Terrace Population Survey and Projections

Prepared by:
Hannes Edinger, Economist
Big River Analytics
4795 Merkley Rd.
Terrace, B.C.
V8G 0B5
250.922.4999
hannes@bigriveranalytics.com
www.bigriveranalytics.com

Table of Contents

Executive Summary 3
Background 4
City of Terrace Population Survey 5
Population Projections 2015-2025 8
    Scenarios 14
        Scenario 1 - Low Economic Development 14
        Scenario 2 - Medium Economic Development 16
        Scenario 3 - High Economic Development 19
        Long-Run Projections 22
        Discussion 23
Works Cited 24
Appendix - Detailed Assumptions 25

Executive Summary

The City of Terrace is in the process of updating their Official Community Plan (OCP). Several indicators suggest that Terrace's population has grown since the last official count in the 2011 Census. Growth indicators include upward pressure in the residential real estate market both for rentals and purchased homes and an increase in the number of issued building permits. The City requires a baseline population estimate that reflects this new growth along with population projections that anticipate future growth as part of the updated OCP. The City conducted a population survey in September 2015 to obtain the required baseline population estimate. The 2015 population estimate was then used to inform a set of population projections based on three possible future development scenarios. This report provides the results of the 2015 population survey along with summaries of the population projections under three development scenarios.

The total population estimate for the City of Terrace as of September 10th, 2015 is 12,494 people. This total is comprised of 11,948 usual residents (people whose primary residence is in Terrace, and who were living or staying in Terrace on September 10th, 2015), and a shadow population of 546 (comprised of people whose primary residence is elsewhere, but who were living or staying in Terrace on September 10th, 2015). A stratified sample of 307 households was produced utilizing the City's tax-roll database and a total of 295 responses were received, a response rate of 96%. The margin of error for the total population estimate is +/- 6%, 19 times out of 20.

The 2015 baseline population estimate is utilized as a starting point for all three population projections. Three potential development scenarios are defined for the projections:

- Low - a single manufacturing facility is built at the Skeena Industrial Development Park, and regional economic activity persists at its current level.
- Medium - a total of ten manufacturing facilities are built at the Skeena Industrial Development Park, three regional mines proceed, and two LNG facilities with associated pipelines proceed, one in Kitimat and one in Prince Rupert.
- High - a total of thirty manufacturing facilities are built at the Skeena Industrial Development Park, three regional mines proceed, and five LNG facilities with associated pipelines proceed.

The scenarios produce the following projection results:

- Under the assumptions of the low development scenario, the population of Terrace increases to 13,079 people by 2020, and to 13,181 by 2025. The trajectory is always increasing for the entire ten-year projection horizon.
- Under the assumptions of the medium scenario, Terrace's population increases quickly to 17,899 people in 2020 before declining slightly to 17,714 people in 2021 following the regional economic boom attributable to the construction of nearby mega-projects. The medium development scenario sees the population of Terrace resume growth after 2022 to 19,363 people in 2025.

- Under the assumptions of the high development scenario, Terrace's population increases to 23,098 people in 2020, and ultimately reaches 27,889 people in 2025.
- Long-run growth projections do not include a migration component beyond 2025. Long-run projections show a slightly declining population trend after 2025 as the working age population attracted to Terrace in the 2015-2025 period begins to age.

Background

The latest official population count for usual residents in the City of Terrace comes from the 2011 Census of the Population conducted by Statistics Canada. The 2011 Census estimated the total number of usual residents in the City of Terrace at 11,486, up 1.5% from the 2006 estimate at 11,320 (Statistics Canada, 2012). Between 2011 and 2015 Terrace has experienced economic and demographic growth at least partially attributable to the construction of the Northwest Transmission line 2012, spillover economic activity from the 2011-2015 Kitimat Modernization Project, an upswing in the local forestry economy, pipeline preparations, amenity migration attracting adventurists and outdoors enthusiasts, and speculation related to proposed forthcoming Liquified Natural Gas development (Hoekstra, 2013).

BC Stats produces annual intercensal population estimates for municipalities, which are the official population estimates used at the provincial level. The intercensal estimates for the City of Terrace start at 11,688 in 2011 and decline to 11,265 in 2014, a drop of just under 4% (BC Stats, 2015). The population decline reported by BC Stats does not reflect day-to-day activity in the City or the experiences of its residents. Reports from citizens and business owners suggest increasing activity in Terrace with associated upward pressure on City services, infrastructure, and housing markets. When the changes in the daily experiences of Terrace citizens are considered along with the appreciable increase in economic activity in the northwest BC region, the population decline reported by BC Stats becomes unlikely. Assertions of increased economic activity and demographic growth in Terrace are supported by an upswing in demand and prices for housing both in the rental and sale markets. The Canadian Mortgage and Housing Corporation (CMHC) statistics related to rental demand in Terrace support the experiences of locals. Specifically, Terrace went from having vacancy rates above the provincial average in 2011 (between 3% and 5%, depending on housing type) to vacancy rates at or near zero by 2012. As demand for rental housing in Terrace increased in 2012 the prices for rental units surged. Between 2011 and 2013 prices for rental units increased by a range of 2.2% to 4.8% depending on housing type (CMHC RMR, 2013). The Terrace rental market has since experienced a recovery in terms of vacancy rates, as reported vacancy rates for the 2014-2015 period approach the provincial average (CMHC RMR, 2015). Over the same 2011-2015 period, the BC Northern Real Estate Board reports that the median price of a home in Terrace increased just under 50% from $200,000 to just under $300,000 (BC NREB, 2015). Housing starts in Terrace are up over 250% in 2014 (101 housing starts), as compared to 2013 (28 housing starts) (BC Stats, 2015).

In response to the apparent discrepancy between the declining provincial estimate of Terrace's population and the demographic growth suggested by signals in the housing markets the City decided to conduct an independent population survey in 2015.
The 2015 survey estimates the current population of the City of Terrace, comprised of usual residents and people who are living or staying in Terrace who have a usual residence elsewhere (as of 10 September 2015). The 2015 estimate will serve as a baseline population for the updating of the Official Community Plan (OCP). Further, the City is interested in the projected growth of the community under a set of "low, medium, and high" development scenarios related to local and nearby industrial development. This report presents the results of the 2015 City of Terrace Population Survey along with the details of 10 year projected growth patterns under each of three different potential development scenarios.

City of Terrace Population Survey

Overview and Results

A stratified random sample consisting of 307 addresses in Terrace was utilized to estimate the total population including usual residents and people living or staying in Terrace on September 10th, 2015 who have a usual residence elsewhere. A total of 295 responses were collected during the two-week enumeration period from September 10th - 22nd yielding a response rate of 96%. The estimate for the total population of the City of Terrace as of 10 September 2015 is 12,494 people. The constituent populations that comprise the total population are presented in Table 1[1].

[1] Note that the primary objective of the study is to estimate the *total* population of Terrace, the sample size was calculated to ensure a level of precision for the total population that is at least +/- 10%, 19 times out of 20. The estimates of the "Soft Shadow", and "Hard Shadow" populations are less precise because they are relatively rare, and it would require a much larger sample to identify those estimates with a higher degree of precision.

Table 1 - Estimates of Terrace's population and its components

Estimate	Usual Residents	Soft Shadow[2]	Hard Shadow[3]	Total[4]
Mean	11,948	244	302	12,494
Lower Confidence Limit	11,449	145	103	11,698
Upper Confidence Limit	12,445	342	500	13,288

The results shown above are in contrast to the most recent (2014) official estimate from BC Stats of 11,265 people. The population estimates presented by BC Stats are based on Census estimates so the "usual residents" definition should be applied in the comparison to Terrace's population survey. A comparison of usual residents shows that Terrace's current population is estimated to be a full 6% higher than the most recent estimate produced by BC Stats. The total population of Terrace, including people who have a usual residence elsewhere is 11% higher than the latest BC Stats estimate. The results of the 2015 City of Terrace Population Survey suggest, in alignment with other indicators, that the population of the City has grown since the last Census in 2011 by an estimated 4%.

Producing the Sample

The 2015 City of Terrace Population Survey utilized the City's tax-roll database to produce a frame that includes all documented residential addresses in the City of Terrace. Administrative data available from the City was then used to identify the appropriate housing type category for each address. Each address was assigned one of three housing type categories: multiplex/townhouse, single family dwelling, or apartment.

