CEATI REPORT
No. T112700-0534

EV PUBLIC FAST CHARGING PLANNING FRAMEWORK

Appendix A

Prepared for CEATI International Inc

UBC TIPS LAB

APPENDIX A. PRECEDENT STUDIES

This appendix contains the longer form precedent studies that have been summarized in Section 2.

A.1 Better Place Company

Palo Alto, California, U.S.A.

Funder: **venture capital**
Station provider: **Better Place Company**
Network provider and maintenance: **depends on country**

Year: **ongoing timeline**

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Siting Strategy
Navigation and Wayfinding
Interface Design
Branding Business Model
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Description / Objectives

Better Place Company is based in Palo Alto, California; its primary research and development facility is located in Tel Aviv, Israel. The company's aim is to construct transportation infrastructure that supports the use of electric vehicles in order to reduce dependency on petroleum.

Better Place has selected Israel, Denmark and Hawaii, U.S.A as initial test markets due to their small size. Israel is the first country to partner with Better Place Company for an all-electric vehicle infrastructure. Better Place hopes that by 2016 more than 50% of the cars in Israel will be electric, and by 2020 the country will achieve independence from oil. The Baran Group in Israel is in the process of building 51 battery switch stations to cover Israel. The electricity required to power the power will come from a solar farm in Israel. Better Place has sold modified Renault Fluence Z.E.s in Israel, primarily to commercial fleets. When installation of the battery switch stations is complete, the Renault Fluence Z.E. will be sold to the general public.

The intention of Better Place is to install its infrastructure on a country-by-country basis with initial deployments starting in 2010 and commercial sales introduced in 2012. It is said that Better Place Company is in the process of planning to expand its network to 25 additional regions around the world including Australia[1] and Ontario, Canada[2].

Charging Infrastructure

A battery switching station is modeled on an automatic car wash. An electric vehicle is aligned on a changing pad and then the depleted battery is replaced with a fully charged one. The entire operation is completed in less than two minutes, a shorter amount of time it would take to charge a car or fill a tank with gas. The CEO of Better Place, Shai Agassi, has pointed out that battery switching stations

make good business sense because they cost $500,000 to build; about half the price of a conventional gas station. Further, the system is highly efficient: a battery switching station needs to have only 15 batteries in order to swap batteries for 2,500 electrical vehicles.

Better Place Company has several demonstration projects:

Better Place first introduced the battery switching station to the public in Yokohama, Japan on May 12, 2009. In April of 2010, a 90-day demonstration was launched in Tokyo, Japan.

In partnership with the cities of San Francisco and San Jose, California, Better Place is launching a three-year demonstration program with electric powered taxis and battery switching stations. The plan is to operate four battery-switching stations to support a fleet of switchable-battery electric vehicle taxis.

Business related info
Better Place Company's business plan includes the selling of electric vehicles and the building of battery switch stations. The company anticipates that they can sell EVs for $5,000 less than the price of an average gasoline car. These cars come without batteries. Owners then enter into a contract with Better Place (similar to that of a cellphone contract) that is based on levels of use. With the contract, owners can swap and use batteries for their electric vehicles according to the terms in the contract. Consumers are therefore not responsible for degrading batteries, warranty issues, maintenance, and the capital cost of an EV battery.

Better Place plans initially to charge US$0.08/mile in 2012, then US$0.04/mile by 2015 and US$0.02/mile by 2020. The per-distance fees cover battery pack leasing, charging and swap infrastructure, purchasing sustainable electricity, profits, and the cost of investor capital.[3]

The Better Place infrastructure network is automated and controlled by a custom software platform.

References:

1 "Australia plans electric vehicle network"
http://afp.google.com/article/ALeqM5il6f9UKjXLMrq0sQ-Ccd8vh5VANA

2 "Better Place Enters Electric Car Network Partnership with Ontario"
http://www.greencarcongress.com/2009/01/better-place-en.html

3 http://en.wikipedia.org/wiki/Better_Place - cite_note-Agassi_TED_talk-22

http://www.betterplace.com
http://en.wikipedia.org/wiki/Better_Place

A.2 CHAdeMO Association

Japan

Funder: **Mitsubishi, Toyota, Nissan, Fuji Heavy Industries**
Utility Provider: **Tokyo Electric Power Company**

Year: - 2010- ongoing timeline

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Siting Strategy
Navigation and Wayfinding
Interface Design
Branding Business Model
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Description / Objectives

Fig-1 CHAdeMO logo

Four Japanese car-manufacturing companies have teamed up with a utility company to create a comprehensive network of charging stations for Japan. The Association seeks to promote "electric vehicles through the efforts of technical improvements of quick chargers, standardization activities of charging methods, and international extension of our knowledge related to quick-charger installations",

The CHAdeMO Association is calling for a standard method for charging vehicles. The Association also hopes that, acting as a powerful force, they can lend leadership to the global installation of fast charging solutions. [1]

The challenges the CHAdeMO Association face includes: developing infrastructure that meets today's as well as future challenges, securing the investment necessary for a electric charging network, securing political will, and getting members of the auto industry to agree on standardized methods for charging (including voltage).

Mitsubishi, Toyota, Nissan, Fuji Heavy Industries and Tokyo Electric Power Company make up the executive members of CHAdeMO. They expect about 158 more companies to join as supporting members; companies including utility companies, battery manufacturers, charging infrastructure manufacturers, vehicle manufacturers). Mazda, Honda and Suzuki have already joined the Association.

CHAdeMO is also the name of a proposed charging solution that the Association hopes to develop and launch both locally and globally.

"CHAdeMO is an abbreviation of 'CHArge de MOve', equivalent to 'charge for moving', and is a pun for 'O cha demo ikaga desuka' in Japanese, meaning 'Let's have a tea while charging' in English." [2]

References:

1 Companies join forces to standardize charging infrastructure Paul Ridden *March 18, 2010* http://www.gizmag.com/chademo-standard-electric-vehicle-charging/14557/?utm_source=Gizmag+Subscribers&utm_campaign=ec99f2bd87-UA-2235360-4&utm_medium=email

2 Ibid

A.3 ChargePoint

Nine Regions: Bellevue-Redmond, WA; Sacramento, CA; San Jose-San Francisco Bay Area; Los Angeles, CA; Austin, TX; Detroit, MI; New York City, NY; Washington D.C.; Orlando, FL, **U.S.A.**

Funder: Department of Energy, $37 million
Charging station provider: Columb Tech.
Network provider and maintenance: ChargePoint America

Year: all charging stations are to be installed by October 2011

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Siting Strategy
Navigation and Wayfinding
Interface Design
Branding Business Model
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Description / Objectives
EVs: The Chevy Volt, Ford Transit Connect, Ford Focus BEV and Smart Fortwo.
Charging Levels: I, II and III

ChargePoint America is a program to provide electrical vehicle charging infrastructure to nine regions in the United States. Charge Point America will offer home and public charging. The program is sponsored by Coulomb Technologies and made possible by the American recovery and Reinvestment Act through the Transportation Electrification Initiative administered by the Department of Energy. The objective of the program is to fast-track the development and production of electric vehicles in order to reduce greenhouse gas emissions, reduce petroleum consumption and to create jobs.

The program unfolds in two phases: the first phase will consist of the allocation and installation of all charging stations. This phase commenced April 2010 and is to be completed October 2011. The second phase is comprised of data collection. As part of the terms of use, all users of the ChargePoint program must agree to anonymous data collection. ChargePoint America will collect data for 2 years, or until October 2013.

Features of the ChargePoint Network include:
-Full support 24/7 via toll-free number.
-Advanced safety features to protect drivers and minimize energy theft.
-Generates automatic text and email alerts to warn drivers of problems with charging or the stations.
-Quickly find locations on your Smart Phone while you're on the go.

Charging Infrastructure
The electric vehicle charging infrastructure will consist of approximately 5,000 fully networked Level II (220v) ChargePoint Networked® Charging Stations. The stations will be of two types: home and public/commercial. Owners are given the opportunity to own the charging stations at no cost.

However, the cost of the installation of the stations will be, in most cases, the responsibility of the station owner or the individual.

All ChargePoint stations will be networked. The networking will benefit both drivers and owners of charging stations. The network allows the driver to identity where charging stations are and whether the stations are in use or not. To benefit the owner, charging stations attached to the network are capable of transmitting information about the charging session including: start time, time of completion, ground fault interruption, or even a disruption in service from vandalism or utility demand response.

Criteria for Location
Owners are encouraged to apply for a ChargePoint station. Upon receipt of the application, ChargePoint America sends an employee to the location to perform a site survey. The function of the site survey is to determine whether the location is suitable, and to give the owner an estimate on how much the actual installation will cost.

There are three criteria for the selection of ChargePoint station sites:

The first criterion is whether ChargePoint America believes that the charging station is in a location that will attract use.

The second criterion is proximity to other stations in the specific region. It is ChargePoint America's desire to create an even network of stations spread throughout the nine metropolitan regions.

The third criterion is whether the owner can install their station in a timeframe befitting ChargePoint America's overall schedule.

Some examples of good locations:
-large parking garages in centrally located areas
-office parks with many employees, some of whom would potentially purchase an electric vehicle
-airports or train stations with a lot of traffic
-shopping malls or restaurants
-high profile places like sporting venues
-monuments or recreation areas (golf courses, marinas).

"The objective is to get highly visible, publically accessible, geographically dispersed locations from which we can provide the DOE and our automobile partners a lot of data on the usage of these charging stations," according to ChargePoint.

Business related info
Private Electrical Vehicle Owners:
Private car owners who purchase an electric vehicle through the ChargePoint America program are eligible to receive a home charging station at no cost. Home charging stations consist are of the Level II type and require 200 volts. Special wiring will be required. At the end of the 2-year data collection program, private car owners will own their charging stations. The private charging station must be contained in a garage or car port. If private car owners do not have a garage or car port, it is recommended that they ask their employer to apply for a public charging station. If the private car

owner parks overnight in a city-run facility, it is recommended that they ask their municipality to apply for a charging station at this location.

Public/Commercial Charging Station Owners:
The charging stations will belong to the property owners of the locations where the stations are installed. The expectation is that owners will continue to function as a charging station after the 2-year data collection program is over. It is the expectation of ChargePoint America that individual owners will charge fees for the use of their charging stations following a fixed fee, a time per hour fee, a monthly all-inclusive fee, or any other fee structure that makes financial sense. The cost of electric energy will be a considerable part of the charging stations' operating cost. It is the speculation of ChargePoint America that as time passes and the running cost of an electric vehicle charging station is better understood, station owners may want to adopt a model that asks consumers to pay for preferred electric vehicle parking.

The owners are responsible for two fees:
1. The Network Standard Service Fee is the monthly fee for any charging station connected to the ChargePoint Network. Being connected to the ChargePoint Network is important so the station owner has visibility to all of his/her charging stations whether they are in one location or multiple locations. In addition, you (or we) can troubleshoot your charging station from a distance and rectify problems without needing to be onsite. Through the ChargePoint Network portals you have access to significant statistics of your charging stations for utilization, energy usage, etc.
2. Transaction fees are charged to the owner when the station is used to generate revenue for the station owner. These are costs associated with billing, credit card validation and processing, and other administrative costs. Up until December 2013, Coulomb Technologies will pay the Network Standard Service Fee for all participating owners from program funds. Transaction fees are only charged to owners who require drivers to pay for station use, as there are costs to Coulomb Technologies for these transactions and the station owner is presumably making a profit on the use. (http://chargepointamerica.com/faq-station-owner.php)

In each region, a Coulomb Technologies participating distributing partner will be established. This partner is responsible for the maintenance of all the charging station in the region, including on-site assistance if necessary.

References:
http://chargepointamerica.com/charging-stations.php
http://chargepointamerica.com/faq-station-owner.php
http://www.coulombtech.com/
http://www.coulombtech.com/library.php
http://www.minit-charger.com/corporate/FAQs.php
http://news.cnet.com/8301-11128_3-20015436-54.html#ixzz1IWjmC8qZ

A.4 EV Project

Washington State, Oregon, California, Arizona, Tennessee and the District of Columbia, **U.S.A.**

Funder: **US Department of Energy**, $114.8 million for 15,000 charging stations
Charging station provider: **ECOtality North America**

Year: **Summer 2010:** Initial infrastructure deployment begins.
Summer 2011: Intended target for entire infrastructure deployment.
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Siting Strategy
Navigation and Wayfinding
Interface Design
Branding Business Model
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Description / Objectives
EVs: Nissan LEAF, Chevrolet Volt
Charging Levels: I, II and III

In response to a Funding Opportunity Announcement from the U.S. Department of Energy, ECOtality was awarded a contract in October of 2009 to "accelerate the development and production of various electric drive vehicle systems to substantially reduce petroleum consumption."[1]

The EV Project encompasses both electric drive vehicles and electric vehicle infrastructure. Through partnerships with Nissan North American and General Motors/Chevrolet, consumers and fleets will be able to purchase the Nissan LEAF zero-emissions electric car and the Chevrolet Volt plug-in hybrid with extended range.

The total size of the project is 15,000 chargers, 5,700 Nissan LEAF zero emissions electric vehicles, and 2,600 Chevrolet Volt electric vehicles with extended-range capability. [1] The vehicles and infrastructure will be implemented in seven pilot regions: Washington State, Oregon, California, Arizona, Tennessee, Texas and the District of Columbia.

The EV Project will undergo an EV Roadmap Infrastructural study within each region to determine the location of the electric vehicle infrastructure. "It is estimated that The EV Project will deploy a total of more than 15,000 chargers distributed in the following quantities: 8,300 Level 2 chargers installed in owner's homes; 6,350 Level 2 chargers installed in commercial and public locations; and 310 Level 3 DC fast-chargers."[2]

The EV Project will collect and analyze data from both the vehicles and the infrastructure in order to better understand vehicle performance, patterns of use of the infrastructure, and the revenue performance of the public and commercial streams of infrastructure.

Charging Infrastructure
The ECOtality electric vehicle infrastructure is either public/commercial or residential and comes in several forms. Among these forms are: commercial fast-charge stations that will attract EV owners to retail locations; fast-charging stations installed at convenient locations (including fueling stations and rest stops); discrete and secure street charging for residential and commercial urban areas, charging in office parks that offer an amenity to employees; and charging in private parking garages. The fast-charge stations are visualized as stand-alone, covered, open-air nodes similar in scale to a

gas station.[3]

Criteria for Location

The seven pilot regions: Washington State, Oregon, California, Arizona, Tennessee, Texas and the District of Columbia were selected through ECOtality's EV Micro-Climate program. The Micro-Climate program uses infrastructure planning and feasibility studies to envisage a comprehensive EV infrastructure system for a region. The Micro-Climate program also specifies an action plan for the successful implementation and maintenance of the infrastructure system. In addition to the Micro-Climate program, the ECOtality website also has the functionality that asks the public to suggest locations for charging stations.[4]

The Nissan LEAF will be capable of fast charging; to reduce consumer anxiety range, fast-charge stations will be installed in high-traffic areas and other strategic lications. Fast-charging will also be implemented along major transportation corridors such as highways and other major roads. For example, the company intends to install fast-charge stations along Interstate 10 between Phoenix and Tuscon, Arizona.

Business Related Information

Private EV car owners will automatically provided with a free residential charger. The EV Project will also pay for most of the costs associated with the installation of the private chargers.

The Federal government has also developed incentive programs to support the EV Project. The first 20,000 electric vehicle purchasers will receive a $7,500 tax credit valid until 2014. In addition, state and local incentives have developed programs that range from reduced vehicle registration charges up to $5,000 state tax credits.[5]

Private consumers who charge from their homes will be charged $.50 to $1.50 a day. Public/commercial fast charge rates are yet to be determined.

References:

1,2,5 EV Project FAQs www.ecotality.com/.../FAQ_DOE_Ecotality_The_EV_Project.pdf
3 http://www.ecotality.com/companies/microclimate.php
4 http://www.theevproject.com/charging-maps.php
http://www.theevproject.com/index.php
http://www.ecotalityna.com/
Alfred Wiederer & Ronald Philip. Policy Options for Electric Vehicle Charging Infrastructure in C40 Cities.

A.5 National ECar Program, Ireland

Ireland

Funder: **Government of Ireland, ESB eCars, Also Sustainable Energy Authority Ireland, IDA, Enterprise Ireland**
Station provider: **Electromotive**
Network provider and maintenance: **ESB**

Year: **ongoing timeline; targets for 2011 and 2020**

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Siting Strategy
Navigation and Wayfinding
Interface Design
Branding Business Model
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Description / Objectives
EVs: Nissan LEAF, Mitsubishi iMiEV, Renault Fluence Z.E., Renault Kangoo Z.E., Peugeot iOn, Citroen C-ZERO
Charging Levels: I, II, DC Fast-Charge

Ireland has a goal to install 1,500 electric car charging points across the nation by December 2011 and to have 10% of its vehicles be EVs by 2020. ESB eCars, a division of ESB (Electricity Supply Board and Ireland's leading electrical utility) has committed to the implementation of a nationwide electric car charging network that has the following targets for the end of 2011:

-30 fast charge points installed
-1500 public charge points available across Ireland
-2000 home charge units installed (dependent on ecar sales)[1]

The first 1,500 stations will be distributed as follows: Dublin: 500, Cork 135, Limerick 45, Galway 45, Waterford 45.[2]

The government has an incentive programs in place for consumers, which makes them eligible for a €5,000 grant and exempted from vehicle registration tax.[2]

Charging Infrastructure
The new charging points will be owned, installed and operated by ESB. The points will provide accessibility for all energy supply companies in Ireland and will support all vehicle types, including the Nissan LEAF, Mitsubishi iMiEV, Renault Fluence Z.E., Renault Kangoo Z.E., Peugeot iOn, Citroen C-ZERO.

