

Watershed Mapping

Using Stoddard Creek Watershed as an Example



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INTRODUCTION

This report was prepared to show the capabilities that exist for anyone who is interested, to use free, open source software and publicly-available data, to quantify and describe designated geographic areas of interest. In this case, I use the Stoddard Creek watershed, which encompasses Charlie Lake, as a study area to gather some of the available data and use Geographic Information System (GIS) software to create map summaries of these data.

The Charlie Lake Conservation Society (CLCS) is a non-profit group of volunteers whose main mission is to promote environmental stewardship of Charlie Lake and its watershed. We've been around since 1996, and over the years we've held many workshops, lectures, field trips and other activities to educate people about the ecosystem and the importance of its appreciation and stewardship.

Highlights from this report will also be used in one of our public lectures in the near future. In recent years there has also been a proliferation of mobile phone apps that allow anyone to use these to record observations in the field, such as, birds, plants, animals etc. and contribute to world-wide databases. This has come to be known as Citizen Science, and in this report there are two examples of this, the eBird and iNaturalist data.

CLCS is planning activities to showcase some of these Citizen Science apps, and this report can be used as a stepping stone into those activities.

METHODS AND DATA SOURCES

Maps were created with a Mac desktop version of QGIS.

“QGIS is a geographic information system (GIS) software that is free and open-source. QGIS supports Windows, macOS, and Linux. It supports viewing, editing, printing, and analysis of geospatial data in a range of data formats. Its name comes from an abbreviation of its previous name, Quantum GIS.” - (Wikipedia)

Geo-referenced data files were downloaded from a number of publicly-available websites, and then imported into QGIS. These data are listed below by website.

WEBSITE	DESCRIPTION	DATA
https://catalogue.data.gov.bc.ca/	Government of British Columbia data portal	<ul style="list-style-type: none"> • Watershed map • Stream lines • Digital elevation models • Land parcel designations • Forest pest infestation
https://www.bc-er.ca/	British Columbia Energy Regulator (BCER)	<ul style="list-style-type: none"> • Well and Facility Areas (Permitted)
https://ebird.org/home	eBird Canada	<ul style="list-style-type: none"> • Bird observations
https://inaturalist.ca/home	iNaturalist Canada	<ul style="list-style-type: none"> • Observations reported in iNaturalist
https://www.openstreetmap.org/#map=3/71.34/-96.82	Open Street Map (OSM)	<ul style="list-style-type: none"> • Various map layers available within QGIS
https://www.sentinel-hub.com/explore/copernicus-data-space-ecosystem/	Copernicus Data Space Ecosystem	<ul style="list-style-type: none"> • Normalized Differential Vegetation Index (NDVI)

Tools within QGIS were used to analyze some of these data. For example, the stream layer was intersected with the roads layer to identify all points where roads crossed a stream. It is important to note that, a lot of these stream lines represent drainages, but they don't necessarily indicate the presence of water. Many of these may have flowing water intermittently when significant rainfall occurs.

Another example of geo-processing is the creation of a 5 by 5 km. grid within the watershed, which was then used to calculate the densities of stream-road crossings and wells and facilities areas permitted by BCER. This provides visualizations of how these variables are distributed within the watershed. All data layers were clipped to the watershed line so it could be visualized just for the watershed. All the maps were created with QGIS, then exported as PNG files and included in this report. It is important to note that the data used in this report is current as of the time of the analysis. Obviously many of these data change over time, but the purpose of this report is not so much to have definitive estimates of the various parameters, rather to show what is possible with open source software and data.

RESULTS

Figure 1 includes the outline of the Stoddard Creek watershed and the drainage lines within the watershed. The area of the watershed is 346.48 km². There are a total of 1,018 drainage lines with a total length of about 403 km.

Figure 2 is a representation of the elevations within the watershed. These are calculated using a Digital Elevation Model (DEM) which is a common method used in mapping software. The range in elevations within the watershed is from 527 to 884 meters above sea level.

Figure 3 shows the land ownership categories within the watershed. Most of the land within the watershed is privately owned (79%).

Figure 4 shows all roads, which range from small well-site access to provincial and municipal roads within the watershed. The total number of distinct road segments within the watershed is 4,737 with a total length of about 1,032 km.

Figure 5 shows all the number of bird observations that were downloaded from the eBird website. Because the majority of observations are within a few locations, the graduated symbols are clumped in those locations. There were 3,957 data points with a total of over 50,000 individual observations. The eBird data contains details on the sources of the observations.

Figure 6 shows the location of iNaturalist observations within the watershed. Data is categorized by taxa. About half of all observations are Plants, while Insects, Fungi and Birds make up about 40 percent, and the remaining 10 percent is made up of the remaining 9 taxa. A total of about 9,000 observations for all taxa were recorded within the Stoddard Creek watershed. These data were downloaded about mid-July 2025 so these numbers will continue to increase with time.

Figure 7 This figure summarizes the forest pest occurrences within the watershed. Note that flooding and fire are included in this list because they also impact forests. The file for the entire province was downloaded and then those observations within the watershed were extracted and summarized below.

CONDITION	# OF EACH CONDITION	TOTAL # OF TREES IMPACTED	TOTAL AREA (ha)
Aspen-Poplar Twig Blight	13	245	3.5
Fire	1	15	0.25
Flooding	1	25	0.25
Mountain Pine Beetle	57	846	15.25
Spruce Beetle	2	6	0.5
TOTALS	74	1137	19.75

Figure 8 This map shows the locations of permitted oil and gas facilities, as reported in the BCER website. The BCER website is well-maintained and all their data is updated daily and available as downloads. A 5 by 5 km grid was superimposed on this map to visualize how the concentration of facilities is distributed throughout the watershed.