With the survey frame in hand, a stratified random sample was generated utilizing housing type as the stratification dimension. Taking a cautionary approach to managing for precision, sample size was calculated based on an unstratified design, ensuring that identified precision objectives (+/- 10%, 19 times out of 20) would be met under a stratified approach. Stratified sampling is a variability reduction technique that increases the efficiency of data collection. A properly stratified sample will reduce the required sample size for a given level of precision. The total sample size was allocated between the three strata (housing type categories). Optimal

[2] "Soft Shadow" population consists of people who are living or staying in Terrace, who have a usual residence elsewhere who have not worked 30 or more days in the greater City of Terrace area in the past year.

[3] "Hard Shadow" population consists of people who are living or staying in Terrace, who have a usual residence elsewhere who have worked 30 or more days in the greater City of Terrace area in the past year. This definition is adapted from the Regional Municipality of Wood Buffalo.

[4] These total estimates are adjusted to reflect undocumented suites. The midpoint of the estimated 75 to 125 undocumented suites is utilized (100). The density of apartments is utilized to estimate the number of people living in undocumented suites (1.44), for a total of 144 individuals living in undocumented suites. These individuals are allocated according the the respective sample proportions of the population types: usual residents, soft shadow, and hard shadow. No accounting for the uncertainty of this population is included, and the upper and lower confidence limits reflect only sampling uncertainty.

allocation in a stratified sample design is the allocation that minimizes the sample variance for a given sample size (Patterson, 2015). Optimal allocation in Terrace's sample was achieved by allocating a larger proportion of the total sample to strata within which higher variance was expected, and allocating a smaller proportion of the total sample to strata within which lower variance was expected. Expectations of relative variance among the three housing type strata were informed by the results of prior Canadian demographic research.

Enumeration

Enumeration took place between September 10th and 22nd, 2015. A total of 5 enumerators were assigned specific catchment areas within City limits. Enumerators were responsible for surveying sampled households within their assigned catchment areas. In general, participation in the survey was very high with a refusal rate of just over 1%. The balance (3%) of unsuccessfully enumerated residences that were unable to be contacted despite multiple visits. The high response rate to the 2015 City of Terrace Population Survey is likely due to the low response burden associated with answering the questionnaire. The questionnaire was intentionally kept short (2 - 4 questions), in an effort to increase the likelihood of participation by sampled households.

Questionnaire

The questionnaire consisted of up to four questions:

1. "How many people are living or staying at this address as of September 10th 2015, even temporarily, including children and infants?"
2. "Is this the usual place of residence for all of the people identified in Question 1?"
3. (if no) "For how many people is this address NOT their usual place of residence?"
4. "How many of the people, for whom this is NOT their usual residence, have worked in the greater City of Terrace area[5] for more than 30 days in the past calendar year?"

The data collected from sampled households based on the questionnaire and associated definitions was analyzed and used to complete the population estimates for the City of Terrace presented in Table 1. Specifically, the total population is calculated by including all people recorded in Question 1, individuals living or staying in Terrace as of 10 September 2015. The 'Soft Shadow' population is estimated by computing the number of people identified in Question 3, minus the number of people listed in Question 4; that is, the number of people living or staying in Terrace who have a usual residence outside of Terrace and who have not worked 30 days in the Greater City of Terrace Area over the past year. The 'Hard Shadow' population is determined by calculating the number of people identified in Question 4; that is, the number of people living or staying in Terrace who have a usual residence outside of Terrace and who have worked 30 or more days in the Greater City of Terrace Area over the past year.

[5] The Greater City of Terrace area includes the operational catchment area of Terrace and area businesses, so long as the person was staying in, and working out of Terrace.

Population Projections 2015-2025

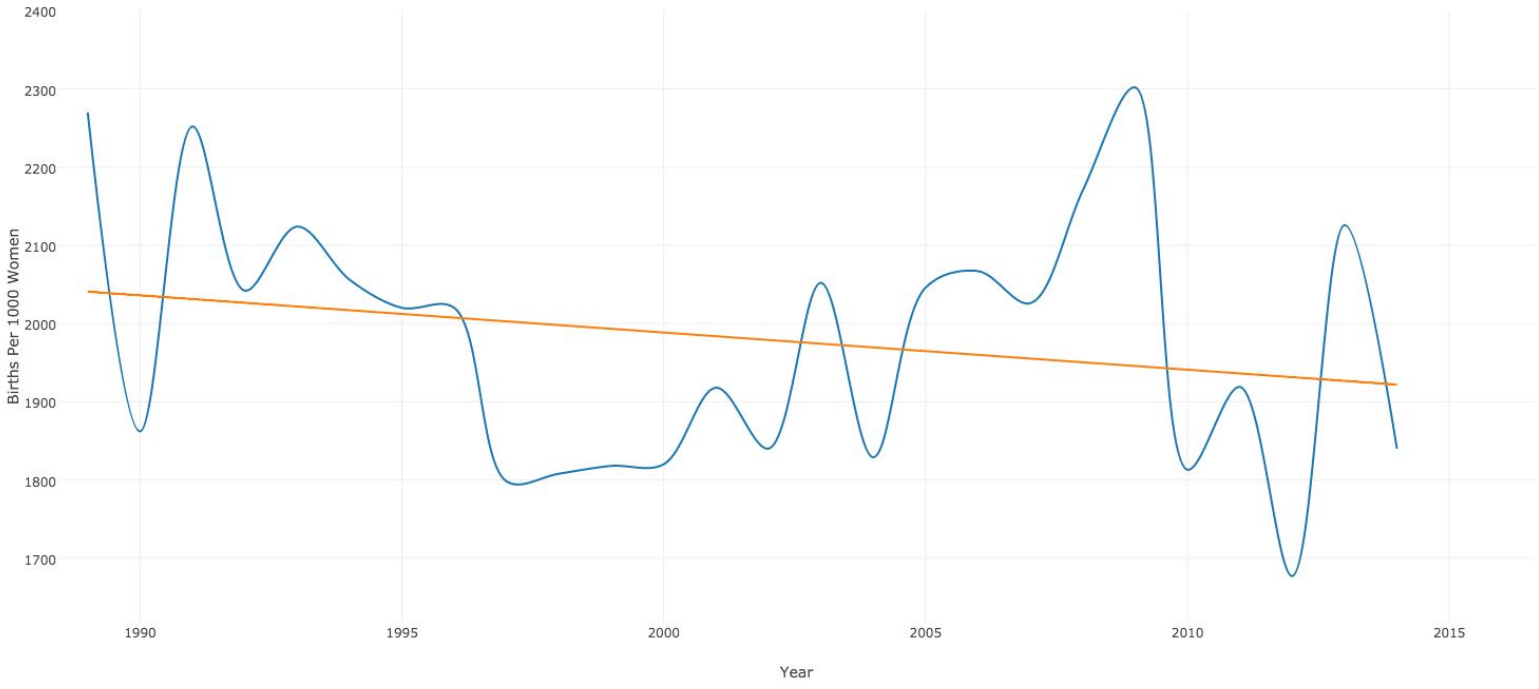
Overview

Population projections were produced for the City of Terrace consisting of two distinct components: natural change, (the result of births and deaths), and migration. Migration is generally included as a component of natural change, though here it is given a separate treatment because we allow migration to vary as a function of the three identified potential development scenarios: low, medium, and high. Total net migration in the Regional District of Kitimat-Stikine, of which Terrace is a constituent community, is presently near zero (BC Stats, 2015). Under the framework of the 2015 City of Terrace population projections migration is assumed to be a function of economic activity; that is, in-migration and out-migration are driven by local and regional economic growth. Net positive migration is assumed to be a function of increases in local and regional economic activity while net negative migration is assumed to be a result of decreases in local and regional economic activity. The current trend toward net-zero migration sets a convenient baseline for the 2015 population projections, which consider future migration as a function of different levels of economic growth.

Baseline Projections - Births and Deaths

A modified version of the Stochastic Cohort Component Model (S-CCM) produced by Edinger (2012) that produces pure Cohort Component Model projections has been implemented to keep the interpretation of the results simple. The data used to inform the baseline projection are sourced from BC Stats and Statistics Canada. Figure 1 shows both the variability and the long, steady decline in the number of births per thousand women in Terrace over the past 20 years. Figure 1 also shows that Terrace's birth rate is presently below the level required for replacement (2100 births per thousand women), so if current trends persist, long run growth in the community must come from migration.