"All installed fast charge points use high speed electronics to turn mains electricity into high power (Direct Current/DC) and are built to the Japanese Chademo standard."[3] Due to Lreland's leadership role, ESB was nominated to the European Chademo Steering Group.

Elektromotive will supply the DC fast-charging stations. They use the Elektrobay Juicepoint. The Elektrobay was first introduced in London in 2006; currently about 135 units are installed in London while 165 more are installed around the UK. The success of Elektromotive's product in the UK has drawn interest internationally. "The company is currently working with national and local governments and organisations in Belgium, Denmark, Luxembourg, Iceland, Sweden, The Netherlands, Germany, South Korea and Saudi Arabia to roll-out the recharging infrastructures that will help accelerate the uptake of electric vehicles. Over 300 Elektrobay units have so far been installed outside the UK."[4]

Fig-2 Phase 1 of ESB eCar Fast Charge Point roll-out plan source: http://www.esb.ie/main/ecars/news-and-events/press-releases/ESB-electric-cars-Fast-Charge-Point-Rollout-Plan-Announced.jsp

Business related info

ESB eCars has agreements with Topaz, The Maxol Group and Lidon Limited, to build fast charging stations along service stations on inter-urban routes. The details of the agreements is not accessible.[6]

References:

1 ESB eCars Fast Charge Point Rollout Announced http://www.esb.ie/main/ecars/news-and-events/press-releases/ESB-electric-cars-Fast-Charge-Point-Rollout-Plan-Announced.jsp

2 Electric Charge Point Map http://www.esb.ie/main/ecars/e-charging/map-of-charge-points.jsp

3 Ireland announces generous EV subsidies http://www.independent.co.uk/life-style/motoring/ireland-announces-generous-ev-subsidies-1943328.html

4 ESB eCars Fast Charge Point Rollout Announced

5 The Electrobay Leads the Way in Ireland's EV Revolution
http://www.juicepoint.ie/featured.php

6 ESB eCars Fast Charge Point Rollout Announced

(2011, Feb 28). Juice Point [Online]. Available: http://www.juicepoint.ie

(2011, Feb 28). Carra [Online]. Available: http://www.carra.ie

(2011, Feb 28). Electricity Supply Board [Online]. Available:
http://www.esb.ie/main/home/index.jsp

(2011, Feb 28). Elektromotive [Online]. Available: http://www.elektromotive.com/html/index.php

A.6 An Electric Vehicle Delivery Plan for London

London, UK

Funder: **Greater London Authority in partnership with the central government and the private sector incl. CENEX**

Year: **ongoing timeline**

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Siting Strategy
Navigation and Wayfinding
Interface Design
Branding Business Model
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Description / Objectives
The EV Delivery Plan is a comprehensive three-prong strategy that includes: the development of EV infrastructure, the promotion of electric vehicles, and the stimulation of the market through incentives, marketing and communications.

The Development of Infrastructure:
As of December 2009, London had a network of 250 charging points located on both the highways and in car parks. The greatest concentration of points is in Central London are located primarily in publicly accessible car parks. 32 of the 250 points are located on the street. The intention is to create a comprehensive network with 25,000 EV charge points by the year 2015.

The factors affecting the development of EV infrastructure include:
- Infrastructure must be compatible with the vehicles produced by different manufacturers
- The development of the infrastructure network must match the targeted EV adoption rate. In the early years, the ration of charging points to owners will be high to increase confidence among consumers. It is expected that this ration will optimize with time.
- Careful consideration must be given to the quickly evolving nature of EV technology so that well-strategized decisions are made about which technologies to adopt.
- Because the electrical grid is already operating close to capacity during peak times, EV charging must be encouraged during off-peak hours. Incentives such as variable fees or additional tariffs may be used to promote off-peak charging.
- A balance must be struck between the addition of EV charging spaces and the loss of conventional parking spaces.
- A concerted effort must be made to integrate on-street EV charging points in a way that is elegant and sensitive to the streetscape.[1]

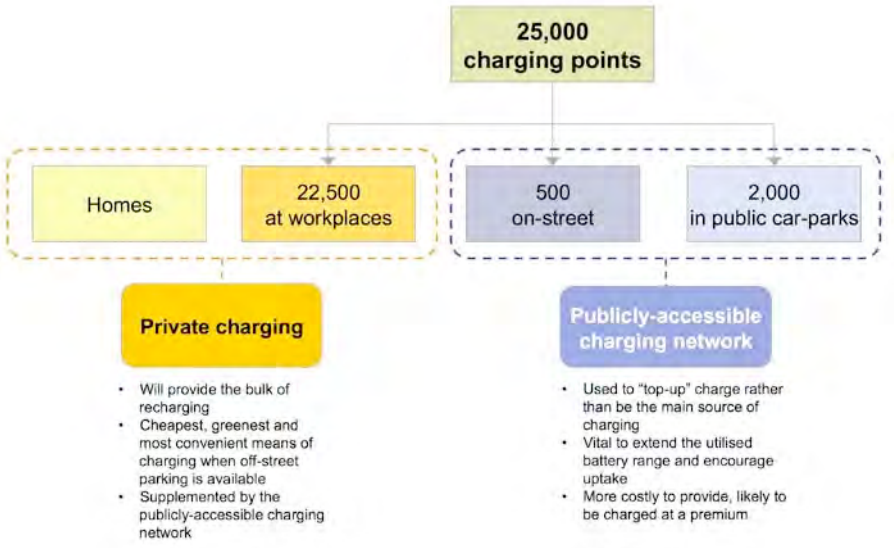

Fig-3 Placement of new charging infrastructure

Across the three types of charging points, the Greater London Authority (GLA) has the following aims:
Slow-Charging (240V, 13A single phase)
-250 on-street charging points by 2012.
-2,000 charging points in public car parks by 2015
-install charging points in London Underground car parks with the first points installed in late 2009.
-work with Network Rail and the Train Operating Companies to install charging points in station car parks.
-work with boroughs and car park providers to deliver additional dedicated charging points in long stay public car parks.[2]

Fast Charging (240V, 32A three phase)
-work with partners to create a network of 50 fast charge points across London by 2012 so that all users are within 3 miles of a fast charge point. Through cooperation with boroughs of London and other partners, this network will be installed in locations such as retail developments, leisure centres and short-stay car parks to assist those who only want to stop for about 30 minutes.
- create an additional 200 fast charging points by 2015.[3]
-Priority locations: Private car parks in shopping and leisure centres, supermarkets, large retail stores, polyclinics, hospitals etc., short stay public car parks in town centres, On Street parking in visible town centres locations, specific city centre locations to cater for taxis, commercial vehicles, Key London arteries, M25/ key motorways.

Rapid Charging (up to 200A, 500V three)
-work with partners to investigate the potential for rapid charging points in London. Rapid charging allows a vehicle to be fully charges within minutes.

The various public charging points are currently part of an uncoordinated network in which individuals belong to separate membership schemes based on borough. The EV Delivery Plan intends to -work with the boroughs and other providers to develop a London-wide charging network, so that registered users in the scheme are able to use all the public charging points

provided.[4] A new brand for London's charging point network will also be developed to ensure that users can easily recognize the location of charging points (in addition to the navigation provided by on-car GPS systems) and to communicate to users throughout the network that the EV charging point network is sufficiently robust.

Promotion of electric vehicles:

As of May 2009, there were 1,700 EVs operating in London (out of 8,000 nation-wide). The Mayor would like to see 100,000 EVs on the streets of London as soon as possible. A multi-pronged effort to achieve such a number is planned that will include:
-To continue with EV trials, including those through the TSB, ETI and CENEX initiatives
-To increase uptake of EVs in the GLA group fleet
-To increase use of EVs amongst suppliers to the GLA group
-To increase uptake of EVs in the borough and other public sector fleets
-To develop EV options for wider public transport, e.g. taxis
-To work with business partners to make EVs an integral part of the wider London fleet market for commercial vehicles and cars.[5]

-To continue with EV trials, including those through the TSB, ETI and CENEX initiatives:

The GLA group (Transport for London (TfL), Metropolitan Police Authority (MPA), the London Development Agency (LDA) and the London Fire & Emergency Planning Authority (LFEPA) is currently participating in the Low Carbon Vehicle Procurement Programme.

Specifically, the Transport for London and the Metropolitan Police Service, are taking part in the Low Carbon Vehicle Procurement programme funded by Cenex. Cenex is the UK's Centre of Excellence for Low Carbon and Fuel Cell Technologies. It is the Department for Transport's delivery partner for the Low Carbon Vehicle Public Procurement programme (LCVPP). The LCVPP provides £20million of funding to assist organizations within the public sector to procure innovative low carbon vehicles.
"The programme provides an opportunity for vehicle manufacturers and suppliers to demonstrate products in high-profile public sector fleets, while allowing public sector organisations to trial low-carbon vehicles in real-world conditions and reduce their carbon footprint without incurring a cost penalty."[5]

In addition to being a recipient of support from the LCVPP, The GLA is a member of a consortium seeking a grant from the Ultra Low Carbon Vehicle Demonstration Programme. Successful acquisition of this grant will allow the GLA to support a range of trials within its fleet to – to inform research and development –consumer behaviour, range of vehicles types, drive cycles and infrastructure, fast charging and smart metering.[6]

-To increase uptake of EVs in the GLA group fleet:

The GLA intends to lead by example and set targets for procurement of EVs within its fleets. A joint procurement plan will be developed to deliver 1,000 EVs by 2015. The GLA recognizes that bulk procurement will help control costs.

-To increase use of EVs amongst suppliers to the GLA group:

The GLA will encourage major suppliers to procure EVs through supplier contracts.

-To increase uptake of EVs in the borough and other public sector fleets:

The GLA will work with the public sector (boroughs and central Government) to encourage the adoption of EVs. Specifically, the GLA sees the 2010 Olympic Games as an opportunity to promote EVs. The GLA intends to work with and support the London Organising Committee for the Olympic Games (LOCOG) in the procurement of EVs so that the commitment to "the greenest games ever" can be met.[7]

-To develop EV options for wider public transport, e.g. taxis:

Currently Transport for London's Public Carriage Office (PCO) is conducting a Low Carbon Taxi trial. The GLA will work with industry and public transport providers to develop solutions to assist in the electrification of vehicles.

The GLA will also work with the Private Hire Vehicles (PHV) sector to identify opportunities and incentives for the adoption of EVs.

Transport for London (TfL) currently considers electric buses incapable of meeting the demands of an 18-hour shift. GLA will encourage the use of hybrid diesel-electric buses that offer a fuel and emissions savings of approximately 30-40%. Currently TfL has 60 hybrid buses in operation. From 2010 all new buses serving London will be hybrids. GLA will work with manufacturers to encourage the technical innovation necessary to make fully electric buses a viable option in the future.[8]

-To work with business partners to make EVs an integral part of the wider London fleet market for commercial vehicles and cars:

The GLA will work with the private logistics sector to encourage the uptake of EVs in their fleet. Targets include UPS, Fed Ex, Royal Mail, Marks & Spencer, Tesco, Sainsbury's and Ocado, which already run a fleet of electric vans.

Stimulation of the market through incentives, marketing and communications:

Incentives National:

In April 2009, the UK Department for Transport (DfT) allocated £230 million for give incentives that will promote the adoption of EVs in the UK. In 2011, the program will give each purchaser of an electric vehicle a rebate of £2,000 -£5,000.[9]

In addition to the rebate, the program exempts new EV owners of the annual vehicle tax.

Incentives London:

Local incentives concern parking, congestion charging, car clubs, and bus lanes:

Parking: Currently various boroughs in London offer subsidized parking for electric vehicles. An example of this is free parking in public car parks in Westminster. Various London Boroughs charge different rates for on-street parking, based on the car's emission rate. An example of this is in Richmond, where a car with a typical emissions output will be charged £90 p.a. while an electric vehicle can park for free. The concern is that there is no coherent parking incentive plan throughout London, creating confusion for EV owners. Also, as EV ownership increases, there is a concern that the disparate policies of free parking for EV owners will not be financially sustainable for the city. The GLA will work with boroughs to create a more consistent and simplified plan for on-street and car park parking incentives for EVs. And when possible, the GLA will create priority parking for

EVs. These stations will be the more conveniently located spaces in ie. in the London Underground or in car parks and town centers.[10]

Congestion Charging: The GLA is committed to maintaining the congestion charging discount currently available to EVs. "The discount is worth £8 per day (£7 for fleet account users) and up to £1,700 per year for regular travellers in the congestion charging zone."[11]

Car Clubs: The GLA will support car clubs in two ways: the first is to encourage car clubs to migrate their vehicles to EVs. The second is to fund the installation of bays and charge points for EVs in car clubs.[12]

Bus Lanes: Following examples from other European cities (ie Oslo) that allow EVs to travel in bus lanes at peak times, the GLA will do a study that assesses the feasibility of allowing EVs into London's bus lanes.

Marketing + Communications

The GLA recognizes the importance of creating a consistent brand for EVs across the city. To this end, the GLA will work with partners to create a simple, strong and easily recognizeable brand. In addition, the GLA will work with partners to create a website dedicated to the dissemination of information regarding EVs. The website will describe the charging network, allow EV users to register and become eligible for the congestion charging discount, and allow EV users to access information relating to their own vehicles.[13]

Criteria for Location

References:

1 Draft Electric Vehicle Infrastructure Strategy
http://legacy.london.gov.uk/electricvehicles/charging/ (14)
2 An Electric Vehicle Delivery Plan for London
http://www.london.gov.uk/who-runs-london/mayor/publications/transport-and-streets/electric-vehicle-delivery-plan-london (15)
3 Ibid (16)
4 Ibid (17)
5 Ibid (21)
6 The Low Carbon Vehicle Procurement Programme
http://www.lcvpp.org.uk/
7 An Electric Vehicle Delivery Plan for London (25)
8 Ibid (27)
9 Ibid (30)
10 Ibid (31)
11 Ibid (32)
12 Ibid (32)
13 Ibid (33)

A.7 Mini E Berlin

Berlin, Germany

Funder: V**attenfall Europe and BMW through $ from the** Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.
Academic Partners: Technical University of Chemnitz, TU Berlin and Technical University of Ilmenau.
Utility provider: Vattenfall Europe

Year: November 2008 - August 2010

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Siting Strategy
Navigation and Wayfinding
Interface Design
Branding Business Model
--

Description / Objectives
EVs: MiniE
Charging Levels: DC Fast-Charge

"Mini E Berlin powered by Vattenfall is a pilot project in Berlin. Through the program, 50 MiniE cars were given to test drivers to use for about a year. The project was an investigation of vehicles, user behavior and requirements for charging infrastructure. The project produced data regarding the requirements of the cars and the density of charging infrastructure. It also produced data regarding the influence EVs have on the grid and the energy requirements of charging stations.

The Mini E is a Lithium-Ion-Battery 35kWh, Range up to 250km, High-Speed 152km/h regulated.
The energy supplied by Vattenfall Europe was generated from wind-turbines.
The 50 cars were driven by 2x40 private users + 10 cars in a fleet application.

Charging Infrastructure
The 50 charging points were designed and installed in non-discriminatory publicly accessible locations. The points were focused within the inner ring area of the S-Bahn commuter rail system in Berlin, that is, within the city's environment zone. [1] The stations experimented with different connectors and currents. Parking spaces at the charging points were dedicated to the EV users.
In addition to the public charging points, 50 charging boxes were installed in private spaces such as private environments or workplaces.

Criteria for Location
The pilot project prioritized locations with attractive places with good accessibility. Locations with proximity to infrastructural mains were prioritized because they made the installation of the charging point more cost effective. Charging points were planned to offer high coverage of a given area. The charging points were also accessible 24/7.

Many of the charging points were installed on publicly accessible but privately controlled sites. Partnerships were struck between the project and the following companies in order to optimize the siting of the charging points. Partners included:

REWE (supermarkets)
Consipark (carparks)
Gravis (Apple-Retail)
Total (Gas stations)
IAV (Automotive engineering)
ECE (shopping malls)
Messe Berlin (Trade Show)

Conclusions from data collected from the trial
The project data showed that the locations users preferred to have charging points included: company-owned parking-lots, carparks, airports / train stations / park&ride, shopping malls museums / cinema / fitness centers, recreation areas.

User-behaviour:
The average number of vehicles that got charged was 3 per day and 9 per night. However, user behavior in general was quite inconsistent. For night charging, the trial showed that people were most likely to charge on Monday and Tuesday evenings, and least likely to do so on the weekend evenings (Saturday and Sunday).

Other findings:
The process for obtaining approval to install a charging point on public ground was a time consuming process. It was considerably easier to install a charging point on private property.

Because of the low # of users using the public charging infrastructure, the study concluded that people in general used their home charging points, and used the public points in the case of an emergency.

More attractive charging points tended to attract more users.

Possible ways to improve the system:
Optimize the control algorithms between the energy grid and the infrastructure.

An easier handling of the electric current transfer or incentive-systems could result in higher availability of EVs for charging.

For more than 90% of the users, the range of the cars sufficient for their daily needs.

For 66% of users the flexibility of the E-Mini is the same as with a normal car.

The mobility-behaviour of 35% of the users has changed, they report to feeling less guilty when driving and have more fun when driving the car

If the average range of the cars is 150km, the users felt that less than 100km is not sufficient, 200km is sufficient and 250km would be optimal.

