# SPACES, PLACES AND POSSIBILITIES

## Summary of Community Systems Modelling and Focus Group Feedback

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## RESEARCHERS

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## BACKGROUND

*Places, Spaces and Possibilities* is a research project led by Rob Newell of Royal Roads University, working in collaboration with Ian Picketts of Quest University Canada. The major objectives of the project are to:

1. Model potential outcomes of different development directions for Squamish (or "community development scenarios") to better understand the implications of different land use decisions in the community.

2. Develop realistic interactive visualizations for specific smaller neighbourhoods within Squamish, based on the "community development scenarios", in order to explore their utility as tools for community engagement.

The first research objective involved a systems modelling[1] exercise, which explored the social, economic and environmental implications of developing Squamish in different ways. This research consisted of three activities:

1. Designing system model and community development scenarios

2. Modelling outcomes associated with developing Squamish in accordance with the scenarios

3. Assessing the model's relevance and usefulness for planning through local government and community stakeholder feedback

[1] Systems modelling refers generally to the use of models to approximate more complex processes. In this project a systems model is used to estimate how groups of people act and interact in different environments. The model is based off of extensive data, and also assumptions, regarding how people typically behave in certain situations.

This report is focused on activities designed to fulfill Objective 1. The document begins with a brief summary of the systems model and community scenario development process (a more detailed discussion on this can be found in a previous project report[2]). The report then discusses the scenario modelling process and outcomes from this exercise, and describes outcomes from a focus group that was assembled to gain feedback on the modelling work. The document concludes with a section on next steps for the research, specifically discussing how focus group feedback will be used to refine the model and inform plans for visualization development.

## SYSTEMS MODEL AND COMMUNITY SCENARIO DEVELOPMENT

In March 2018, the researchers met with the District of Squamish's Community Planning and Infrastructure Department for a preliminary scoping meeting for the project. The purpose of the meeting was to discuss local planning challenges, identify neighbourhoods that are of particular interest in terms of future development planning, and develop rough ideas for possible community development scenarios. Following the meeting, four scenario ideas were identified that captured multiple variables but were primarily defined through density: low-density residential neighbourhoods, medium-density row housing and low-rise neighbourhoods, medium-density high(er)-rise neighbourhoods, and high-density community nodes.

The scenario ideas provided a useful "starting point" for further scenario development, which was done through a focus group held in April 2018. The focus group represented a range of community sectors and interests, including non-profit, local government, business interests, development, public transportation, and academia. Focus group discussion involved commenting on the rough scenario ideas, suggesting changes or alternative scenarios, identifying key variables to explore when modelling a scenario, and elucidating local development challenges. Ten major themes emerged through this discussion:

1. Squamish is growing, and all scenarios should incorporate this population growth.
2. Many development projects within Squamish have been approved. These approved residential and commercial units should be included within all of the scenarios.
3. Employment spaces are important. There is need for local employment to both boast community economic development and reduce commuting distances.
4. Scenarios should explore a range of densities, from single-detached housing to missing middle density to high density neighbourhood nodes.
5. An 'optimal density' scenario should be explored, which involves developing neighbourhoods so that they meet the density required for local businesses and mass transit to become viable.

[2] Newell, R., and Picketts, I.M. (2018). Spaces, Places and Possibilities: Summary of systems model and scenario development. Royal Roads University. https://www.crcresearch.org/sites/default/files/imce/robertgnewell/SpacesPlacesPossibilities-ScenarioDevelopment_May2018.pdf

6. Community accessibility is important, meaning communities should be walkable and residents should have access to services and amenities.
7. The community should develop neighbourhoods with diverse housing types, in order to allow people to reside within a neighbourhood throughout different stages of their lives and encourage social diversity.
8. Housing affordability is a significant issue in Squamish.
9. Developing all land as residential is not desirable. Certain areas should be developed for other purposes such as agricultural and/or commercial.
10. Many neighbourhoods in Squamish are located within a floodplain, and this dictates the types of residential units that can be built in these areas.

These considerations informed the development of a systems model and the refinement of the scenario ideas. Five new scenarios were identified through this process:

1. Single-detached family housing neighbourhoods
2. Missing middle development and mixed housing options
3. Medium density townhouses in community nodes
4. Medium density and hillside development (reserving valley floor space for commercial purposes and/or agriculture)
5. High-density neighbourhood nodes

Three neighbourhoods were noted to be particularly relevant to these scenarios and thus would be suitable for detailed visualization work: Loggers East, Garibaldi Estates, and Dentville.

## SCENARIO MODELLING

Scenario modelling was guided by the systems model developed through the first research activity (i.e., the systems model was used to test the scenarios), and it involved a workflow that primarily used ArcGIS and MS Excel.[3] Concisely stated, the process consisted of developing baseline scenarios, building community development scenarios upon the baselines, and modelling community outcomes using the systems model.