FACILITY TYPE	NUMBERS
Battery Site	28
Compressor Dehydrator	4
Compressor Station	8
Disposal Station	2
Gas Dehydrator	2
Gas Sales Meter	14
Injection Station	1
Oil Sales Meter	4
Pipeline Gathering	3
Processing Battery	5
Pump Station	1
Satellite Battery	12
Tank Terminal	1
Well Facility	22
Grand Total	107

Figure 9 This figure shows where roads intersect with stream drainage lines. This was done with tools within QGIS by intersecting the roads lines and stream lines layers. Reminder that all stream lines do not necessarily have water, rather, they are drainage lines, but also include all known named streams within the watershed. The total number of crossings identified by the analysis is 123. As with the Oil and Gas facilities, a 5 by 5 km grid was superimposed to visualize densities of the crossings throughout the watershed

Figure 10 This figure shows the Normalized Difference Vegetation Index (NDVI) for the watershed. As defined in <https://browser.dataspace.copernicus.eu/> :

The normalized difference vegetation index is a simple, but effective index for quantifying green vegetation. It is a measure of the state of vegetation health based on how plants reflect light at certain wavelengths. The value range of the NDVI is -1 to 1. Negative values of NDVI (values approaching -1) correspond to water. Values close to zero (-0.1 to 0.1) generally correspond to barren areas of rock, sand, or snow. Low, positive values represent shrub and grassland (approximately 0.2 to 0.4), while high values indicate temperate and tropical rainforests (values approaching 1).

NDVI values for the Stoddard Creek watershed were grouped into five categories, and the percentages of each categories shown in the table below:

NDVI Category	Percent
<= 0.05	5%
0.05 - 0.21	6%
0.21 - 0.36	23%
0.36 - 0.51	41%
>= 0.51	24%

In this example there are relatively more of the high NDVI values indicating most of the watershed has significant amounts of green vegetation. It's important to note that these data were from August 2025 satellite data, consequently the NDVI will fluctuate accordingly throughout the year, to reflect the changes in vegetation cover.

Figure 11 This figure is a handy summary of characteristics of Charlie Lake and its watershed, Stoddard Creek. Some of the data in this figure are from a great report prepared for our Society by Todd French and Bruce Carmichael (French and Carmichael, 1999).

CONCLUSION AND RECOMMENDATIONS

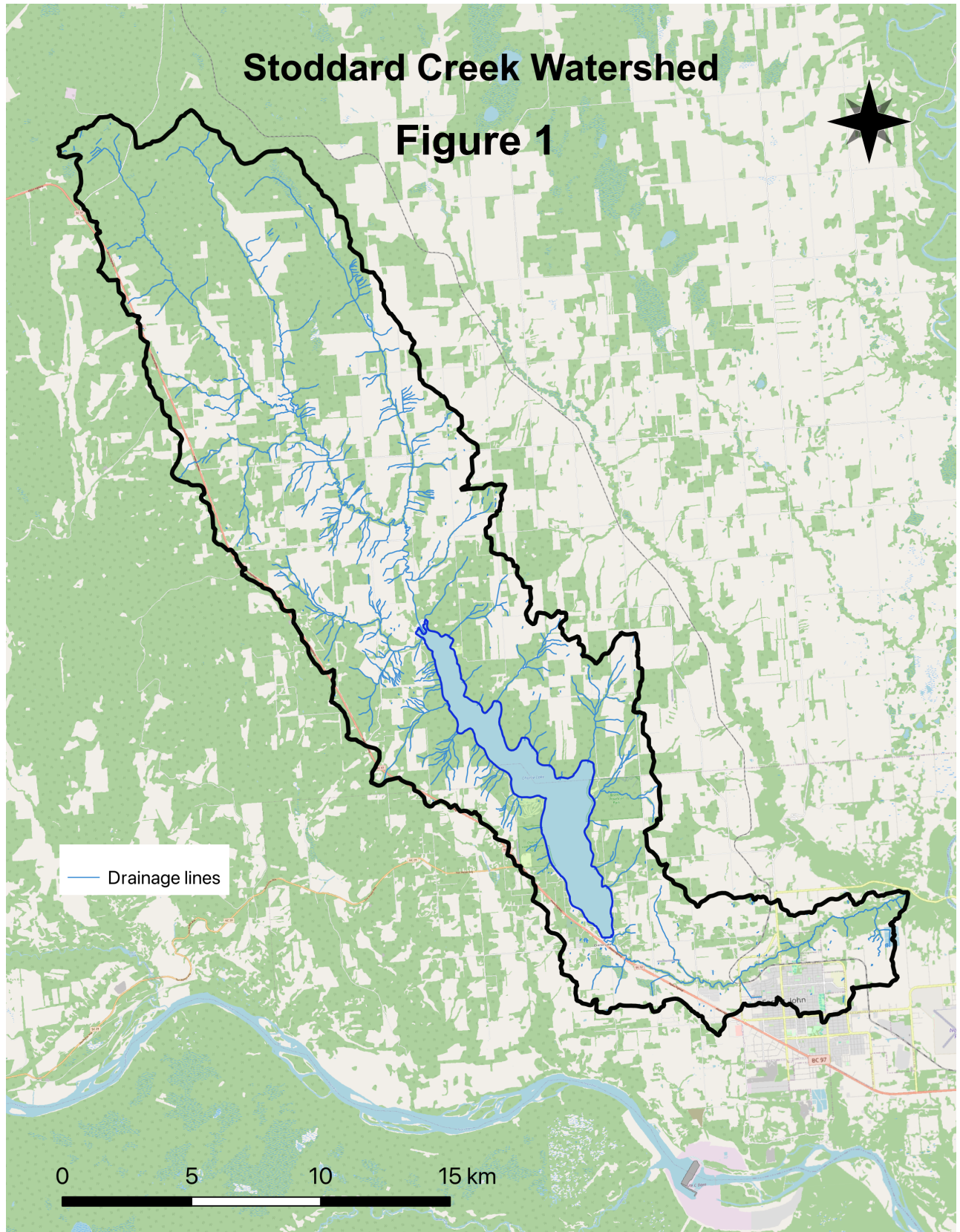
This report was written to show the variety of data that can be easily downloaded and used in QGIS to generate descriptive maps for a watershed, or any other distinct geographical boundary. The availability of free, open-source software has created incredible opportunities for anyone who is willing to learn the software to create reports such as this one.