References:
1 Mini E Berlin powered by Vattenfall **http://www.vattenfall.com/en/mini-e-berlin-powered-by-vatt_107362.htm**

http://green.autoblog.com/2008/11/26/50-mini-e-vehicles-bound-for-berlin/

http://www.minispace.com/en_us/article/MINI_E_Berlin_2_full/374/

A.8 National Platform for E-Mobility Charging Infrastructure and Grid-Integration

Germany

Funder: **Federal Government of Germany with partners BMWi/BMU, BMVBS, E.On**

Year: May 3, **2010** to **2011-2020-2040**

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Siting Strategy
Navigation and Wayfinding
Interface Design
Branding Business Model
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Description / Objectives
On May 3, 2010, the Federal Government of Germany established a National Platform for Electric Mobility (NPE).

Working groups within the NPE include:
1. AG Drive technology
2. AG Battery technology
3. AG Infrastructure / Grid-Integration
4. AG Standardization / Certification
5. AG Materials / Recycling
6. AG Education / Qualification
7. AG General conditions [1]

The intention of the NPE is to establish a concrete plan to so that Germany becomes a leading market in the electric mobility sector, with at least 1 million EVs in Germany by 2020, by 2030 5 million, or 10% of all vehicles on the road. The plan unfolds in three major stages: the first is the Test/Pilot Stage in which data is collected from early adopters so that implementation issues can be identified and solved. This first stage runs until 2011. From 2011-2020, the second stage called the Small Series stage unfolds. Fleets and trendsetters will be targeted so that business models and the set-up of commercial structures can be tested. The last stage, Market Maturity, is when the mass market will adopt the EV. In this stage, market structures will be established, and synergies between the vehicle interface and the energy supply structure will be better understood. [2]

Within the NPE, different groups have received funding to research specific aspects of E-mobility adoption. For example, BMWi/BMU are researching Information and Communication Technologies (ICT) for E-Mobility in seven regions. The research projects focus on systems integration such as smart charging, vehicle-to-grid systems, vehicle navigation, driving assistance, and fees and bill payment systems.[3]

Fig-4 BMWi / BMU research in IKT for E-Mobility

The Ministerium fuer Verkehr, Bau und Staedtentwicklung (BMVBS) is studying "Electromobility Model Regions." These projects focus creating cooperation between jurisdictional authorities to encourage and expedite the introduction of EVs to the market.

Fig-5 BMVMS "Electromobility Regions"

Within each Electromobility Region, the MBVBS is seeking to:
- Verifying the functionality, reliability and suitability for everyday use of new vehicles and energy supply schemes (especially a customer-friendly interoperable charging infrastructure)
- Obtaining relevant information for future mobility concepts, also examining issues such as customer acceptance or possible business models

- Obtaining key data on user behaviors, energy requirements and their development over time as well as on ways for grid stabilization through adaptable charging and feedback times
- Studies on costs from such factors as electricity demand, additional vehicle outlay, infrastructure costs. [4]

Charging Infrastructure
The charging network that is planned through the NPE is comprised of
-Private charging (garage / garage-parking-space / carport / private parking lots from the house feeding point, Low Voltage Network, 3-phase-connection 400V / 1-phase connection 230V, AC Voltage)
-Public Charging in commercial areas like Supermarkets, Malls, Car Parks, Office Parking Spaces, Gas Stations etc.

The assessed basic needs of the users are reliability, cost, comfort, safety, and non-discriminatory accessibility.

Possible Designs of a Charging Point:
Home Charging is expected to be the most common way of charging EVs. With home charging, the car is connected to the grid for a long time. While charging with a standard electrical socket is not recommended, it is possible and will encourage good acceptance of EVs because no special installation will be required. Home charging also offers the biggest potential for an intelligent integration of the EV´s into the grid and other communication-infrastructures (grid-stability, integration of renewable energies, vehicle to grid applications).

Public Low Voltage Charging is appropriate in public and semi-public spaces. This form of charging will require special provisions for vandalism-security, maintenance. access protection, the enabling of charging, measurement and billing.

With AC Charging, a charge time under 30 minutes is possible till 2015 (44kW/400V). Because this form of charging draws heavily from the electrical grid, a control for available net-capacity will be necessary.

DC-Charging is an alternative to AC Charging and is well suited to public fast-charging stations. The cables used in DC Charging have a smaller diameter and are therefore more manageable in the context of a station. With DC-Charging, the rectifier is not in the car, it is in the charging station.

The limiting factor with Fast-Charging is technology of the battery. Charging currents over 150A will damage most of the batteries in the market today, so the charging current must be kept to a lower rate. The infrastructure for Fast-Charging is also quite expensive. Theoretically, Fast-Charging will make the experience of driving and charging an EV comparable to a gas vehicle. The fast charging currents will charge a battery in less than 15 minutes, similar to the time spent at a conventional gas station.

Germany has not considered Battery-Swap-Stations because it believes that the capacity to standardize the battery through an agreement with all car and battery manufacturers is unlikely to be achieved.

Potentials of integrating of EV´s into a smart-grid:

There are two essential requirements to the integration of EV´s into a smart-grid: the first is the ability to observe, measure and collect data of all users in the network. The second requirement is the ability to control the grid by mediating the generation of power and evening out the loads throughout the day.

The goals of a smart grid include:
-The opening of energy markets
-Securing of the quality of supply
-Better use of renewable energies
-Integration of the consumer in energy accounting
-Transparency of energy consumption

References:
1
http://www.bmvbs.de/DE/VerkehrUndMobilitaet/Zukunftstechnologien/Elektromobilitaet/elektromobilitaet_node

2 Martin Ohmer, "Status of E-Mobility in Germany" www.electricmotion.cz/download/07---Martin-Ohmer.pdf p4

3 Information and Communication Technologies (ICT) for Electric Mobility http://www.ikt-em.de/en/index.php

4 Martin Ohmer, "Status of E-Mobility in Germany" www.electricmotion.cz/download/07---Martin-Ohmer.pdf p10

A.9 The Mobi.E Program

Portugal

Funder: not clear
Charging station provider: several providers; technology by Efacec
Network provider: Mobi.E partnered with Inteli, Rener Living Lab, Ceiia-Ce, and Remobi

Year: By **2012** a pilot network shall be developed encompassing 25 municipalities.

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Siting Strategy
Navigation and Wayfinding
Interface Design
Branding Business Model
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Description / Objectives
EVs: compatible with Smart, Renault, Mitsubishi, Nissan, Citroen, Peugeot, Mercedes-Benz
Charging Levels: II and III

Portugal considers itself to be a leader in sustainable energy and electric mobility. The government, through its National Energy Strategy 2020 (ENE2020), seeks to be a leader and reach ambitions goals of energy sustainability.[1]

The ambition of the MOBI.E is to be the first national electric mobility network.
The MOBI.E system is an integrated electric mobility network that supports sustainable energy policies and sources energy from renewable and clean sources (including hydroelectric dams). The MOBI.E Program will be initiated through a pilot network that encompasses 25 municipalities in Portugal in locations that include airports, car parks and service stations. The network is compatible with several makes of electric vehicles.

The MOBI.E management entity (SGORME) integrates all retailers and charging point operators into a single system. Within this single system, MOBI.E ensures open technical compatibility to encourage market competition.

Users all hold MOBI.E cards but are able to select their preferred Electric Mobility Electricity Retailer (CEME) and eventually charge anywhere in the country. In order to formally join the MOBI.E network users are required to first obtain a MOBI.E card.[2]

The MOBI.E card is simply slotted into quick charging points to pay for the charge. There is the intention to broaden the functionality of the card to include public transport and the charging of mobile phones.

The pilot network of the MOBI.E Program includes the following:
-The installation of 1300 standard charging points and 50 quick charging points, on public roads. The standard charging points will be installed in public parking locations in the streets of 25 cities

including Almada, Aveiro, Beja, Braga, Bragança, Cascais, Castelo Branco, Coimbra, Évora, Faro, Guarda, Guimarães, Leiria, Lisbon, Loures, Portalegre, Porto, Santarém, Setúbal, Sintra, Torres Vedras, Viana do Castelo, Vila Nova de Gaia, Vila Real and Viseu. The 50 fast charging points will be road preferably located between these municipalities. IN addition to these 1350 charging points, it is expected that private operators will install public access charging points. These charging points will be fully integrated into the MOBI.E system, thus increasing the scope and scale of the network.
-Data gathering to study the network as an internationally relevant case study.

Incentives for users to buy an EV:

The purchasers of the first 5,000 electric vehicles purchased from 2010 will be entitled to a €5,000. If the new electric vehicle replaces an end-of-life vehicle, the incentive may be raised to €6,500.

The purchase of the electric vehicle will entitle the purchaser to Income Tax relief (for individuals) and Corporation Tax relief (for companies). And, electric vehicles are exempt from both ISV - Vehicle Tax - and IUC - Single Circulation Tax.[3]

Charging Infrastructure

The charging of an electric vehicle through the MOBI.E network requires the use of a MOBI.E card. During the charging process, users can access their online MOBI.E account and monitor the charging process as well as make changes to the account settings/configuration including the creation of automatic reports and status alerts. When the charging process is complete, the user is notified via SMS or email so they know to return to their vehicles. The online account is also automatically updated at this time to reflect electricity cost, and any other residual fees. Through the MOBI.E website, users can access a broad range of information about their accounts including history of use and recent transactions. All charges made through the MOBI.E card are integrated into a single monthly invoice.

To find a MOBI.E charging point, one can check the MOBI.E website for a continuously updates list of public access charging points. MOBI.E is working on programming that will allow users to reserve charging periods at points. The GPS system within the vehicles will also allow users to locate the closest available charging point and assist with route planning.

The process of charging a vehicle is designed to be very smooth. After parking in an available space next to a charging point, the user swipes the contactless MOBI.E card to authenticate him or herself at the central hub. The user then specifies which point / socket the vehicle is parked at and selects the type of charge he or she desires. The user can also use this central interface to check account balance. The selected socket / point will be activated, and once the cable is plugged into the vehicle the charging will commence. The indicator light on the charging point will turn green to show that charging is underway. The charging process is concluded when the user provides authentication once again at the central hub. The charging point is then stopped and the light will turn to red. After the plug is removed, the light will turn to blue, indicating that it is ready to charge the next vehicle.

Business related info

Fig-6 MOBI.E Transactions Management model

As part of this commercial policy, MOBI.E leaves the question of the method of recharging the MOBI.E card to each individual retailer.

In the first half of the pilot phase (until June 2011), the cost of the electricity and infrastructure access fee will be completely free of charge.
In the second half of the pilot phase when privately run, publicly accessible charging points will be built (June 2011- end of 2010), each Electric Mobility Electricity Retailer (CEME) may set the price for the electricity, thus introducing a free market model. The free use of the pilot network will continue, but private locations available to the public may charge a fee for infrastructure access. A energy regulator will set a ceiling for these prices.

References:
1 http://www.renewable.pt/en/Portugal%20and%20Energy/Pages/PortugaleaEnergia.aspx
2 COMMENT: Portugal charging ahead By: Simon Warburton 10 November 2010
http://www.just-auto.com/comment/portugal-charging-ahead_id107065.aspx
3 http://www.mobie.pt/en/faqs

(2011, Feb 28). *MOBI.E* [Online]. Available: http://www.mobie.pt/en/homepage

S. Warburton. (2010, Nov 10). *Portugal charging ahead* [Online]. Available: http://www.just-auto.com/comment/portugal-charging-ahead_id107065.aspx

(2011, Feb 28). *Re.New.Able.* [Online]. Available: http://www.renewable.pt/en/ABLE/Pages/Transportes.aspx

J. Murray. (2010, Nov 4). *Portugal pioneers electric car charging swipe card scheme* [Online]. Available: http://www.businessgreen.com/bg/news/1869359/portugal-pioneers-electric-car-charging-swipe-card-scheme

U. Wang. (2008, Nov 25). *Portugal, Renault-Nissan set electric-car plan* [Online]. Available: http://www.greentechmedia.com/articles/read/portugal-renault-nissan-set-electric-car-plan-5272/

CEATI REPORT
No. T112700-0534

EV PUBLIC FAST CHARGING PLANNING FRAMEWORK

Appendix B

Prepared for CEATI International Inc

TIPS LAB

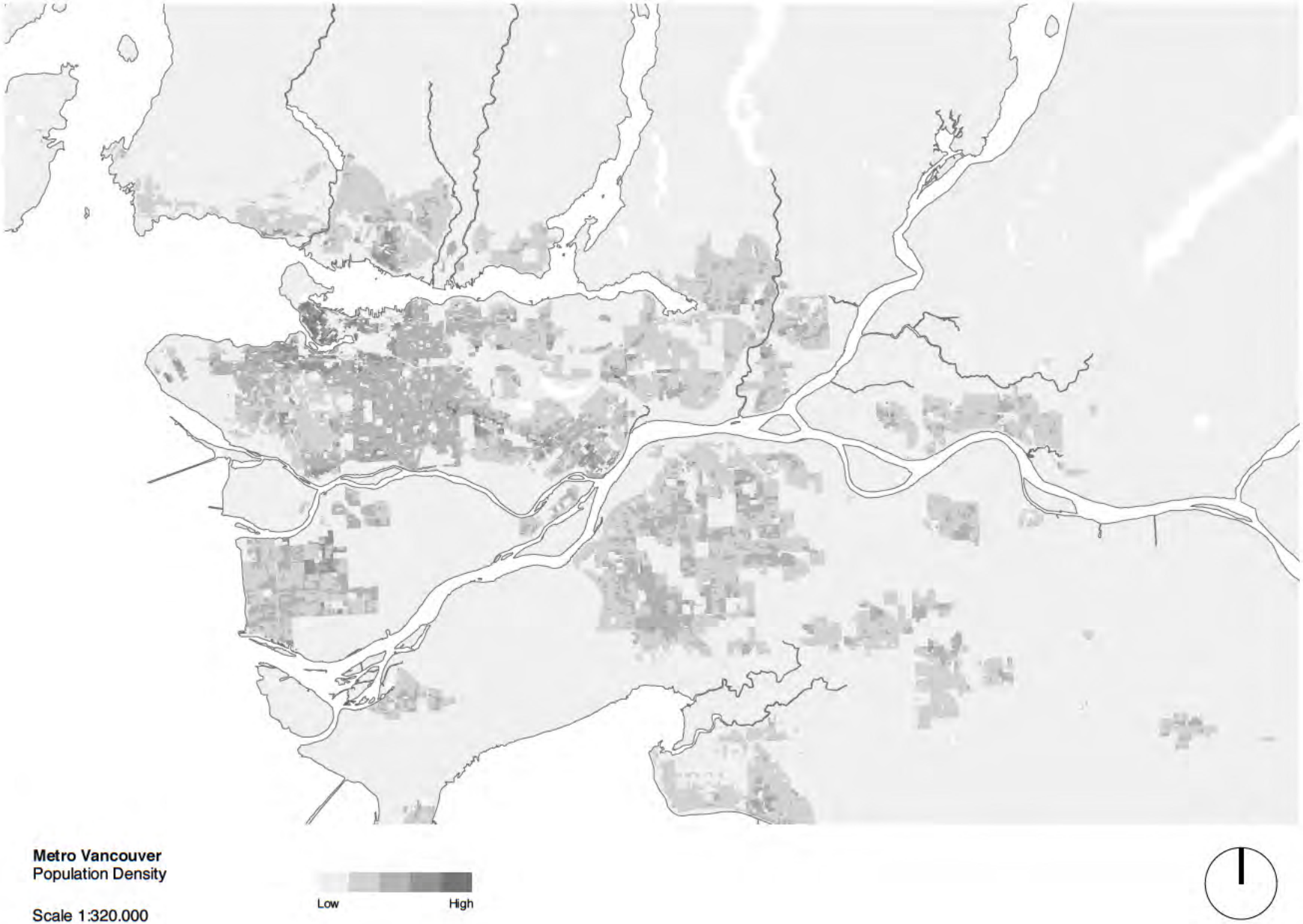
APPENDIX B. MAPPING

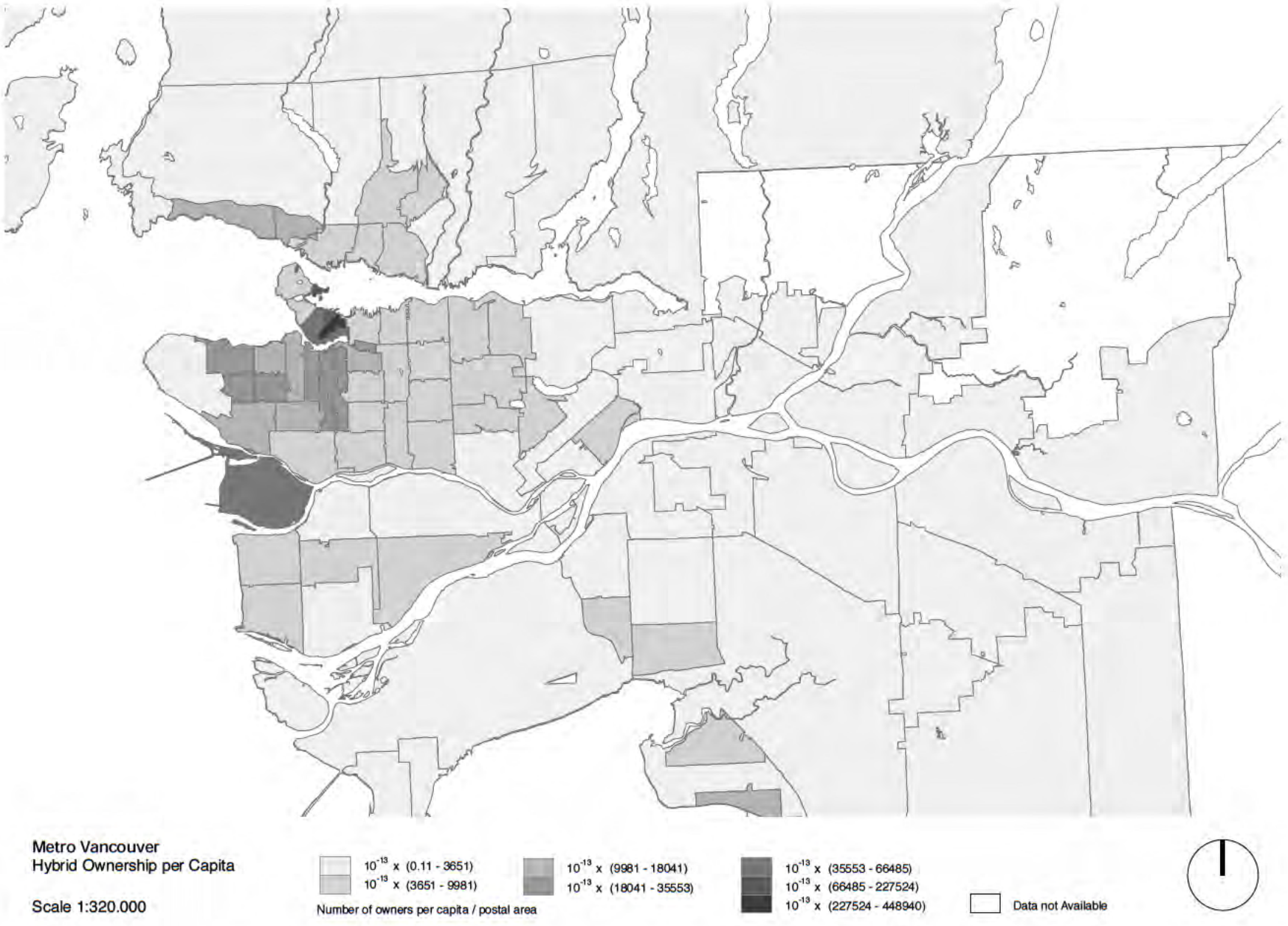
Appendix B contains the detailed mapping carried out for BC. The first section is the cluster mapping, the second section is the corridor mapping.