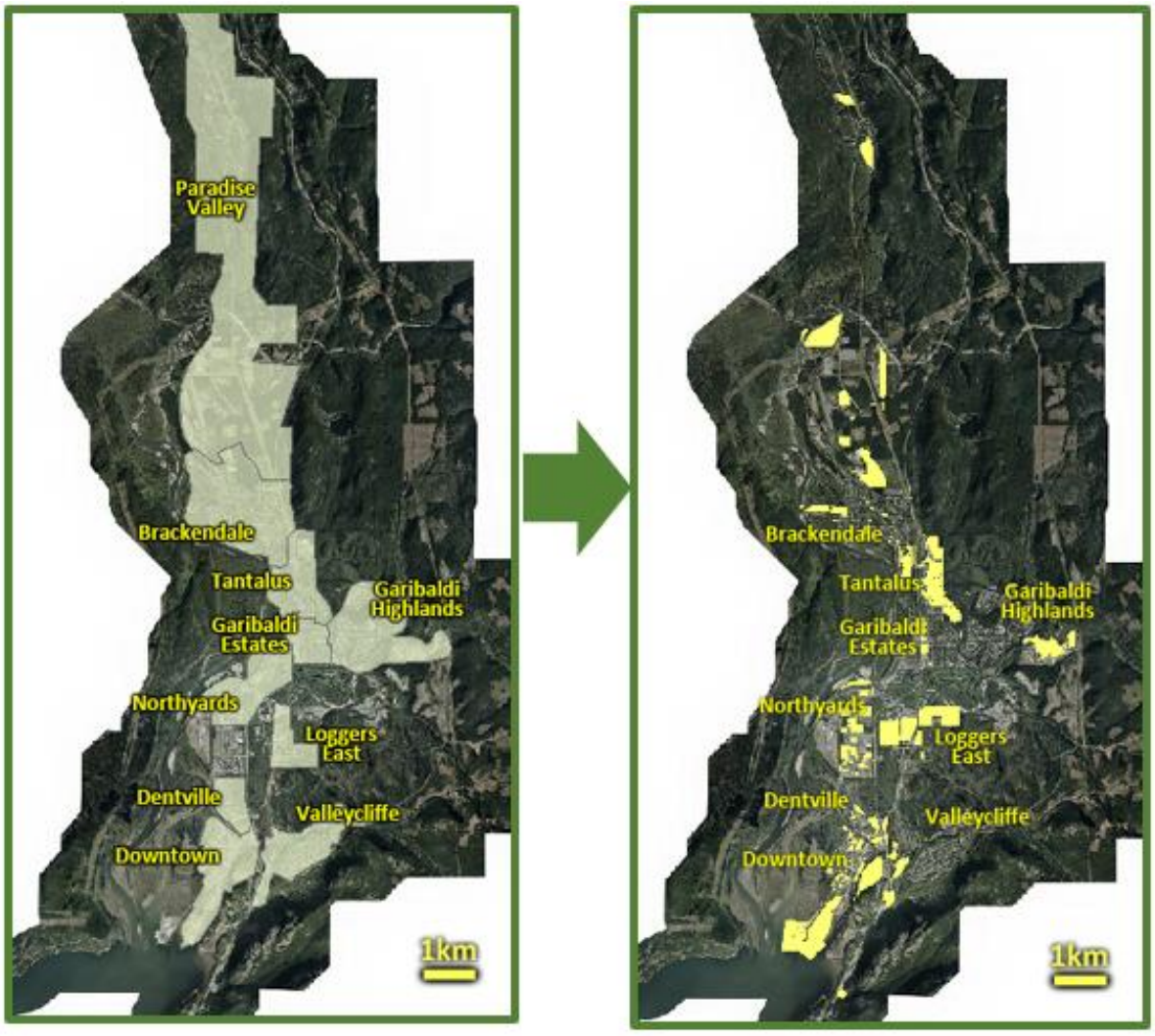
### *Baseline Scenarios*

Prior to modelling community development scenarios, two baseline scenarios were developed. The first baseline scenario roughly captured "current conditions" in Squamish in terms of how the population and businesses are distributed. Using Statistics Canada 2016 Census data and the

[3] This report presents methods used for the first version of the model, which can (somewhat) be considered a "prototype" version. MS Excel and Power Query functions were used for calculations in this version; however, the next version and refined model will likely use R software instead.

Squamish Open Data Portal building footprint GIS layer, residents were distributed throughout Squamish and placed in seven different types of dwelling units: single-detached, duplex townhouse, apartment in building of five storeys or more, apartment in building less than five storeys, mobile dwelling unit, or other attached units (e.g., triplex, fourplex). The population of this Current Baseline is 19,602, which is comparable to the population of 19,512 listed in the 2016 Census. Business, services and other places of employment were then distributed throughout Squamish using Open Data Portal GIS layers containing business licenses, schools and other employment locations. Employee numbers for these organizations/institutions were estimated using 2017 Business Registrar data.

Maps of Squamish neighbourhoods and areas of added residential/commercial development for Future Baseline scenario



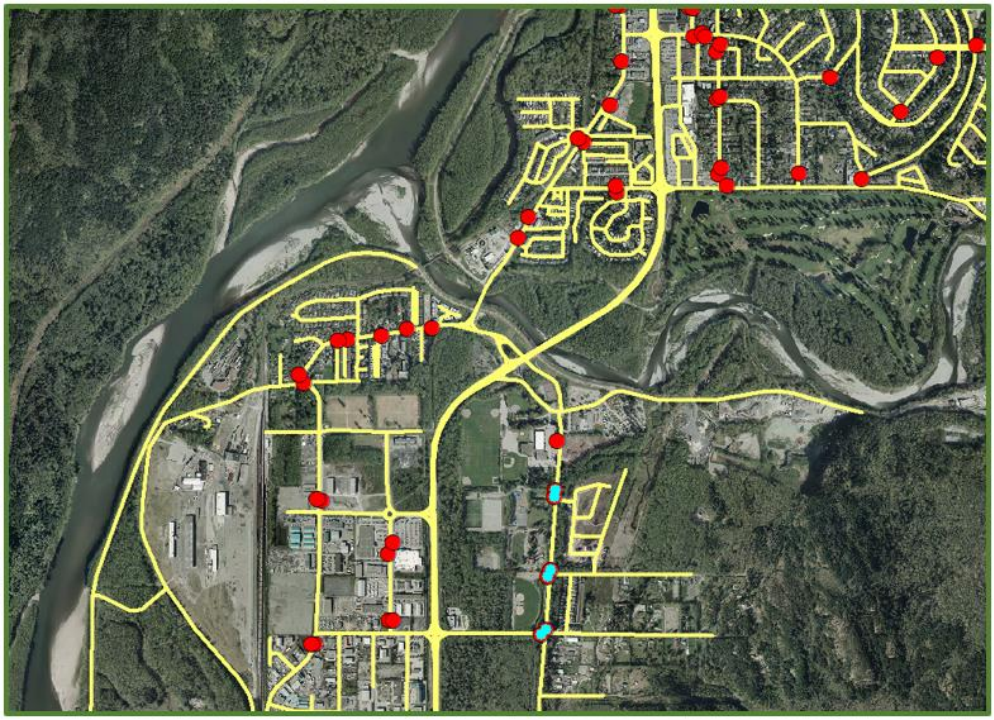

The second baseline scenario modelled what the “future conditions” in Squamish would be after building all approved residential and commercial developed. Residential development was added to the Current Baseline scenario layer using the Squamish Development Showcase Map and a table of approved development. Population growth was distributed throughout these new dwellings based on the types of housing units, and a 4% vacancy rate for apartments was

included (using guidelines given by the Town of Banff[4]). New employment was also added based on both planned commercial development (i.e., Squamish Development Showcase) and potential commercial development identified through Squamish's Employment Land Strategy.[5]