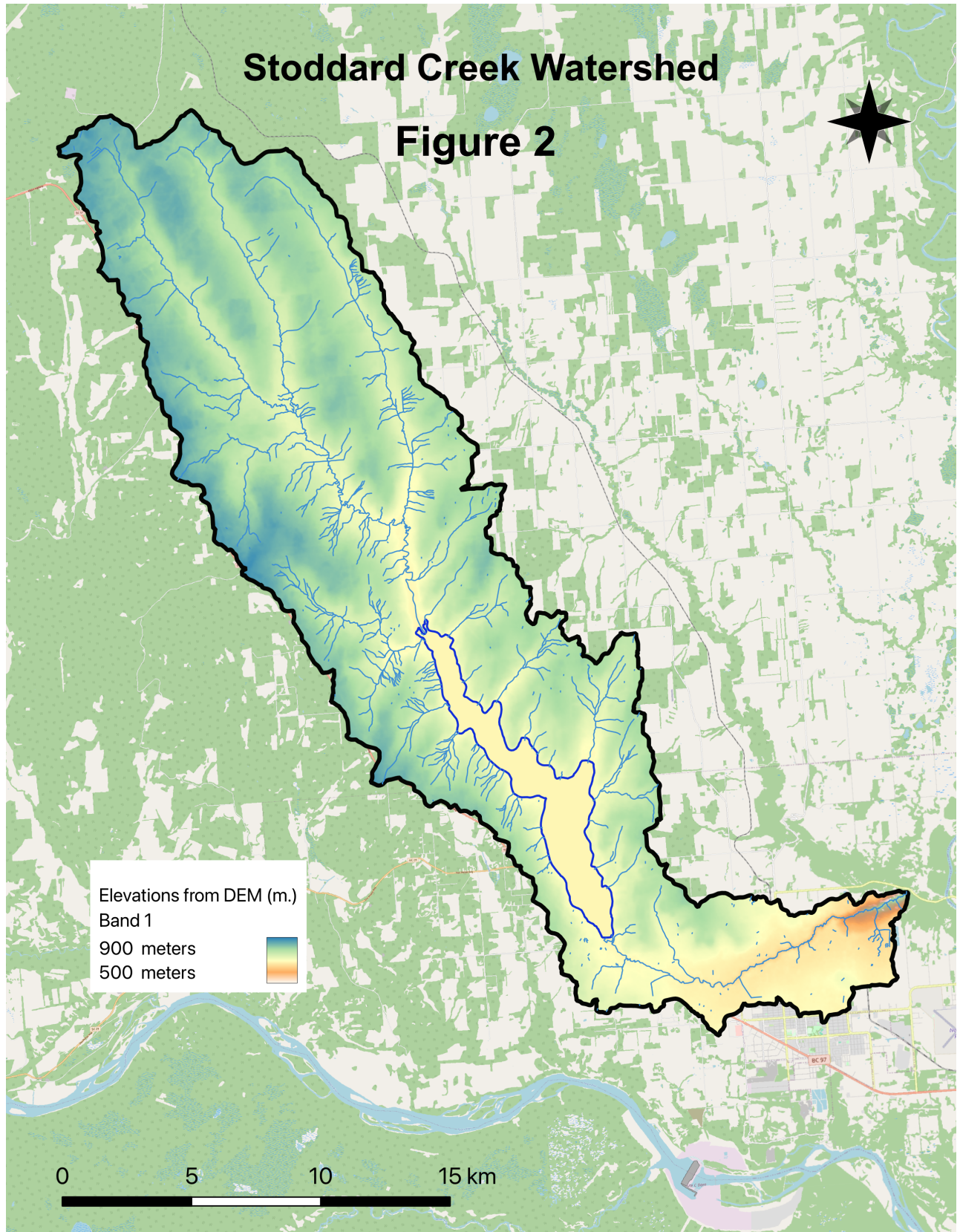
Wasn't long ago that these data and software were only available to government agencies and other large companies who could afford to buy GIS software licenses and also purchase the data. Making these widely available and free, has opened up possibilities for small, non-profit organizations, such as ours, the Charlie Lake Conservation Society, to use these tools to analyze the data and use the results to educate others through our stewardship activities.

The more people become knowledgeable about our ecosystems, the more likely they are to become engaged to influence public policy through all levels of government.

