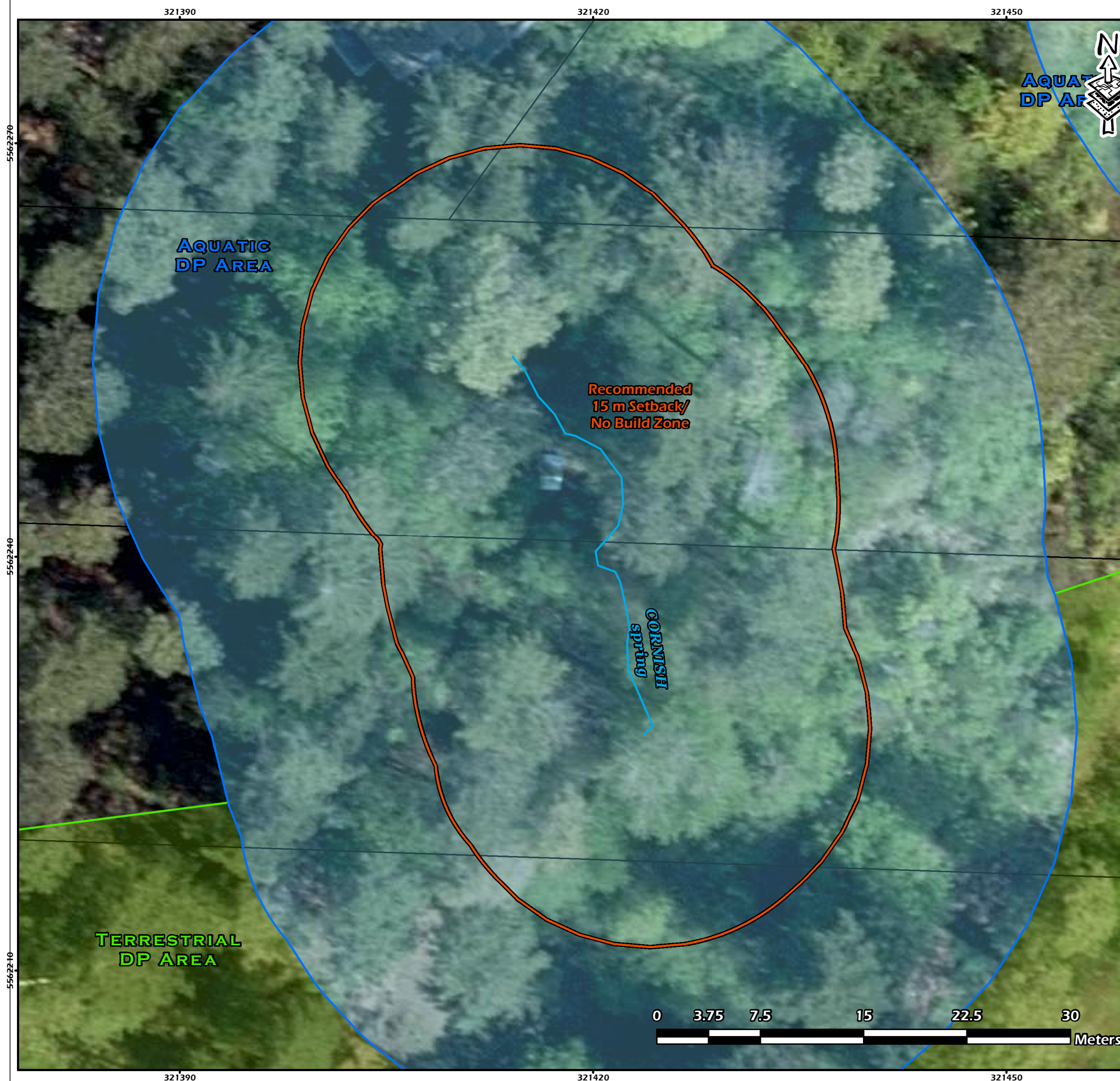


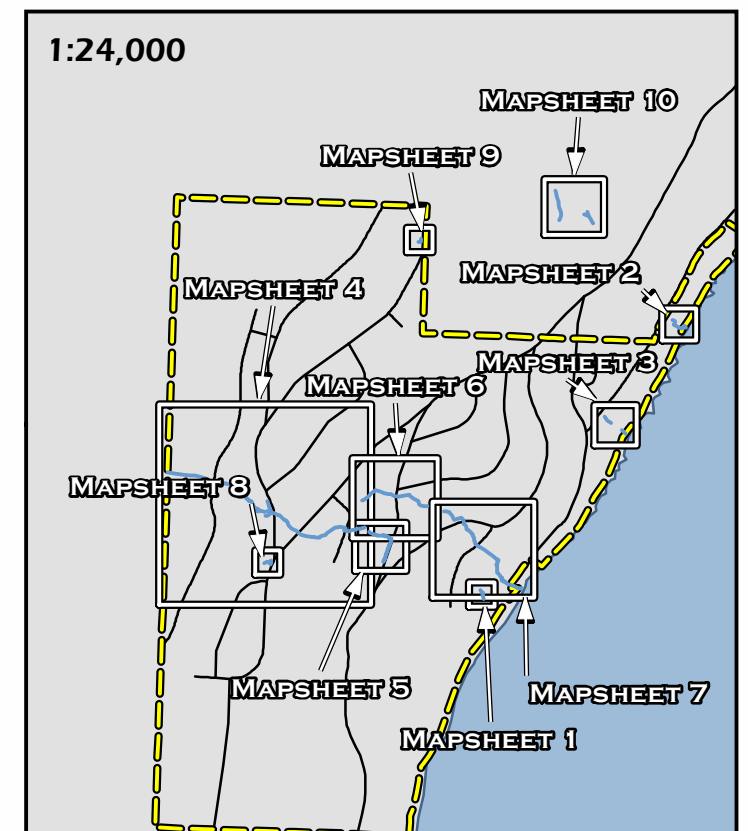
FIGURE 5-1: KILLINEY BEACH
Aquatic Features and Riparian Setbacks

Mapsheet: 1

Watercourse: *Cornish Spring*

LEGEND

- | | |
|---|------------|
| Stream Centerline | Mapsheets |
| Pond | Study Area |
| Cadastre | Lake |
| Recommended 15 m Setback/ No Build Area | Roads |
| Aquatic Development Permit Area | |
| Terrestrial Development Permit Area | |
| RAR Features (if Applicable) | |
| Zone of Sensitivity - Shade | |
| Zone of Sensitivity - Large Woody Debris | |
| Zone of Sensitivity - Litterfall | |
| Streamside Protection and Enhancement Area (SPEA) | |