Road and path networks were also added to the baseline scenarios, and two networks were added to each scenario: only roads and both roads and paths. The purpose of adding both networks was to ensure that the modelling can calculate (and differentiate between) travel by walking/cycling (i.e., roads and paths) and travel by driving (i.e., only roads). New roads and paths were added to the Future Baseline, using publicly available plans for new developments.

After adding the road and path networks, transit networks and bus stops were incorporated into the baseline scenarios. In the Future Baseline, a new transit line was added that ran down Loggers Lane in order to provide service for the growing population in Loggers East.

Bus transit stops in Current Baseline (red) and new bus stops added to Future Baseline (blue)



A GIS layer containing parks and green spaces was added to the baseline scenarios (retrieved from the Open Portal Data), and a layer with park access points was built, ensuring that these points were positioned in the appropriate places on the road and path networks. As done with the other scenario features, new parks and access points were added to the Future Baseline in accordance with development plans.

[4] Town of Banff (2018). Progress report on community housing strategy. Submitted to Council by Sharon Oakley, Manager of Housing Sustainability. https://banff.ca/DocumentCenter/View/5288

[5] District of Squamish (2015). Employment lands strategy. Prepared by EcoPlan International for the District of Squamish. Squamish, Canada. https://squamish.ca/assets/Economic-Development/RTC-ELS-Council-Regular-Mar-17-150310-COMPLETE.pdf

The baseline scenarios also included agricultural land, and this was added using Squamish's Agricultural Land Inventory.[6] Agricultural land was classified using six categories: currently farmed, available for farming, agricultural support (e.g., farm buildings), limited farming potential (due to geographical constraints), community gardens, and unavailable for farming. When adding commercial/residential development to agricultural land, the classifications of these areas were changed to "unavailable for farming".

### *Community Development Scenarios*

Community development scenarios were built upon the Future Baseline. Each scenario targeted a population of (roughly) 34,000, based on a medium growth projection given by the District of Squamish[7] that estimates this population level will be reached by 2036. The Future Baseline scenario can accommodate 29,920 people, and thus scenario modelling involved distributing approximately 4,100 people around the community in different ways for each scenario (i.e., every scenario models a population in which 88% of people [29,920 out of 34,000] are already established). For the most part, the scenarios followed those defined through the first research activity; however, some modifications were made. Five scenarios were modelled:

Low density residential – All dwellings built beyond the Future Baseline were single-detached units. The added residential areas assumed a density of 10 units/ha, based on average densities calculated for other Squamish neighbourhoods, such as Garibaldi Estates, Garibaldi Highlands, Dentville and Valleycliffe. The scenario was created by developing/redeveloping rural residential parcels were until the target population was reached (beginning south and moving north toward Paradise Valley).

In Loggers East, Dentville and Garibaldi Estates, development occurred at the same density as other residential areas. No new commercial buildings, businesses or parks were added.

Downtown density concentration – The Oceanfront neighbourhood was redeveloped with a capacity similar to that advertised on the Newport Beach website, i.e., 6,300 residents.[8] In other scenarios, the Oceanfront neighbourhood is approximately a third of this based on the 1,136 townhouses, low-rise and mid-rise condos planned for the area (according to the Wallace Green Real Estate Team).[9] The increased population would result in high-density

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[6] BC Ministry of Agriculture (2017). Agricultural land use inventory: District of Squamish & Squamish-Lillooet Regional District Electoral Area D. Government of British Columbia, Strengthening Farming Program https://www.slrd.bc.ca/sites/default/files/reports/squamish_ead_aluireport.pdf

[7] District of Squamish (2017). District of Squamish OCP Update. Phase 3: Community engagement summary report. https://squamish.ca/assets/OCP-Review/Phase-3-Engagement-Summary-FINAL-with-ADDENDA-Sep7.pdf

[8] Newport Beach Developments LP (n.d.). Newport Beach: Squamish, British Columbia [*website*]. http://www.newportbeachsquamish.ca/

[9] Wallace Green Real Estate Team (n.d.). Squamish Oceanfront Peninsula by Newport Beach Developments LP [*webpage*]. https://www.wallacegreen.ca/buildings/view/16469/squamish-oceanfront-peninsula-by-newport-beach-developments-lp/squamish/downtown-sq/37200-galbrath-road

units, namely stacked townhouses and a series of high-rise buildings. Employment spaces were also added to the scenario to roughly match the job figure of 2,300 that is presented on the Newport Beach website (Oceanfront jobs were approximately half of this number in other scenarios).

High density neighbourhood nodes – Loggers East, Dentville and Garibaldi Estates were redeveloped as high-density walkable neighbourhood communities with local amenities. Development was placed toward transit lines to increase density around bus stops (i.e., transit corridor development), and most developments (aside from Dentville) were built to take 50% of the parcel spaces.

In Loggers East, mixed-use high-rise (8 storeys) and low-rise (4 storeys) developments were added to the neighbourhood. Most buildings were mixed-use residential, but a primarily commercial building (referred to as "Loggers Centre") and an office building were added because retail/commercial access is limited in the area. A park and community garden were added under the transmission line, as this is acceptable land use in transmission corridors (according to BC Hydro[10]). Restaurants, retail and grocery amenities were added, and the area was designed with a density of 25 to 50 people/ha within a quarter mile of the commercial area in order to have adequate local customer support for the businesses.[11] In Dentville, three mixed-use high-rise buildings and about 40 townhouses were developed, and amenities were added such as retail and restaurants. Parcels are smaller in Dentville than in the other neighbourhoods, so taller buildings were added (approximately 10 storeys) that covered more than 50% of the parcel space (modelled on the Village Green Way apartment building). In Garibaldi Estates, mixed-use high-rise buildings were added (containing restaurants and retail), as well as one purely residential apartment building.

