REPORT

City of Kelowna

Great Basin Spadefoot Exclusion Fencing: Effectiveness Monitoring Report

MAY 2021

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1 INTRODUCTION

Associated Environmental Consultants Inc. (Associated) presents this Great Basin Spadefoot Amphibian Exclusion Fencing: Effectiveness Monitoring Report for John Hindle Drive in Kelowna, BC. The City of Kelowna retained Associated to conduct amphibian monitoring to determine the effectiveness of the amphibian exclusion fencing along a newly constructed section of John Hindle Drive. This report summarizes the findings for the spring of 2021, which are focussed on Great Basin spadefoot (*Spea intermontane*). The report includes recommendations for additional mitigation measures to protect species-at-risk amphibian populations and future study.

The driver for reporting is to provide context and identify issues when determining mitigations for Great Basin spadefoot. The efforts along John Hindle Drive focus on Great Basin spadefoot as the target species because of their species-at-risk status, although the management measures benefit all amphibians and reptiles using the local area. The goal is to reduce the impacts from vehicular induced mortality on amphibians, specifically the Great Basin spadefoot population. The loss of reproductive females is more significant for populations of amphibians and reptiles and just a few breeding adults may result in a sink population that is unsustainable without immigrants from nearby populations (MoECCS 2020). Reducing the impacts from vehicular collisions on the Great Basin spadefoot population is the intent of the amphibian exclusion fencing. This report documents the effectiveness of the amphibian exclusion fencing on spring 2021 amphibian movements since it was just installed in December 2020, being the first-spring, post installation.

1.1 Project Background

John Hindle Road is a road development through agricultural fields just north of Robert Lake and west of UBC Okanagan, connecting Glenmore Road and Highway 97, and provides access to UBCO.

The following includes a brief history of the project including the baseline review and planning:

- An environmental assessment for road development approval (2006-2009)
- Federal designation of the area as critical 'core' habitat (2017)
- Project construction and monitoring (2017-2019)
- Volunteer data collection of amphibian mortalities (2017-present)
- Development of a Great Basin Spadefoot Management Plan (2019)
- Amphibian exclusion fencing installation (December 2020)

In addition, in 2006, Associated (formally Summit Environmental Consultants Ltd.) completed an environmental assessment (EA) for the John Hindle Road project. A component of the EA was identification of high-value wildlife habitat, and outlining the importance of maintaining connectivity to and from Robert Lake (Summit 2006). In the 2006 report, Associated recommended retention of wildlife corridors, including no-disturbance setbacks to ensure that encroachment on natural habitats be minimized. Future UBC Okanagan Campus area land-use plans for development proposed in 2009 in the Environmental Assessment and Mitigation Strategies for the Wildlife Corridor UBCO South (Summit 2009), recommended that one wildlife corridor, approximately 25 m in width, be reserved outside of future project development. The purpose of the wildlife corridor was to provide uninhibited movement of wildlife from Robert Lake, through natural open ponderosa pine grasslands, and throughout the Robert Lake area. Planning for

ecological connectivity allows for wildlife species to access critical habitat areas in rapidly developing communities like the Robert Lake area (Parrott 2019).

Great Basin spadefoot are federally threatened[1] and provincially Blue-listed species[2] (of Special Concern). Environment and Climate Change Canada published a Recovery Strategy for Great Basin spadefoot in 2017 which identified UBC Okanagan and Robert Lake as critical 'core' habitat and the land-in-between as critical 'connectivity' habitat (Figure 1). Critical habitats and wildlife corridors can be fragmented by the construction of new roadways and have a negative impact on wildlife if construction is not mitigated (Crosby 2014). The habitat connectivity in the Robert Lake area has been compromised when John Hindle Drive was constructed.

John Hindle Drive project was approved by the Ministry of Transportation and Infrastructure (MoTI), before the area was federally declared as critical habitat for Great Basin spadefoot. Often responsibilities to conserve critical habitats are distributed across multiple levels of government (federal, provincial, local) and this can hinder the coordination necessary for environmental conservation (Parrott 2019). The final phase of John Hindle Drive construction was completed by the Ministry of Transportation and Infrastructure in August 2018. The project consisted of an additional 1.8 km roadway connecting John Hindle Drive from the City of Kelowna Glenmore Landfill to the UBC Okanagan Campus at Alumni Avenue. A new intersection and a traffic signal were installed at Upper Campus Way and Academy Way and the road was constructed with catch basins for stormwater. During construction, Associated was the environmental auditor and held the permit to handle wildlife. Great Basin spadefoot were salvaged and released to suitable habitat outside of the Project area. Associated worked with the City to install one-quarter inch mesh on the catch basins, preventing Great Basin spadefoot from entering the catch basins.