REFERENCES

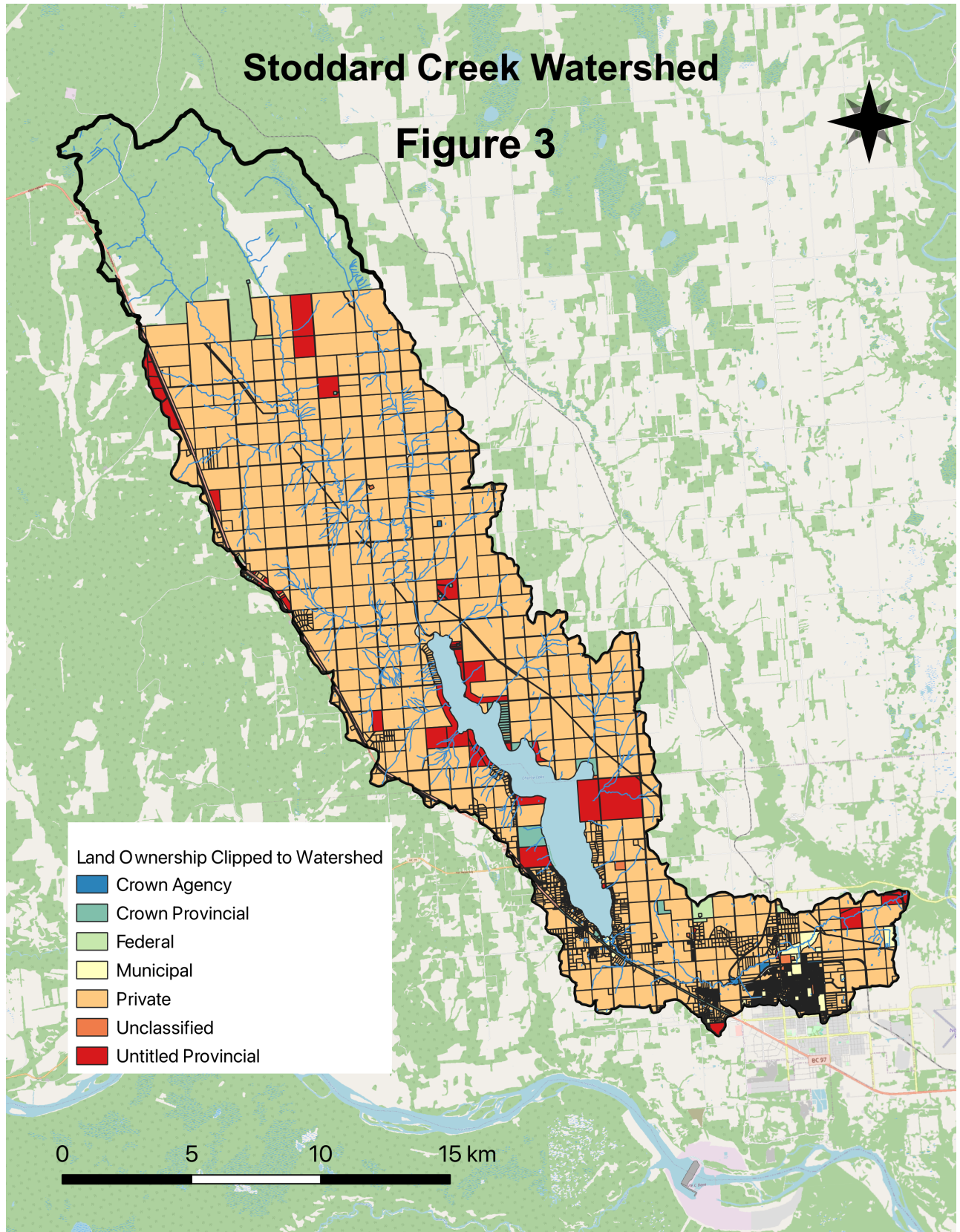
French, T.D. and B. Carmichael. 1999. *Limnological Aspects of Charlie Lake (Peace River Drainage, British Columbia): A Summary of Data Collected Between 1974 and 1995*. December, 1999. 115 pp.