Figure 1: Terrace Births Per 1000 Women 1989-2014



For the Cohort Component Model (CCM) projections, two components related to fertility are included in the model. The first is the Total Fertility Rate (TFR), or proportionately, the number of births per 1000 women. The second is the Tempo Of Fertility, the rate at which women have children over the course of their lifetime. The Tempo Of Fertility is modeled as a density function that assigns a probability of giving birth to each age cohort, in our case, to each year of a woman's life.

Figure 2: Age Specific Fertility for Terrace, 1989-2014

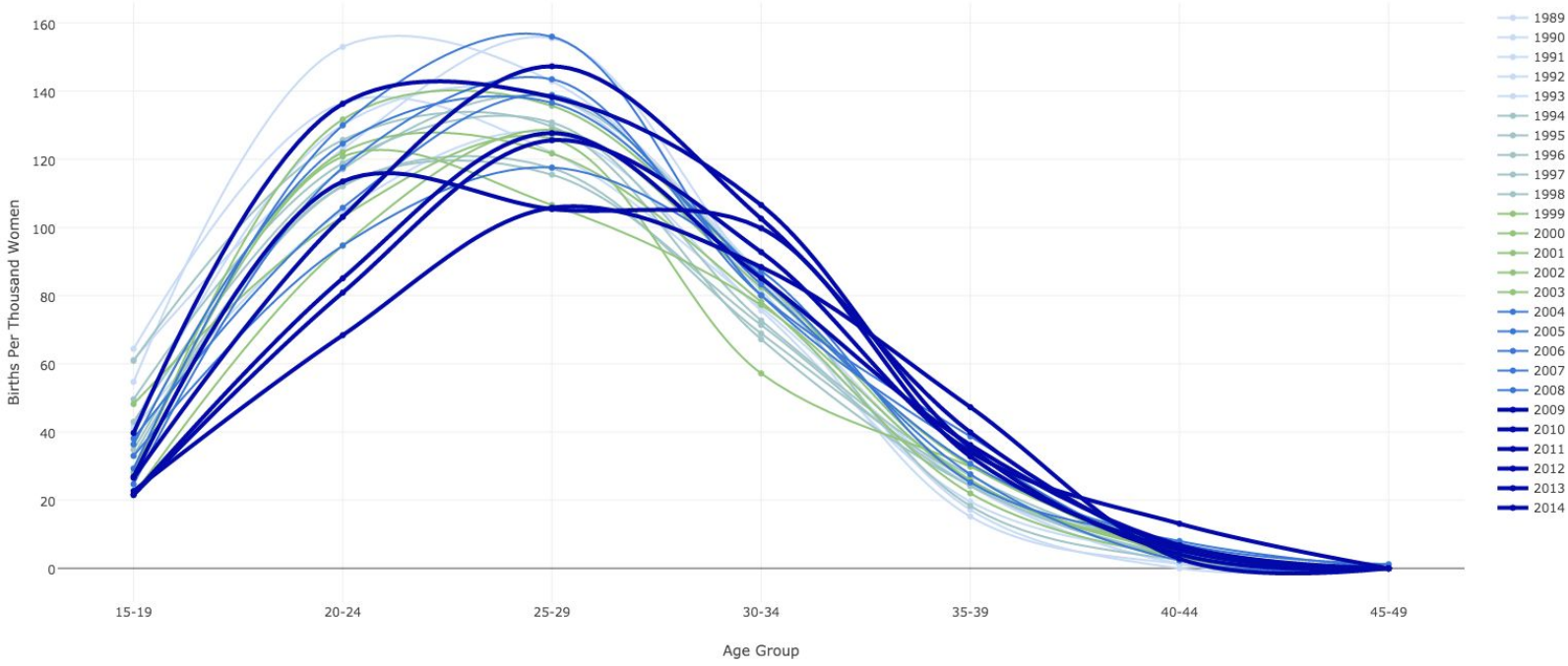


Figure 2, Age Specific Fertility for Terrace, 1989-2014 depicts a trend toward fertility being pushed later in life. Due to the short time horizon (10 years) of the projection, we apply the average age specific fertility rate from the past 5 years (2010-2014) throughout the projection. These most recent 6 years are shown in the darker, thicker lines.

Mortality is treated in a similar way to fertility though instead of the TFR, life expectancy at birth is used, and instead of the Tempo Of Fertility, a life table that assigns a probability of surviving into the subsequent year at any given age is employed. Figure 3 shows life expectancy at birth increasing on average both in Terrace and British Columbia as a whole. Figure 4 shows survival probabilities by gender for each age; this can be considered the Tempo Of Mortality.

The information related to mortality and fertility is combined with migration to produce the 2015 population projections for the City of Terrace.

Figure 3: Life Expectancy at Birth in Terrace, and BC 1992-2014

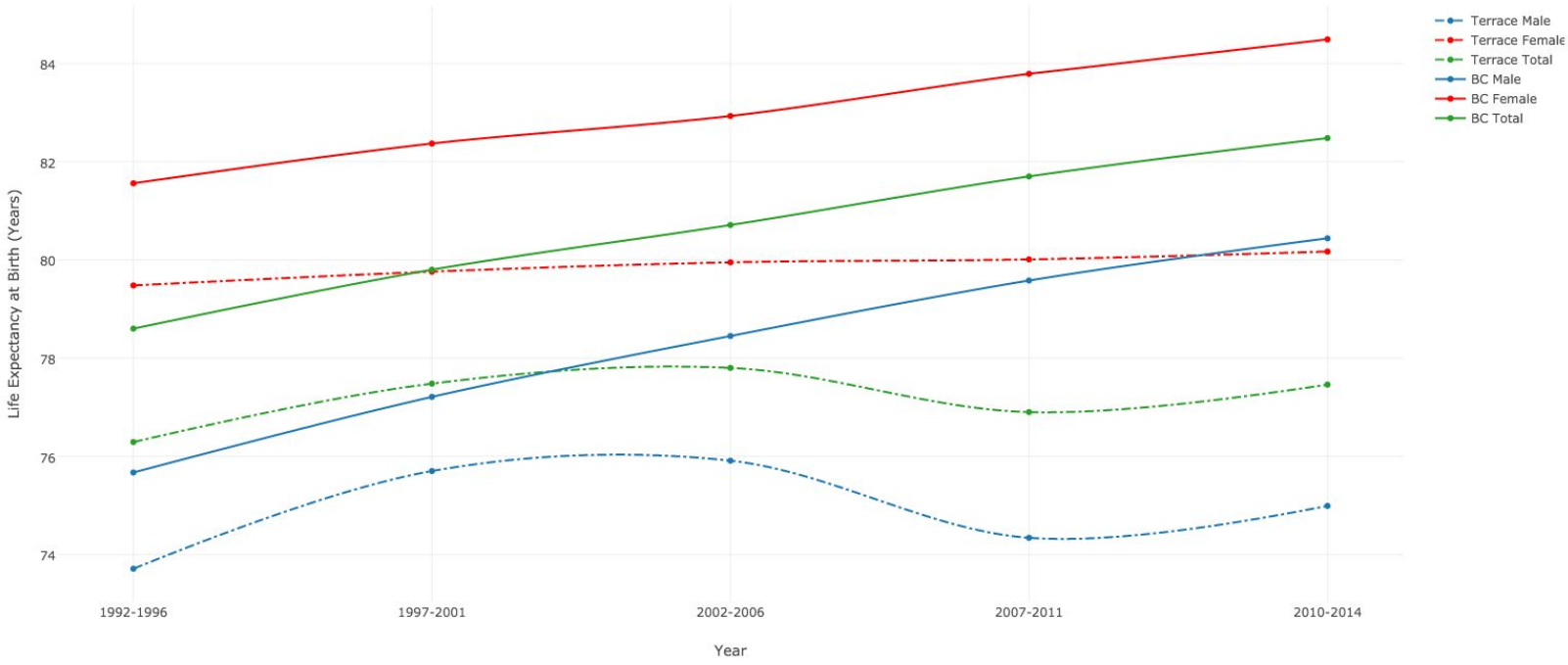
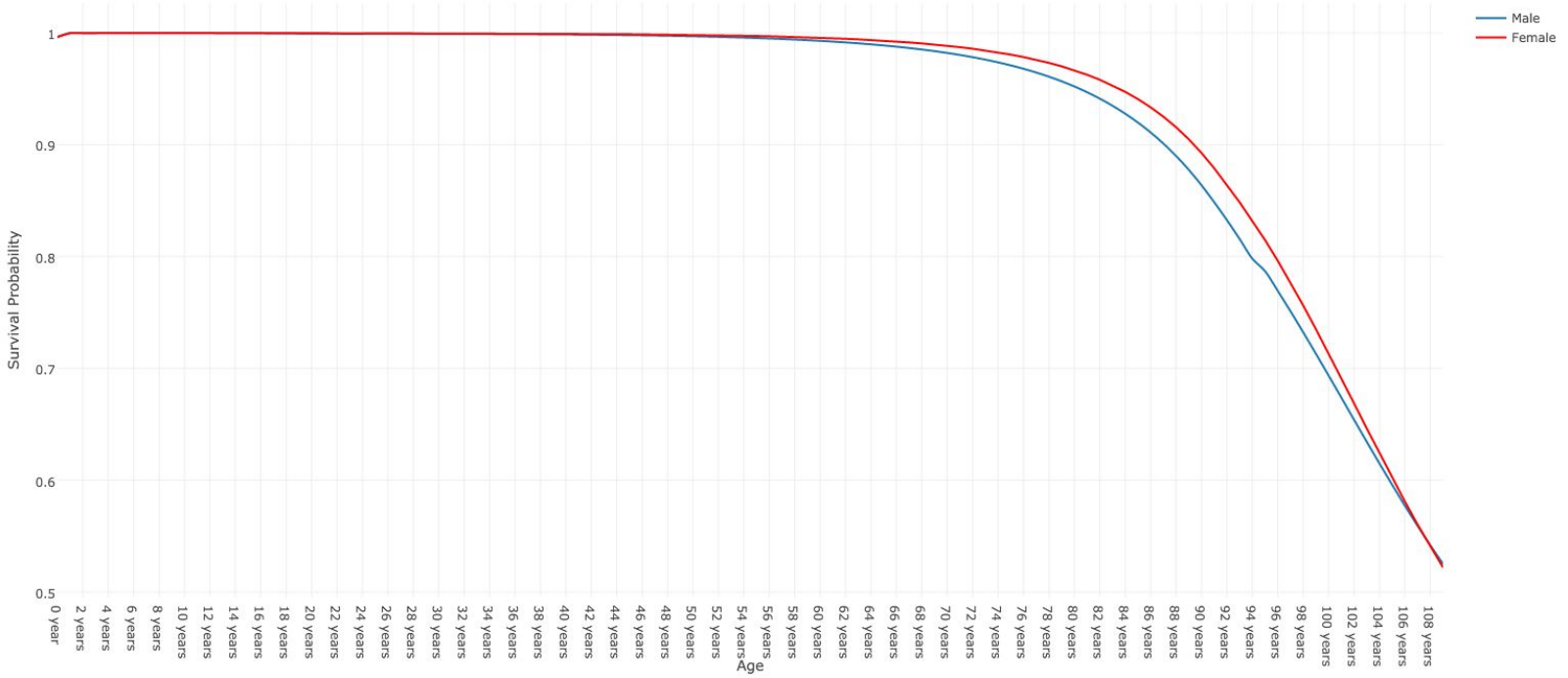