B.1 Cluster mapping

Mapping for urban areas (clusters) is first done on two scales: the regional and the city scale. The regional scale is looked at for connectivity with other areas, and the more close up scale is to look at the more dense areas of the city itself.

Mapping was carried out for Vancouver and Victoria and regions. The detailed maps are shown first and then the summary maps (already included in the report).

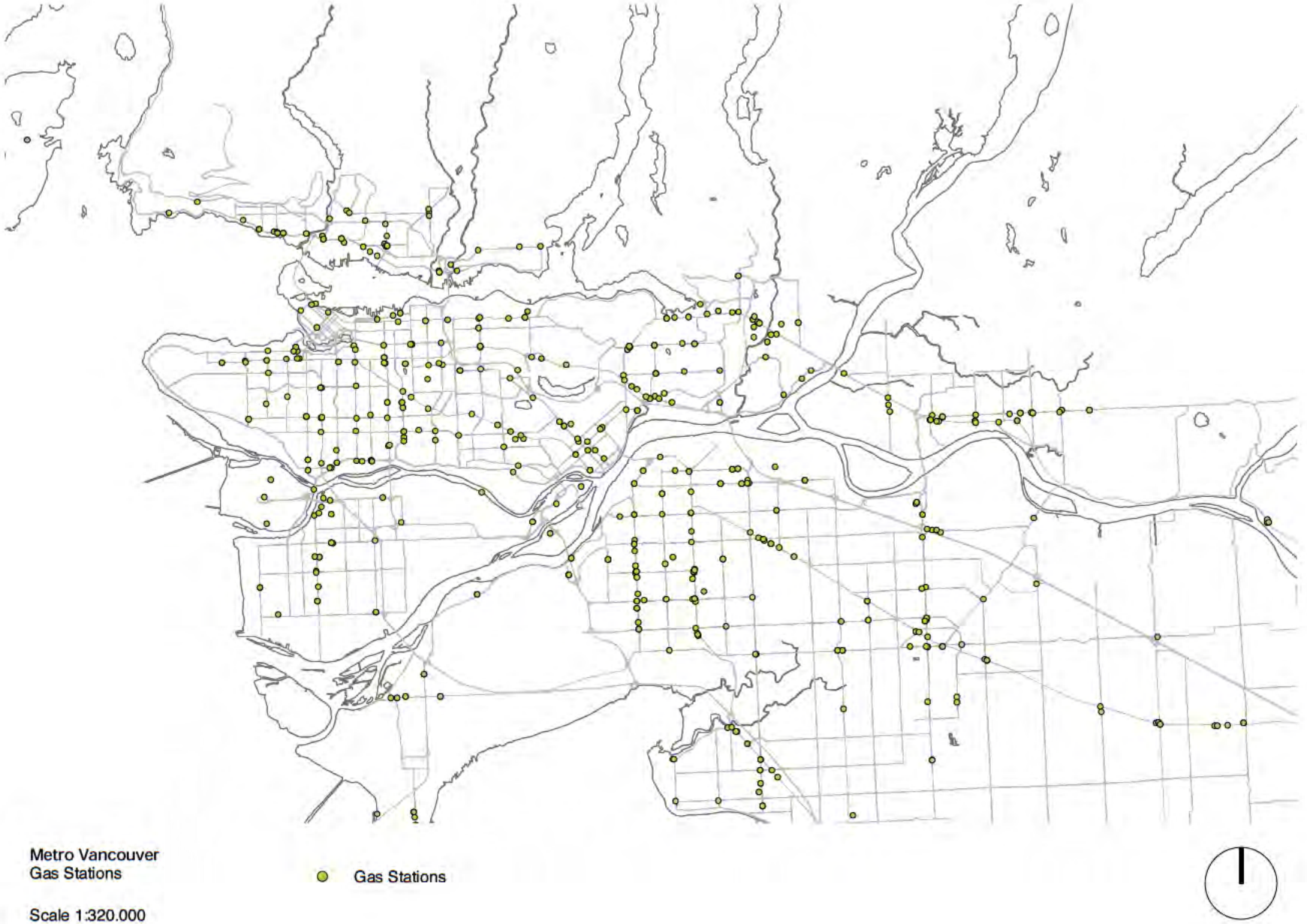

Metro Vancouver
Population Density
Scale 1:320.000
Low
High


Metro Vancouver
Hybrid Ownership per Capita
Scale 1:320.000
10^{-13} x (0.11 - 3651)
10^{-13} x (3651 - 9981)
10^{-13} x (9981 - 18041)
10^{-13} x (18041 - 35553)
10^{-13} x (35553 - 66485)
10^{-13} x (66485 - 227524)
10^{-13} x (227524 - 448940)
Number of owners per capita / postal area
Data not Available

Metro Vancouver
Highways & Roads

Scale 1:320.000


Metro Vancouver
Gateways
Scale 1:320.000
Ferries
West Coast Express Stations
International Airport
Central Bus / Train Station
Helijets


Metro Vancouver
Gas Stations
Scale 1:320.000
Gas Stations

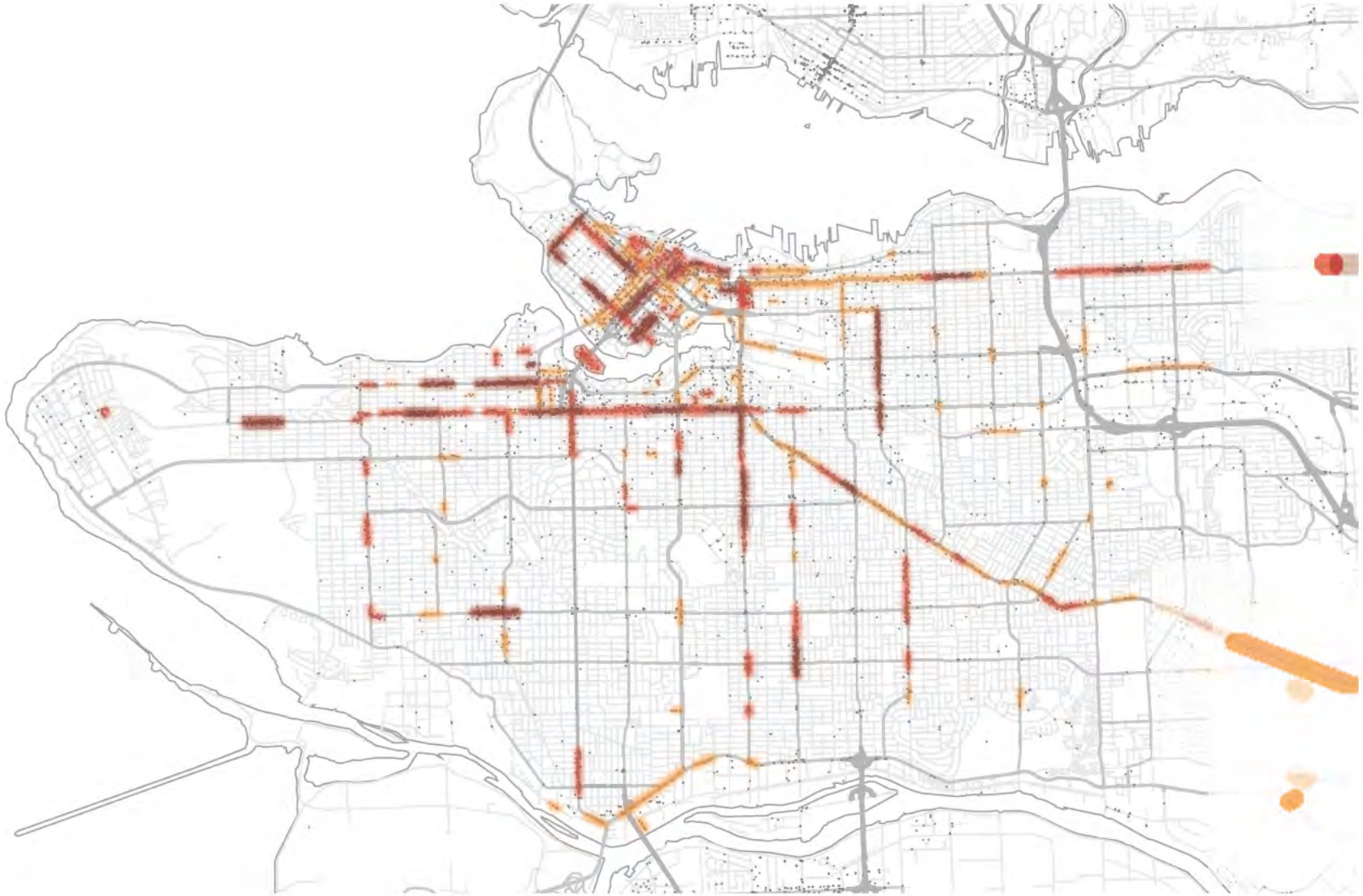

High
Low
Vancouver
Population Density
Scale 1:100.000

Vancouver
Hybrid Ownership per Capita

Scale 1:100.000

10^{-13} x (0.11 - 3651)
10^{-13} x (3651 - 9981)
10^{-13} x (9981 - 18041)
10^{-13} x (18041 - 35553)
10^{-13} x (35553 - 66485)
10^{-13} x (66485 - 227524)
10^{-13} x (227524 - 448940)

Number of owners per capita / postal area



Vancouver
Commercial Areas

Scale 1:100.000

High Commercial Density
Medium Commercial Density
Low Commercial Density

Vancouver
Gas Stations

Gas Stations

Scale 1:100.000

Vancouver
Public Parkades

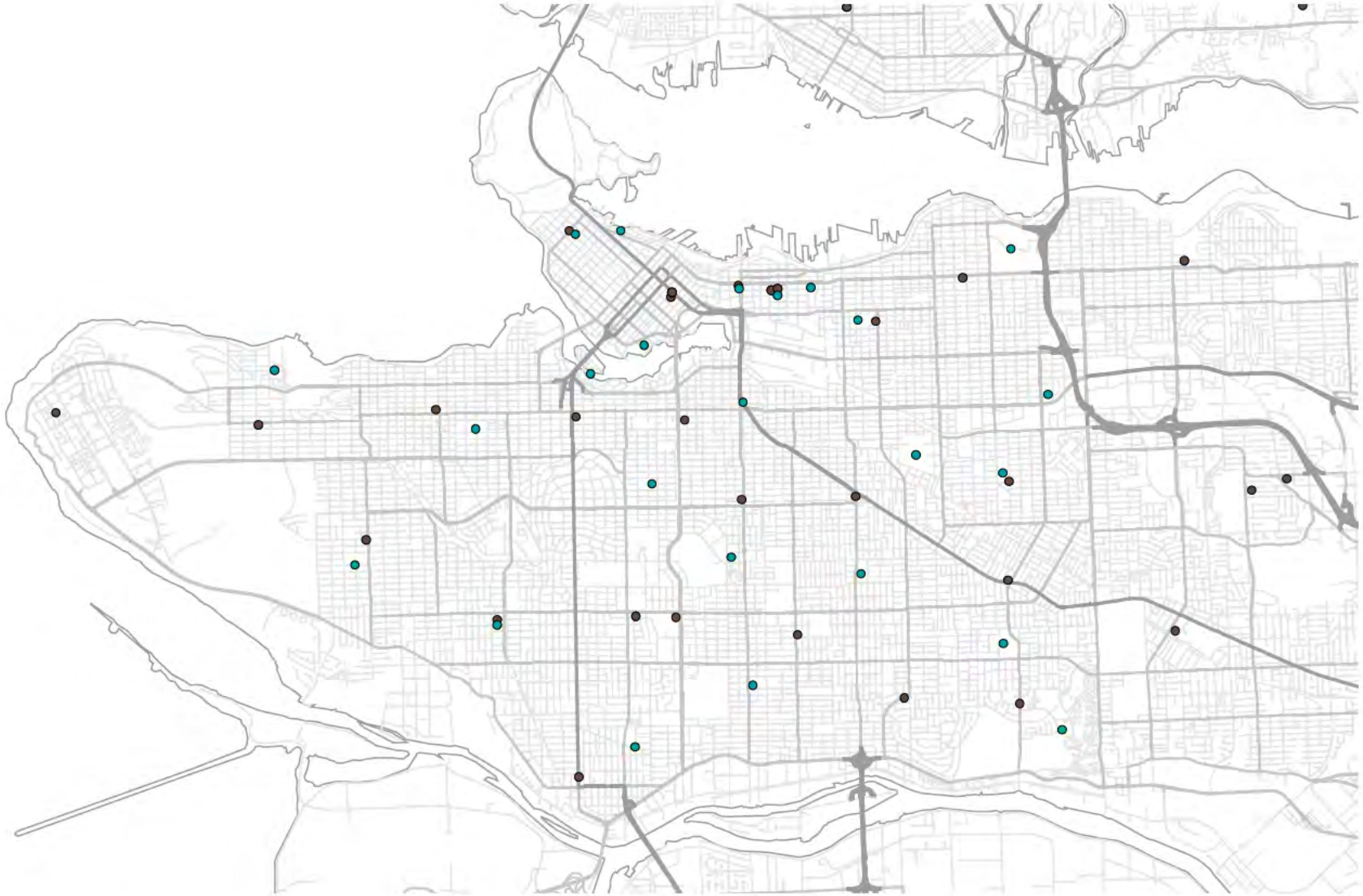
Scale 1:100.000

- Public Parkade / Public Surface Parking
- Public Parkade / Public Surface Parking associated with Business