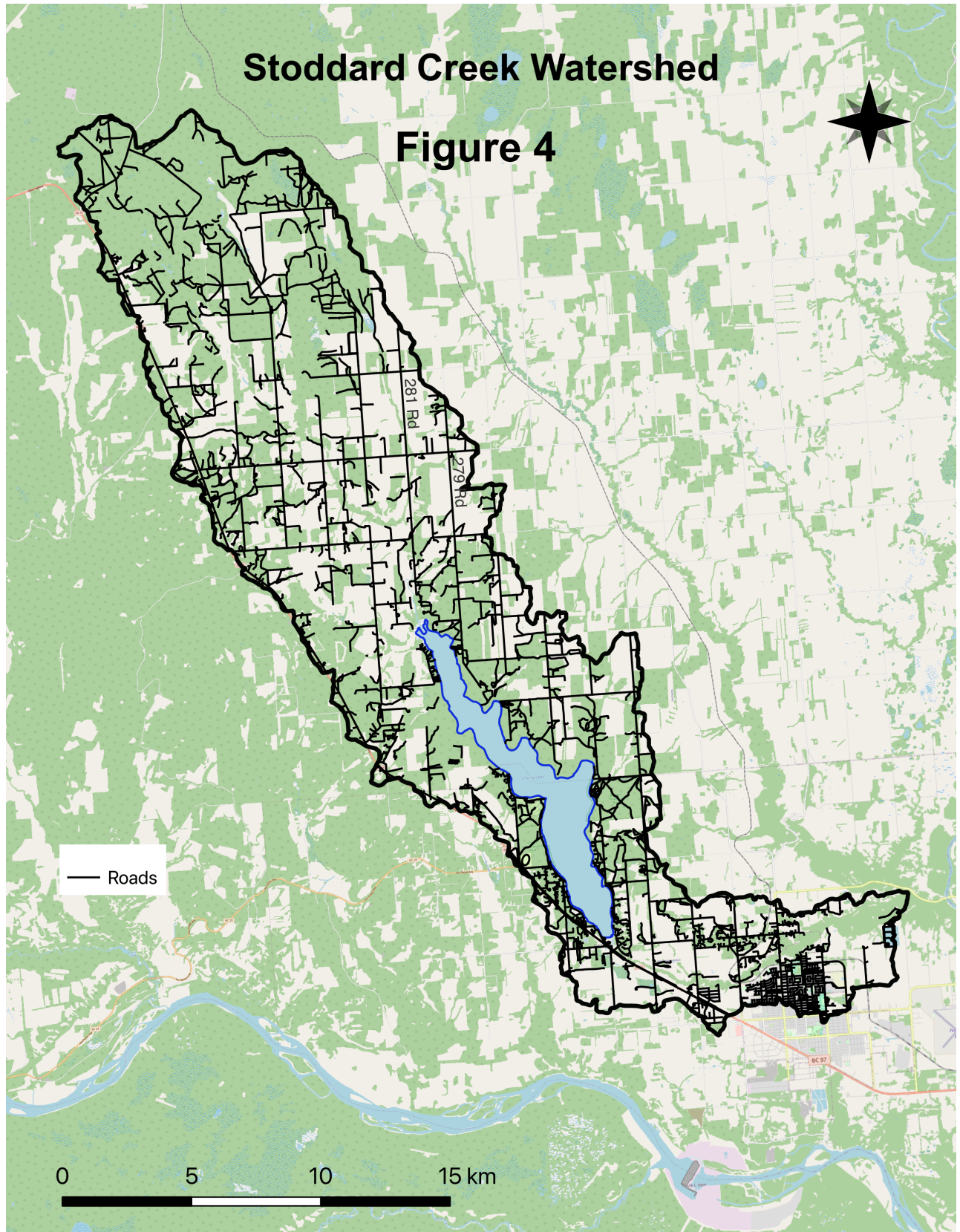


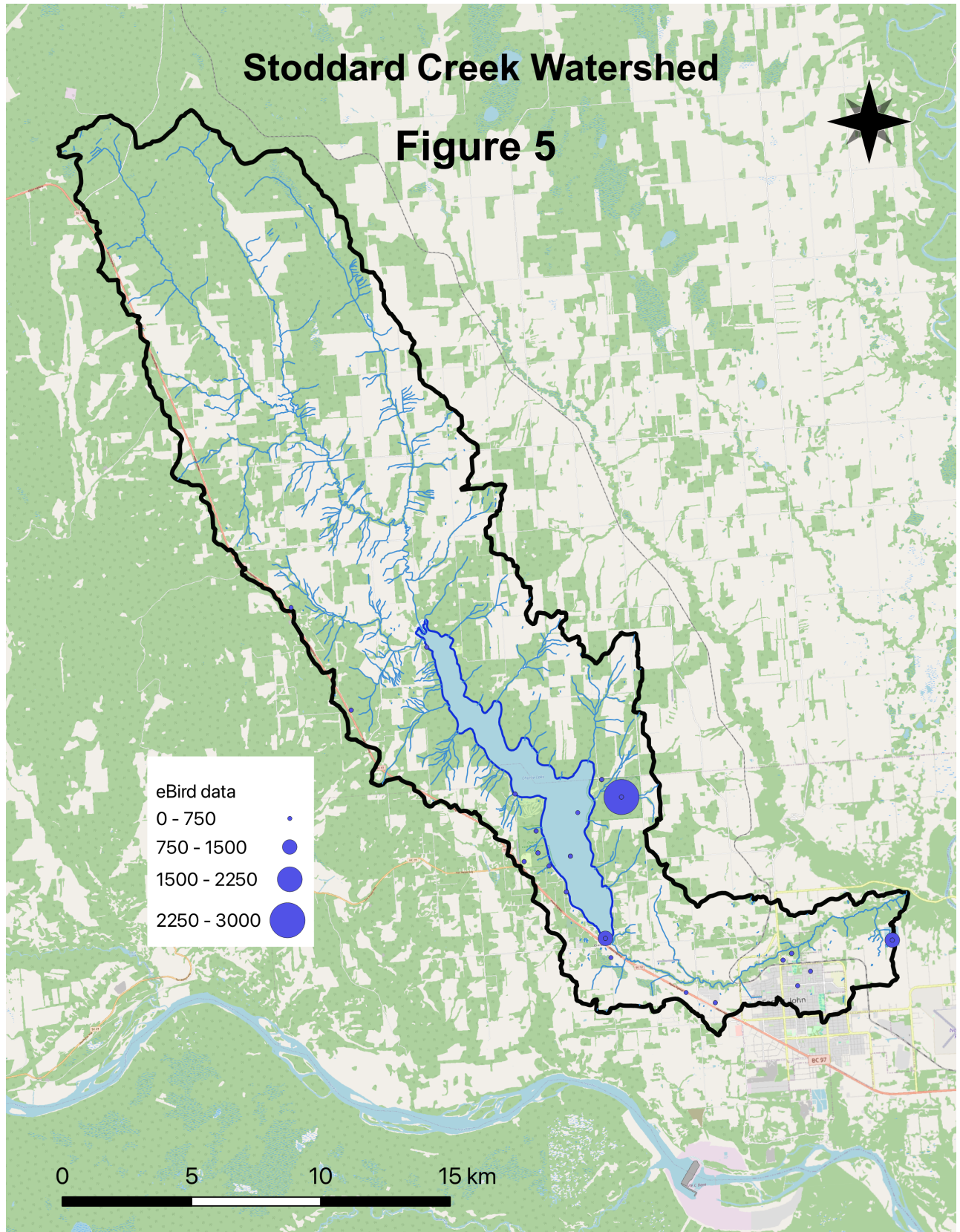


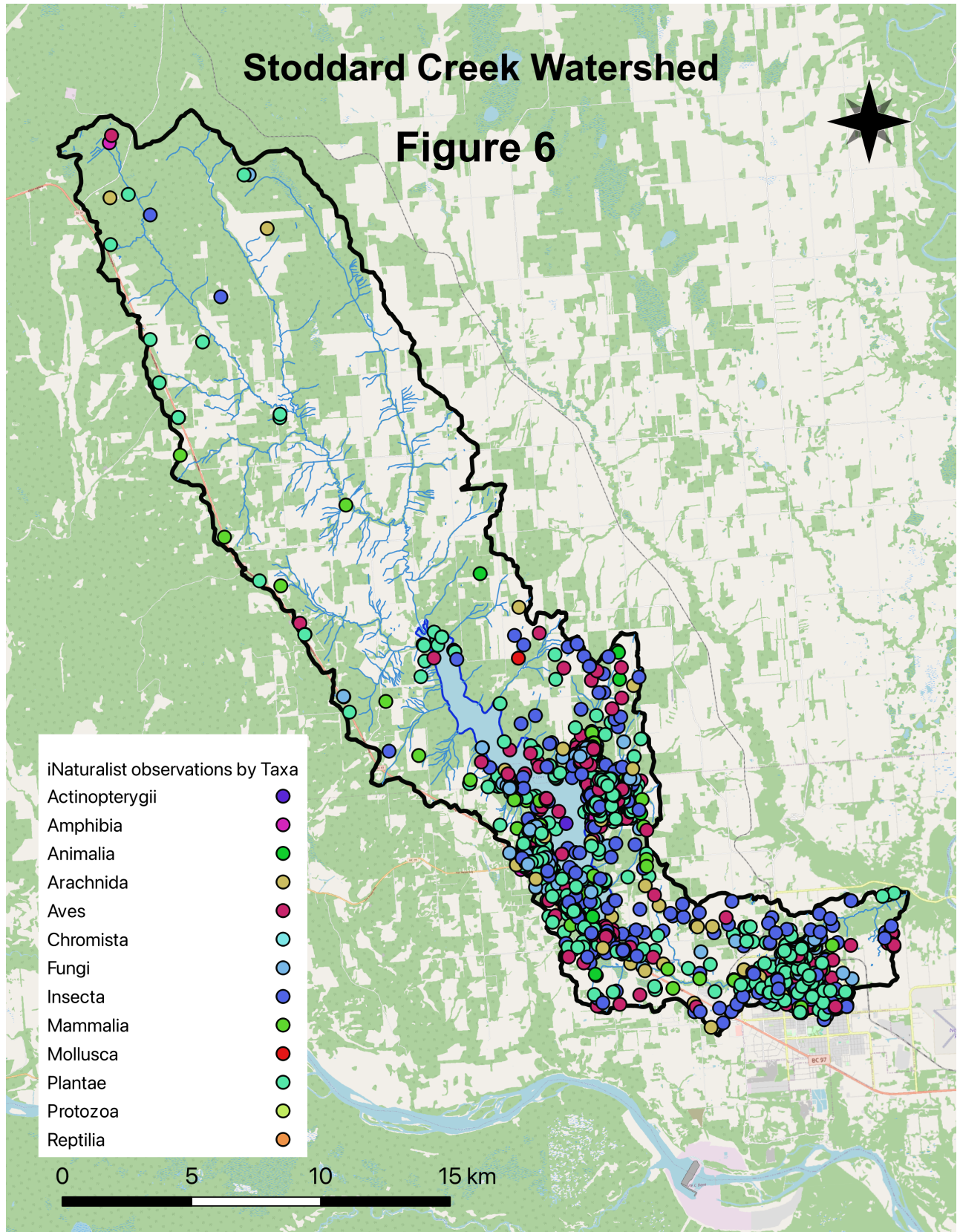