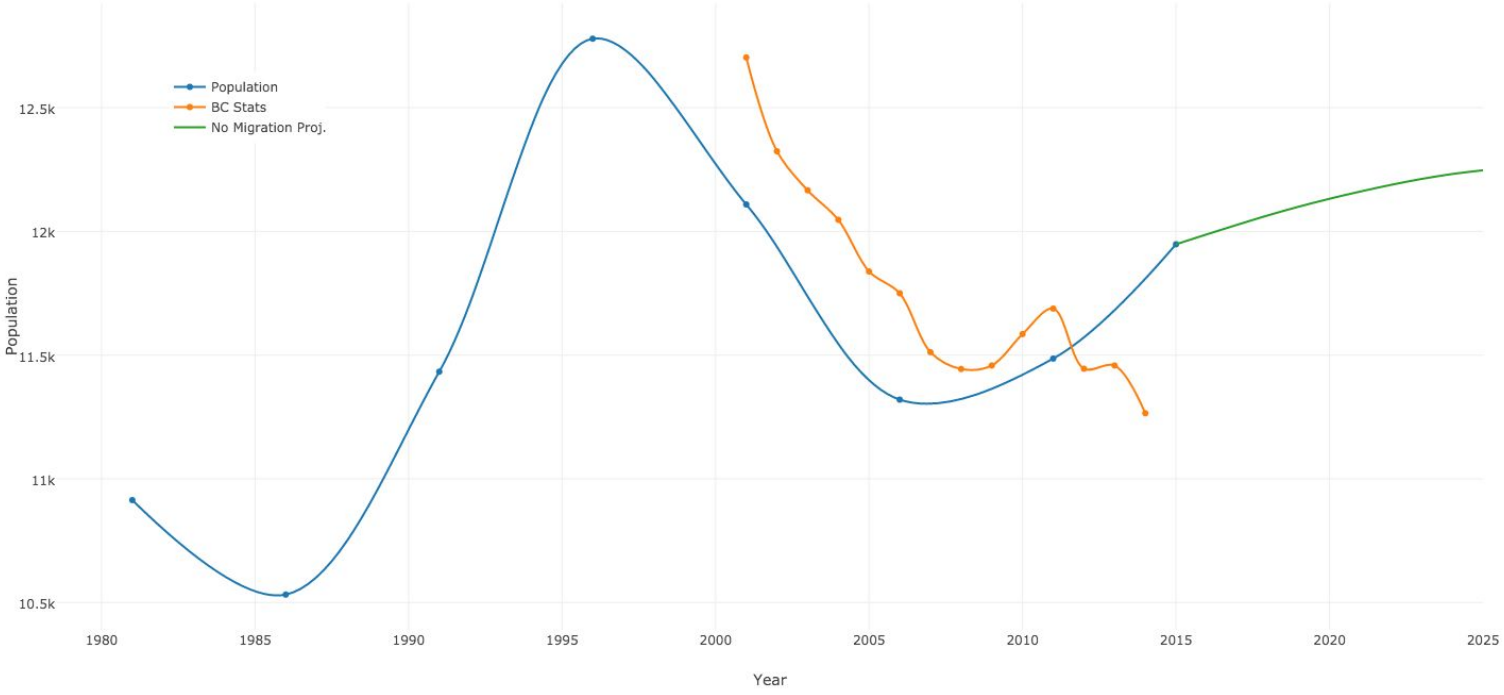
Figure 4: Survival Probabilities by Age for BC



Zero Migration

The natural change (births, deaths) in the current population of Terrace can be projected by omitting migration. By omitting migration a baseline is established against which different migration scenarios can be compared. Figure 5 shows the expected population trajectory for Terrace from 2015 - 2025 with zero migration. Note that this projection is for usual residents only. We estimate an additional 546 shadow population currently in Terrace, of which 302 have worked 30 or more days in the greater City of Terrace area in the past year. Shadow populations are not included in the dynamic projections (births and deaths through time) because they have not settled in Terrace and they are therefore not expected to reproduce or die while in Terrace. The usual resident population is shown to allow for a comparison to historical data.

Figure 5: Terrace's Population 1981-2025, Projected With Zero Migration



Migration

It is important to note that probabilities have not been assigned to any one of the three identified development scenarios considered in this study. Presented herein are informed estimates of possible population impacts under three potential future development scenarios. The likelihood of the respective scenarios is dependent on a complex set of underlying factors including global demand for raw materials and energy, interest rates, and competing investment opportunities. Estimates and conclusions presented here have been informed by data from three main sources: development of the oil sands industry in the Wood Buffalo economic region of Alberta, the Rio Tinto Alcan Kitimat Modernization Project, and various proponent submitted project descriptions required for the Environmental Assessment process in British Columbia. Data from the Wood Buffalo Region in Alberta, where extensive oil sands development has occurred, provides specific characteristics of worker migration flows, for example, the age and gender profile of migrants. Data from the Kitimat Modernization Project informs the expected spillover effects of regional economic development in Kitimat and Prince Rupert specifically. Project descriptions submitted for the provincial Environmental Assessment process provide rough outlines of the level of employment the projects are expected to create during construction, the total person-years of employment during construction, and the long run employment requirements for the respective projects.