Vancouver
Tourist Attractions

Tourist Attractions

Scale 1:100.000



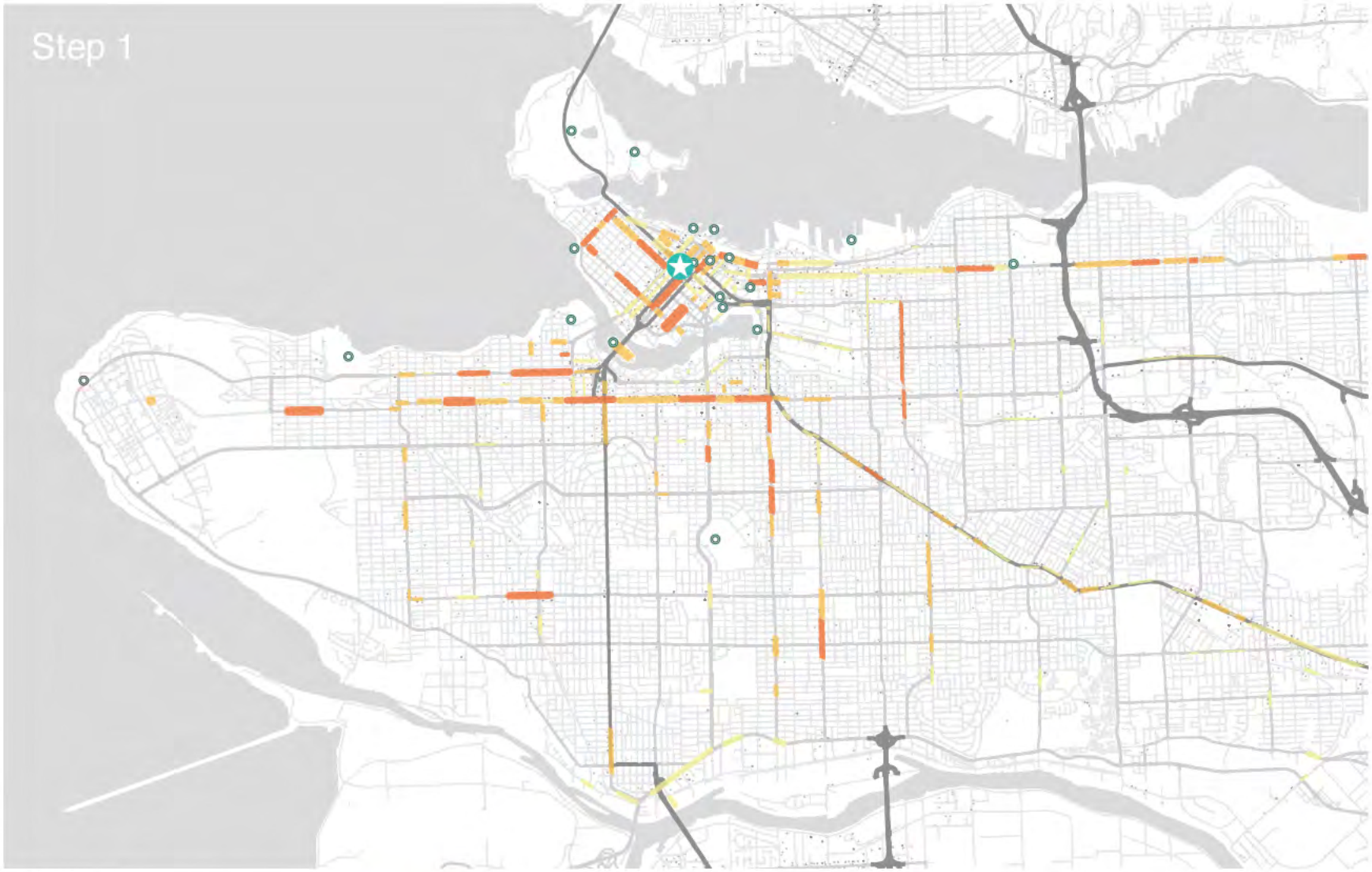
Vancouver
Civic Centers

Scale 1:100.000

- Community Centers
- Libraries

Vancouver
Highways & Roads

Scale 1:100.000



Vancouver
Proposed Stations- VIP

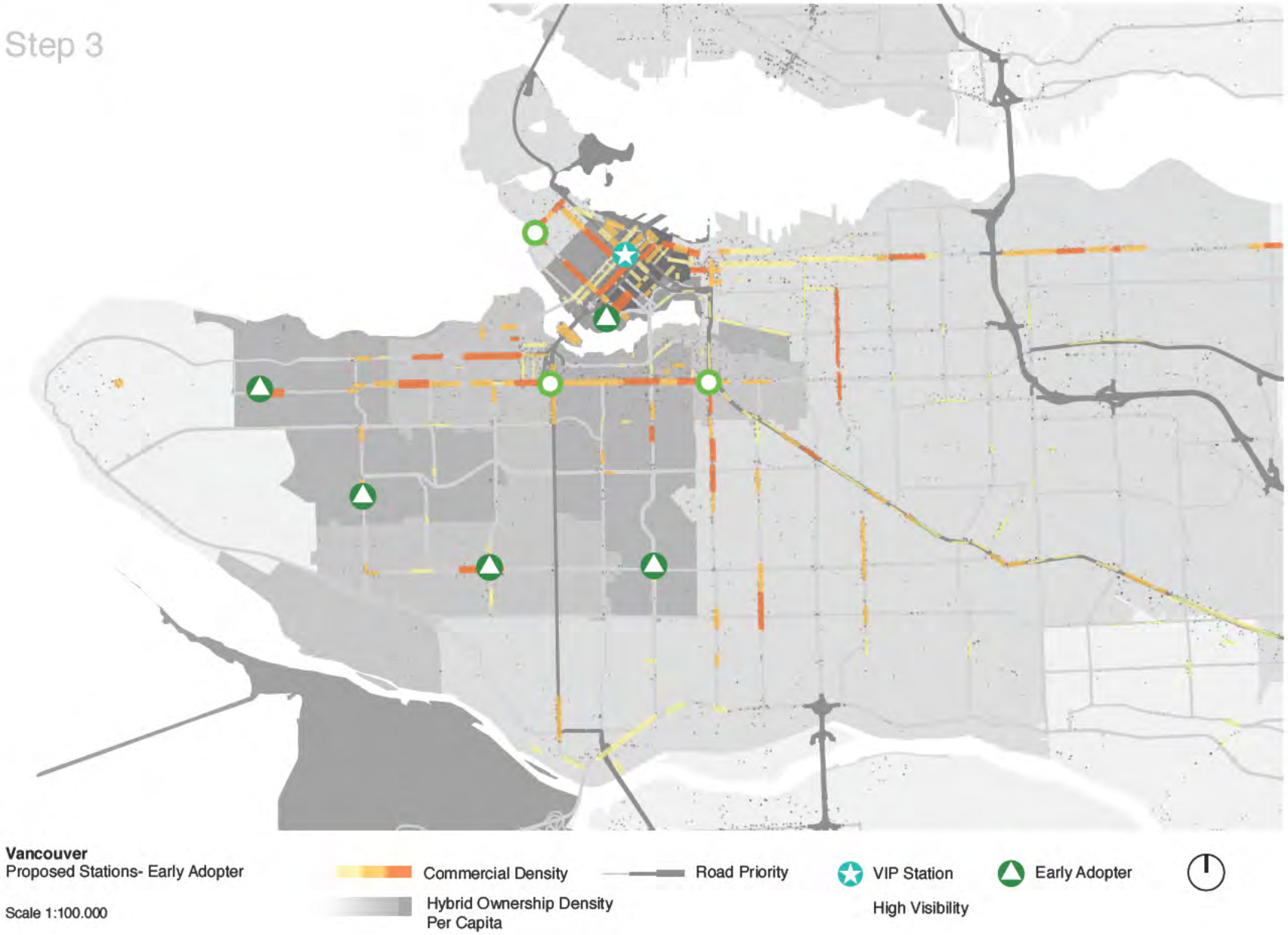
Commercial Density

Tourist Attractions

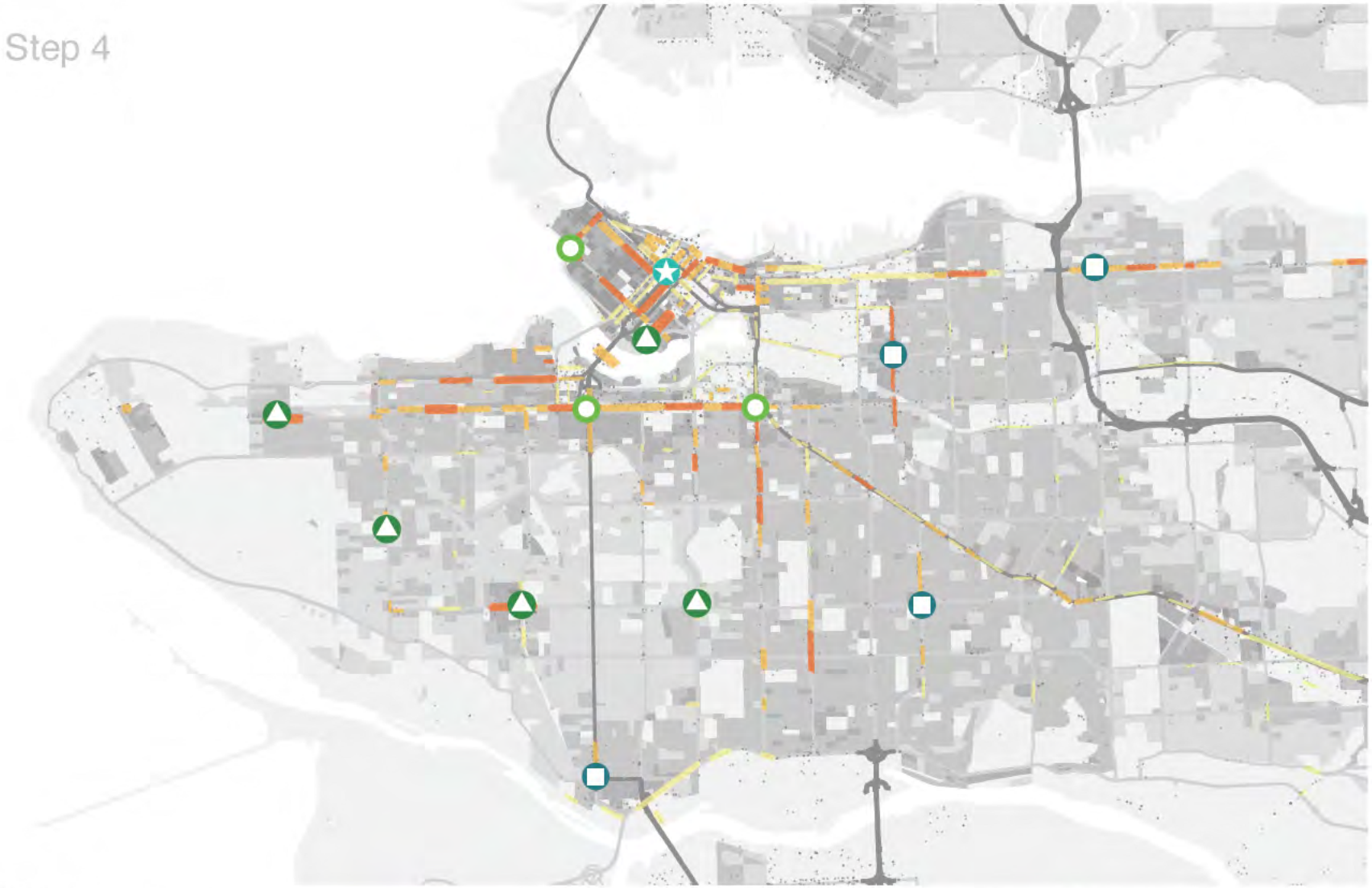
VIP Station

Scale 1:100.000


Step 2
Vancouver
Proposed Stations- High Visibility
Scale 1:100.000
Commercial Density
Road Priority
VIP Station
High Visibility


Step 3
Vancouver
Proposed Stations- Early Adopter
Scale 1:100.000
Commercial Density
Hybrid Ownership Density
Per Capita
Road Priority
VIP Station
High Visibility
Early Adopter

Step 4



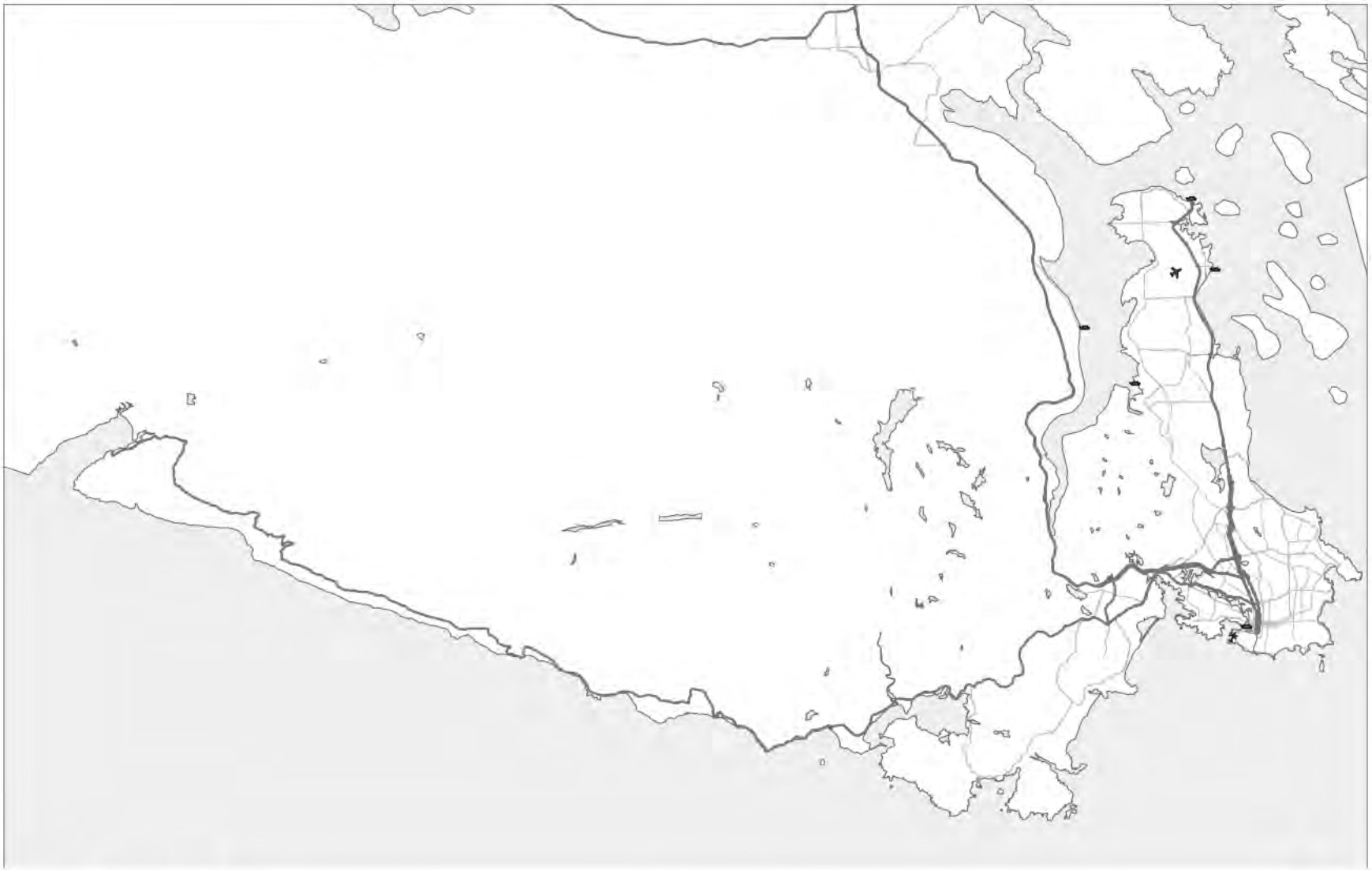
Vancouver
Proposed Stations- Basic Functionality

Scale 1:100.000

Commercial Density
Population Density
Road Priority
VIP Station
High Visibility
Early Adopter
Basic Functionality

Capital Regional District
Highways & Roads

Scale 1:410.000



Capital Regional District
Gateways

Scale 1:410.000

Ferries

International Airport

Helijets

Capital Regional District
Gas Stations

Gas Stations

Scale 1:100.000


Victoria
Population Density
Scale 1:100.000
Low
High

Victoria
Commercial Areas

Scale 1:100.000

High Commercial Density
Medium Commercial Density
Low Commercial Density

Victoria
Gas Stations

Gas Stations

Scale 1:100.000

Victoria
Civic Centers

Libraries

Scale 1:100.000

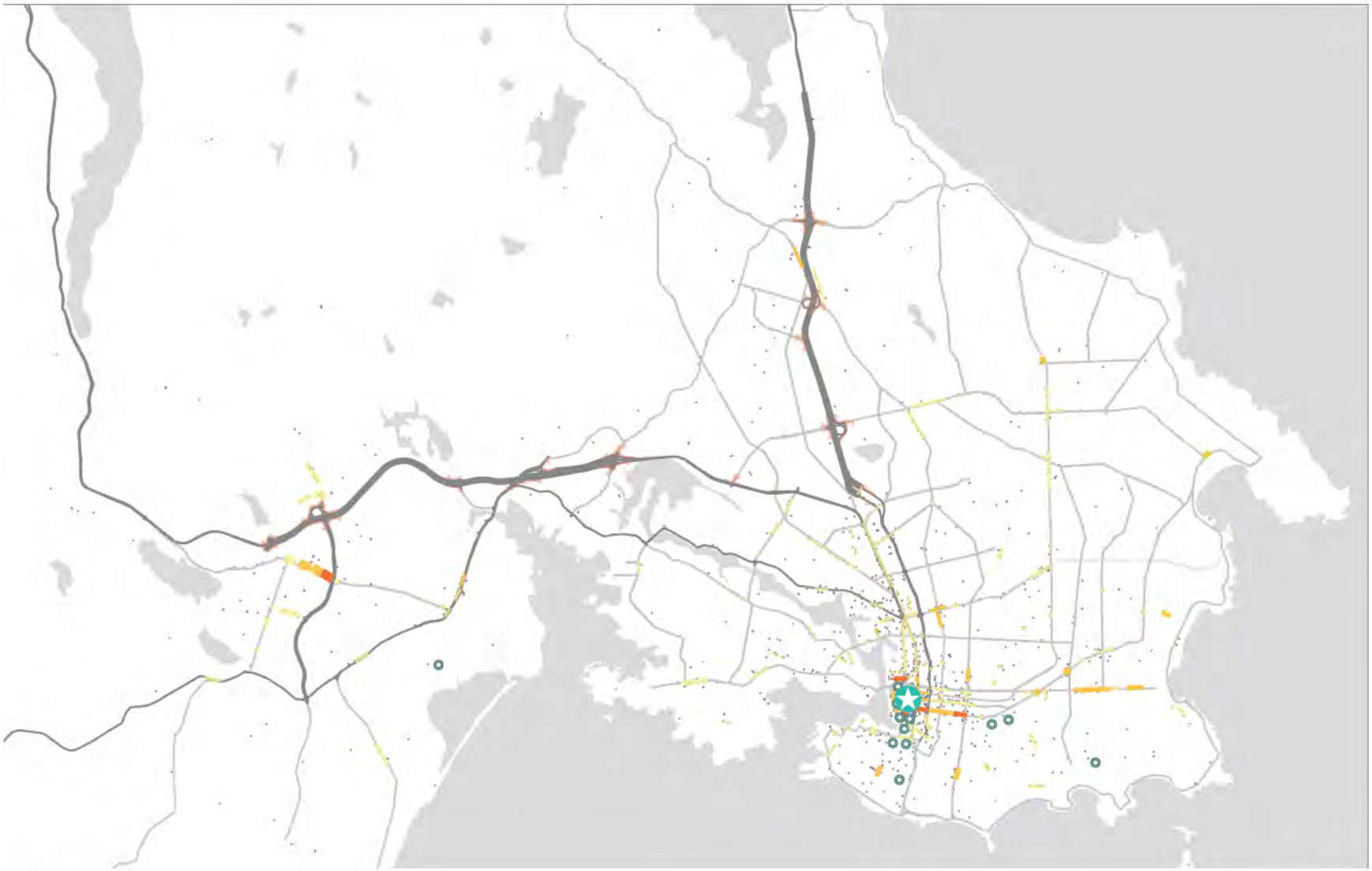
Victoria
Tourist Attractions

Scale 1:100.000

Tourist Attractions

Victoria
Highways & Roads

Scale 1:100.000


Victoria
Proposed Stations- VIP
Scale 1:100.000
Commercial Density
Road Priority
Tourist Attractions
VIP Station