Stoddard Creek Watershed

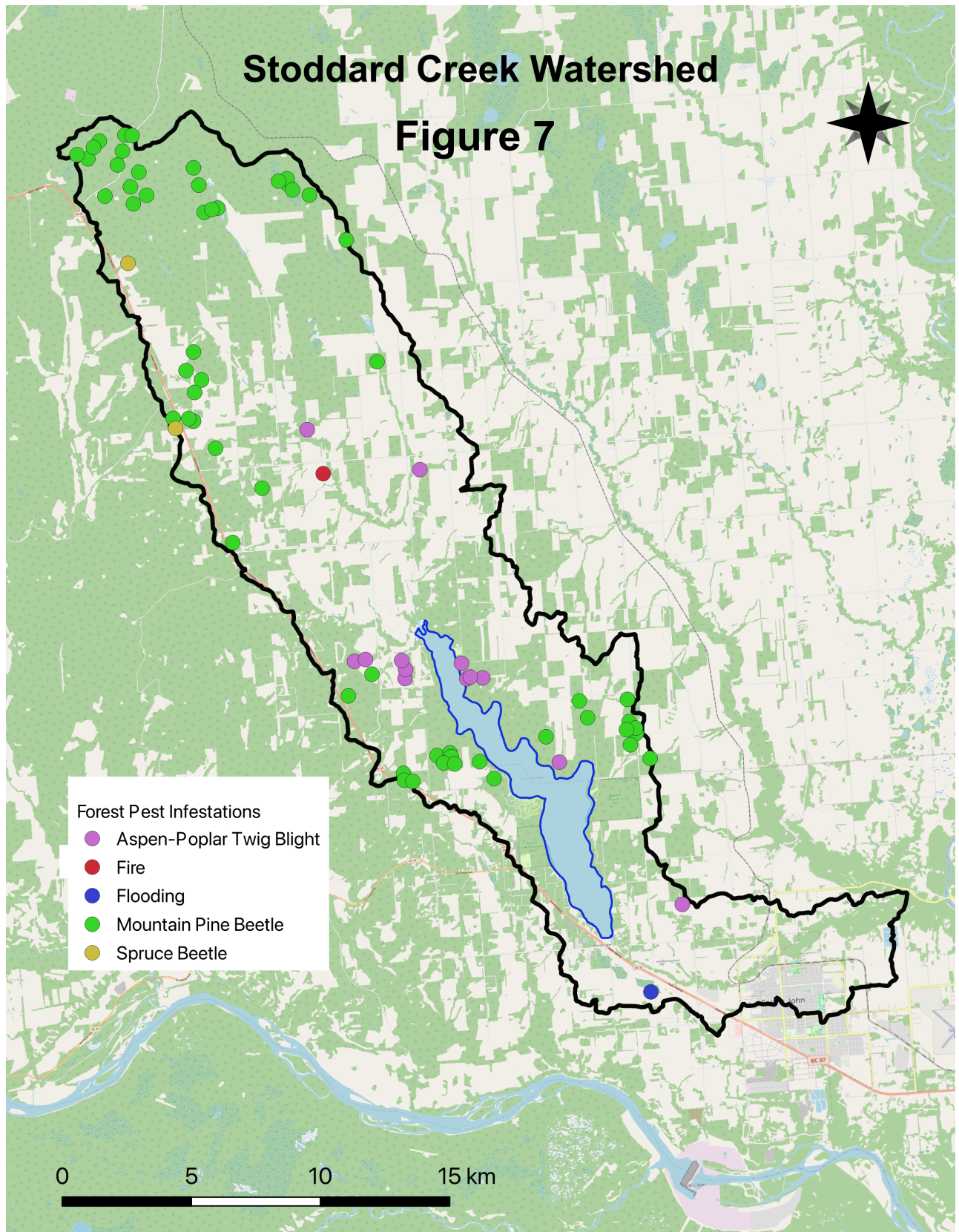
Figure 3





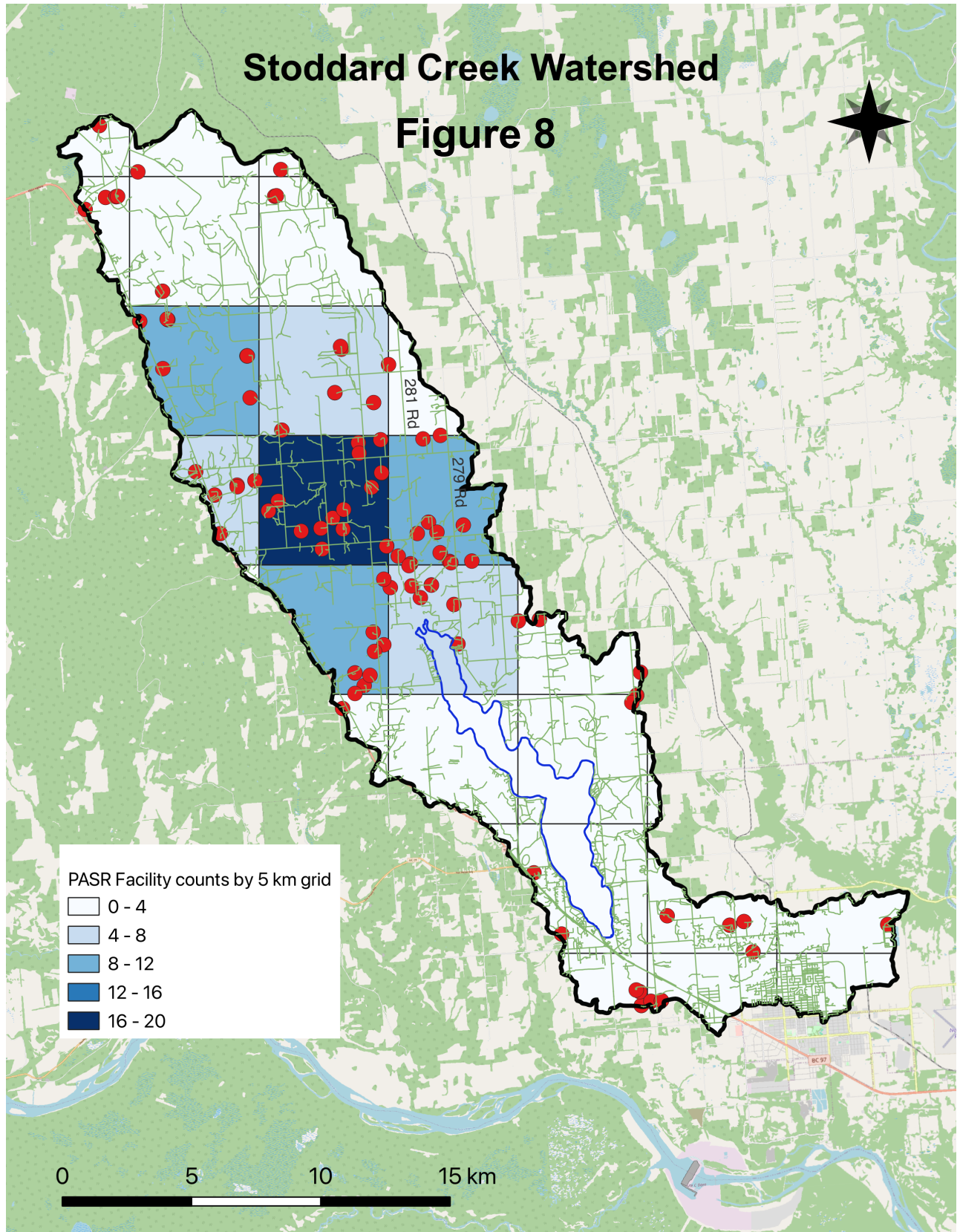