Missing middle medium density – Loggers East, Dentville and Garibaldi Estates were redeveloped to contain a mix of duplexes, fourplexes, multiplexes, townhouses, bungalow court and semi-detached houses. The average density for this mix of housing units was about 42 units/ha.

In Loggers East, the neighbourhood had sufficient density to support a mixed-use commercial centre, so the Loggers Centre from the High Density Neighbourhood Nodes scenario was also included in this scenario (as well as the transmission corridor park and community garden). In Dentville, missing middle housing was the primary development type, but the transit corridor was developed with more townhouses to achieve a higher density here. A mixed-use building was also added in Dentville (referred to as "Dentville

[10] BC Hydro (2017). BC Hydro rights of way guidelines: Compatible uses and development near power lines. https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/safety/row-guidelines-2017.pdf

[11] Easton, G., and John, O. (2009). Creating walkable neighborhood business districts: An exploration of the demographic and physical characteristics needed to support local retail services. *MAKERS Architecture and Urban Design*, 1-27.

Centre") because local density was sufficient for supporting retail and restaurants. In Garibaldi Estates, residential parcels were redeveloped as missing middle residential, and no mixed-use or commercial developments were added

Increased commercial and agricultural lands - This scenario built on the Missing Middle Medium Density scenario (using it as a "starting point"), with the aim of reserving most of Loggers East valley floor area for agricultural and commercial purposes.

In Loggers East, most of the valley floor is developed as commercial and agricultural land with one mixed-use building (i.e., "Loggers Centre"). The commercial buildings contain office space, restaurants and retail space, and space was allocated for selling food produced from local farm activities. Residential development on sloped/hilly parcels was added in Loggers East to save valley space for commercial/agricultural land, and this residential area assumed densities similar to the Crumpit Woods neighbourhood (4 units/ha). In Dentville, low-rise buildings were added (along transit corridor) to increase residential capacity, and more parcels were redeveloped in south Dentville using the missing middle residential form. In Garibaldi Estates, more parcels were redeveloped using the missing middle residential form.

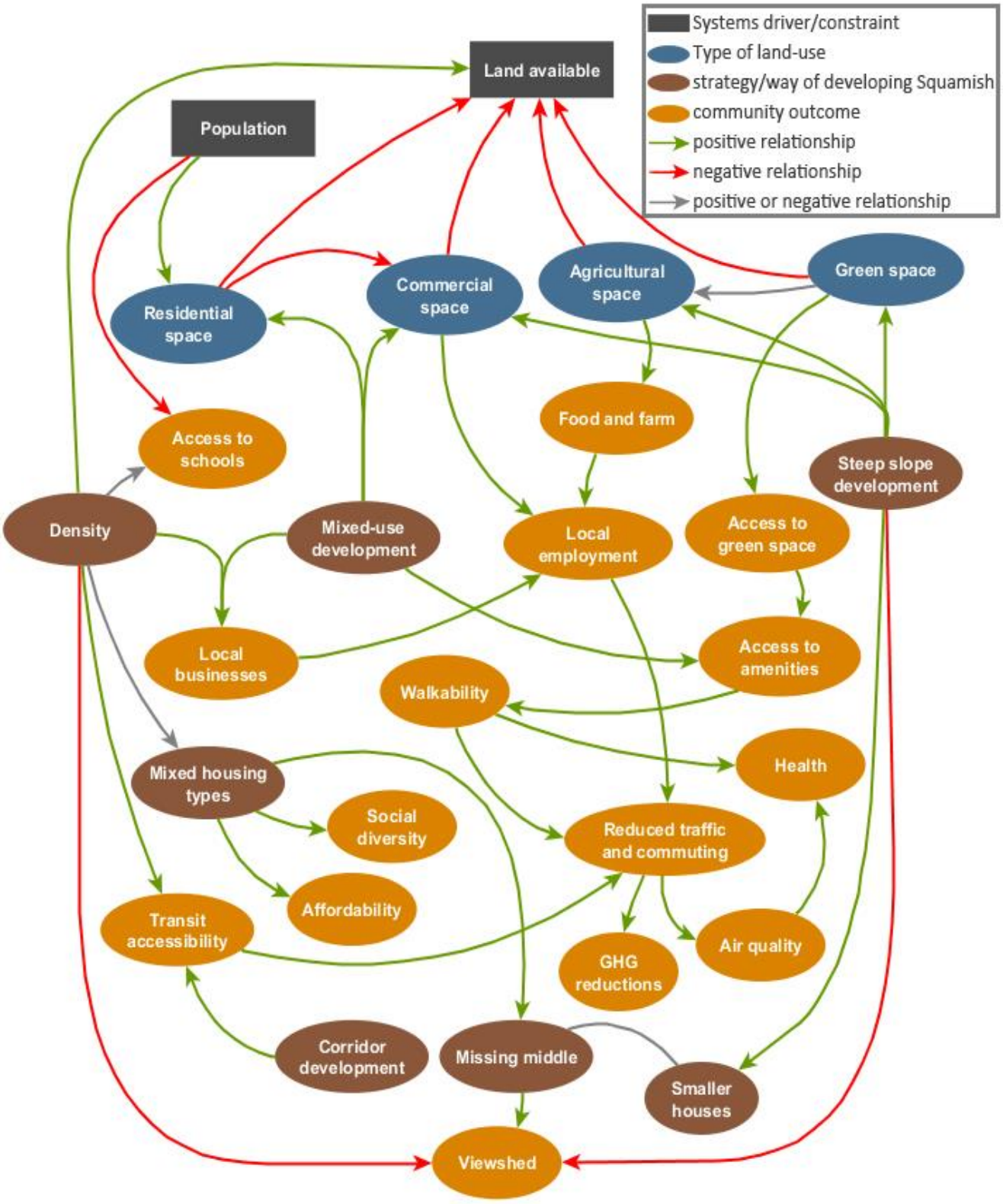
Populations of Squamish and neighbourhoods for different community development scenarios