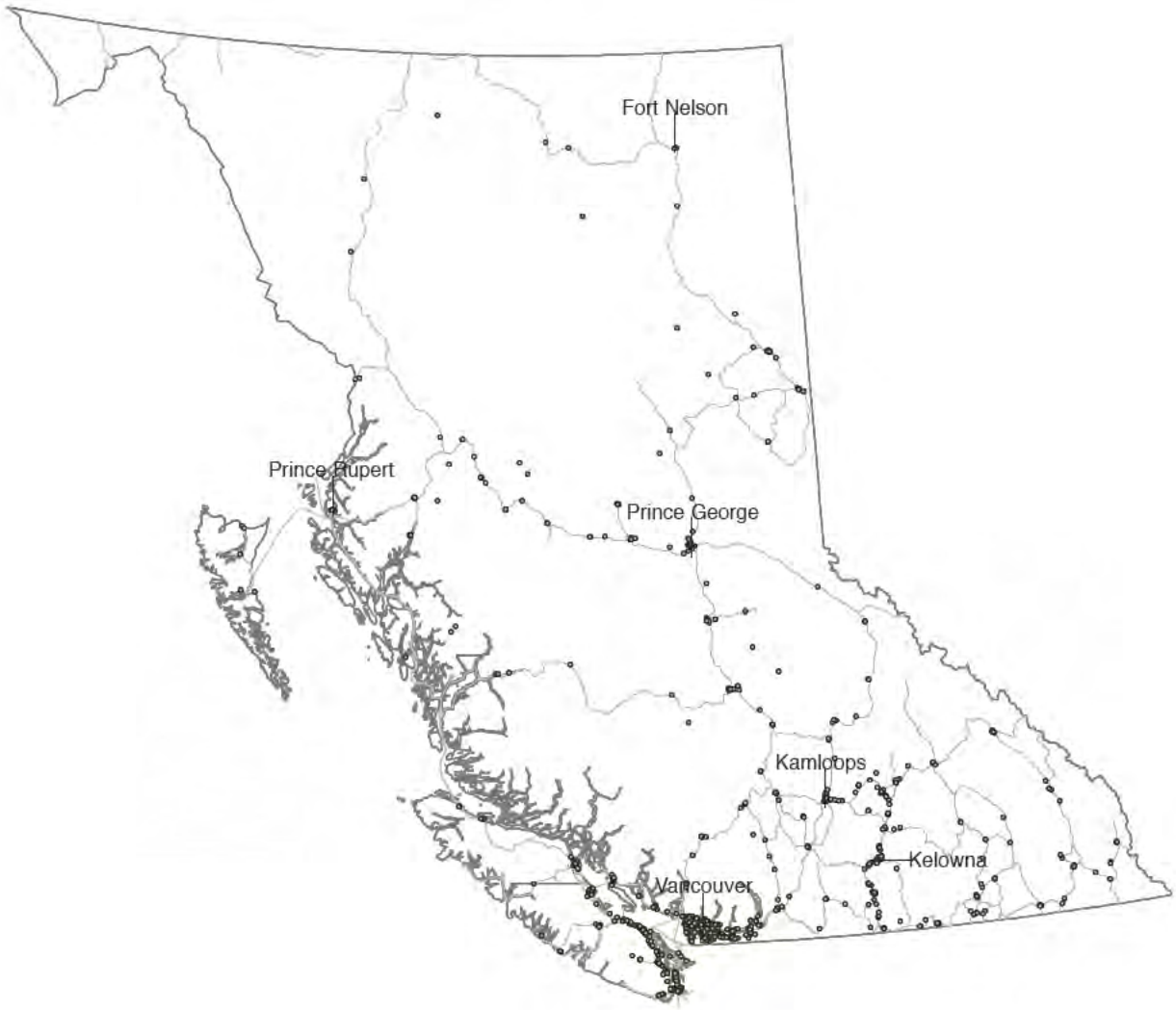

Victoria
Proposed Stations- High Visibility
Scale 1:100.000
Commercial Density
Road Priority
Tourist Attractions
VIP Station
High Visibility


Victoria
Proposed Stations- Basic Functionality
Scale 1:100.000
Commercial Density
Population Density
Road Priority
VIP Station
High Visibility
Basic Functionality

B.2 Corridor mapping

Corridor mapping is based on circles with radii developed from the car range analysis carried out for BC. Mapping is done for all major highways in BC although implementation on all will likely not be carried out immediately. Gas stations are shown on all maps.

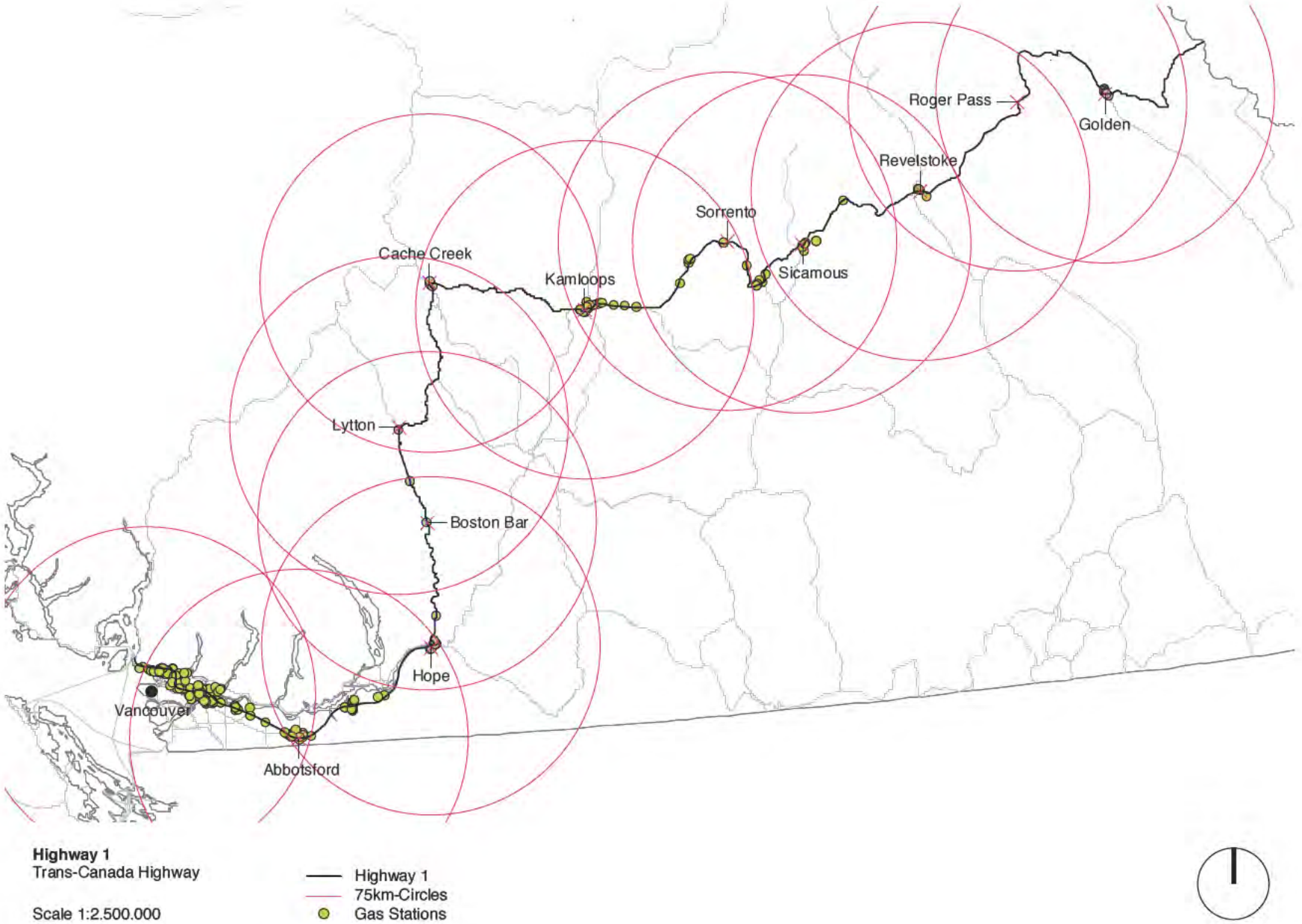
A summary map of the highways of BC is included first to orient the reader to the province.



Highways
British Columbia

Scale 1:10.000.000

Province
Highway
Gas Stations


Roger Pass
Golden
Revelstoke
Sorrento
Cache Creek
Kamloops
Sicamous
Lytton
Boston Bar
Hope
Vancouver
Abbotsford
Highway 1
Trans-Canada Highway
Scale 1:2.500.000
Highway 1
75km-Circles
Gas Stations

Highway 1

Charging Stations and Locations

Location: **West Vancouver**	*Population*: **44.058**
Points of Interest: Park Royal, Horseshoe Bay, Cypress Provincial Park	

73 km

Location: **Abbotsford**	*Population*: **138.179**
Points of Interest: Visitor Centre	

79 km

Location: **Hope**	*Population*: **6.322**
Points of Interest: Othello Quintette Tunnels, Visitor Centre, Art Gallery	

65 km

Location: **Boston Bar**	*Population*: **596**
Points of Interest: Access to Nahatlach Valley	

55 km

Location: **Lytton**	*Population*: **226**
Points of Interest: Gold Pan Provincial Park	

80 km

Location: **Cache Creek**	*Population*: **1.085**
Points of Interest: Intersection Hwy 1 / Hwy 97	

79 km

Location: **Kamloops**	*Population*: **87.110**
Points of Interest: Visitor Centre, Art Gallery, Secwepemc Museum	

76 km

Location: **Sorrento**	*Population*: **700**
Points of Interest: ---	

64 km

Location: **Sicamous**	*Population*: **2.963**
Points of Interest: Visitor Centre, Shuswap Lake	

73 km

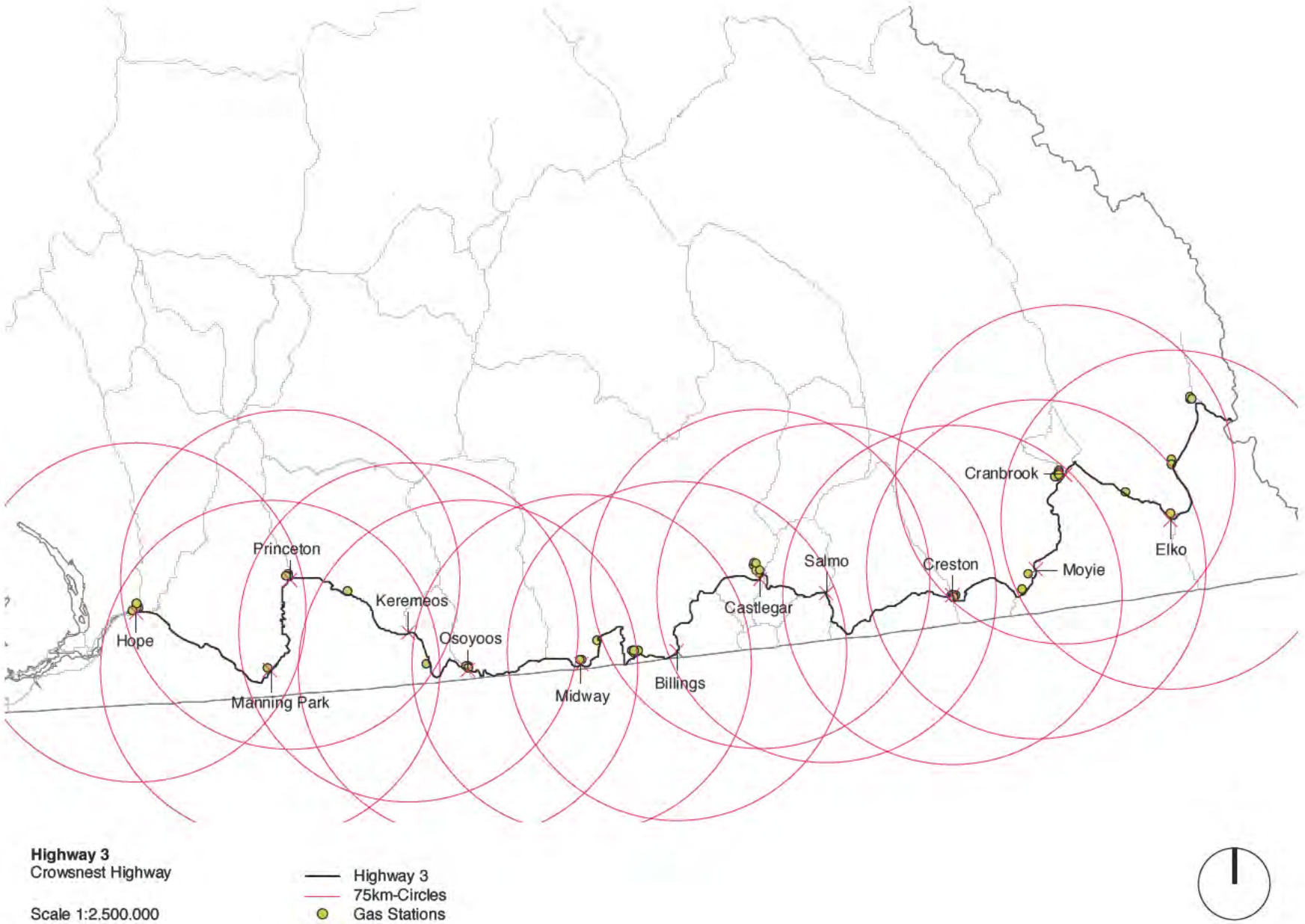
Location: **Revelstoke**	*Population*: **7.271**
Points of Interest: Mount Revelstoke National Park, Visitor Centre, Railway Museum	

68 km

Location: **Rogers Pass**	*Population*: **-**
Points of Interest: Glacier National Park, Rogers Pass Centre	

80 km

Location: **Golden**	*Population*: **3.935**
Points of Interest: Kicking Horse River, Yoho National Park, Golden- and District Museum	


Hope
Princeton
Manning Park
Keremeos
Osoyoos
Midway
Billings
Castlegar
Salmo
Creston
Moyie
Cranbrook
Elko
Highway 3
Crowsnest Highway
Scale 1:2.500.000
Highway 3
75km-Circles
Gas Stations

Highway 3

Charging Stations and Locations

Location: **Hope**	*Population*: **6.322**
Points of Interest: Othello Quintette Tunnels, Visitor Centre, Art Gallery	

67 km

Location: **Manning Park**	*Population*: **-**
Points of Interest: Provincial Park	

67 km

Location: **Princeton**	*Population*: **2.994**
Points of Interest: Museum	

67 km

Location: **Keremeos**	*Population*: **1.517**
Points of Interest: Grist Mill, Fruit Growing Region	

48 km

Location: **Osoyoos**	*Population*: **5.203**
Points of Interest: Desert Centre, Museum, Freshwater Lakes, Sand Beaches	

69 km

Location: **Midway**	*Population*: **663**
Points of Interest: ---	

79 km

Location: **Billings**	*Population*: **<20**
Points of Interest: Gladstone Provincial Park	

76 km

Location: **Castlegar**	*Population*: **7.879**
Points of Interest: Doukhobor Discovery Centre, Kootenay Gallery, Zuckerberg Island Heritage Park, Arrow Bay- and Syringa Provincial Park	

40 km

Location: **Salmo**	*Population*: **1.070**
Points of Interest: ---	

78 km

Location: **Creston**	*Population*: **5.245**
Points of Interest: Museum, Visitor Ventre, Summit Creek Park	