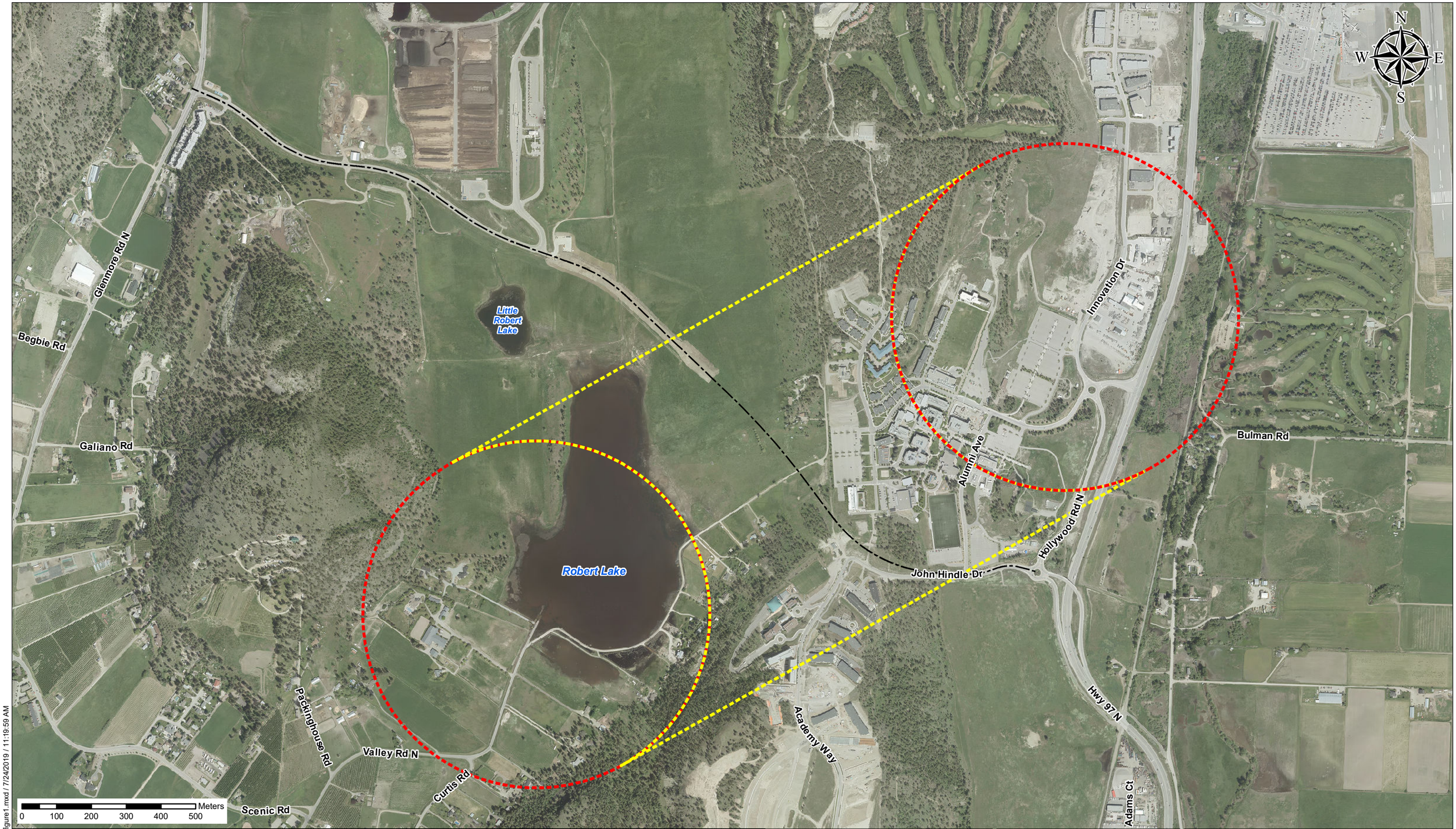
After completion, the responsibility for John Hindle Drive was handed over to the City of Kelowna. In 2018, UBC Okanagan staff observed amphibian mortalities on the new section of John Hindle Drive and directed their concerns to the City. The City of Kelowna approached Associated to conduct amphibian monitoring for Great Basin spadefoot within the newly-constructed section of road and Associated developed a mitigation plan to reduce the number of amphibian mortalities.

Thanks to volunteer efforts, Associated has documented locations of live Great Basin spadefoot and amphibian mortalities since 2017 (Figure 2). Associated and UBC staff found eight amphibian carcasses in the spring of 2019, and it was determined from genetic testing that 6 of the 8 mortalities were Great Basin spadefoot. Based on these mortalities, mitigation measures were developed by Associated in a Great Basin Spadefoot Management Plan (the Plan).

1.2 Project Description

Associated has worked with the City since 2019 to develop mitigation measures to reduce potential for Great Basin spadefoot mortalities along John Hindle Drive. Based on information gathered through auditory night surveys and visual surveys for mortalities, specimen collection and specimen results, a proposal was prepared to mitigation Great Basin spadefoot from vehicular wildlife collisions.

[1] *Species at Risk Act*. SC. 2002. c.39.
[2] Includes any native species or subspecies considered to be of Special Concern in BC. Taxa of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events. Blue-listed taxa are at risk, but are not Extirpated, Endangered or Threatened.



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Associated Environmental

Critical Habitat variant

- Core
- Connectivity

PROJECT NO.:	2019-8287.000
DATE:	July 2019
DRAWN BY:	BdJ

FIGURE 1: GREAT BASIN SPADEFOOT CRITICAL HABITAT

City of Kelowna

John Hindle Drive - Spadefoot Monitoring

Glenmore Rd N

Little Robert Lake

Robert Lake

Galiano Rd

Curtis Rd

Academy Way

John Hindle Dr

Hwy 97 N

Academy Way Inset

John Hindle Drive Inset (Adjacent to Robert Lake)

figure2_may2020.mxd / 2020-06-10 / 2:33:16 PM

Associated Environmental

Amphibian encounters

- Spadefoot - live
- Unknown amphibian - dead

Meters
0 50 100 150 200 250

PROJECT NO.: 2019-8287
DATE: June 2020
DRAWN BY: BdJ

FIGURE 2: KNOWN LOCATIONS OF GREAT BASIN SPADEFOOT (2017-2019)

City of Kelowna

John Hindle Drive - Spadefoot Monitoring

Associated proposed to the City that amphibian exclusion fencing be installed along of the new section of John Hindle Drive in 2019 to prevent Great Basin spadefoot from entering the road. However, the fencing was not installed at that time. UBC Okanagan staff continued to observe and collect amphibian mortalities in the spring of 2019 and 2020. Associated approached the City again in 2020 and again proposed the installation of amphibian exclusion fencing, as evidence of amphibian mortalities continued to be reported. The City accepted the proposal from Associated in August of 2020 and approved the Amphibian Exclusion Fencing and Spadefoot Monitoring project (the Project). The amphibian exclusion fencing was installed in the fall and winter of 2020 (Figure 3) and the goal was for amphibians and other wildlife to be directed towards the corrugated steel culverts that cross under John Hindle Drive.

1.3 Project Objectives

The main objective for Great Basin spadefoot monitoring is to test the efficacy of the amphibian exclusion fencing and to determine if the monitoring methods were effective (adaptive management) or if it warrants changes to the existing monitoring efforts. Although without the use of wildlife cameras, it was difficult to determine if amphibians are using the corrugated steel culverts to cross under the road sand pads were used to determine use.