| Scenario | Squamish | Loggers East | Dentville | Garibaldi Estates | Downtown |
|---|---|---|---|---|---|
| Current baseline | 19,602 | 213 | 1,463 | 1,182 | 2,261 |
| Future baseline | 29,920 | 797 | 1,908 | 1,450 | 8,452 |
| Low density residential | 34,027 | 1,239 | 1,908 | 1,682 | 8,452 |
| Downtown density concentration | 34,051 | 797 | 1,908 | 1,450 | 12,584 |
| High density neighbourhood nodes | 34,050 | 2,368 | 2,368 | 3,088 | 8,452 |
| Missing middle density | 34,029 | 2,409 | 2,355 | 3,421 | 8,452 |
| Increased commercial and agricultural lands | 34,011 | 1,305 | 2,851 | 4,278 | 8,452 |

### *The Systems Model*

As noted above, a systems model was developed based on local government and community stakeholder discussions, and this model provided guidance on what should be measured in a quantitative modelling exercise, particularly the community outcome elements. Through a review of academic and grey literature, a series of potential measurement methods were identified for the various model outcomes. In some cases, the literature did not explicitly identify a particular method for calculating an indicator, rather it served to stimulate thinking about relationships between various aspects of a community and possible ways to quantify these.

Integrated systems model for examining community scenarios




Methods and tools used to calculate community outcomes varied, depending on the outcome. Many of the measurement methods involved calculating walking/biking/driving distances, and thus Network Analyst (ArcGIS) was a tool frequently used in the modelling and analyses.

## Community systems model outcomes and measurement methods

| Community outcome | Measurement methods |
|---|---|
| Walkability | • Distance to green space, schools, health, restaurants, grocery stores, etc., and percentage of population within 400m, 800m, and 1600m[12] of these facilities<br>• Commutes done by walking/cycling based on average distances from residences to employment and availability of local employment |
| Access to green spaces | • Distances from residences to parks and trails (400m, 800m and 1600m)<br>• Percentage of population within distances of parks of various size |
| Access to schools | • Distances from residences to schools (400m, 800m and 1600m)<br>• School space per number of children (calculated by catchment) |
| Preserving natural spaces | • Residential, commercial/industrial and agricultural land encroaching on green space and habitat (i.e., within a 30m buffer)<br>• Residential density near critical habitat and sensitive ecosystems |
| Transit accessibility | • Percentage of population within 400m, 800m, and 1600m of bus stops<br>• Percentage of stops within transit supportive density (50 [people + jobs]/ha[13])<br>• Estimated public transportation ridership based on residential distance to stops |
| Reductions in traffic and commuting | • Estimated change in vehicle kilometers travelled by commuters based on local employment and average distances from residences to employment (calculations incorporate Metro Vancouver and Squamish-Lillooet commutes, and home-based and no-fixed workplace employment) |
| GHG emissions | • $CO_2e$[14] emissions based on vehicle kilometers travelled by commuters (total and per capita values) |
| Air quality | • $PM_{2.5}$[15] emissions based on vehicle kilometers travelled by commuters (total and per capita values) |
| Health | • General metric of health Inferred through walkability and air quality variables |
| Food and farm systems | • Total amount of land reserved for agriculture<br>• Distance from residences to food services (e.g., grocery, restaurants, food education programs, community gardens)<br>• Community garden space available for higher density residents (e.g., apartments, row houses) |
| Local businesses | • Amount of space reserved for commercial/industrial activities<br>• Percentage of local business employees within walkable area (32ha) of 25 to 50 people/ha density (i.e., business viability measurement) |
| Local employment | • Amount of available commercial/industrial space<br>• Number of potential jobs (based on business size and employees per work area estimates)<br>• Percent of population commuting outside of Squamish |
| Social diversity | • A measure of heterogeneity of housing options inferred through the level of diversity in housing types within a neighbourhood (i.e., Simpsons Index) |
| Affordability | • A measure of housing cost inferred through using average prices for different housing types (using 2017/2018 benchmark prices from the Real Estate Board of Greater Vancouver) and mixes of housing types |

[12] These are the distances commonly associated with walkability and consistently used in the literature. The distance of 400m is typically used to represent an easy 5-minute walk, and 800m represents a 10-minute walk.

[13] A hectare (ha) is an area of land equivalent to 100m by 100m or 0.01 $km^2$. It is 2.47 times the size of an acre.

[14] $CO_2e$ is the equivalent carbon dioxide emissions, when normalizing all greenhouse gas emissions to $CO_2$'s warming potential.

[15] $PM_{2.5}$ refers to small particulate matter that is suspended in air and consists of particles with diameters less than 2.5 micrometers. It is an air pollutant related to respiratory health issues.

### *Modelling Outcomes*

The modelling exercise resulted in extensive output, producing a summary table that consisted of over 400 values for each scenario. Listing the entirety of the model output here is not practical; therefore, a sample of these outputs (representing each community outcome) is featured in this report instead.

Overall, High Density Neighbourhood Node development produced distinctly different outcomes than the Low Density Residential scenario, with the other scenarios typically falling somewhere in between. In some cases, High Density Neighbourhood Node outcomes were similar to other scenarios, particularly Increased Commercial and Agricultural Lands. However, what is not featured in this table is the High Density Neighbourhood Node scenario includes a number of high-rise buildings, which results in trade-offs such as impacts to views and community character.