1:300

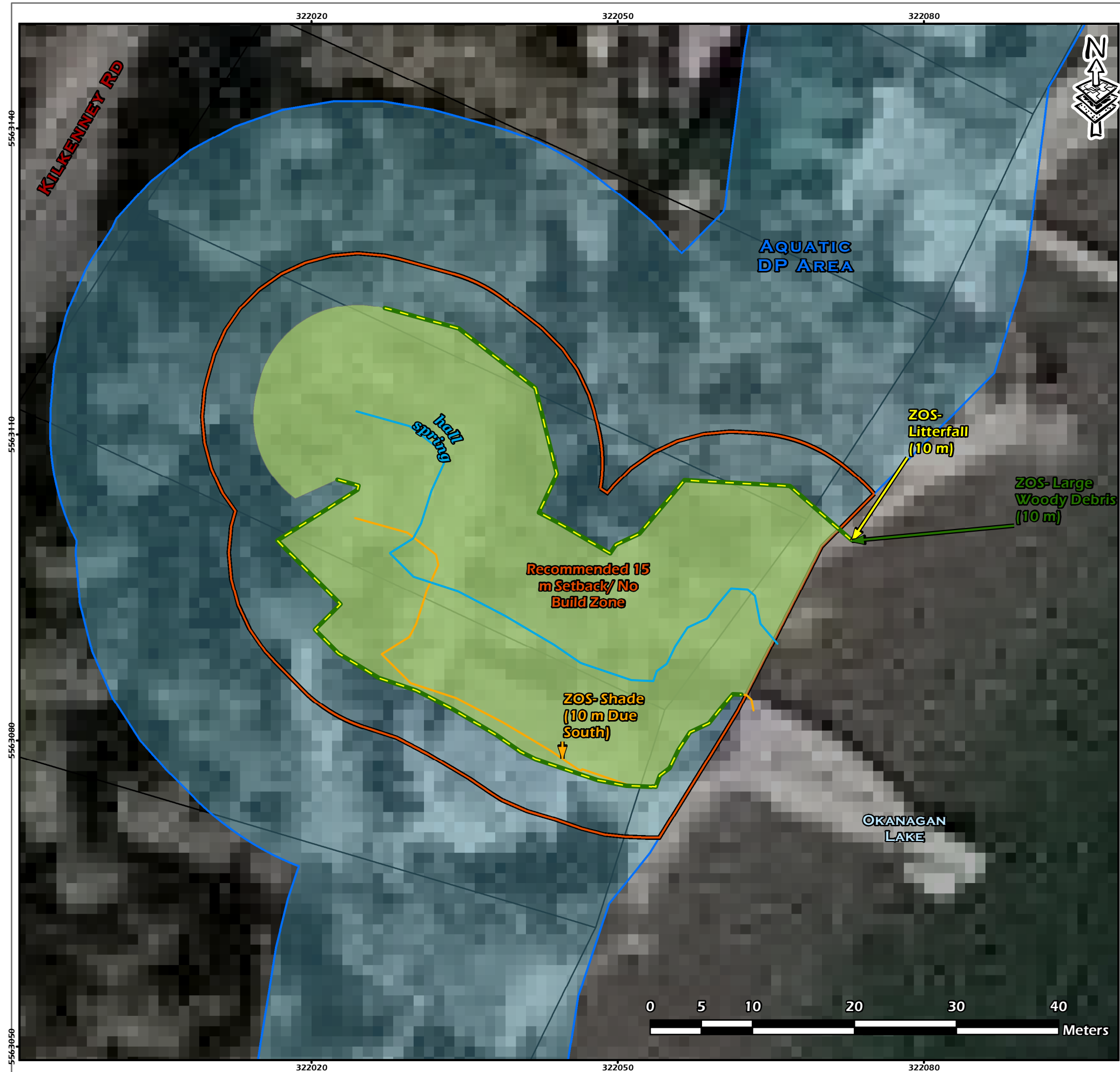


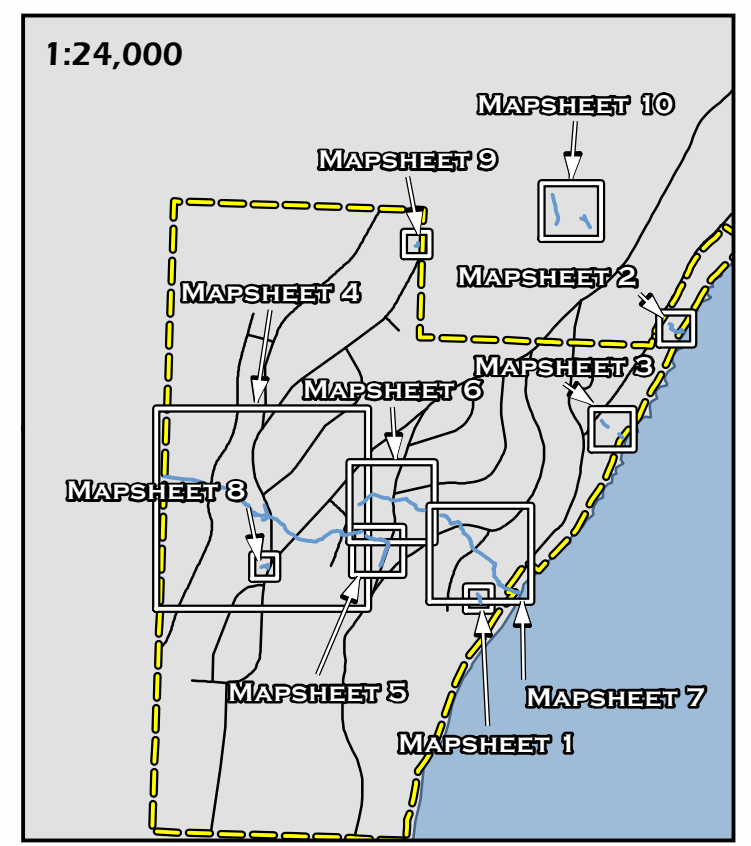
FIGURE 5-2: KILLINEY BEACH
Aquatic Features and Riparian Setbacks

Mapsheet: 2

Watercourse: *Hall Spring*

LEGEND

- | | |
|---|------------|
| Stream Centerline | Mapsheets |
| Pond | Study Area |
| Cadastre | Lake |
| Recommended 15 m Setback/ No Build Area | Roads |
| Aquatic Development Permit Area | |
| Terrestrial Development Permit Area | |
- RAR Features (if Applicable)
- Zone of Sensitivity - Shade
 - Zone of Sensitivity - Large Woody Debris
 - Zone of Sensitivity - Litterfall
 - Streamside Protection and Enhancement Area (SPEA)