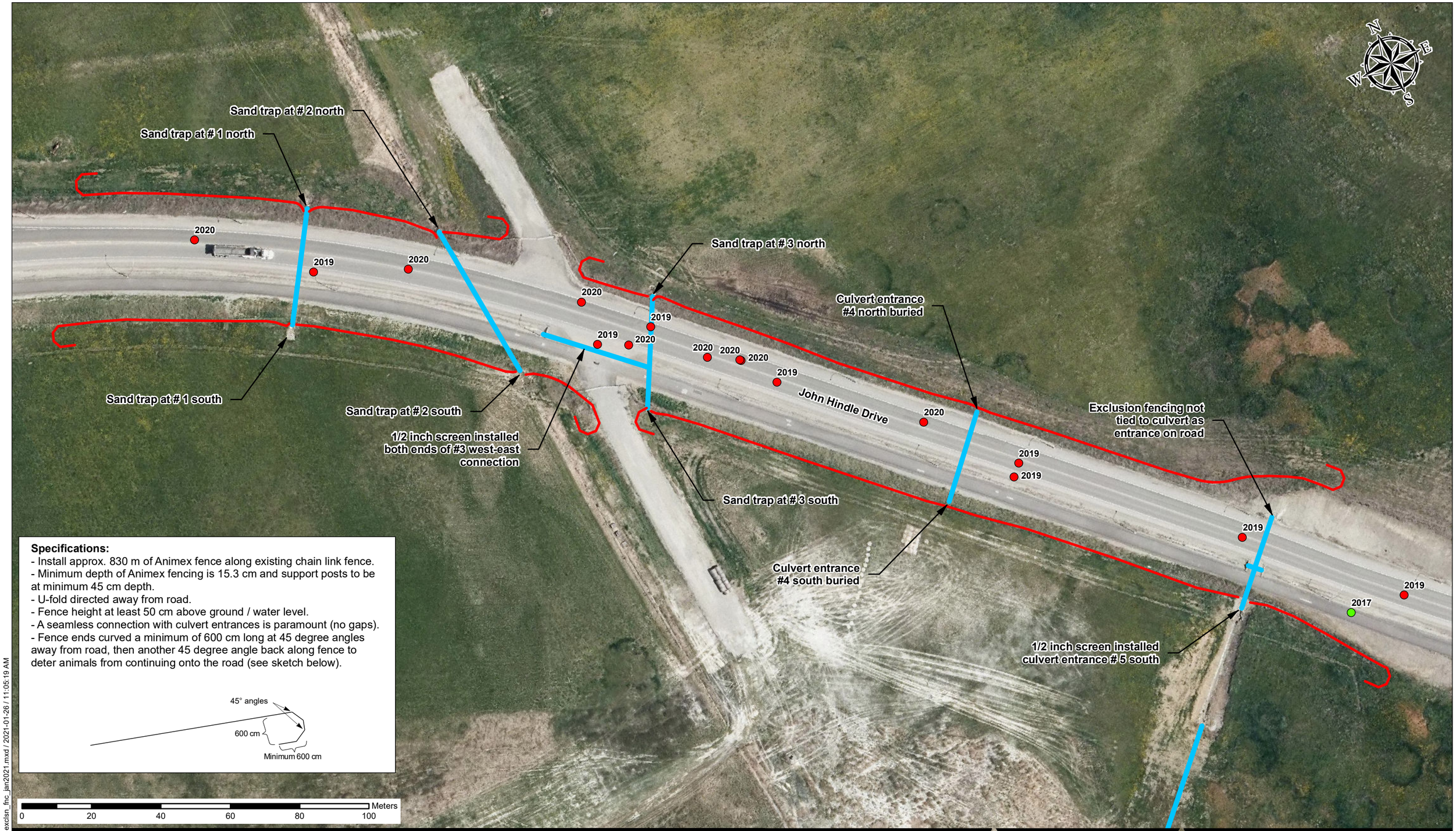
This report outlines the background information, habitat value at the site and monitoring methods. It will be the basis for directing collaborative monitoring and data collection by Associated Environmental (Associated) and volunteers. The data collected and results to date include only one spring season (2021) and will continue through the fall of 2021 with the aid of volunteers. Based on the results from monitoring, the goal is to determine if the amphibian exclusion fencing is successful at preventing amphibian mortalities and the data will be compared to 2019 and 2020 data. If the results indicate that the amphibian exclusion fencing is not effective, data will be collected on areas of improvement where gaps within the amphibian exclusion fencing are evident. The results of this study will inform the City on the effectiveness of amphibian exclusion fencing methods to mitigate for road kill on John Hindle Drive. It will also inform other wildlife managers across Provincial and local governments on how to decrease wildlife and species-at-risk mortalities on linear developments.

2 METHODS

Methods include a review of background information to determine the environmental baseline conditions, direction on fence installation and the monitoring of fence efficacy.

Environmental Baseline Conditions
Associated reviewed existing information and assessed habitat conditions at the site and completed a literature review of amphibian exclusion fencing studies in the Okanagan. Associated also completed a search of potential wildlife species within a 5 km radius of the project. Data sources that were reviewed prior to the start of the Project included, but were not limited to:

Mapping and Data
- BC Species and Ecosystems Explorer (CDC 2020);
- BC Conservation Framework (BC MOE 2020);
- Google Earth© online imagery;



Specifications:
- Install approx. 830 m of Animex fence along existing chain link fence.
- Minimum depth of Animex fencing is 15.3 cm and support posts to be at minimum 45 cm depth.
- U-fold directed away from road.
- Fence height at least 50 cm above ground / water level.
- A seamless connection with culvert entrances is paramount (no gaps).
- Fence ends curved a minimum of 600 cm long at 45 degree angles away from road, then another 45 degree angle back along fence to deter animals from continuing onto the road (see sketch below).

Meters
0 20 40 60 80 100

exclsn_fnc_jan2021.mxd / 2021-01-26 / 11:05:19 AM

Associated Environmental

Completed exclusion fencing

Culvert

Amphibian encounters

Spadefoot - live

Amphibian - dead

PROJECT NO.: 2019-8287
DATE: January 2021
DRAWN BY: BdJ

FIGURE 3: EXCLUSION FENCE PLAN

City of Kelowna

John Hindle Drive - Spadefoot Monitoring

- iMap BC (DataBC 2020);
- Open Government Portal (Government of Canada 2020).