68 km

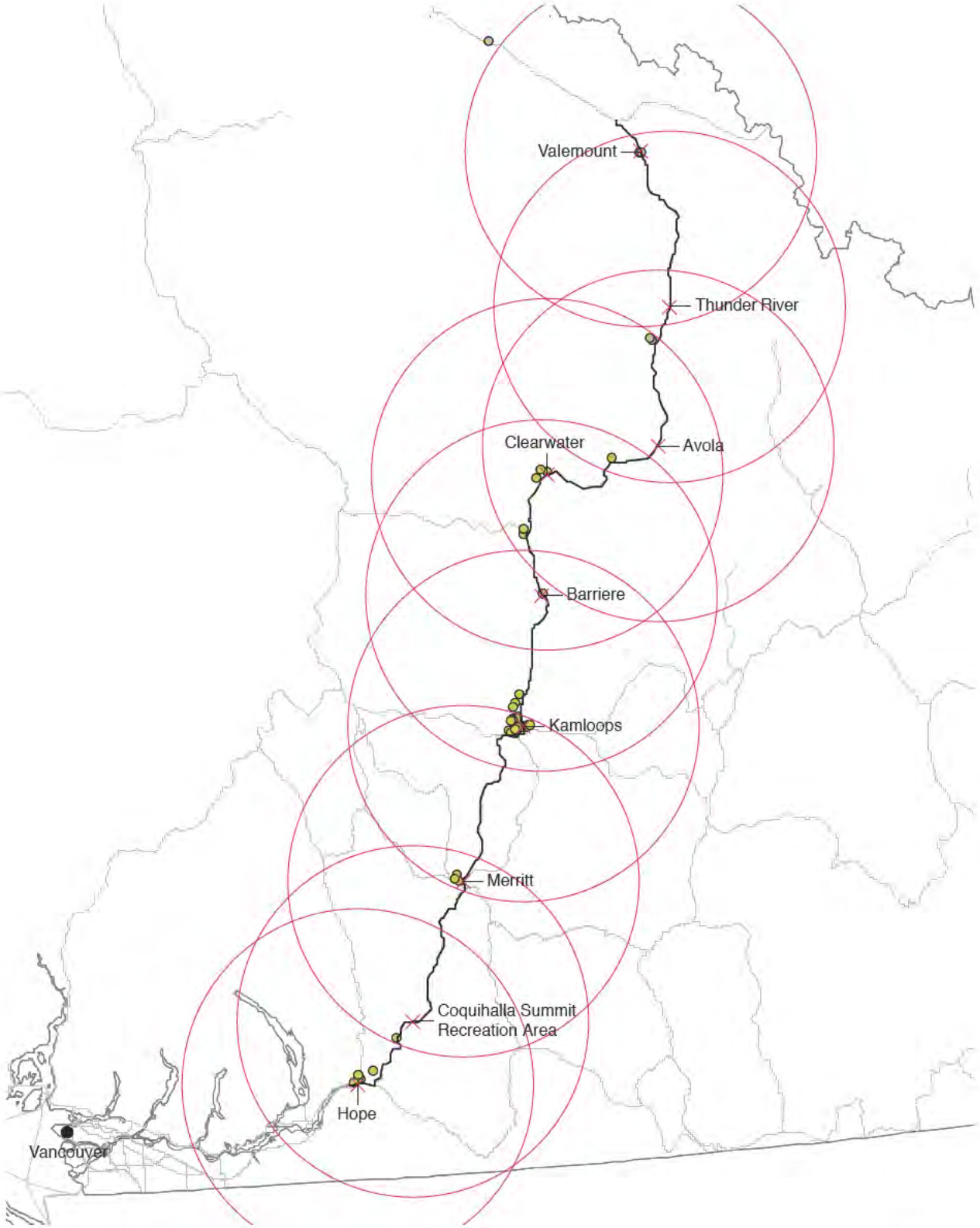
Location: **Moyie**	*Population*: **450**
Points of Interest: Moyie Lake	

80 km

Location: **Cranbrook**	*Population*: **19.123**
Points of Interest: Canadian Museum of Rail Travel	

67 km

Location: **Elko**	*Population*: **87.110**
Points of Interest: ---	



Highway 5
Coquihalla Highway

Scale 1:2.500.000

Highway 5
75km-Circles
Gas Stations

Highway 5
Charging Stations and Locations

Location: **Hope**	*Population*: **6.322**
Points of Interest: Othello Quintette Tunnels, Visitor Centre, Art Gallery	

56 km

Location: **Coquihalla Summit Recreation Area**	*Population*: **-**
Points of Interest: Recreation Area	

73 km

Location: **Merrit**	*Population*: **7.285**
Points of Interest: Visitor Centre, Nicola Valley Museum, Nicola Lake	

80 km

Location: **Kamloops**	*Population*: **87.110**
Points of Interest: Visitor Centre, Art Gallery, Secwepemc Museum	

64 km

Location: **Barriere**	*Population*: **1.712**
Points of Interest: ---	

63 km

Location: **Clearwater**	*Population*: **2.355**
Points of Interest: Wells Gray Provincial Park	

66 km

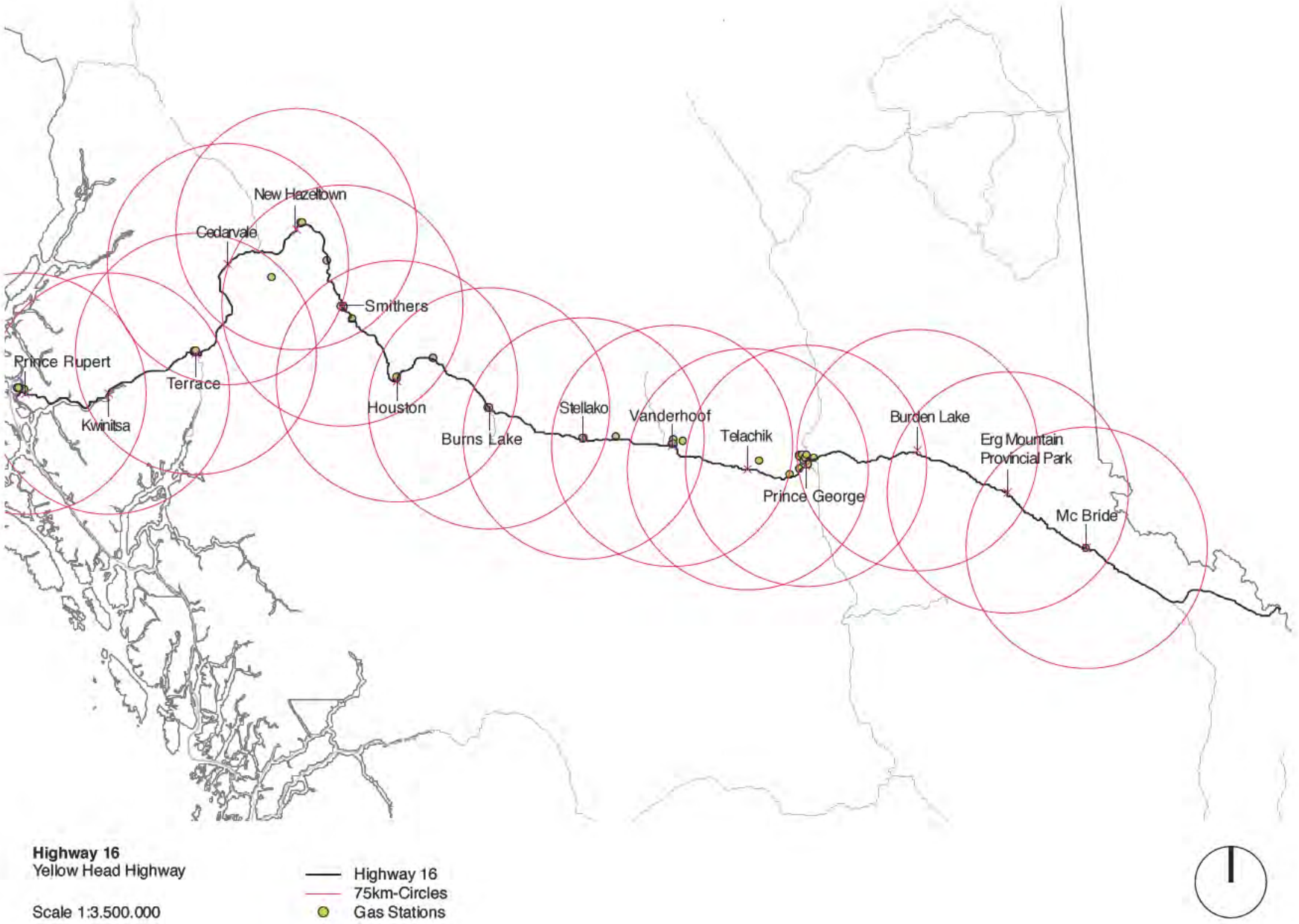
Location: **Avola**	*Population*: **-**
Points of Interest: ---	

55 km

Location: **Blue River**	*Population*: **260**
Points of Interest: ---	

77 km

Location: **Valemount**	*Population*: **1.062**
Points of Interest: George Hicks Regional Park, Visitor and Interpretive Centre, Starrat Wildlife Sanctuary	


New Hazeltown
Cedarvale
Smithers
Prince Rupert
Terrace
Kwinitsa
Houston
Burns Lake
Stellako
Vanderhoof
Telachik
Prince George
Burden Lake
Erg Mountain
Provincial Park
Mc Bride
Highway 16
Yellow Head Highway
Scale 1:3.500.000
Highway 16
75km-Circles
Gas Stations

Highway 16
Charging Stations and Locations

Location: **Prince Rupert**	*Population*: **12.994**
Points of Interest: Visitor Centre, Museum of Northern BC, Airport	

52 km

Location: **Kwinitsa**	*Population*: **-**
Points of Interest: Skeena River	

85 km

Location: **Terrace**	*Population*: **11.931**
Points of Interest: Visitor Centre, Heritage Park Museum, Airport	

75 km

Location: **Cedarvale**	*Population*: **-**
Points of Interest: Seven Sisters Protected Area	

63 km

Location: **New Hazeltown**	*Population*: **603**
Points of Interest: Seeley Lake Provincial Park	

68 km

Location: **Smithers**	*Population*: **5.408**
Points of Interest: Visitor Centre, Wildlife Museum, Airport	

64 km

Location: **Houston**	*Population*: **3.008**
Points of Interest: ---	

58 km

Location: **Burns Lake**	*Population*: **2.142**
Points of Interest: Burns Lake Provincial Park	

66 km

Location: **Stellako**	*Population*: **-**
Points of Interest: Fraser Lake	

62 km

Location: **Vanderhoof**	*Population*: **4.049**
Points of Interest: Community Museum	

60 km

Location: **Telachick**	*Population*: **-**
Points of Interest: ---	

40 km

Location: **Prince George**	*Population*: **75.568**
Points of Interest: Visitor Centre, Railway and Forestry Museum, Eploration Place	

65 km

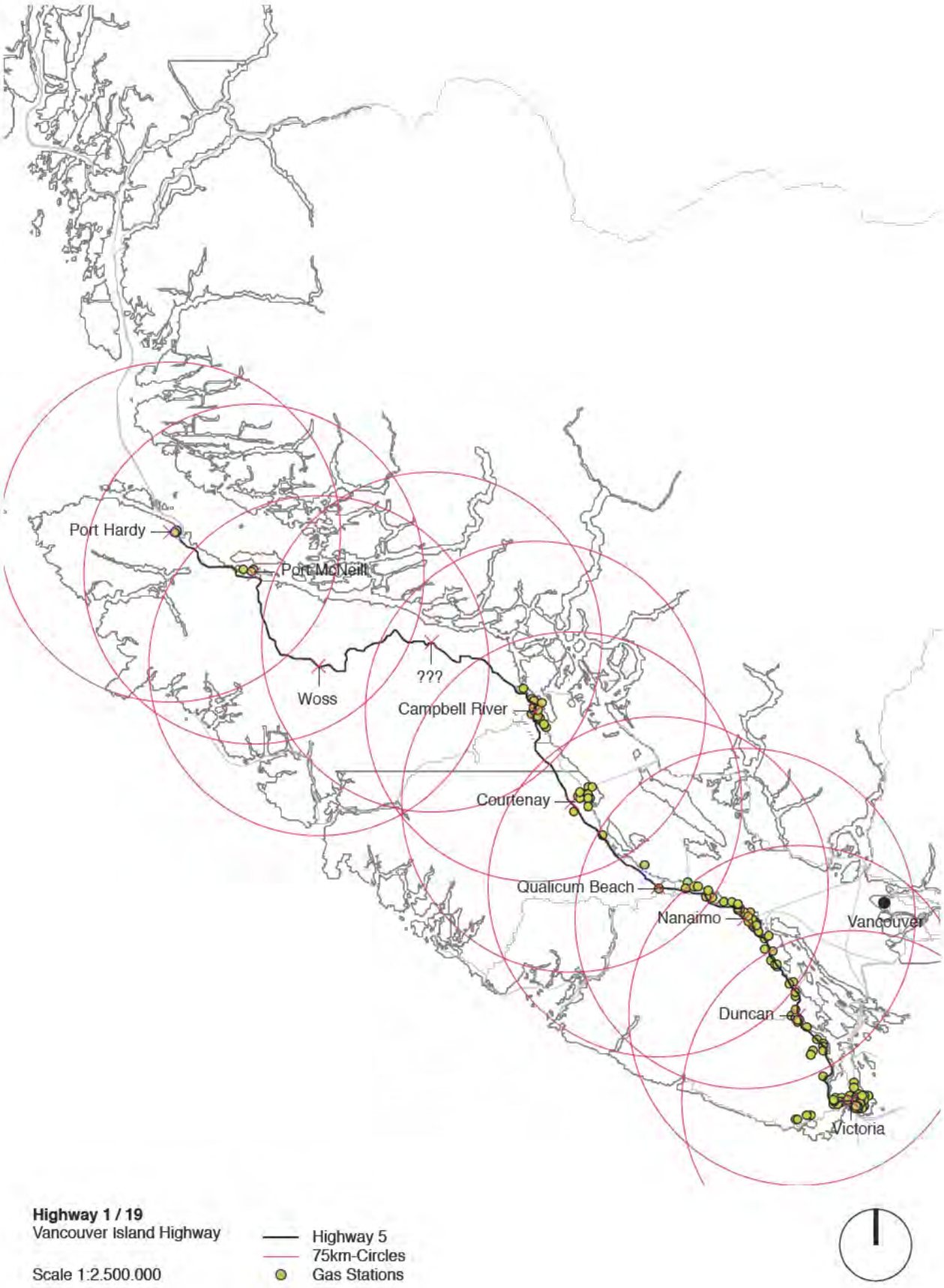
Location: **Purden Lake**	*Population*: **-**
Points of Interest: ---	

58 km

Location: **Erg Mountain Provincial Park**	*Population*: **-**
Points of Interest: Provincial Park	

60 km

Location: **Mc Bride**	*Population*: **677**
Points of Interest: Fraser River	


Port Hardy
Port McNeill
Woss
???
Campbell River
Courtenay
Qualicum Beach
Nanaimo
Vancouver
Duncan
Victoria
Highway 1 / 19
Vancouver Island Highway
Scale 1:2.500.000
Highway 5
75km-Circles
Gas Stations

Highway Vancouver Island

Charging Stations and Locations

Location: **Victoria**	*Population*: **83.362**
Points of Interest: Art Gallery, Bastion Square, Airport	

61 km

Location: **Duncan**	*Population*: **4.987**
Points of Interest: BC Forest Discovery Centre	

55 km

Location: **Nanaimo**	*Population*: **85.512**
Points of Interest: Art Gallery, Bastion Square, Airport	

49 km

Location: **Qualicum Beach**	*Population*: **8.729**
Points of Interest: Visitor Centre, Big Qualicum Hatchery	

65 km

Location: **Courtenay**	*Population*: **23.369**
Points of Interest: Airport, Museum, Visitor Centre, Airforce Museum	

52 km

Location: **Campbell River**	*Population*: **30.447**
Points of Interest: Airport, Visitor Centre, Museum	