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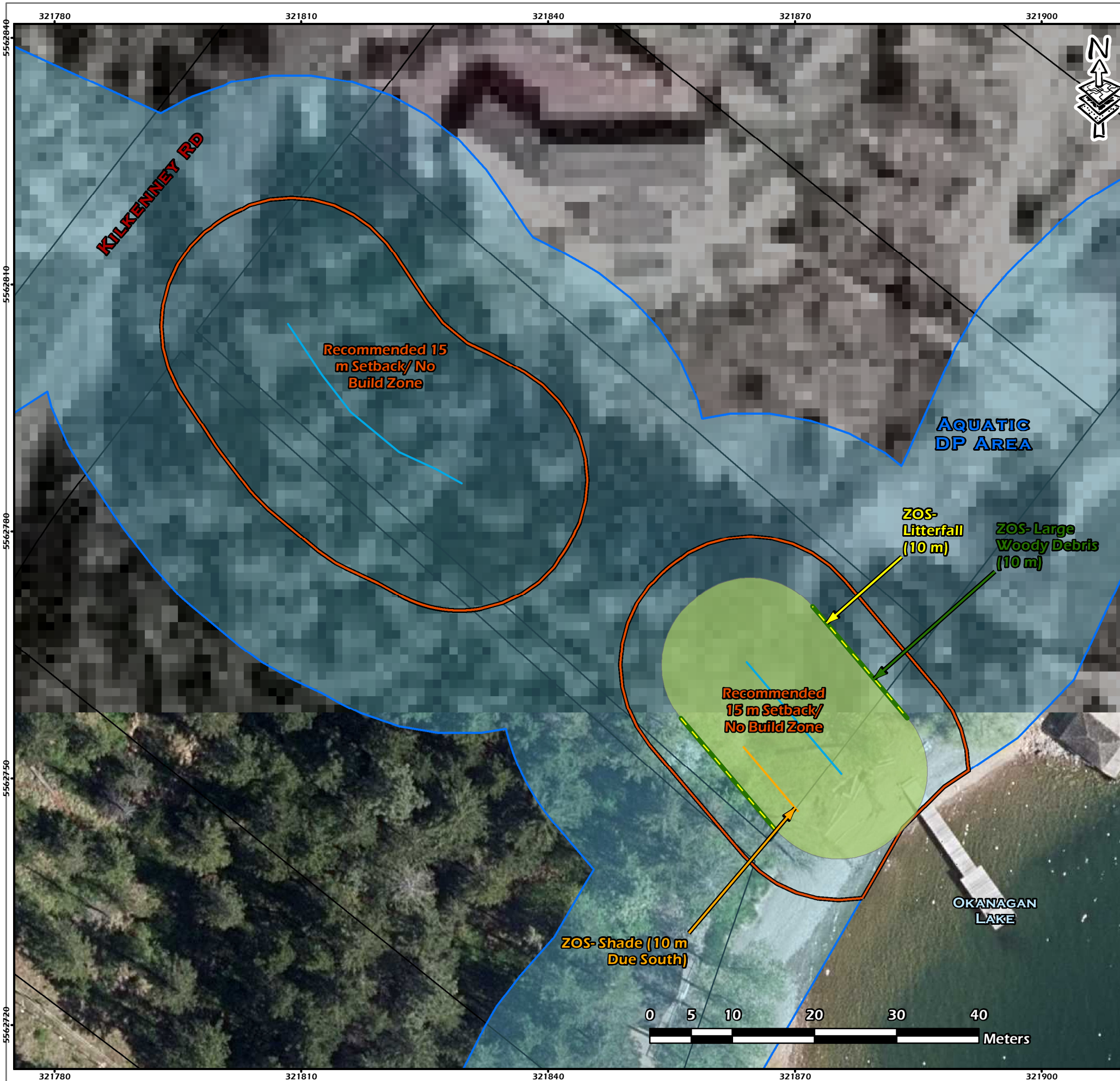


FIGURE 5-3: KILLINEY BEACH
Aquatic Features and Riparian Setbacks

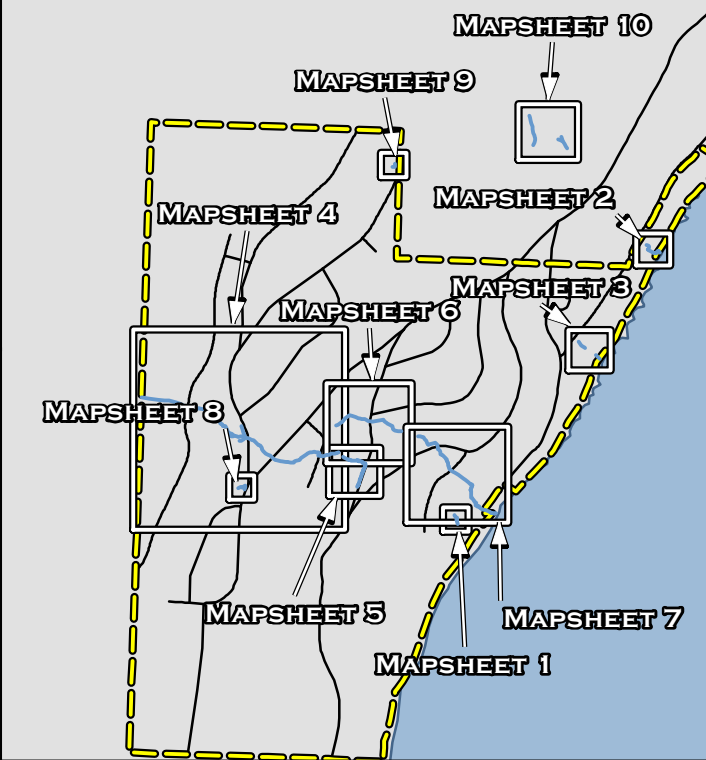
Mapsheet: 3

Watercourse: Killiney Spring 1

LEGEND

- Stream Centerline
- Pond
- Cadastre
- Recommended 15 m Setback/ No Build Area
- Aquatic Development Permit Area
- Terrestrial Development Permit Area
- RAR Features (if Applicable)
- Zone of Sensitivity - Shade
- Zone of Sensitivity - Large Woody Debris
- Zone of Sensitivity - Litterfall
- Streamside Protection and Enhancement Area (SPEA)
- Mapsheets
- Study Area
- Lake
- Roads

1:24,000



1:500



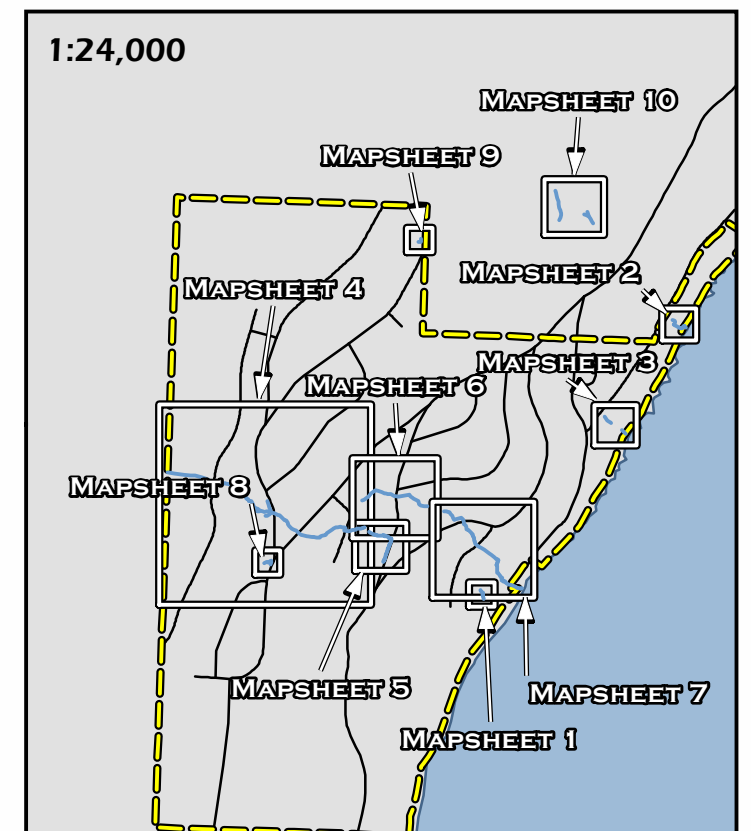
FIGURE 5-4: KILLINEY BEACH
Aquatic Features and Riparian Setbacks