Details on exclusion fence design, monitoring, surveys, and specimen collection are presented below:

Amphibian Exclusion Fencing
830 m of permanent Animex polymer plastic AMX P40 (AMX P1015) wildlife amphibian exclusion fencing was installed along John Hindle Drive, which included 415 m on both sides of the road (Figure 2) between November 5, 2020 and January 7, 2021. The fencing is located inside the existing farm fencing, and there is a seamless connection with the farm fencing where the two fences intersect. The fence was installed at a minimum depth of 15.3 cm to prevent wildlife from digging underneath it. The ends of the exclusion fence curve inwards for a length of 6 m at a 45-degree angle (Specification detailed in Figure 3), in order to direct wildlife towards the 600 mm corrugated steel culverts. The fencing has a seamless connection with three of the corrugated steel culvert entrances allowing wildlife to travel through.

Amphibian Monitoring
To monitor Great Basin spadefoot presence and movement, and to test the effectiveness of the amphibian exclusion fencing, three monitoring Site locations were chosen. The study area was divided into 3 Sections of road along John Hindle Drive as outlined in Figure 4. Two site locations (Sections 2 & 3) were chosen within the amphibian exclusion fencing, and the third site location was a control site (Section 1), outside of the amphibian exclusion fencing. Associated coordinated a very keen and dedicated group of volunteers including the University of British Columbia Okanagan Campus (UBC Okanagan) Wildlife Society students, UBC Okanagan and Thompson Rivers University (TRU) staff, the Central Okanagan Naturalist Club and Friends of Robert Lake. Associated liaised with UBC Okanagan and TRU staff to develop the Great Basin spadefoot monitoring plan for 2021 which included Associated training volunteers to monitor and collect data and scheduling 14 shifts per week for visual and auditory monitoring.

For ongoing monitoring, Associated completed auditory and visual site surveys in the spring of 2021 to determine if Great Basin spadefoot are in the area and if they are utilizing the corrugated steel culverts.

The following approach was our attempt to detect Great Basin spadefoot:

1) The team of volunteers, with Associated monitored the area for auditory calls in early April in an attempt to capture Great Basin spadefoot calling during emergence from hibernation. The breeding calls are typically heard when the Great Basin spadefoot moves from higher elevation, dry sites, to water for breeding and to lay eggs. Auditory surveys continued through April and May to determine their presence.
2) Associated incorporated checked sand pads for tracks at either end of the corrugated steel culverts to determine evidence of use. Sand pads were constructed by adding fine sand on plastic trays to create a substrate track pad that will show wildlife tracks (Photo Documentation – Appendix A). The pads were slid in and out of corrugated steel culvert entrances for inspection. Sand pad observations were conducted at intervals during breeding and dispersal (typically April through June). Amphibian use of corrugated steel culverts were monitored at night from April 4 to May 23, 2021, when Great Basin spadefoot are typically most active and moving between winter and summer core habitats.

Sand pad
Sand pad
John Hindle Drive
Sand pad
Sand pad
N
E
S
W
0 20 40 60 80 100 Meters
figure4.mxd / 2021-05-26 / 1:20:50 PM

Associated Environmental

- Installed exclusion fencing
- Culvert
- Section 1
- Section 2
- Section 3
- Spadefoot calls (approximate)

Amphibian Encounters

- Amphibian - live (2017 - 2018)
- Amphibian - live (2021, post fence installation)
- Amphibian - dead (2019 - 2020)
- Amphibian - dead (2021, post fence installation)

PROJECT NO.: 2019-8287
DATE: May 2021
DRAWN BY: BdJ

FIGURE 4: SPADEFOOT EXCLUSION FENCING MONITORING - SPRING 2021

City of Kelowna

John Hindle Drive - Spadefoot Monitoring

3) Volunteers and Associated will monitored the road for amphibians in the early mornings, before sunrise. Visual observations were completed by looking for live amphibians and amphibian mortalities along John Hindle Drive. The mortality surveys were short but frequent walks along the section of amphibian exclusion fencing along John Hindle Drive (seven mornings a week) between April 4 and May 23, 2021.

Auditory Surveys

Auditory surveys (April 4th through May 23, 2021) were conducted when daytime temperatures reached 15°C. These surveys included walking along the John Hindle Drive bike path and stopping at two known locations for auditory calls and one control site. The three locations are presented on Figure 4. Volunteers were asked to stop at each of the three locations to record calls for a specified time (as detailed below) and were encouraged to record calls from all locations from John Hindle Drive that they observed Great Basin spadefoot calls. Surveys were completed seven evenings a week, although it was optimal to complete surveys on rainy evenings or evenings with thunder and/or high humidity. A sample data sheet (Table 1 Sample Data Sheet - Appendix B) was prepared for volunteers to record data. Recorded data included:

- name, date, time, weather, air temperature, and humidity (located on the weather app)
- did it rain in the last 24 hours?
- amphibian species code observed (e.g. Great Basin spadefoot (SPIN), Pacific chorus frog (PSRE)
- GPS location of survey (Google Earth)
- location/direction of Great Basin spadefoot calls from John Hindle Drive
- number of calls over 3 minute intervals x 3 when calls are heard

Auditory surveys were completed after dusk when Great Basin spadefoot are most active. Auditory surveys required a minimum of 15 minutes of survey time at each location to allow for time for the Great Basin spadefoot to begin to call before observers left the site (a minimum of 45 minutes in total for the three locations). As John Hindle Drive is high traffic zone, volunteers were asked to wear reflective/high visibility clothing, carry flashlights, and stay alert while completing the survey.

Associated arranged auditory survey training for volunteers without experience with Great Basin spadefoot calls. This training (April 5, 2021) included auditory recordings of Great Basin spadefoot and Pacific tree frogs, with the intention of volunteers surveying on their own. Gisele Rehe of Associated met with several volunteers (as requested) for additional survey training.

Visual Surveys

As if it became possible that wildlife would have to be handled (moving them off the road), Associated applied for a General Wildlife Permit (application # 100346031). It was planned that Associated train the volunteers on safe handing procedures (FLNRORD 2016) when the permit was received. If injured amphibians and reptiles were found the road, the Province requires that they be handled properly and euthanized, if necessary. If wildlife were observed travelling across the road, wildlife was collected and released in the direction that they were travelling (MoECCS 2020). As of May 27, Associated has not received the General Wildlife Permit.