**Sample of scenario modelling output for different community outcomes**

| Community outcome | Community outcome variable (Example of model output) | Low density | Downtown density | Density nodes | Missing middle | Commercial agricultural |
|---|---|---|---|---|---|---|
| Walkability | Population (%) can access four amenities[16] within 400m | 20.8 | 22.0 | 31.2 | 24.8 | 24.6 |
| Access to schools | Student body compared capacity (%) at Squamish Elementary | 261.9 | 350.3 | 310.0 | 298.9 | 277.9 |
| Access to green space | Population (%) within 400m of 10 acres (or greater) parks | 11.9 | 12.4 | 15.4 | 12.3 | 11.5 |
| Preserving natural areas and habitat | Residential pressure on sensitive habitat (people x ha developed within 30m) | 85,609 | 48,750 | 46,838 | 46,131 | 46,380 |
| Transit accessibility | Bus stops (%) within 400m of transit supportive density (50 [people + jobs]/ha) | 5.3 | 5.3 | 15.3 | 10.7 | 12.2 |
| Reduced commuting | Total annual commuted distances (million VKT/year) | 131.7 | 112.5 | 111.1 | 126.6 | 111.2 |
| GHG emissions | $CO_2e$ emissions produced through commuting (t/year) | 34,470 | 29,455 | 29,087 | 33,151 | 29,103 |
| Air quality | $PM_{2.5}$ emissions produced through commuting (kg/year) | 799.5 | 683.2 | 674.6 | 768.9 | 675.0 |
| Health | Commuters walking and biking to work (number of people) | 1,393 | 1,580 | 1,946 | 1,661 | 1,865 |
| Food and farm systems | Community garden space for apartment dwellers ($m^2$/person) | 0.99 | 0.69 | 0.83 | 1.30 | 0.91 |
| Local businesses viability | Local business employees (%) within walkable area (32ha) of 25 people/ha density | 58.1 | 58.1 | 63.1 | 56.9 | 46.3 |
| Local employment | Home-based and locally employed residents (people) | 10,873 | 12,098 | 12,070 | 11,047 | 12,069 |
| Social diversity | Diversity of housing types (Simpson Index) | 0.57 | 0.59 | 0.60 | 0.65 | 0.64 |
| Affordability | Average price for dwelling based on 2017/2018 values ($) | 793,873 | 736,047 | 722,162 | 773,469 | 766,912 |

[16] Nine amenities were considered: restaurants/cafes, retail (non-food), health, social and mental health, exercise, childcare, grocery, parks and trails, and elementary schools.

## SCENARIO MODELLING FOCUS GROUP

In October 2018, a focus group of local government and community stakeholders (representing a diversity of interests and sectors) was held to gain feedback on the modelling exercise. Some participants were involved in the previous focus group session and some were new to the project. The session began with background information on the project and the scenario modelling process and an overview of the model outcomes. The group then engaged in discussion guided by the following questions:

- *Do the scenarios represent plausible futures for Squamish? Are there any changes to the scenarios that would be worth exploring?*
- *What information produced from the model do you find most useful for understanding and thinking about the implications of Squamish developing in a certain way?*
- *Are there any model outcomes that find to be confusing and/or not informative?*
- *Is there anything missing from the model that you feel would increase its usefulness?*
- *What areas of Squamish should the visualization focus on? As a visualization user, where would you like be located to "walk" and "look" around within the scenarios?*

Following the focus group, further feedback was obtained through meetings with the District of Squamish's Community Planning and Infrastructure Department and BC Transit. Through analysis of feedback forms, researcher notes and group discussions transcripts, several themes with important implications for refining and using the model as a tool for public engagement and planning were identified. Noteworthy outcomes are as follows:

*Rethink what density means in terms of building heights* – The mixed-use developments modelled in the High Density Neighbourhood Nodes and Downtown Density Concentration scenarios involved buildings that were 8 to 10 storeys tall. Such building heights were noted to be incongruous with the Squamish's "small-town character" and likely would be considered unacceptable by the community. In some ways, this could be regarded as a trade-off from the benefits received from densification; however, the lack of acceptability also reduces the plausibility of the high-density scenarios. To make the scenarios more relevant to Squamish, building heights should not exceed 6 storeys.

*Redesign the low-density scenario with a different sprawl pattern* – An interest in exploring a scenario with poor growth management was expressed. It was recognized that the Low Density Residential scenario relates poor growth management; however, in reality, the growth patterns would differ from what is currently modelled. The Low Density Residential sprawl extends upward through Paradise Valley, and it was noted that such growth in the floodplain is unlikely. Instead, modelling sprawl in areas north and east from Garibaldi Highlands, Loggers East and Valleycliffe would make for a more realistic scenario.

*Combine the high-density scenarios to create a single "density node" scenario* – Several comments indicated that combining scenarios would be desirable, particularly Downtown Density Concentration and High Density Neighbourhood Nodes. As all the scenarios build on the Future Baseline, each includes some level of downtown densification. Downtown will be a major focus for development and planning and neighbourhoods plans will be developed for locations throughout Squamish, so a combined scenario could be highly relevant to Squamish's planning needs.

*Incorporate conservation and ecological values* – A frequent topic of discussion in the focus group was how the model underrepresented ecological concerns and conservation values. Currently, the model captures encroachment on sensitive habitat by calculate area developed within a 30m buffer of this habitat; however, it was suggested that such a buffer could be inadequate for protecting certain types of habitats and species. In addition, the encroachment metric is relatively simple, and it does not differentiate between different types of habitats or account for ecological connectivity. Comments indicated that scenarios should incorporate relevant key ecological features and conservation projects, such as the riparian corridor running through Dentville and the Mamquam Reunion Project work in the Loggers East neighbourhood.

Other suggestions from the focus group included incorporating certain ecological services into the model. It was noted that consideration should be given to how the scenarios can impact hydrological features of the community, such as groundwater, stormwater management and flood control. Another suggestion was for the model to calculate loss or retention of natural carbon sinks in different scenarios, and that these values could be quantified in addition to calculating vehicle-related GHG emissions.

*Incorporate climate adaptation into the model* – Some of the focus group feedback referred to climate adaptation planning, including comments on flood and wildfire management. The model outcomes do not explicitly contain measures for climate resilience; however, the modelling process involved developing scenarios at a fine-grained spatial resolution and thus scenarios can be built with adaptation considerations in mind. For example, flood management considerations can be taken into account by mapping development in sloped/hilly areas (and this can take medium residential density form to increase residential capacity outside the floodplain) Similarly, scenario maps could be examined to identify urban-forest interface areas that present potential wildfire concerns.