Mapsheet: 4

Watercourse: Norris Creek 1

LEGEND

- | | |
|---|------------|
| Stream Centerline | Mapsheets |
| Pond | Study Area |
| Cadastre | Lake |
| Recommended 15 m Setback/ No Build Area | Roads |
| Aquatic Development Permit Area | |
| Terrestrial Development Permit Area | |
- RAR Features (if Applicable)
- Zone of Sensitivity - Shade
 - Zone of Sensitivity - Large Woody Debris
 - Zone of Sensitivity - Litterfall
 - Streamside Protection and Enhancement Area (SPEA)



1:2,500



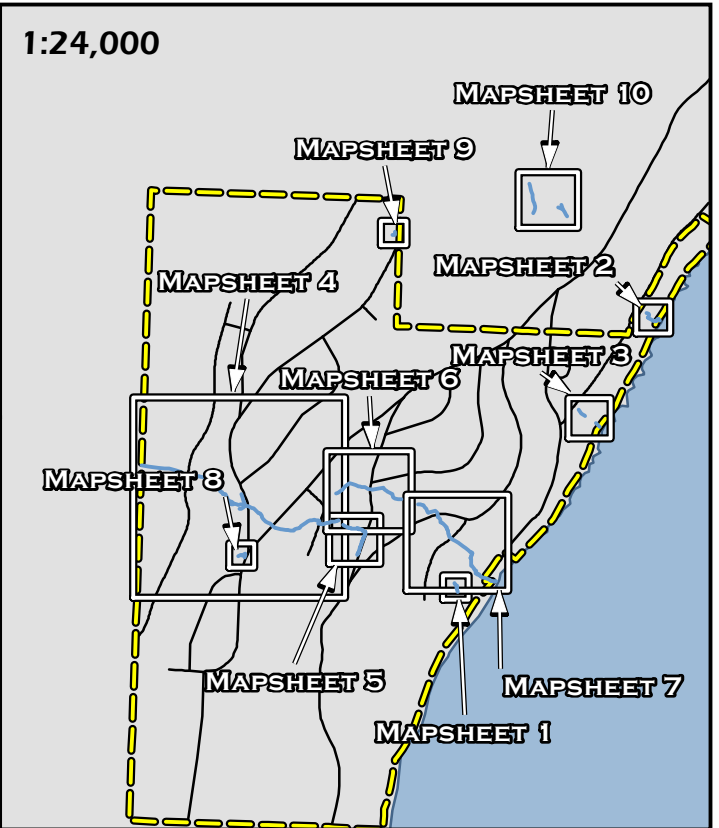
FIGURE 5-5: KILLINEY BEACH
Aquatic Features and Riparian Setbacks

Mapsheet: 5

Watercourse: *Norris Creek 2*

LEGEND

- | | |
|---|------------|
| Stream Centerline | Mapsheets |
| Pond | Study Area |
| Cadastre | Lake |
| Recommended 15 m Setback/ No Build Area | Roads |
| Aquatic Development Permit Area | |
| Terrestrial Development Permit Area | |
- RAR Features (if Applicable)
- Zone of Sensitivity - Shade
 - Zone of Sensitivity - Large Woody Debris
 - Zone of Sensitivity - Litterfall
 - Streamside Protection and Enhancement Area (SPEA)