Modeling Migration

A custom model of migration has been developed as part of the 2015 population projections for Terrace, as existing models are specific to the regional, provincial, or national level. The particulars of the community play an important role in understanding the impacts of migration as a function of local and regional economic development. The economy of Terrace is largely natural resource driven and the city's historical population trajectory closely tracks business cycles associated with local and nearby natural resource development activities. The period from 1995-2005 saw a shrinking of the local forestry industry with the closure of a local mill and a general reduction in natural resource related economic activity. The same period saw substantial net negative migration (see Figure 5). Considering the long standing relationship that exists in Terrace between economic activity and migration, the initial simplifying assumption built into the forecasting model for the 2015 population projections is that migration is a function of local and regional economic development. According to the latest data, at the regional district level (Kitimat-Stikine) net migration is essentially flat in 2013-2014, ending a decade long run of net negative migration (BC Stats, 2015). In order to reconcile this regional net-zero migration with Terrace's recent growth the following points were considered: first, there is no data available for 2014-2015 migration, which likely followed the decadal trend and resulted in net positive migration to the region. Second, the Regional District of Kitimat-Stikine (RDKS) is a relatively large catchment area in which we can expect some centres to grow and other to remain static or shrink. Acknowledging Terrace's recent growth produces an apparent contradiction to one of our underlying assumptions: the current level of economic activity produces net-zero migration for Terrace. This apparent contradiction isn't a problem when we further assume that the 2011-2015 population growth observed in the Population Survey stems

from the heightened period of activity between 2012 and the end of 2014, and growth has since slowed in 2015. These additional assumptions are supported by CMHC rental data that shows increasing vacancy rates in 2015, and personal communications with staff at the City of Terrace.

The second simplifying assumption underlying the 2015 projections is that in-migrants to Terrace either become usual residents and move here permanently, or they remain part of the shadow population. For regional development, it is assumed that 60% of in-migrants to Terrace will become usual residents, and 40% of in-migrants will remain part of the shadow population; these parameters were estimated using the 2015 Population Survey data. Migrants that become part of the usual resident population will be dynamically incorporated into the population projection and they will start to have children in the community while members of the shadow population do not become part of the community population dynamics. Permanent, local jobs are assumed to be taken by usual residents who are included in the dynamics of the projections.

The third simplifying assumption underlying the projections relates to the impact of regional economic development on the population of Terrace. With large LNG developments proposed for Kitimat and Prince Rupert, it is unreasonable to assume that Terrace will experience an equal share of the economic activity generated, but it is also unreasonable to assume that Terrace will not be impacted by regional industrial developments. An estimate of the proportion of the total jobs generated by the proposed mega-projects that will be held by people living in Terrace is required; data collected by unions involved in the Kitimat Modernization Project (KMP) has been used to inform the estimate of that proportion under the 2015 projections. Specifically, representatives of the respective unions and the Haisla Shuttle Service were contacted to obtain an estimate of the proportion of the workforce that was working on the KMP project who also lived in Terrace either temporarily or permanently. Further, projects have been classified according to their anticipated impact on the City of Terrace. For example, local developments are expected to have the largest impact when considering the ratio of the expected number of in-migrants to Terrace to total jobs. Developments in Kitimat are expected to have a larger impact than developments in Prince Rupert because worker willingness to commute decays as a function of distance (Monte, *et al.* 2015). Finally, some mining developments are expected to have larger impacts than developments in either Kitimat or Prince Rupert because of their remote nature and their relative proximity to Terrace. In these cases, Terrace is assumed to be a service hub for mining developments. Spillover effects are divided into two phases - during construction a smaller spillover effect (in terms of the total proportion of workers) is expected than during operation. This is evidenced through experience with the Rio Tinto Alcan modernization and usual operation phases.

The fourth simplifying assumption underlying the projections is that in-migrants to Terrace who are arriving to work on projects will have the same age-and-gender profile as in-migrants to the Wood Buffalo Economic Region over the period 2005-2015.

The fifth simplifying assumption supporting the projections is that, for those migrants who are treated as usual residents, a single job will result in a net migration of 1.78 people. Shadow population migrants are assumed to only be in Terrace for the duration of their employment and as such a single person is added to Terrace's population per job. The estimate of 1.78 originates in the cross sectional data from the 2011 NHS. Specifically, 1.78 is the ratio of the total population to the number of household maintainers.

The sixth simplifying assumption supporting the projections is that local jobs in the traded goods sector will result in 1.6 jobs in the nontraded goods sector. This multiplier is informed by the 2010 study "Local Multipliers" by Enrico Moretti at UC Berkeley. A more comprehensive list of assumptions is documented in the Appendix.

Scenarios

The scenarios presented here include a subset of the 44 proposed developments in the North Coast region identified by the Province of BC's Major Projects Inventory as of 10 October 2015. Considering all 44 listed projects, over 150 billion dollars of investment is proposed for the North Coast region over an unspecified time frame. The rationale for not including an extreme growth scenario is that with each development that goes ahead, additional developments become less viable. The 'high' development scenario presented here is considered possible given available information. The included development scenarios can be summarized as follows:

- Low - Zero LNG development, some planned local development going ahead at the Skeena Industrial Development Park, and maintaining the current level of regional economic activity.
- Medium - Two LNG facilities are developed, one in each of Kitimat and Prince Rupert, additional planned and currently unplanned development at the Skeena Industrial Development Park goes ahead, and there is an increase in regional mining.
- High - A total of five LNG facilities are developed, there is an increase in regional mining, and the entire Skeena Industrial Development Park is developed.

Scenario 1 - Low Economic Development

Scenario 1 assumes that the following local and regional economic development will take place:

- Phase 1 of the Qinhuangdao Economic & Technological Development Zone (QETDZ) plan will proceed to 2020 including a $30 million alfalfa extraction plant resulting in 170 local jobs. Regional development remains at its current level over the 10 year projection horizon.

Figure 6: Terrace Total Population Including Shadow Population to 2025 - Low Scenario