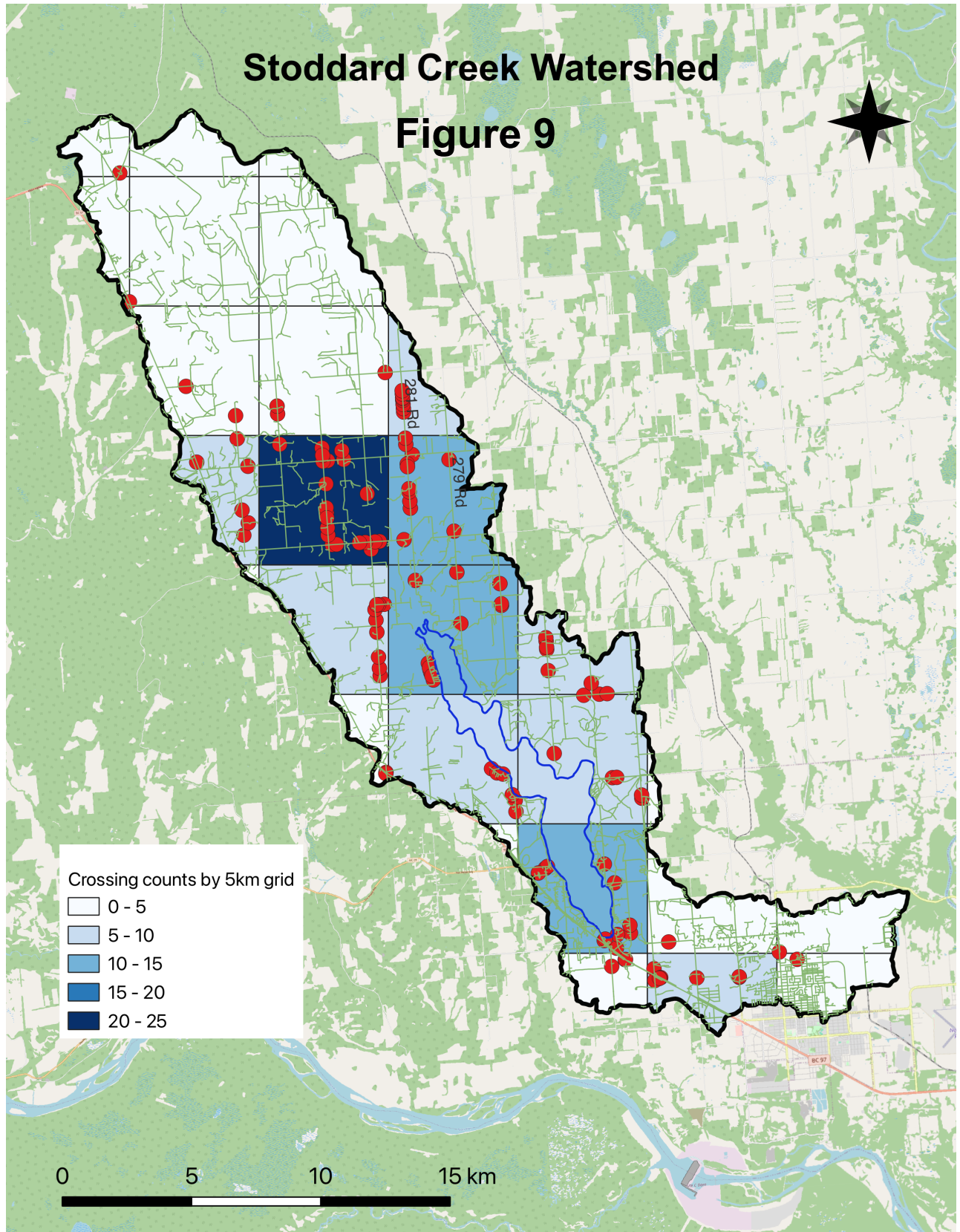
Stoddard Creek Watershed

Figure 8

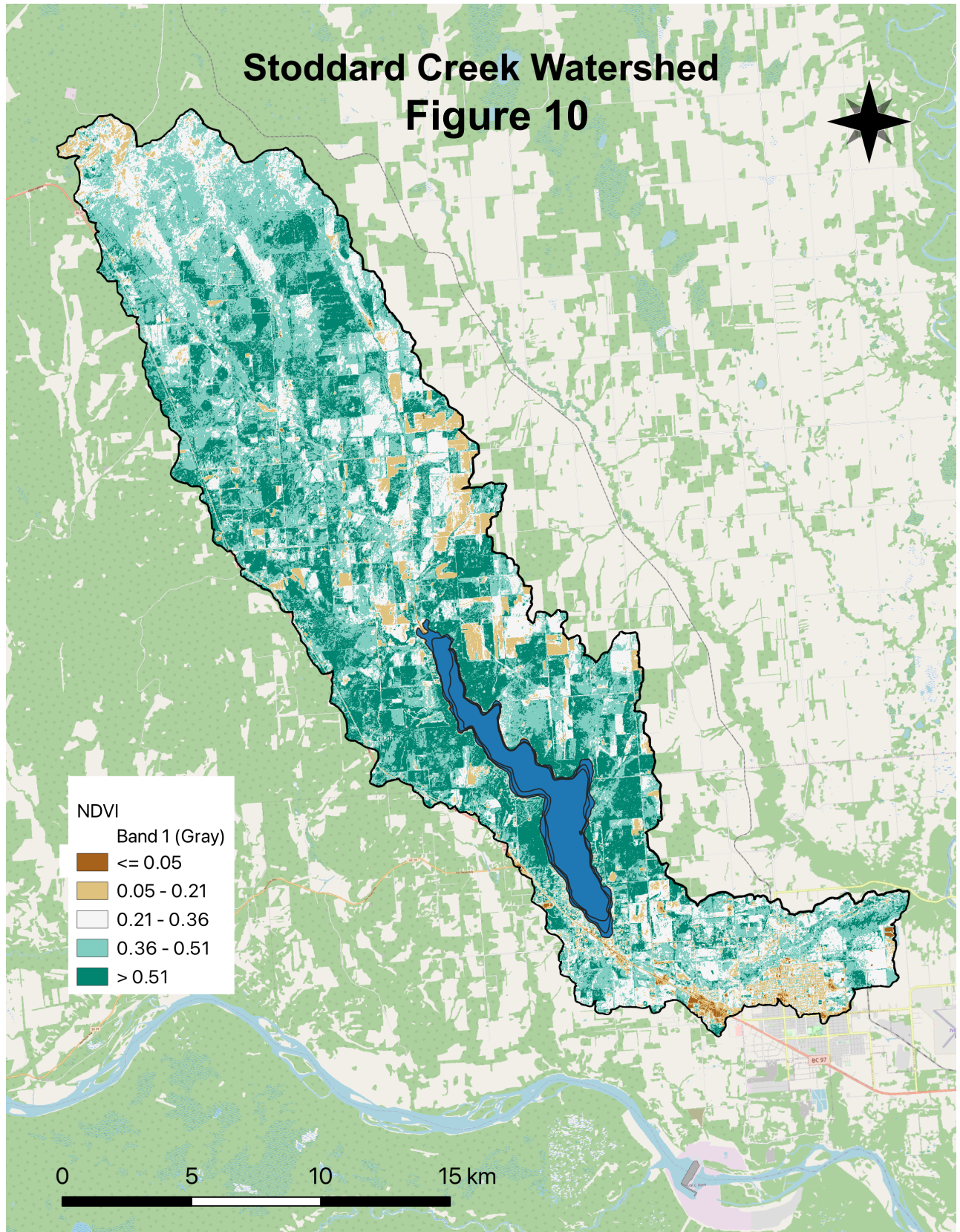


Stoddard Creek Watershed

Figure 9



Stoddard Creek Watershed Figure 10



Charlie Lake and its Watershed