130 km

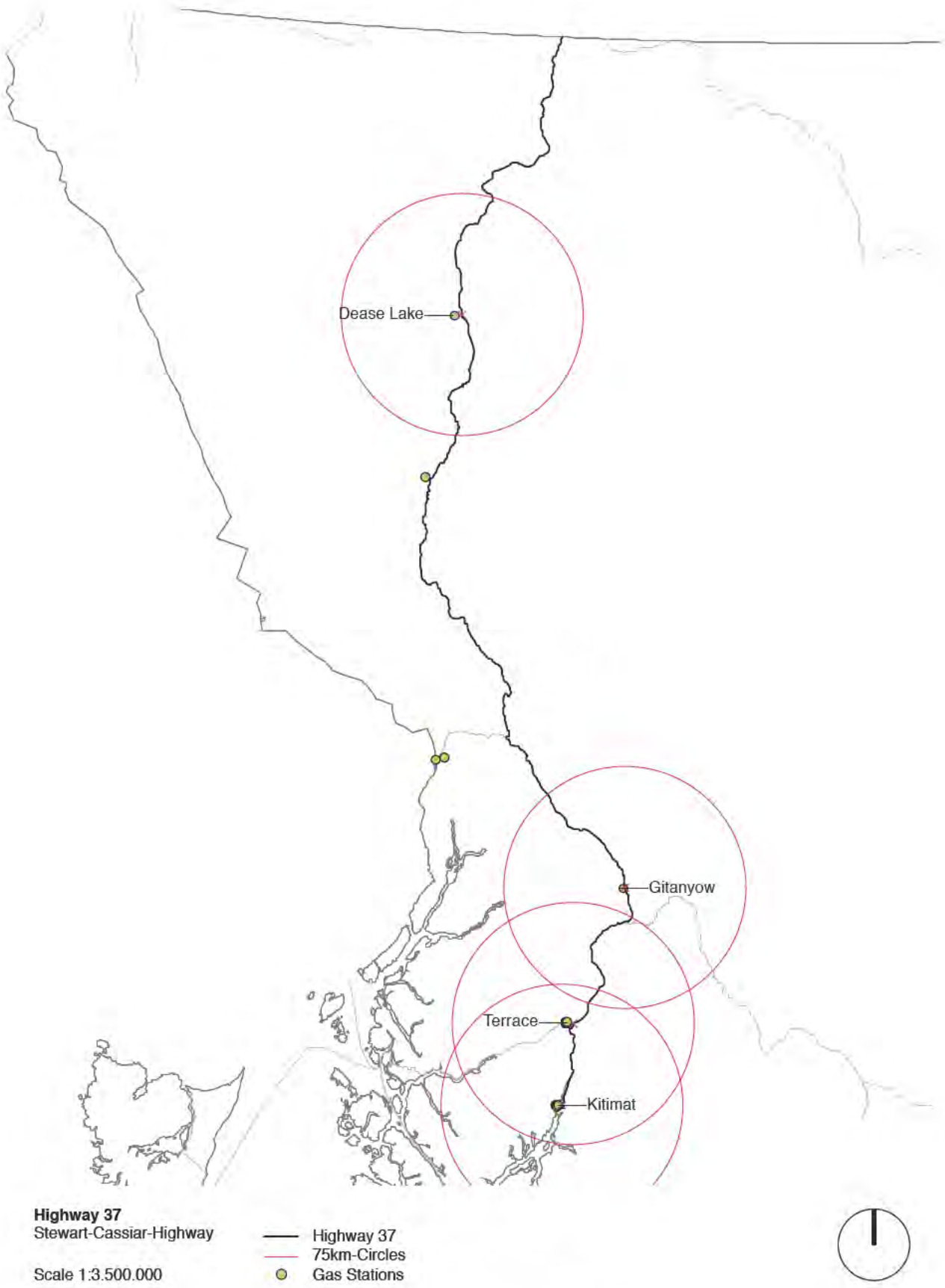
Location: **Woss**	*Population*: **400**
Points of Interest: ---	

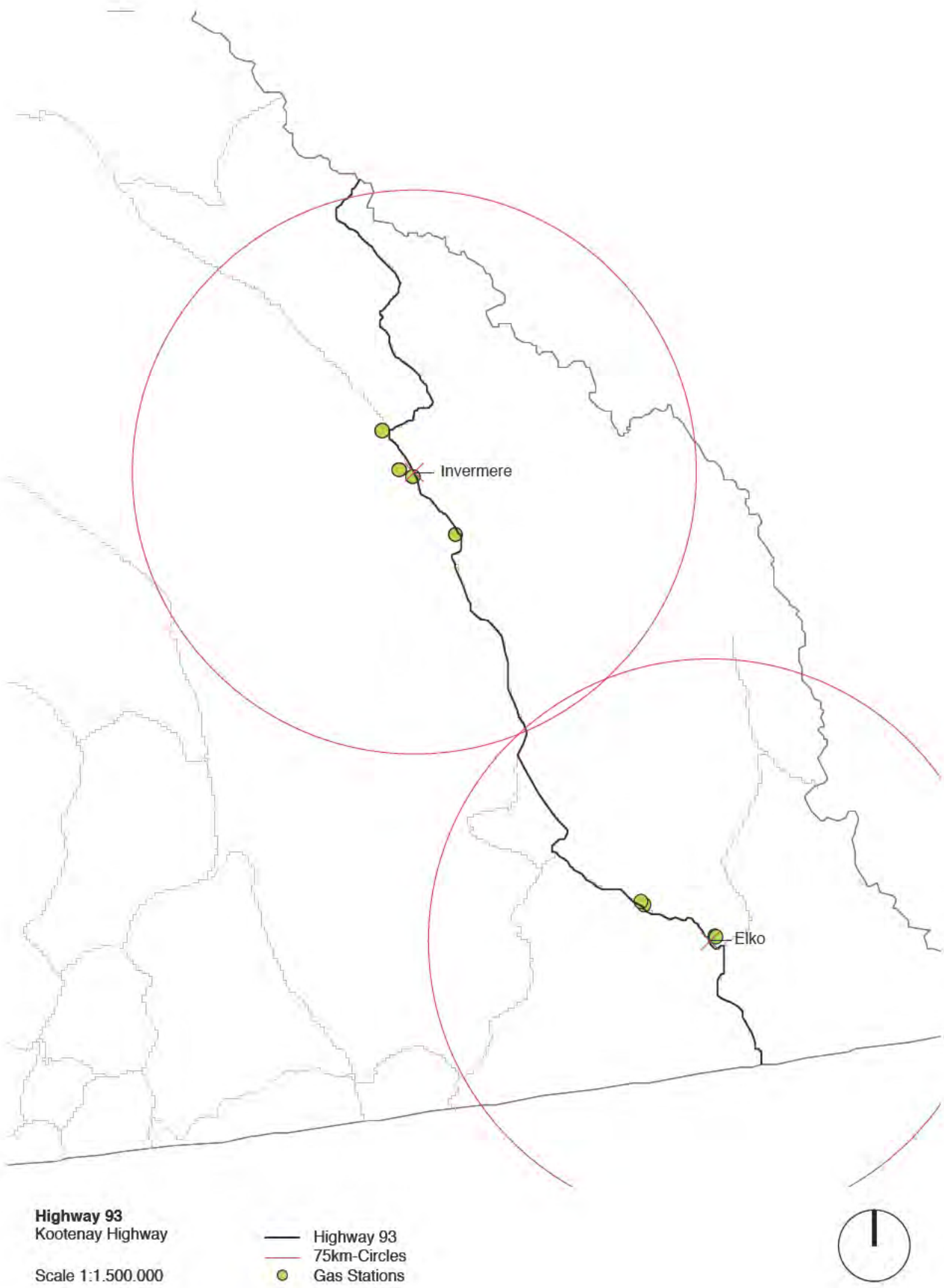
67 km

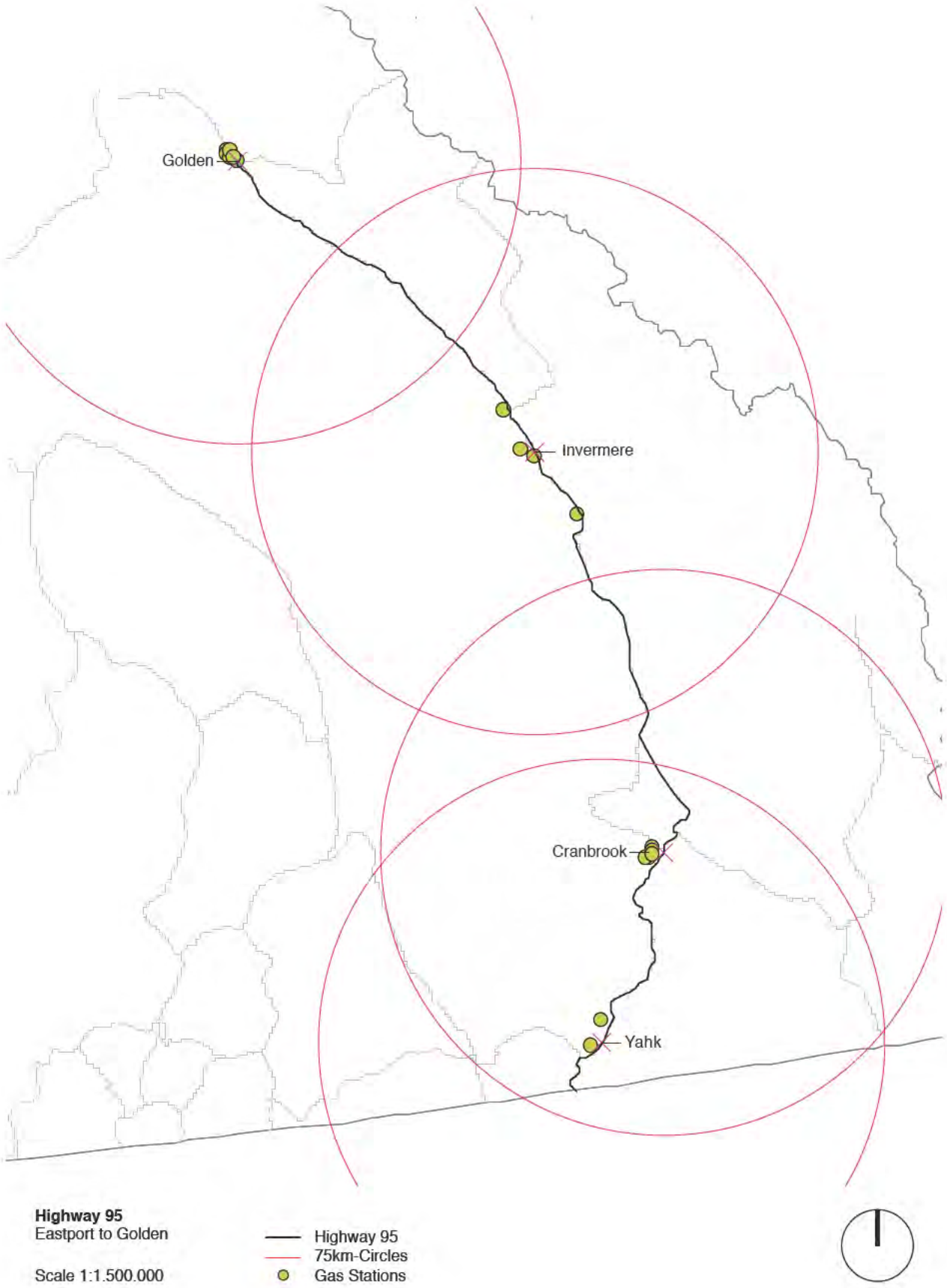
Location: **Port McNeill**	*Population*: **2.648**
Points of Interest: Visitor Centre	

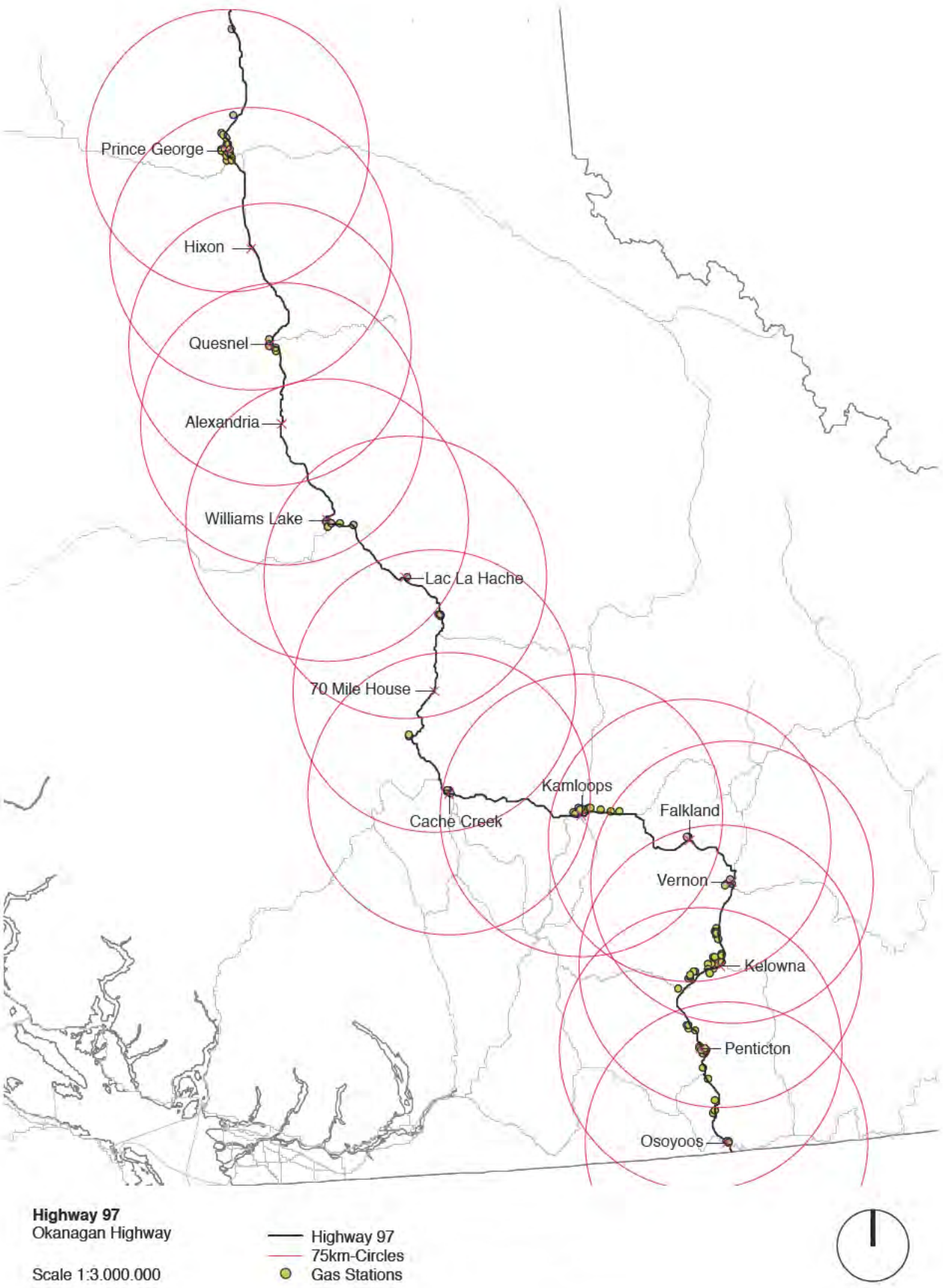
44 km

Location: **Port Hardy**	*Population*: **3.950**
Points of Interest: ---	


Dease Lake
Gitanyow
Terrace
Kitimat
Highway 37
Stewart-Cassiar-Highway
Scale 1:3.500.000
Highway 37
75km-Circles
Gas Stations


Invermere
Elko
Highway 93
Kootenay Highway
Scale 1:1.500.000
Highway 93
75km-Circles
Gas Stations


Golden
Invermere
Cranbrook
Yahk
Highway 95
Eastport to Golden
Scale 1:1.500.000
Highway 95
75km-Circles
Gas Stations


Prince George
Hixon
Quesnel
Alexandria
Williams Lake
Lac La Hache
70 Mile House
Cache Creek
Kamloops
Falkland
Vernon
Kelowna
Penticton
Osoyoos
Highway 97
Okanagan Highway
Scale 1:3.000.000
Highway 97
75km-Circles
Gas Stations

Highway 97
Charging Stations and Locations

Location: **Osyoos**	*Population*: **5.203**
Points of Interest: Desert Centre, Museum, Freshwater Lakes, Sand Beaches	

62 km

Location: **Penticton**	*Population*: **33.078**
Points of Interest: Art Gallery, Visitor Center, Sicamous Maritime Museum, Airport	

68 km

Location: **Kelowna**	*Population*: **121.306**
Points of Interest: Orchad Industry Museum, Wine Museum, Sculpture Gardens, Airport, Heritage Museum	

50 km

Location: **Vernon**	*Population*: **38.895**
Points of Interest: Museum, Kalamalka Lake Provincial Park, Okanagan Science Centre, Art Gallery	

45 km

Location: **Falkland**	*Population*: **623**
Points of Interest: ---	

74 km

Location: **Kamloops**	*Population*: **87.110**
Points of Interest: Visitor Centre, Art Gallery, Secwepemc Museum	

80 km

Location: **Cache Creek**	*Population*: **1.058**
Points of Interest: Intersection Hwy 1 / Hwy 97	

72 km

Location: **70 Mile House**	*Population*: **1.885**
Points of Interest: ---	

67 km

Location: **Lac La Hache**	*Population*: **953**
Points of Interest: Lake La Hache	

67 km

Location: **Williams Lake**	*Population*: **11.002**
Points of Interest: Airport, Museum of Cariboo Chilcotin, Scout Island Nature Center	

74 km

Location: **Alexandria**	*Population*: **17**
Points of Interest: ---	

45 km

Location: **Quesnel**	*Population*: **9.746**
Points of Interest: Airport, Cottonwood House Historic Site, Visitor Centre	

59 km

Location: **Hixon**	*Population*: **500**
Points of Interest: ---	

63 km

Location: **Prince George**	*Population*: **75.568**
Points of Interest: Visitor Centre, Railway and Forestry Museum, Eploration Place	


Clinton
Cache Creek
Lillooet
Duffy Lake
Provincial Park
Pemberton
Whistler
Squamish
Vancouver
Highway 99
Sea-to-Sky Highway
Scale 1:1.500.000
Highway 99
75km-Circles
Gas Stations

Highway 99
Charging Stations and Locations

Location: **West Vancouver**	*Population*: **44.058**
Points of Interest: Horseshoe Bay, Cypress Provincial Park, Park Royal	

68 km

Location: **Squamish**	*Population*: **17.898**
Points of Interest: Visitor Centre, West Coast Railway Heritage Park	

59 km

Location: **Whistler**	*Population*: **10.531**
Points of Interest: Tourism Whistler, Wild Play Element Park, Mountainbike Park	

33 km

Location: **Pemberton**	*Population*: **2.437**
Points of Interest: ---	

45 km

Location: **Duffy Lake Provincial Park**	*Population*: **-**
Points of Interest: Provincial Park	

54 km

Location: **Lillooet**	*Population*: **2.368**
Points of Interest: Museum, Visitor Centre	