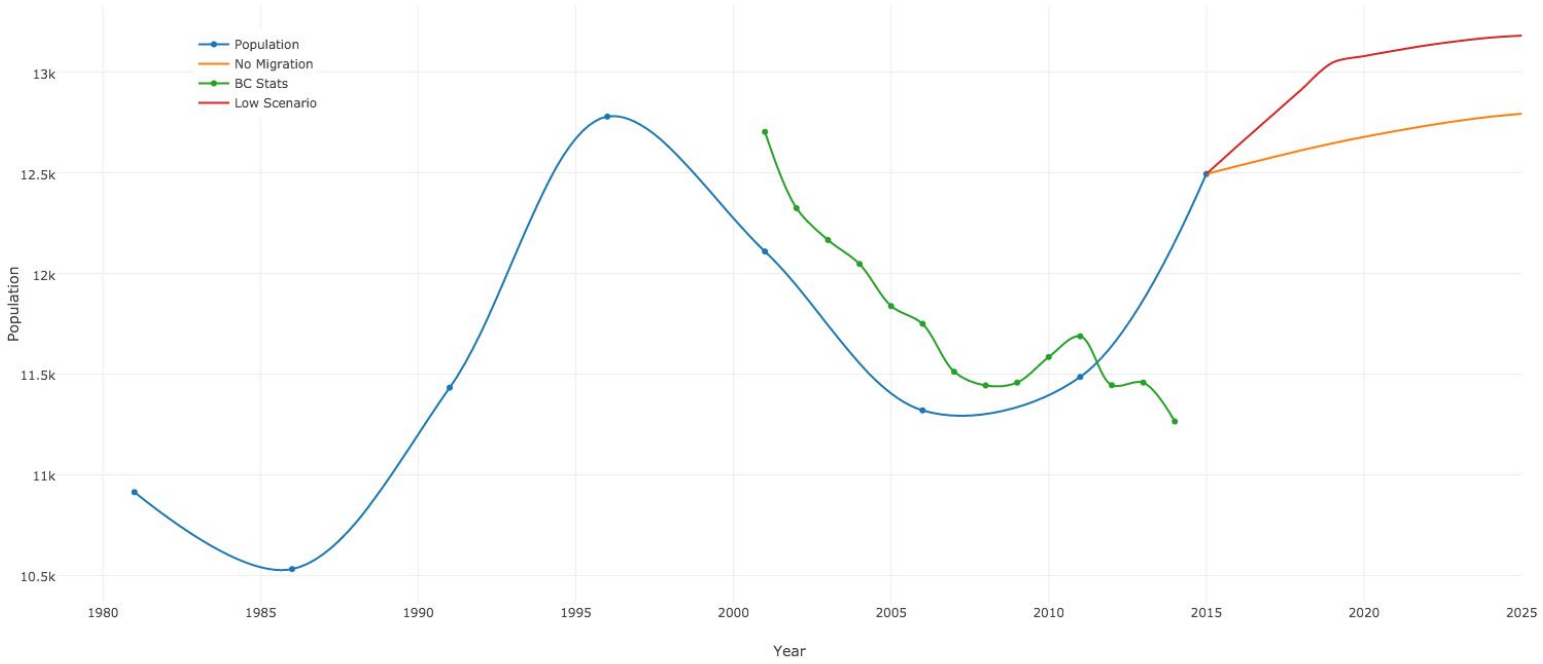
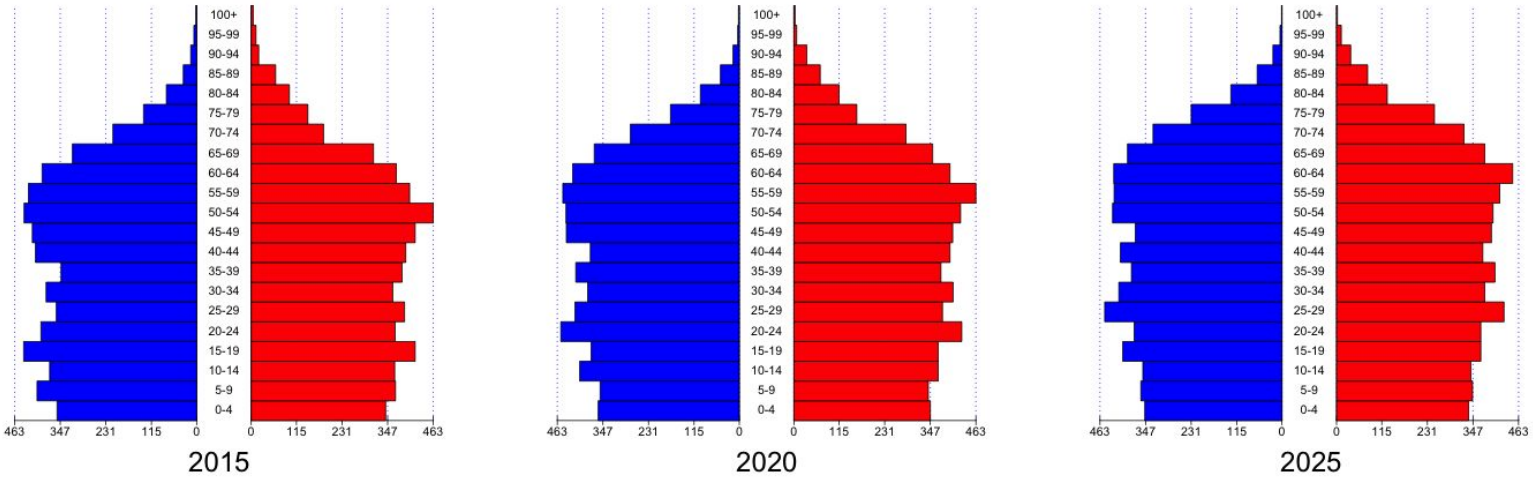


Table 2 - Low Development Scenario Projections

Year	Usual Residents	Shadow Population	Total Population
2015	11,948	546	12,494
2016	12,089	546	12,635
2017	12,227	546	12,773
2018	12,365	546	12,911
2019	12,501	546	13,047
2020	12,533	546	13,079
2021	12,561	546	13,107
2022	12,587	546	13,133
2023	12,608	546	13,154
2024	12,625	546	13,171
2025	12,635	546	13,181

Figure 7: Population Pyramids, Low Scenario, Males (Blue) and Females (Red)



The low development scenario assumes that regional development maintains its current pace. No specific projects are modeled in terms of regional development and we assume zero regional migration. The planned $30 million dollar alfalfa plant is constructed in the Skeena Industrial Development Park (SIDP) employing 170 people who, in turn, bring a total of 442 new people to the City once both the indirect to direct jobs multiplier (1.6) the population multiplier (1.78) are applied, and the total impact is divided between Terrace and the Regional District of Kitimat-Stikine. Figure 6 shows the relatively rapid build-up in the QETDZ project to full employment in 2018 at which point the natural dynamics of fertility and mortality dictate the remainder of the projection. The relatively young population of Terrace allows for a short-run natural increase in the total population even though the Total Fertility Rate is below replacement (Statistics Canada, 2012). In the long-run, this natural increase effect will disappear, and unless the Total Fertility Rate changes, or new young migrants move to Terrace, the City's dynamics of fertility and mortality will result in a declining population. Figure 7 shows that under the low development scenario the age and gender structure of the population remain stable over the projection horizon. Under the low development scenario there are slightly more infants (0-4 year olds) expected in 2020 than there are currently in Terrace, but this effect begins to reverse itself by 2025.

Scenario 2 - Medium Economic Development

Scenario 2 assumes that all development outlined in Scenario 1 proceeds in addition to the following local and regional economic development:

- Skeena Industrial Development Park will continue:

    - Phase 2 of the QETDZ plan will proceed in 2020 - 2025 (additional $70 million dollar investment)
    - Four additional manufacturing facilities will be built on the developed QETDZ land (for a total of five)
    - 50% of remaining Skeena Industrial Development Park acreage will be developed (406.5 acres) with five additional manufacturing facilities by the end of the 10 year projection horizon.
- LNG Canada and Coastal GasLink Pipeline proceed.
- Avanti Kitsault Mine proceeds.
- Pacific Northwest LNG and Prince Rupert Gas Transmission Project proceed.
- Brucejack Mine proceeds.
- Seabridge KSM Mine proceeds.

Figure 8: Terrace Total Population Projections Including Shadow Population to 2025 - Medium Scenario