*Add more planned or "likely" infrastructure* – Scenario development involved adding new buildings, roads and transit lines; however, it was noted that the further infrastructure could be added to better represent likely future conditions in Squamish. For example, transit lines could be added or extended in order to service high growth areas, such as the Oceanfront neighbourhood, Waterfront Landing and Scotts Crescent. As another example, more schools could be added to the scenarios to reflect plans for developing new schools within the District of Squamish.

*Consider how technological and economic trends may influence community outcomes* – The modelling exercise projects two decades into the future, and it was noted that certain trends may affect the estimated outcomes. Examples discussed include increased car efficiency resulting in reduced emissions, automated business processes requiring fewer workers in a company, and gentrification and housing market trends leading to increased housing prices. It is difficult to incorporate these factors in the model. In many cases these will affect outcomes of all the scenarios relatively equally (e.g., auto efficiency will reduce GHGs for all scenarios) and thus the scenarios can still be compared to one another. However, in other cases, some local trends will affect certain scenarios more than others, for example, a downtown densification trend could result in parking fees, which in turn could encourage transit ridership. In these cases, it is worthwhile to consider how certain development patterns may augment or diminish model outcomes in ways not experienced with other development patterns.

*Link the model to the Squamish's Official Community Plan* – Another of topic of discussion was the possibility of linking the model to indicators and targets identified through Squamish's Official Community Plan (OCP).[17] Doing such would increase the relevance of the model to the community's planning goals and needs. Although the model does not comprehensively capture the indicator set presented through the OCP, many of the modelling outcomes are related to OCP targets. Thus, opportunities exist for illustrating model-OCP linkages when communicating model outcomes to community members.

Related to the discussion on the model's relevance to the OCP were questions/comments about "weighting" or putting different values on model outcomes when using this tool for planning and decision-making. The purpose of the model is to communicate and quantify implications of developing Squamish in certain ways, and not to provide recommendations for any specific development path. To add weights/values to particular model outcomes, modelling output could be compared with Squamish documents and plans (such as the OCP) in order to determine which development directions provide (what the community considers to be) essential benefits and acceptable trade-offs.

*Communicate model assumptions and outcomes more clearly* – The scenario modelling involved plethora of calculations and produced extensive output. Therefore, even in a 2-hour session it is difficult to get a complete impression of how the work was done and what the main findings were. This was noted in the focus group with comments indicating that it is was challenging to get a clear sense of all the assumptions and inputs used create the model. Such comments suggest that a method is needed to better communicate the model's assumptions, method and results. Even in cases where certain information was made available during the focus group, recommendations were made for presenting this

[17] District of Squamish (2017). Squamish 2040: Official Community Plan Schedule "A". Bylaw 2500. https://issuu.com/squamish/docs/ocp_dec_1_first_reading

information in different formats to better communicate to model users (e.g., a single table that displays local populations of each neighbourhood for all different scenarios). Documents such as this report can provide clarity on the modelling process and outcomes; however, many model users may not wish to spend time reading reports of this length.

In addition to communications on assumptions and inputs, recommendations were made for more clearly communicating the modelling results and outcomes. This discussion included ideas such as better illustrating what factors lead to significant variation in the outcomes, as well as considering different metrics for the output (e.g., a "walkability index" can be used to complement the access to amenities outcomes). These recommendations also provide rationale for decreasing the number of scenarios that are modeled/quantified.

*Illustrate the key differences between development directions* – Some of the focus group discussion centered on how outcomes of the different scenarios were similar in value and could be considered qualitatively the same. This was in part due to how all the scenarios incorporated currently planned development. After accommodating part of the projected population growth with the planned development, only approximately 4,100 people (12% of the population) remained, resulting in only subtle changes for some of the community scenario outcomes. Suggestions were made for altering the scenarios in order to trigger more dramatic differences (e.g., scenario with all local employment versus a scenario with all workers commuting to Metro-Vancouver), as well as playing with the scenario characteristics to see what would result in larger changes (e.g., reduction in single occupancy vehicles). The changes in sprawl patterns for the Low Density Residential scenario and also the combination of the high-density scenarios (noted above) may result in more dramatic differences and address this comment.

It is worth recognizing that in some cases, the lack of significant differences in the modelling results is a function of how the outcomes were presented. Some metrics are more illuminating (and useful) than others, for example, walking/cycling commuting outcomes are better represented as percentages of all regular commutes rather than percentages of the entire workforce. In addition, certain types of development patterns very well could lead to similar outcomes (which in itself can be a useful finding), and in these cases, simply highlighting areas where differences are observed could be valuable.

*Consider what community development scenarios mean when implemented on the ground* – Showing the extent of neighbourhood redevelopment in some of the scenarios was found to be highly useful, and it was commented that some of the maps were "shocking" in this regard. Some of the scenarios could be considered quite controversial because they could be viewed as mass conversions of infrastructure in neighbourhoods where people have had homes for many years. In recognition of this issue, it was noted that these scenarios should be considered more as zoning projections and possible changes over a significant period of time. Also, scenarios such as those with missing middle development could be considered an exercise in exploring infill potential.

When presenting model outcomes to the public, it important to express that the modelling exercise should be understood as a zoning projection, rather than a plan to convert current infrastructure. Redevelopment areas in map-based visuals should be roughly outlined rather than identifying specific parcels, as to avoid suggesting that specific lots are targeted for development/redevelopment. Challenges will still exist for the visualization process because this will involve changing the building types in specific areas as different scenarios are toggled on and off; however, exploring such challenges is an objective of this research effort. These comments also speak to the importance of clarifying to participants that this is an independent research effort and not a District-led planning initiative.

## MODEL REFINEMENT AND VISUALIZATION

The next stages of the project will involve using the feedback from the October 2018 focus group session (and related meetings) to refine the model, create a user interface for exploring model outcomes, and develop visualizations of the scenarios. The following sections outline specific plans for each of these activities.