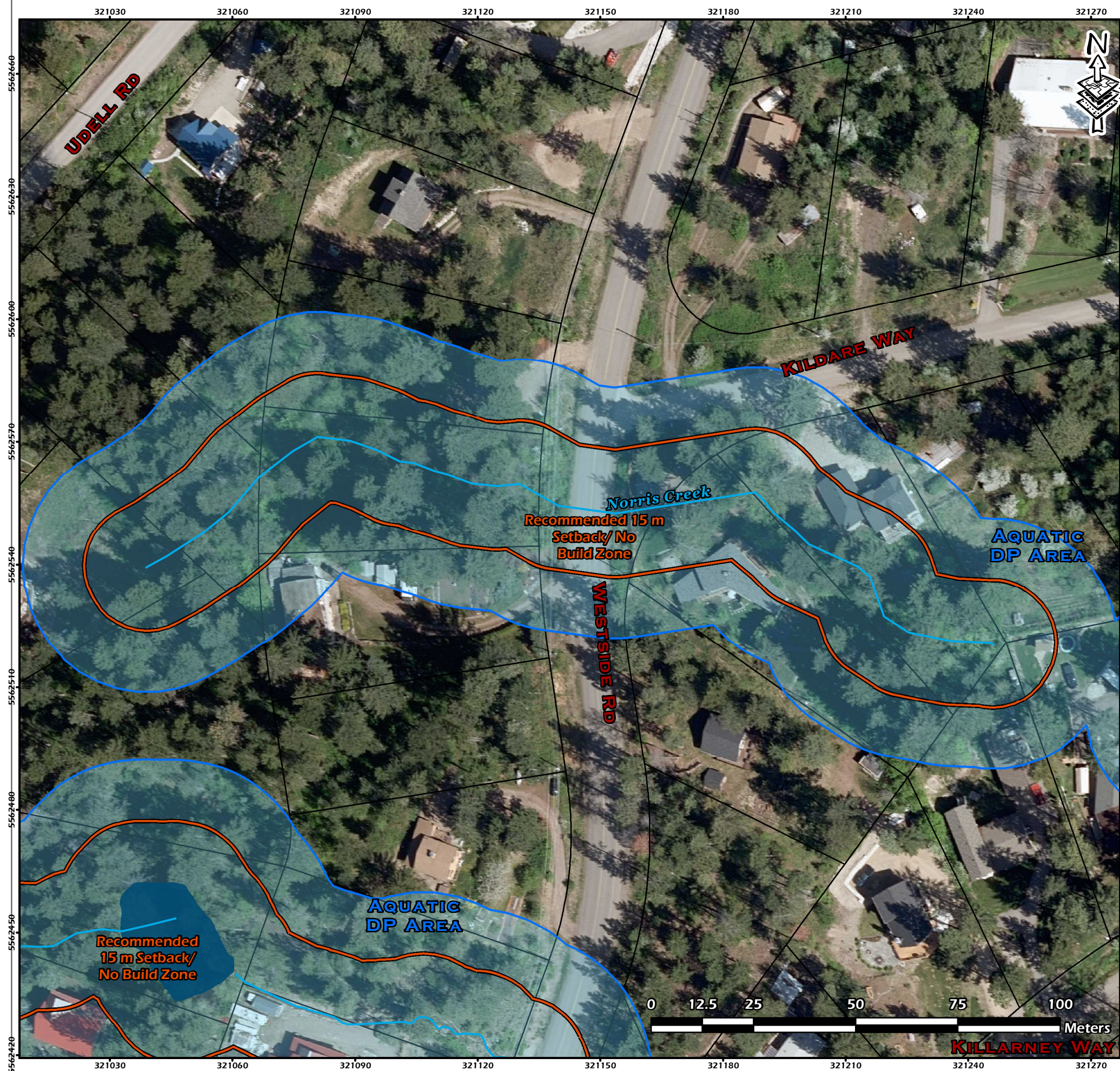


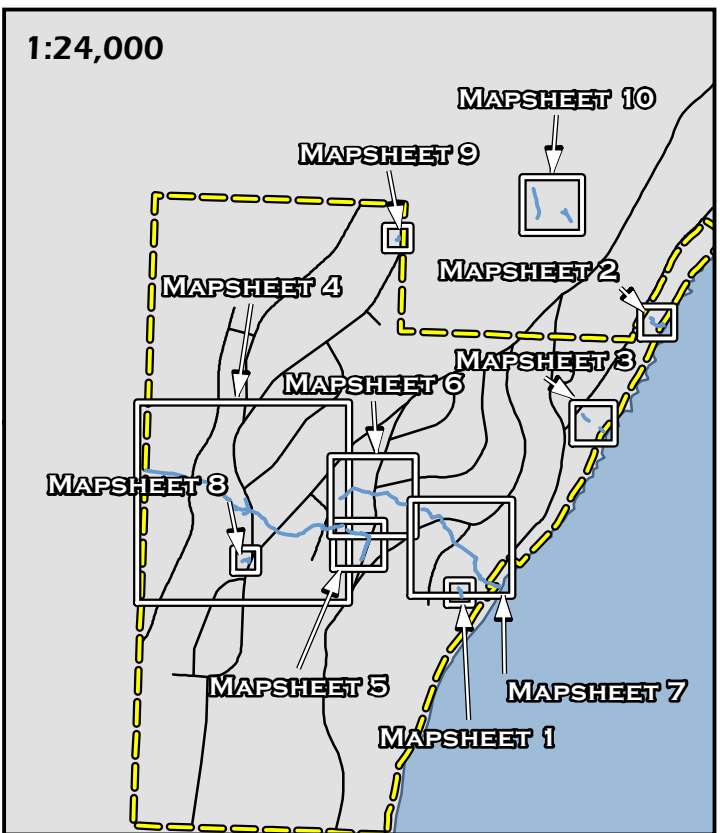
FIGURE 5-6: KILLINEY BEACH
Aquatic Features and Riparian Setbacks

Mapsheet: 6

Watercourse: *Norris Creek 3*

LEGEND

- | | |
|---|------------|
| Stream Centerline | Mapsheets |
| Pond | Study Area |
| Cadastre | Lake |
| Recommended 15 m Setback/ No Build Area | Roads |
| Aquatic Development Permit Area | |
| Terrestrial Development Permit Area | |
- RAR Features (if Applicable)
- Zone of Sensitivity - Shade
 - Zone of Sensitivity - Large Woody Debris
 - Zone of Sensitivity - Litterfall
 - Streamside Protection and Enhancement Area (SPEA)



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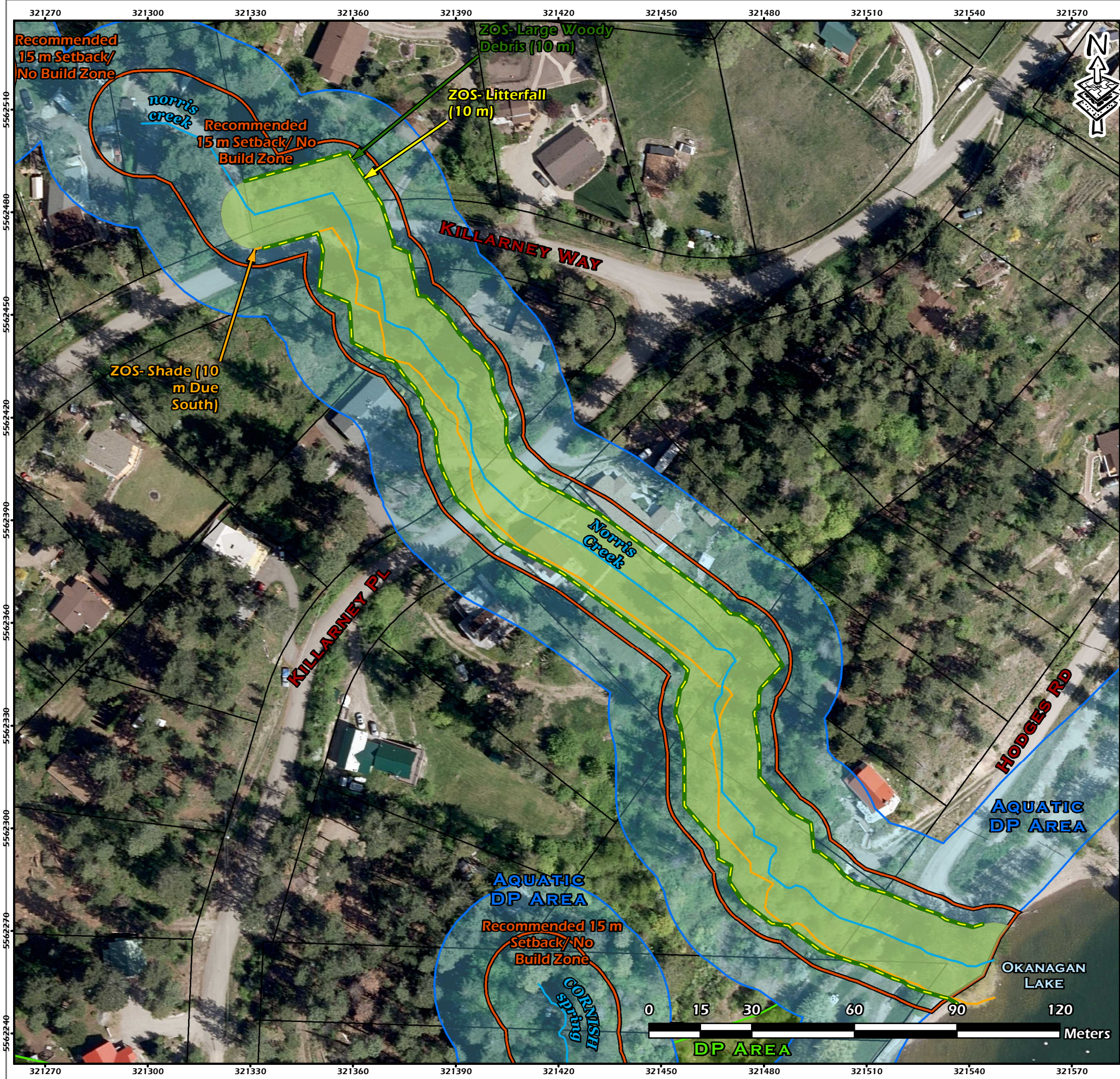