Visual surveys began with the team driving at 20 km/hour along John Hindle Drive and parking at the intersection of Landfill Road. Visual surveys then required walking along John Hindle Drive beginning at the start of Section 1 (Figure 4) and continuing on for the length of amphibian exclusion fencing (Sections 2 and

3), along both sides of road adjacent to the bike path. Auditory surveys were completed at the same time noting the occurrence (direction) of Great Basin spadefoot calls. Surveys were completed every morning between April 4 through May 23. A sample data sheet (Table 2 Sample Data Sheet - Appendix B) was prepared for volunteers to record data. Surveys require volunteers to walk along John Hindle Drive just before sunrise. Visual surveys of live amphibians or mortalities were completed with a flashlight if it was still dark. Volunteers were asked to carefully observe the road and road shoulders as Great Basin spadefoot are small (4 to 6.5 cm) and can easily be missed. Photographs were also collected of amphibian observations (Photo Documentation – Appendix A). As John Hindle Drive is a high traffic zone, volunteers were asked to stay safe while surveying for amphibians by wearing reflective/high visibility clothing, carrying flashlights and staying alert and aware of traffic. Recorded data included the following information:

- number of live amphibians observed, or mortalities collected
- photograph of live amphibians or mortalities
- GPS location of live amphibians or mortalities
- name, date, time, weather, and air temperature
- did it rain in the last 24 hours?

Volunteers were asked to record all auditory and visual observations, even if no amphibians observations were made.

Amphibian Mortality Collection

Amphibian mortalities were collected for future genetic testing. This required collecting the mortality with sterile gloves and tweezers and transferring the mortalities to labelled Whirl-paks (or freezer bags). Associated supplied a secure storage container on site (at the farm access gate within Section 1) which contained gloves, tweezers, freezer bags, permanent markers, flashlights and hand sanitizer. Individual specimens were bagged separately and labelled with your observer's name, date, time, GPS location and specimen. Volunteers were instructed to keep samples in a freezer until the samples were picked up by Associated.

3 RESULTS

3.1 Environmental Baseline

Habitat

The Project area is located in the Okanagan Very Dry Hot Ponderosa-pine (PPxh1) biogeoclimatic subzone variant. The PP zone is the driest and warmest forest zone in British Columbia and is found at low elevations (from 335 m to 900 m); along the dry valleys of the southern interior (Lloyd et. Al. 1990). This zone has a high number of red- and blue-listed ecological plant communities, wildlife and plant species. The high number of listed species is due to the limited range of the PPxh1 zone and its location in valley bottoms, in areas subject to development.

Great Basin spadefoot have been observed to reside and travel within the Project area. Adult Great Basin spadefoot require both aquatic and terrestrial habitats within an average of 500 m or more of one another although some Great Basin spadefoots have been tracked by radio telemetry to travel up to 2.35 within the BC Thompson Okanagan region (Crosby 2014). After overwintering in burrows in friable soils from late October to April, Great Basin spadefoot move to potential breeding habitats (Government of Canada 2017). Primary migration (which can be tracked using radio telemetry) involves resident adults moving to and from

breeding sites and secondary migration involves adults foraging for food, refugia and overwintering. However Great Basin spadefoot metamorph emigration from the breeding ponds can be more difficult to determine using radio telemetry (Crosby 2014). The installation of pitfalls and transect line surveys has been successful for some Great Basin spadefoot metamorph studies (Crosby 2014). Adult Great Basin spadefoot breed in a variety of wetland habitats including shallow, ephemeral ponds and ditches so they can adapt quickly to a new breeding site (COSEWIC 2007). The critical connectivity habitat area that includes John Hindle Drive links desired habitat, specifically the dry sandy-loam hills towards the northeast (at the base of UBC Okanagan) and the wetlands to the south that are within the area of Robert Lake and Tutt Pond.

Culverts as Wildlife Corridors

The 600 mm corrugated steel culverts (Photo Documentation – Appendix A) are approximately 25 m in length and may not be a desirable method of travel for the Great Basin spadefoot. Structures that have been built with the intention for amphibian migration are most effective when they have a bed natural substrate (sand-gravel) along the entire floor, provide adequate lighting, minimal temperature change, and suitable airflow throughout the culvert which may include light shafts or holes. The corrugated steel culverts may not provide a suitable travel path for migration, as amphibians prefer shorter culverts to pass through (Crosby 2014). The lack of light may cause amphibians to hesitate about entering the corrugated steel culvert. These culverts may be large enough in diameter to create enough airflow and light and reduce temperature changes, but without natural substrate along the entire corrugated steel culverts, travel may be undesirable for amphibians.

Amphibians and Reptiles in Project area

A number of amphibians and reptiles suspected within the Project area based on the habitat (CDC 2021) may include; Great Basin spadefoot, Western painted turtle (*Chrysemys picta belli*), western toad (*Anaxyrus boreas*), Columbia spotted frog (*Rana luteiventris*), Pacific chorus frog (*Pseudacris regilla*), long-toed salamander (*Ambystoma macrodactylum*), northern alligator lizard (*Elgaria coerulea*), terrestrial garter snake (*Thamnophis elegans*), common garter snake (*Thamnophis sirtalis*), western skink (*Plestiodon skiltonianus*), northern rubber boa (*Charina bottae*), North American racer (*Coluber constrictor*), Great Basin gopher snake (*Pituophis catenifer deserticola*), western rattlesnake (*Crotalus oreganus oreganus*).

Other Listed Species in Project Area

There are a number of other Provincially red-listed and blue-listed species within the Project area, including the red-listed American badger (*Taxidea taxus*), blue-listed American Avocet (*Recurvirostra Americana*), and Western Screech Owl (*Megascops kennicotti*).

3.2 Monitoring Fence Efficacy

Data collected by UBC staff (volunteers) and Associated have been recorded since 2017, with the number of live amphibians identified and mortalities collected. The results collected in 2021 have been compared to the results from 2017 through 2020, prior to the amphibian exclusion fencing.

Great Basin spadefoot were first observed within the Project area on April 20, 2021, once the daily temperature reached 19.8° Celsius. Although the daily temperatures fluctuated between 3° Celsius and 24° Celsius through May 24th, 2021 (average of 13° Celsius), the presence of Great Basin spadefoot remained. The emergence of the Great Basin spadefoot within the Project area has fluctuated in recent

years with the emergence of individuals calls being documented (by Associated staff) on April 8, 2019 and then not until May 7 of 2020. Although the daily temperature on April 8, 2019 only reached 10.5° Celsius the humidity reached 90% and the previous day's temperature had already reached 15.6° Celsius. The daily temperature on May 7, 2020 reached 16.8° Celsius with 78% humidity. 2020 was observed to be a late year for the arrival of Great Basin Spadefoot. Temperature fluctuated throughout the survey period however Great Basin Spadefoot remained within the Project area, consistently calling each evening for several weeks.