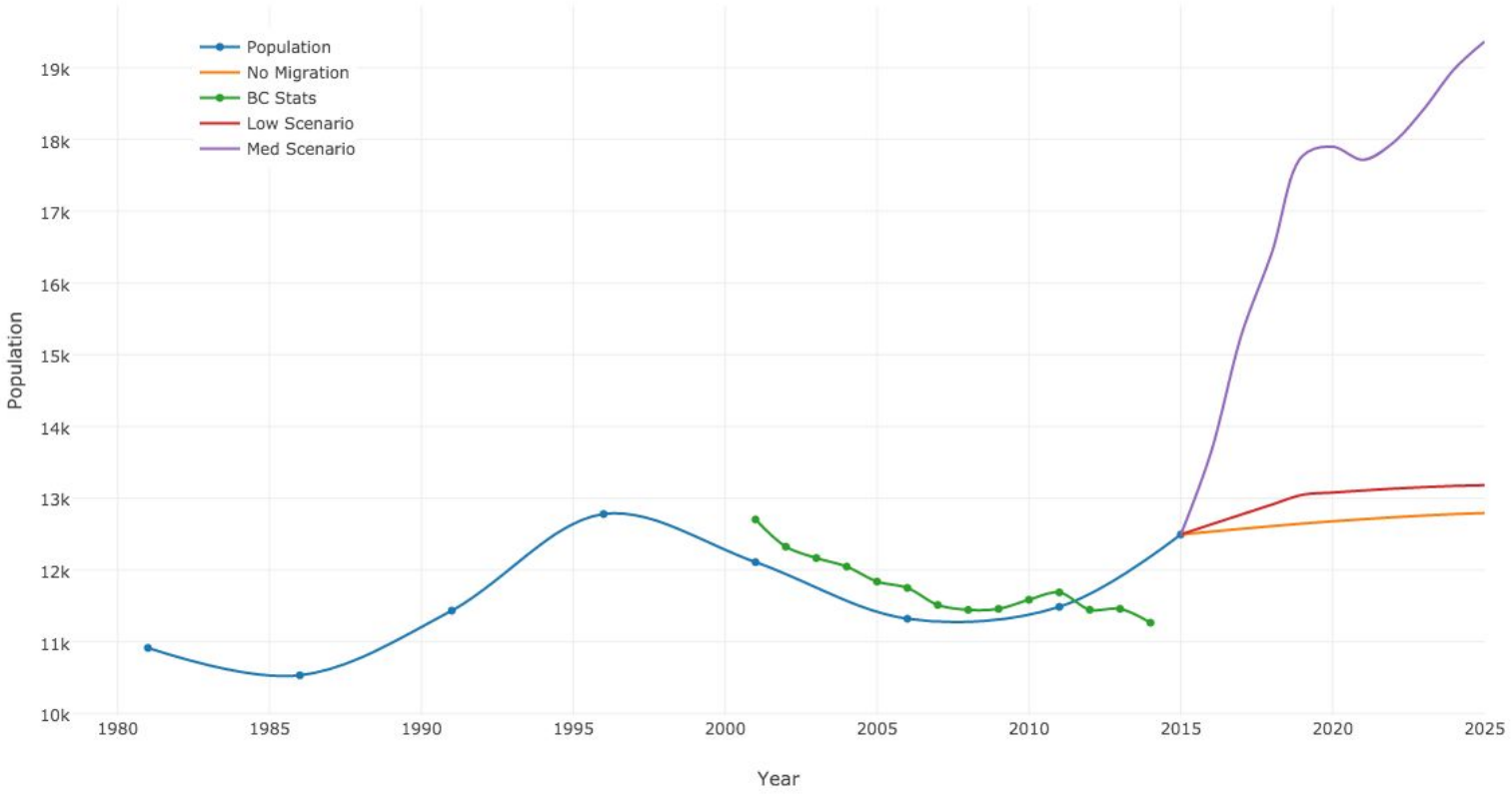
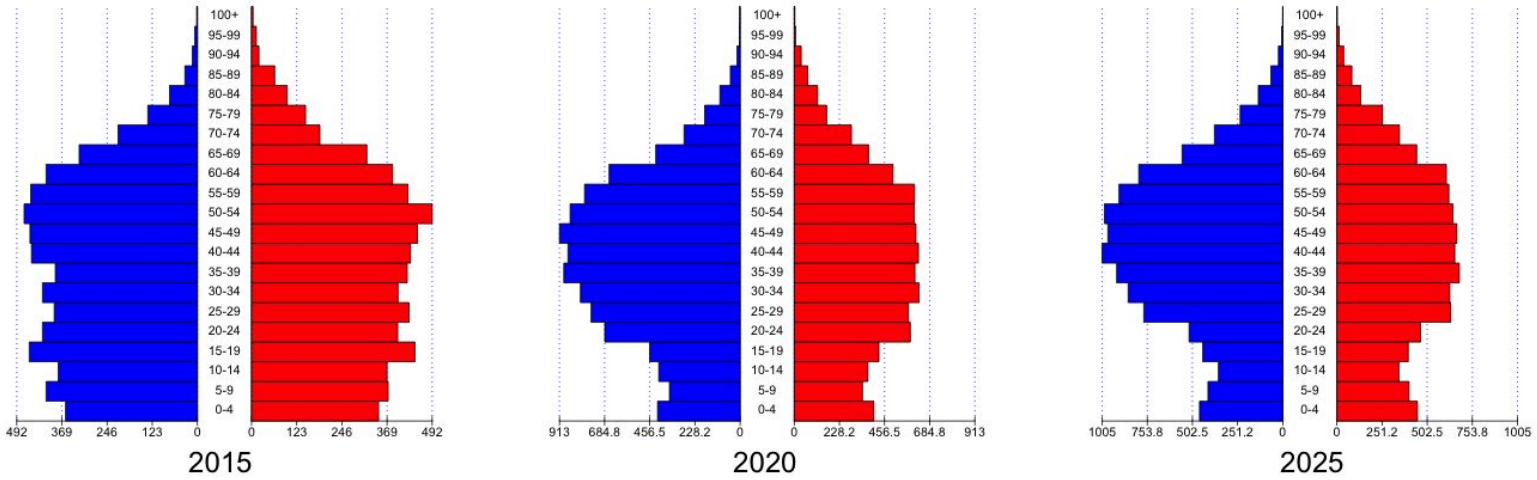


Table 3 - Medium Development Scenario Projections

Year	Usual Residents	Shadow Population	Total Population
2015	11,948	546	12,494
2016	12,839	809	13,647
2017	14,022	1,261	15,283
2018	14,911	1,514	16,424
2019	15,920	1,846	17,767
2020	16,163	1,736	17,899
2021	16,214	1,500	17,714
2022	16,519	1,437	17,956
2023	16,957	1,465	18,422
2024	17,448	1,531	18,979
2025	17,831	1,531	19,363

Figure 9: Population Pyramids, Medium Scenario, Males (Blue) and Females (Red)



The medium development scenario results in substantial change to the population of Terrace. This scenario assumes the construction of a total of ten manufacturing facilities on SIDP lands, the construction of an LNG facility in both Kitimat and Prince Rupert, and three new mines becoming operational within the projection horizon. The effects of SIDP development dominate the results of the model under this development scenario. On net, over the 10-year projection, the ten facilities on SIDP lands contribute just over 4,000 net people to Terrace's population whereas, over the same period, regional developments (LNG and mining) contribute a total of 2,463 net people by the end of the projection horizon (2025). Figure 8 shows that regional development peaks in 2020, at which point Terrace begins to experience net-negative migration due to the wind-down of regional LNG and mine construction. The SIDP developments moderate the downward pressure on Terrace's population and Terrace sees only one year (2022) of population decline before resuming growth. The difference between the effects of

SIDP development and regional development are attributable to the way the projection model treats the respective projects. SIDP developments are assumed to produce permanent local jobs taken by people who move to Terrace, and their usual place of residence becomes Terrace. This type of permanent migration has the largest impact due to the associated multiplier effects. Shadow populations are assumed to remain in Terrace only during the construction phase of projects and they are are not included in the dynamic fertility and mortality portions of the projection. Figure 9 shows that the age and gender distribution of the community changes under the moderate development scenario. Changes in the structure of the age and gender distribution of the community under the medium development scenario are attributable to the assumptions built into the migration component of the projection model. Specifically, the working age population tends to grow quickly to take advantage of the new employment opportunities and the gender balance tends to skew toward males as males tend to be over-represented in construction-related worker migration. The migration component assumes that the age and gender profile of interprovincial migrants to the Wood Buffalo region (including Fort McMurray) between 2000 and 2010 will match the age and gender profile of people moving to Terrace.

Scenario 3 - High Economic Development

The high development scenario assumes that all development outlined in Scenarios 1 and 2 proceeds in addition to the following local and regional economic development:

- Full development of the Skeena Industrial Development Park
    - The remaining 50% (406.5 acres) of the Skeena Industrial Development Park will be developed and sold, supporting a total of 10 manufacturing facilities.
    - All available QETDZ lands will be developed and utilized, supporting a total of 20 manufacturing facilities.
- Prince Rupert LNG and Westcoast Connector Pipeline proceed.
- Kitimat LNG and Pacific Trails Pipeline proceed.
- WCC LNG project and TBD pipeline proceed.