FIGURE 5-7: KILLINEY BEACH
Aquatic Features and Riparian Setbacks

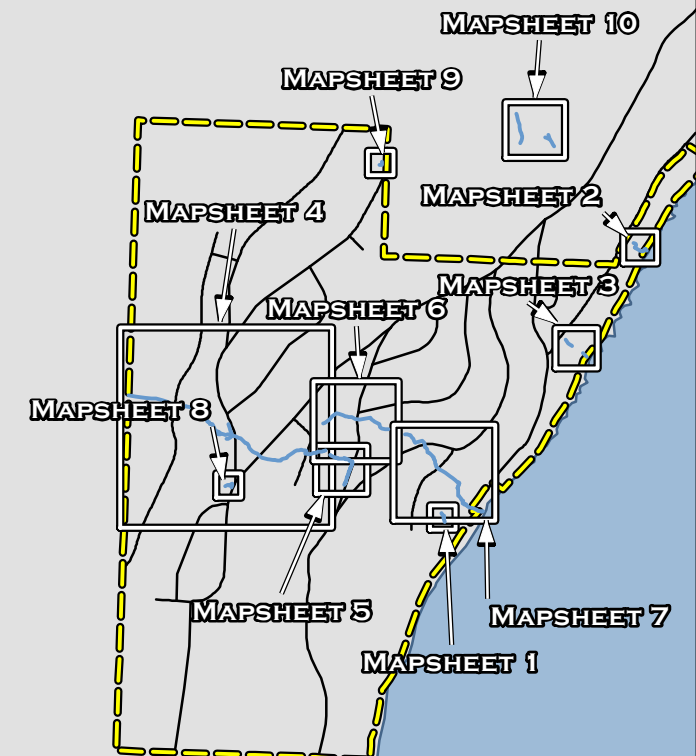
Mapsheet: 7

Watercourse: Norris Creek 4

LEGEND

- | | |
|---|------------|
| Stream Centerline | Mapsheets |
| Pond | Study Area |
| Cadastre | Lake |
| Recommended 15 m Setback/ No Build Area | Roads |
| Aquatic Development Permit Area | |
| Terrestrial Development Permit Area | |
- RAR Features (if Applicable)
- Zone of Sensitivity - Shade
 - Zone of Sensitivity - Large Woody Debris
 - Zone of Sensitivity - Litterfall
 - Streamside Protection and Enhancement Area (SPEA)