Auditory Surveys Results 2021

Great Basin spadefoot auditory surveys were conducted nightly between April 4 to May 23, 2021. Survey efforts were concentrated between Sections 1, 2 and 3. Although it was not expected to observe Great Basin Spadefoot directly within Section 1 (Site 1 being the control site outside of the amphibian exclusion fencing), Great Basin spadefoot were heard north of Site 1 (within Section 1) directly in front of the City Recycling Centre within a small marsh area northwest of Tutt Pond. Great Basin spadefoot remained concentrated (with their calls) in Section 2 (Photo Documentation – Appendix A), southeast to Robert Lake (northwest side) and southwest to Tutt Pond (northeast side), but observations were also made within Section 2 that were north of Site 2 (across road, east of the City Landfill in farm field), within 1 flooded corrugated steel culverts (within amphibian exclusion fencing of Section 2) and 1 dry corrugated steel culvert (outside of the amphibian exclusion fencing but within Section 2) with a single individual broadcasting. Great Basin Spadefoot were observed in Section 3 to the north of Site 3 towards a marsh adjacent to the road. The concentration of individuals was observed to be within Section 2. Location of calls were recorded are mapped on Figure 4. Calls were recorded at 3-minute intervals and averaged 22.5 calls per minute with 3 to 5 distinct individuals per evening.

Visual Surveys Results 2021

Visual surveys resulted in 8 amphibian mortalities, 2 live Pacific tree frogs (PSRE) and 1 long-toed salamander (AMMA) being observed along John Hindle Drive (Figure 3-1) (Table 3-1). Two live Pacific tree frogs were found crossing the bike path heading south toward Tutt Pond on April 16 and May 3 (Section 1). A long-toed salamander was found in Section 2 travelling south towards Robert Lake on May 18. Amphibian mortalities were found on April 24, 28 & 29, May 11, 14, 20, 21 and 23 between Sections 1 to 3 (Figure 3-2). Total amphibian individuals were found most often along Section 1 with 6 individuals recorded and Section 2 with 4 individuals recorded (Figure 3-1). Only 1 amphibian mortality was found in Section 3 (Figure 3-1). In some cases, amphibian mortalities were not conclusively identified due to their condition, but specimens were photographed and collected for potential genetic testing. With only Great Basin spadefoot and Pacific tree frogs being heard in the Project area, amphibian mortalities were likely determined to be these species (Photo Documentation – Appendix A). Sand pads were unsuccessful in determining if Great Basin spadefoot were using the corrugated steel culverts. It was hard to identify wildlife tracks on the sand pads, let along amphibian, so these results were inconclusive (Photo Documentation – Appendix A). Therefore other monitoring methods to determine if Great Basin spadefoot are using the corrugated steel culverts are necessary.

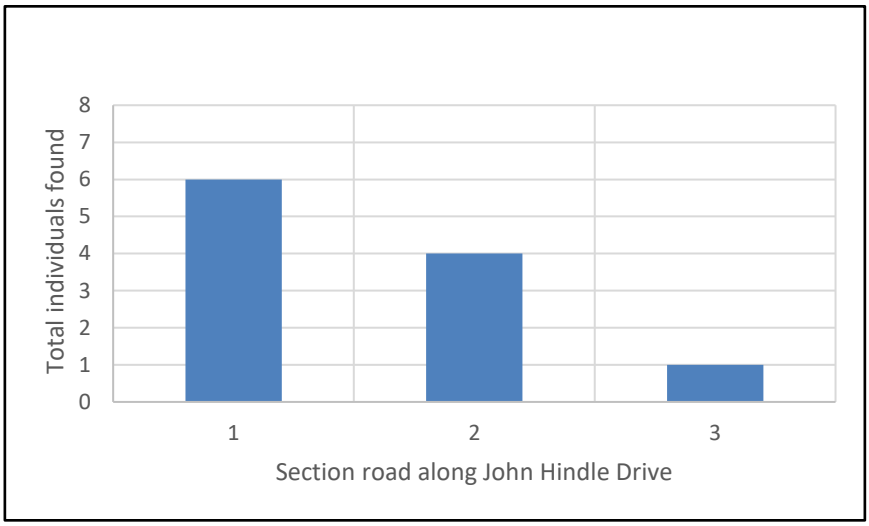


Figure 3-1 Total amphibians found along sections of John Hindle Drive.

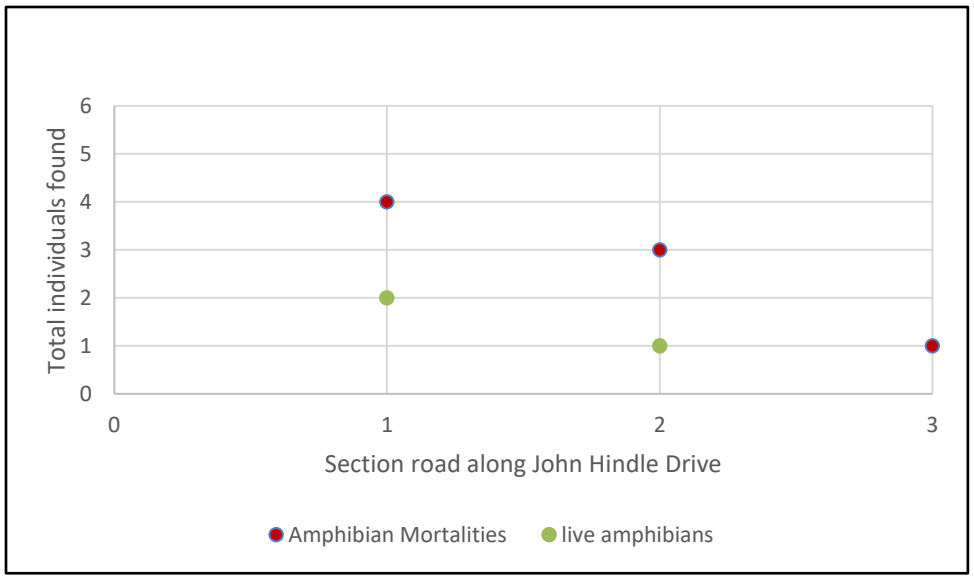


Figure 3-2 Total amphibian mortalities and live individuals found along road Sections for 2021.