### *Model Refinement*

The scenarios will be refined (and rerun) to better reflect desired development directions and plausible Squamish futures. The Downtown Density Concentration scenario will be integrated into the High Density Neighbourhood Nodes scenario, which will involve further densification of the downtown area. In addition, the high-density scenario will no longer contain buildings that exceed 6 storeys, but instead involve development that follows a density gradient. Currently, the model assumes only 50% of a parcel will be developed for high-density buildings; thus, some flexibility exists for incorporating a variety of building types that result in similar overall densities. The Low Density Residential scenario will also be refined; it will no longer involve development in Paradise Valley, and instead, will consist of northeastward sprawl. In addition, in effort to simplify the model output, the Increased Commercial and Agricultural Lands scenario may be removed, and instead, “increased commercial” will be captured in High Density Neighbourhood Nodes and “increased agriculture” will be incorporated into Missing Middle Medium Density.

Ecological concerns and conservation values will be more significantly incorporated into the model. The scenarios will be updated to include buffer space in Loggers East for freshwater habitat and the Mamquam Reunion Project, and increased hillside development to accommodate more residents in places other than valley floors (which also aligns with many climate adaptation interests). In addition, the buffer size for sensitive habitat encroachment analysis will potentially be increased (extending beyond 30m), and differentiation between habitat types will be considered. Finally, the possibility of calculating for loss and/or preservation of carbon sinks will be explored.

The model will also include new infrastructure. Elementary schools will be added to the scenarios[18], and student capacities will be attributed to these schools based on the average capacity of all other Squamish elementary schools. In addition, downtown transit lines will be extended to the Oceanfront area, and the Valleycliffe bus route will be altered to service Waterfront Landing and Scotts Crescent (and run twice as frequently).

### *User Interface*

An online user interface for exploring the model outcomes will be developed, and it will be built as an interactive HTML5-based tool in a similar manner to Surrey's Sustainability Dashboard[19] or Winnipeg's Peg[20] community indicator system interface. Users will be able to click buttons to see maps of the scenarios, the systems models, information on the scenarios and model variables, and outcomes from the scenario modelling exercise. As per the feedback on the model, the map-view of the scenarios will outline general areas for redevelopment rather than specific parcels.

The purpose of creating the user interface is three-fold:

1. Firstly, the interface will vastly improve people's ability to explore and understand the model, as well as the implications of the outcomes. Information on the model's methods, assumptions and limitations can be included in the interactive tool, and key differences in scenario outcomes can be highlighted and brought to a user's attention.

2. Secondly, a series of other potential benefits, trade-offs and/or concerns associated with the scenarios can be presented as qualitative modelling outcomes. This will allow for better incorporation of community feedback, and considerations/concerns such as wildfire risks, impacts to particular habitats, traffic congestion, social benefits of community spaces, etc. can be presented with the different scenarios.

3. Thirdly, the user interface can illustrate linkages between the model and Squamish's OCP by listing the OCP indicators/targets that are relevant to the various model outcomes.

### *Visualization*

The final discussion question of the focus group solicited suggestions for where the visualization should focus. The Lead Researcher initially suggested the visualization could provide a view from the Squamish Chief looking over the community and from within the Loggers East

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[18] Locations for future schools were identified in the focus group, and these included sites in the Cheema Lands (north of Garibaldi Highlands), Cheekeye, and the Quest University area. Maps from School District No. 48 indicate future schools could be located in Paradise Valley, the Cheekeye Fan, and near the Cheekye Ranch. The researchers will consult with School District No. 48 before adding more schools to the scenarios to ensure that these additions represent likely future developments.

[19] City of Surrey (n.d.). Sustainability dashboard [*website*]. http://dashboard.surrey.ca

[20] United Way Winnipeg and the International Institute for Sustainable Development (IISD). Peg: Tracking progress, inspiring action [website]. https://www.mypeg.ca

neighbourhood. However, it was recommended not to pursue the Chief-view idea because it would require vertical exaggerations to clearly see differences between scenarios and it may not lead to meaningful insights regarding how people will respond to certain development approaches. The discussion then turned to visualization the three neighbourhoods, and each was noted to have particular advantages. These advantages are as follows:

- Garibaldi Estates – The proximity of this neighbourhood to commercial areas positions it as a suitable neighbourhood for increasing density. It currently consists of low density residential, but it could potentially go through a rezoning process.
- Loggers East – The changes in this neighbourhood depicted through the scenarios are dramatic. In addition, development in the area involves important ecological concerns that are not present in Garibaldi Estates.
- Dentville – This neighbourhood is currently a fairly quiet place to live and is next to ecological sensitive riparian area, and densification can significantly impact these local features/characteristics.

Ideally, visualizations would be created for all three neighbourhoods; however, this may not be feasible due to time and capacity limitations. Instead, the visualization exercise will first focus on Garibaldi Estates due to the real possibility of zoning changes and densification within the neighbourhood. Time permitted, a Loggers East or Dentville site will be included in the visualization after the Garibaldi Estates visualization has been completed. Regardless of which neighbourhood is visualized, users will be provided access to the online model interface in order to be able to understand the full implications of a particular scenario.

Other suggestions for visualization included selecting vantage points from downtown or the estuary to determine impacts to the viewshed. The visualization will focus on a neighbourhood outside of downtown, largely because substantial development has already been approved and thus the future od downtown is unlikely to vary significantly between the scenarios. As mountainscape views are accessible throughout Squamish, users will still be able to assess viewshed impacts of densification. Suggestions were also made to include traffic and noise pollution within the visualization/model, and this will be done by incorporating animation and sound into the visualization tool.

It is anticipated that the refinement of the model and development of the online interface will be completed by May 2019. The visualization will be developed throughout the spring and summer, and its expected completion date is in September 2019. After the visualization is developed, a final focus group will be held in October 2019, where participants will interact with and assess the visualization. In November 2019, a public open house event will be held where community members can learn about the project, interact with the model interface and visualization, and provide feedback on these tools.