1:24,000



1:1,200

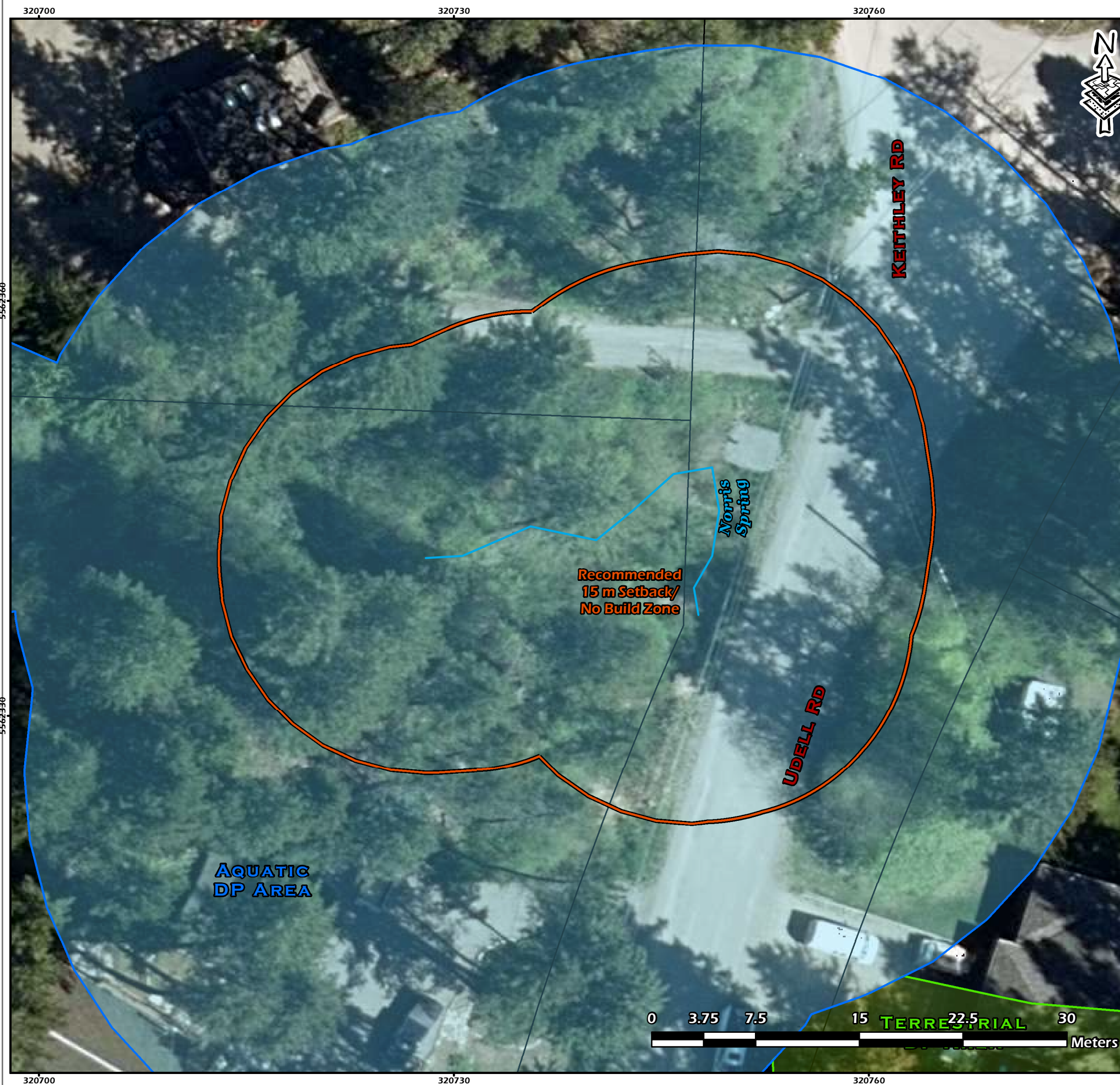


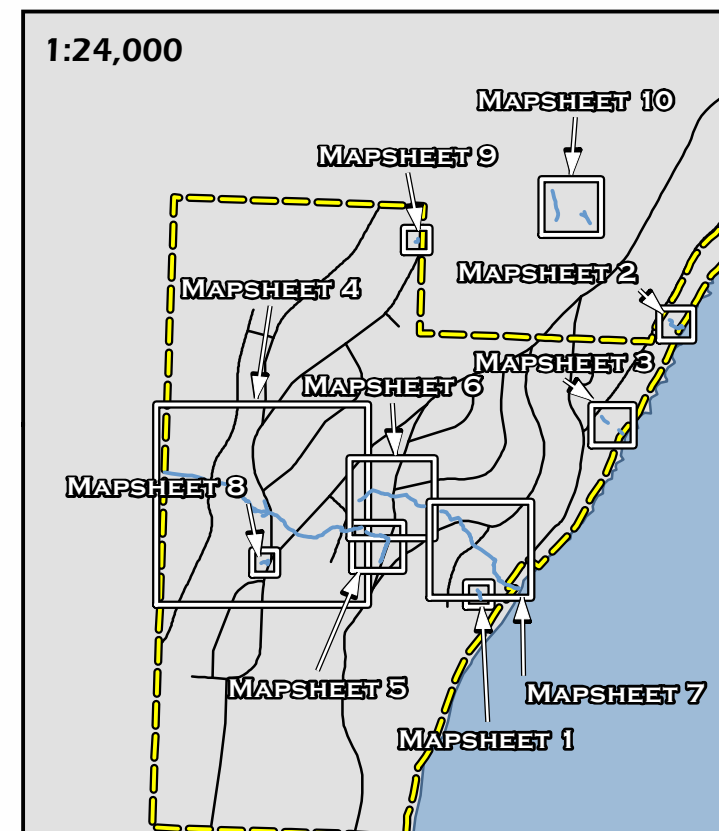
FIGURE 5-8: KILLINEY BEACH
Aquatic Features and Riparian Setbacks

Mapsheet: 8

Watercourse: Norris Spring

LEGEND

- | | |
|---|------------|
| Stream Centerline | Mapsheets |
| Pond | Study Area |
| Cadastre | Lake |
| Recommended 15 m Setback/ No Build Area | Roads |
| Aquatic Development Permit Area | |
| Terrestrial Development Permit Area | |
- RAR Features (if Applicable)
- Zone of Sensitivity - Shade
 - Zone of Sensitivity - Large Woody Debris
 - Zone of Sensitivity - Litterfall
 - Streamside Protection and Enhancement Area (SPEA)