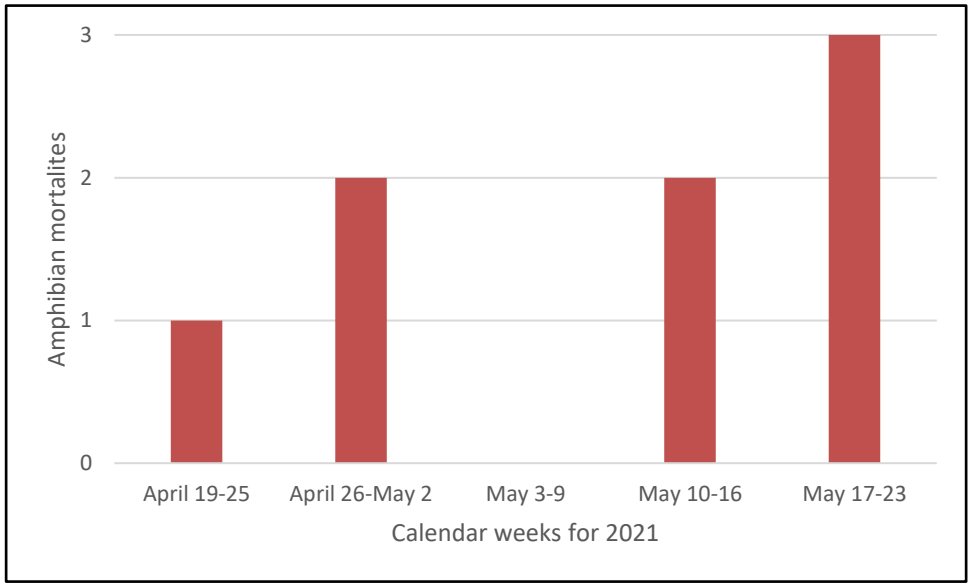


Figure 3-3 Total amphibian mortalities found within Project area.

Table 3-1. Species found in 2021 within Project area after installation of amphibian exclusion fencing.

Amphibian Species	Amphibian (live or mortality	Location by Section	Date
PSRE[3]	live	1	April 16
SPIN[4]	mortality	2	April 24
Unidentified	mortality	2	April 28
Unidentified	mortality	1	April 29
PSRE	live	1	May 3
Unidentified	mortality	3	May 11
Unidentified	mortality	1	May 14
AMMA[5]	live	2	May 18
Unidentified	mortality	2	May 20
Unidentified	mortality	1	May 21
Unidentified	mortality	1	May 23

Visual Survey Results comparing results from 2019 through 2021

The total number of amphibian mortalities (Photo Documentation – Appendix A) by Section of road (from 2019 through 2021) are shown in Figure 3-2. The location of amphibian mortalities has changed since the

[3] Pacific tree frog
[4] Great Basin spadefoot
[5] Long-toed salamander

installation of the amphibian exclusion fencing. In 2019 and 2020, amphibian mortalities were found only in Sections 2 and 3, with the majority in Section 3. In 2021, the total number of amphibian mortalities were found in all 3 sections but equal amounts being found in Section 1 and 2. With Section 3 being fully fenced, it can be assumed that the amphibian exclusion fencing is working to exclude amphibians from entering the road. The increased numbers of amphibian mortalities being found in Section 1 and 2 indicates that amphibians are entering the road through gaps in the amphibian exclusion fencing. These gaps include the areas of the farm access gates, extending toward the landfill. Fenced areas within Section 2 to 3 shows a reduction in amphibian mortalities being found. The increased number of mortalities found in Section 1 and 2 indicates that the amphibian exclusion fencing should be extended to include Section 1 and that the gaps within the fencing (farm access gates) be mitigated.

The total effort for 2021 (visual morning surveys for amphibian mortalities April 4 to May 23) was 23.25 hours. This increased from the 2019 and 2020 total effort being 12 hours and 15 hours, respectively. However effort was recorded for Associated staff only. Additional effort by UBC Okanagan staff was not recorded for 2019 or 2020. Assuming an increased level of effort surveying (for mortalities and live amphibians) may have contributed to a higher number of amphibian mortalities being found after installation of the amphibian exclusion fencing.

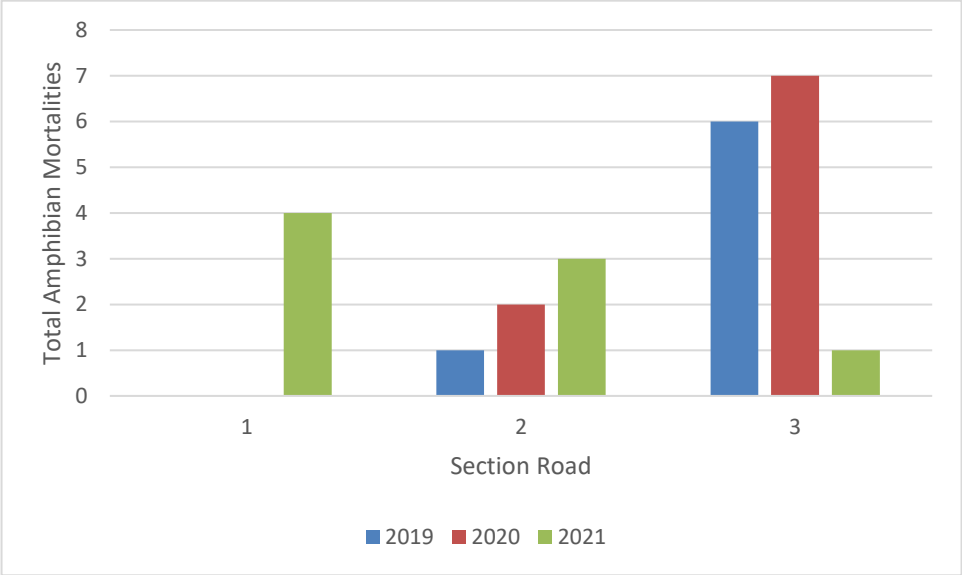


Figure 3-4 Total amphibian mortalities within Sections of road.