1:300

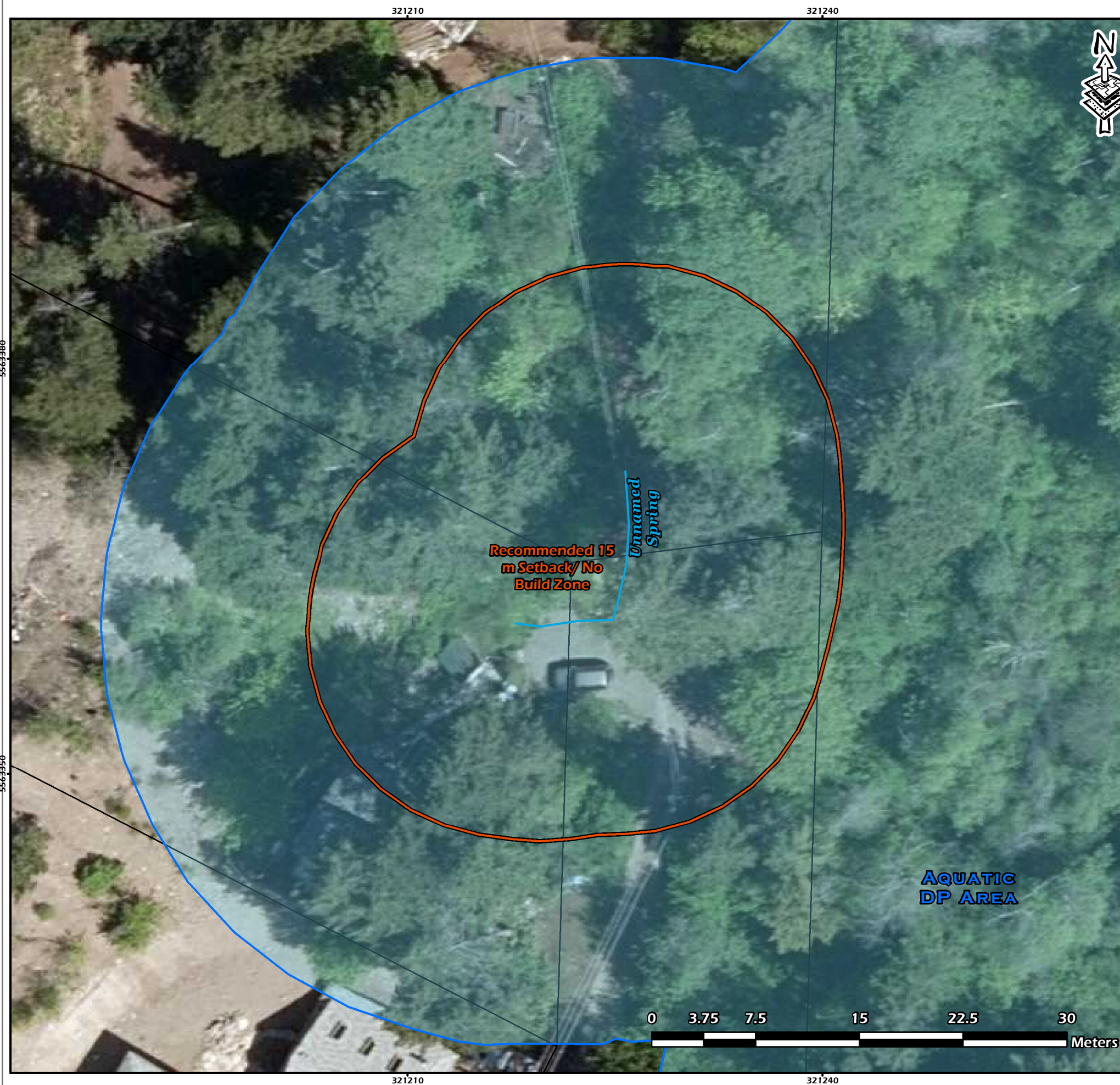


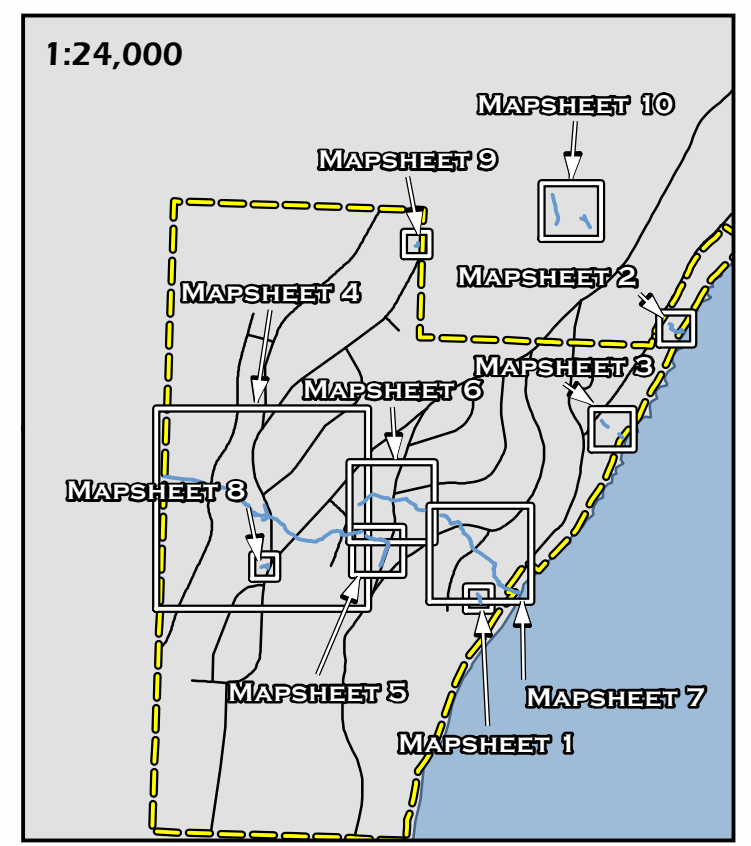
FIGURE 5-9: KILLINEY BEACH
Aquatic Features and Riparian Setbacks

Mapsheet: 9

Watercourse: *Unnamed Spring*

LEGEND

- | | |
|---|------------|
| Stream Centerline | Mapsheets |
| Pond | Study Area |
| Cadastre | Lake |
| Recommended 15 m Setback/ No Build Area | Roads |
| Aquatic Development Permit Area | |
| Terrestrial Development Permit Area | |
- RAR Features (if Applicable)
- Zone of Sensitivity - Shade
 - Zone of Sensitivity - Large Woody Debris
 - Zone of Sensitivity - Litterfall
 - Streamside Protection and Enhancement Area (SPEA)



1:300

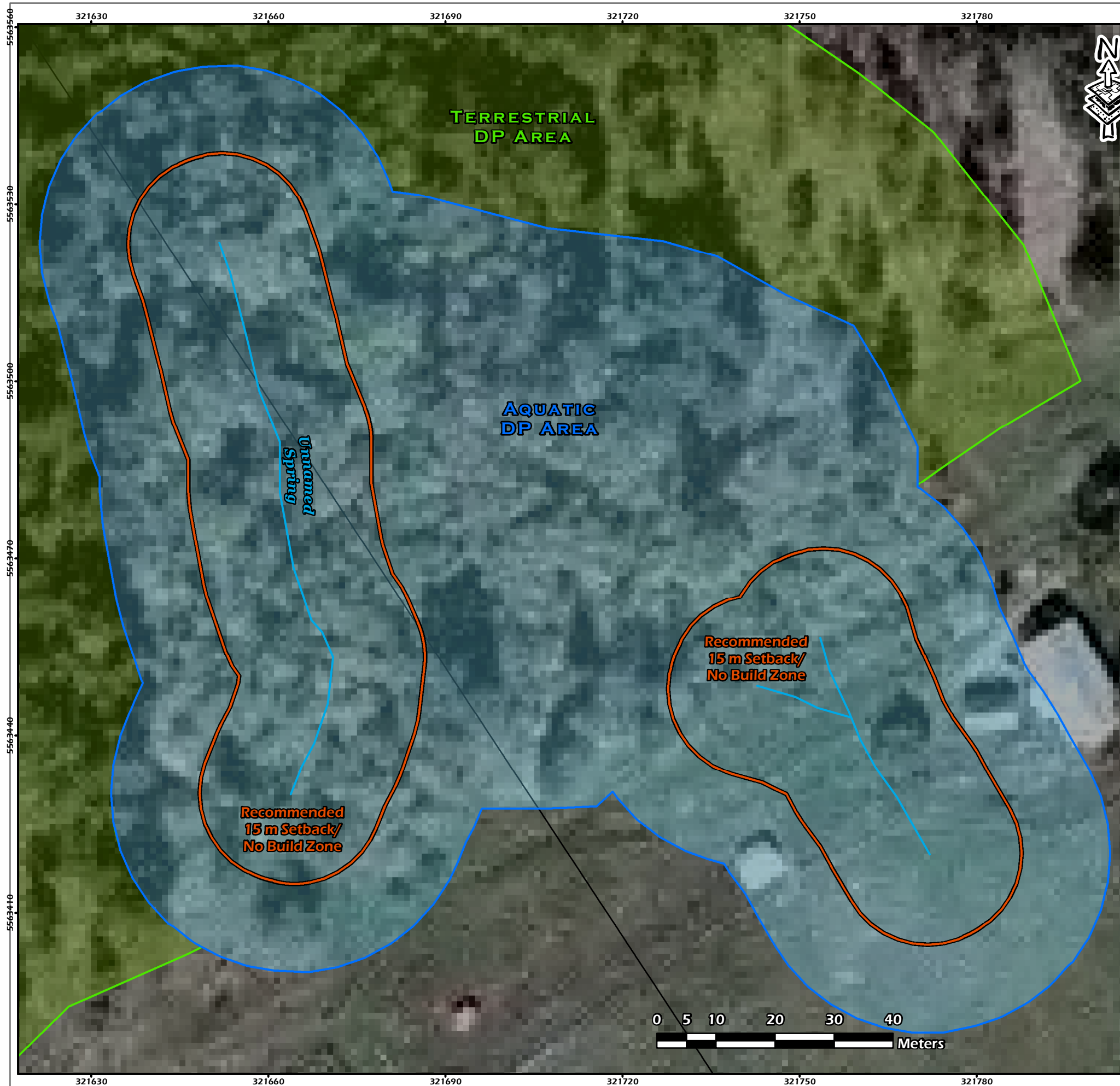


FIGURE 5-10: KILLINEY BEACH
Aquatic Features and Riparian Setbacks

Mapsheet: 10

Watercourse: Unnamed Springs

LEGEND

- | | |
|---|------------|
| Stream Centerline | Mapsheets |
| Pond | Study Area |
| Cadastre | Lake |
| Recommended 15 m Setback/ No Build Area | Roads |
| Aquatic Development Permit Area | |
| Terrestrial Development Permit Area | |
| RAR Features (if Applicable) | |
| Zone of Sensitivity - Shade | |
| Zone of Sensitivity - Large Woody Debris | |
| Zone of Sensitivity - Litterfall | |
| Streamside Protection and Enhancement Area (SPEA) | |