An average of 22.5 calls were heard on the evenings between April 20 and May 23. Call totals ranged from 1 to 93 calls over 3 minute intervals. On average, 3 to 5 individual Great Basin spadefoot were calling at the time of the surveys. Because we do not have data on the number of Great Basin spadefoot calls or individuals calling from previous years, we not know if the number of calls has changed.

The results indicate no significant change in the number of amphibian mortalities since the amphibian exclusion fencing was installed. More amphibian mortalities may have been observed in 2021 as a result of the increased level of survey effort. As we do not have data from previous years for the number of Great Basin spadefoot calls, it is not known if the population has changed. Wildlife are still accessing the road at the farm access gates and around the ends of the amphibian exclusion fencing. Since the sand pads were an unsuccessful method for determining if amphibians are using the corrugated steel culverts as corridors, it remains unknown.

4 DISCUSSION AND RECOMMENDATIONS

Associated and volunteers have observed several incidents where vehicles were driving at excessive speeds, making it dangerous for pedestrians, cyclists, motorists and wildlife along John Hindle Drive. A reduction in the speed limit to 50 km per hour (instead of the posted 60 km per hour) and the installation of speed bumps and/or traffic cameras may deter excessive speed and increase the safety for all people and wildlife using the road. Installing wildlife crossing signs would increase wildlife awareness for the Robert Lake area and also potentially deter motorists from driving at excessive speeds, if they were aware they were driving through a critical habitat area.

Based on the number of amphibian mortalities collected in 2021, the amphibian exclusion fencing does not indicate efficacy. Associated expects that amphibian mortalities will continue along John Hindle Drive until the deficiencies in fencing are mitigated. Deficiencies include: gaps in the amphibian exclusion fencing located at 2 farm access gates within Section 2 (east), a gap in amphibian exclusion fencing along the remaining length of Section 2 (west), and the entire length of Section 1 lacks amphibian exclusion fencing (Figure 5). Four cattle guard installations (at the farm access gates) are proposed where amphibian exclusion fencing is not possible (Figure 5). The recommended extensions and installations are justified in reducing the ongoing stress to the Great Basin spadefoot population within the Project area. The recommendations proposed can significantly reduce the number of amphibian mortalities, and prevent the Robert Lake Great Basin spadefoot population from declining.

The Ministry of Transportation & Infrastructure has graciously offered to lend 4 wildlife cameras to the City to use for ongoing amphibian monitoring in the fall of 2021. The wildlife cameras would be used to detect amphibian movement through the corrugated steel culverts and to further test the effectiveness of the amphibian exclusion fencing. Associated would mount the cameras at the end of two corrugated steel culverts located within Section 2 (Figure 3) before monitoring begins again in mid-September. Wildlife cameras installed within four corrugated steel culverts entrances will serve to determine if Great Basin spadefoot are using the culverts to move between summer and winter habitats, as the sand pad method was unsuccessful. To encourage passage through the corrugated steel culverts, it is recommended to place sand along the length of the bed to increase use.

Future study to determine the Great Basin spadefoot population size and movement within the corrugated steel culverts could be studied using methods like permanent drift fencing and radio telemetry. Ongoing study to determine the population and migration patterns within this critical habitat area is encouraged. Continued amphibian monitoring for the fall of 2021 and 2022 will aid in determining the effectiveness of the proposed mitigation measures and be used as an example on how to mitigate other newly constructed or existing roads within critical habitat for Great Basin spadefoot.

Environmental planning at a local government level needs to incorporate species-at-risk critical habitat mapping into road development planning. More transparency between critical mapped regions within the federal government and provincial government need to be communicated to local governments. At present, the responsibility for researching and proposing mitigation measures to protect critical habitat areas lies with the qualified environmental professionals. The City of Kelowna does not have specific mitigation procedures in place for critical habitat areas and will only react with an operational response if they deem it large enough. At a federal level, species-at-risk are only protected on federal lands so Great Basin spadefoot have no protection on City of Kelowna or private properties.

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Associated Environmental

- Proposed exclusion fencing
- Installed exclusion fencing
- Culvert
- Cattle guard
- Section 1
- Section 2
- Section 3
- Spadefoot calls (approximate)

Amphibian Encounters

- Amphibian - live (2017 - 2018)
- Amphibian - live (2021, post fence installation)
- Amphibian - dead (2019 - 2020)
- Amphibian - dead (2021, post fence installation)

PROJECT NO.: 2019-8287
DATE: May 2021
DRAWN BY: BdJ

FIGURE 5: SPADEFOOT EXCLUSION FENCING PROPOSAL FUTURE MONITORING

City of Kelowna

John Hindle Drive - Spadefoot Monitoring

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APPENDIX A – PHOTO APPENDIX

Photo 1 – Amphibian exclusion fencing seamlessless connected to the 600 mm corrugated steel culverts that cross underneath John Hindle Drive.

Photo 2- Great Basin spadefoot call location concentrated west of Robert Lake.

Photo 3 – Long-toed salamander observed travelling south across John Hindle Drive on May 18, 2021.

Photo credit to Dr. Ian Walker (volunteer and UBC Okanagan Campus staff).

Photo 4 – Pacific tree frog observed travelling south across John Hindle Drive on the evening of April 16, 2021.

Photo 5 – Sand pads located at the ends of 4 corrugated steel culvert openings.

Photo 6 – Amphibian mortality - specimen found April 21, 2020.

Photo credit to Dr. Ian Walker (volunteer and UBC Okanagan Campus staff).

Photo 7 - Amphibian mortality - specimen found April 24, 2021.

Photo credit to Taitum Lincoln (volunteer and UBC Okanagan Campus student).

Photo 8 – One proposed cattle guard location at a farm access gate between Section 2 & 3, where a concentration of amphibian mortalities have been found in 2021.

APPENDIX B – SAMPLE DATA SHEETS

Table 1 – Auditory monitoring record of amphibians observed (2 pages)

Site # (GPS location)	Observer's Name	Observation Date	Time	Weather			Species observed	Direction calls observed	# calls per 3 min intervals (or record zero calls)			Submitted results to Associated?
				Air Temp °C	Rain last 24 hrs?	% humidity						

Table 2 – Visual observations for amphibian along John Hindle Drive

# of amphibians found (dead or alive) record if zero	GPS location	Observer's Name	Observation Date	Time	Weather			Photo obtained Y/N	Carcass collected Y/N	Submitted results (& carcass) to Associated?
					Air Temp °C	Rain Last 24 hrs?	% humidity			