Figure 10: Terrace Total Population Including Shadow Population to 2025 - High Scenario

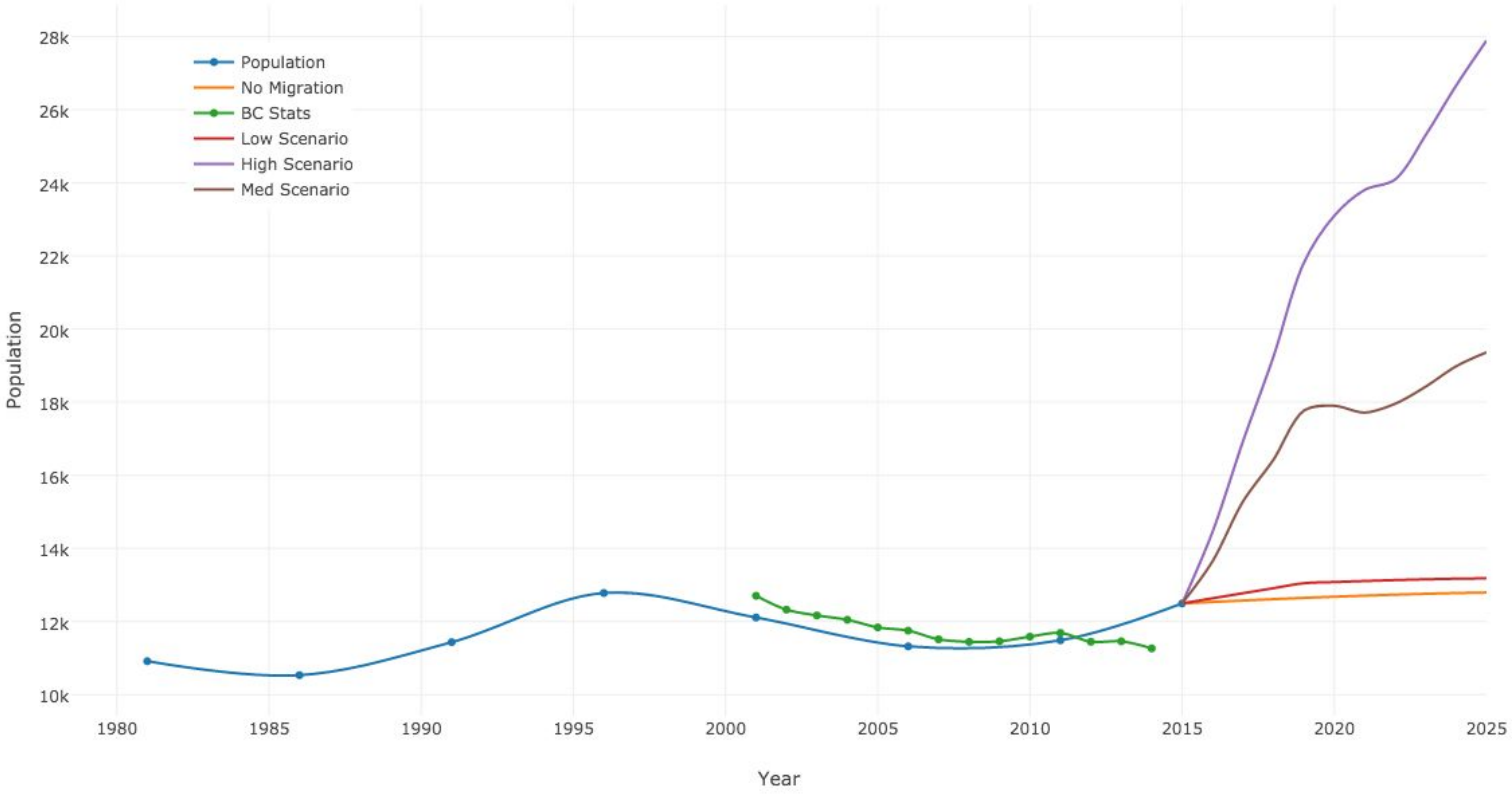
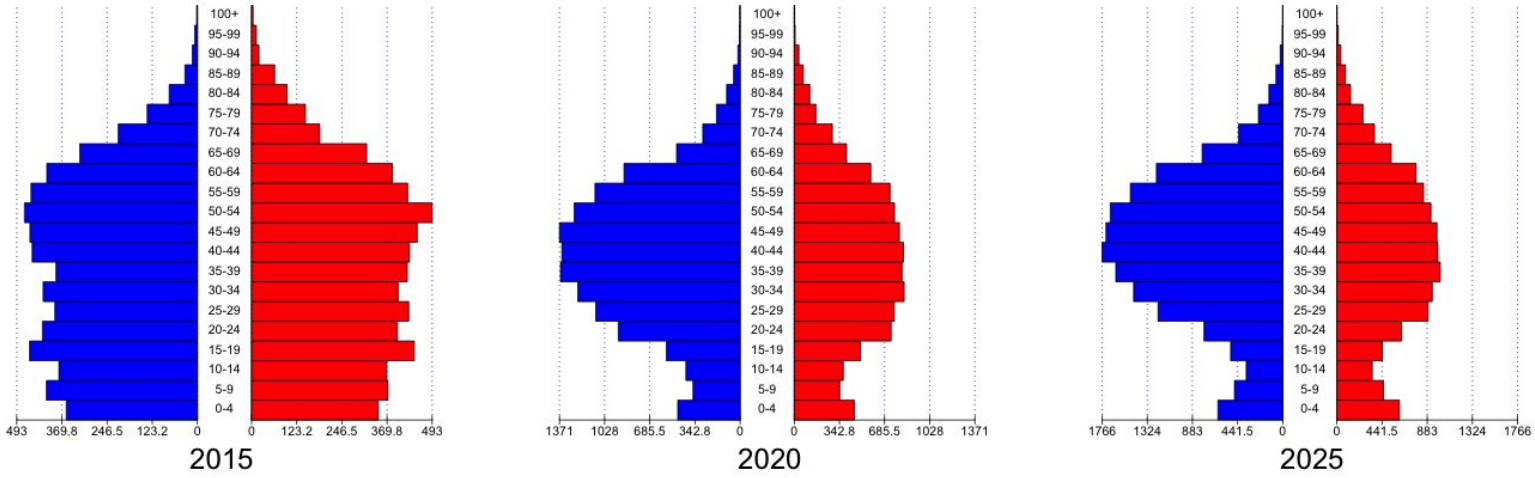


Table 4 - High Development Scenario Projections

Year	Usual Residents	Shadow Population	Total Population
2015	11,948	546	12,494
2016	13,643	809	14,452
2017	15,657	1,272	16,929
2018	17,575	1,665	19,240
2019	19,654	2,159	21,812
2020	20,922	2,176	23,098
2021	21,845	1,961	23,807
2022	22,513	1,577	24,090
2023	23,737	1,565	25,302
2024	25,044	1,610	26,654
2025	26,279	1,610	27,889

Figure 11: Population Pyramids, High Scenario, Males (Blue) and Females (Red)



The high development scenario includes a total of 5 LNG facilities and a total of 30 manufacturing facilities on SIDP lands in addition to the mining developments outlined in the medium scenario. The assumptions underlying the high development scenario produce drastic population growth, as shown in Figure 10, with Terrace reaching nearly 28,000 people over the next 10 years. The sizable population growth pushes the limits of some of the underlying assumptions built into the model, specifically the age and gender distribution of people moving to Terrace. For less extreme scenarios, the assumption that people moving to Terrace for work in new industrial facilities would roughly have the same age and gender composition as people who moved to Wood Buffalo for work between 2000 and 2010 seems reasonable. For much higher development scenarios, like the one presented here, where over half of the population is assumed to have moved to Terrace for work in an SIDP manufacturing facility or for the construction and operation of regional LNG or mining facilities, the assumption may be less tenable. Evidence for this assertion comes from Wood Buffalo, Ft. McMurray specifically, where the male to female ratio is 1.12 to 1.00 males to females whereas the high scenario projection for Terrace produces a male to female ratio of 1.44 to 1.00. Comparisons between hypothetical development scenarios and real-life industrial development is difficult, and maybe Terrace's male to female ratio under a high development scenario would approach those estimated by the projection model, or perhaps they would be roughly in line with Ft. McMurray. Under the assumptions of the projection model, the gender ratio would be pushed toward equality over a longer time horizon. The results depicted in Figures 10 and 11 would moderate as worker migration slows over time, and the effects of fertility and mortality begin to reshape the community in the long-run.

Long-Run Projections

The 10 year projections for the population of Terrace presented in the preceding sections have detailed migration assumptions built into the underlying projection models. For the following long-run projections, migration analysis has been abandoned and natural population dynamics based on fertility and mortality have been allowed to play out over the course of 35 years, to 2050. Long-run projections are inherently subject to a greater margin of error than are shorter term projections. The extent to which these long-run assumptions (net-zero migration past 2025, stable fertility and mortality) approximate the real world will determine the accuracy of these long-run projections. The population decline associated with the respective low/medium/high development scenarios depicted in Figure 12 is the result of the assumed age of migrant workers. The vast majority of migrant workers in the model are between the ages of 25 and 60, with a significant proportion being between the ages of 45 and 60. In 2050, those workers migrating to Terrace in 2015 would be between 70 and 95 years old, ages at which mortality is expected to play a significant role in the population dynamics of the community. Figure 13 shows how the medium development scenario would play out, based on the model's assumptions, in terms of the age and gender composition of the community to 2035.

Figure 12: Long-Run Population Projections Terrace, 1980 - 2035

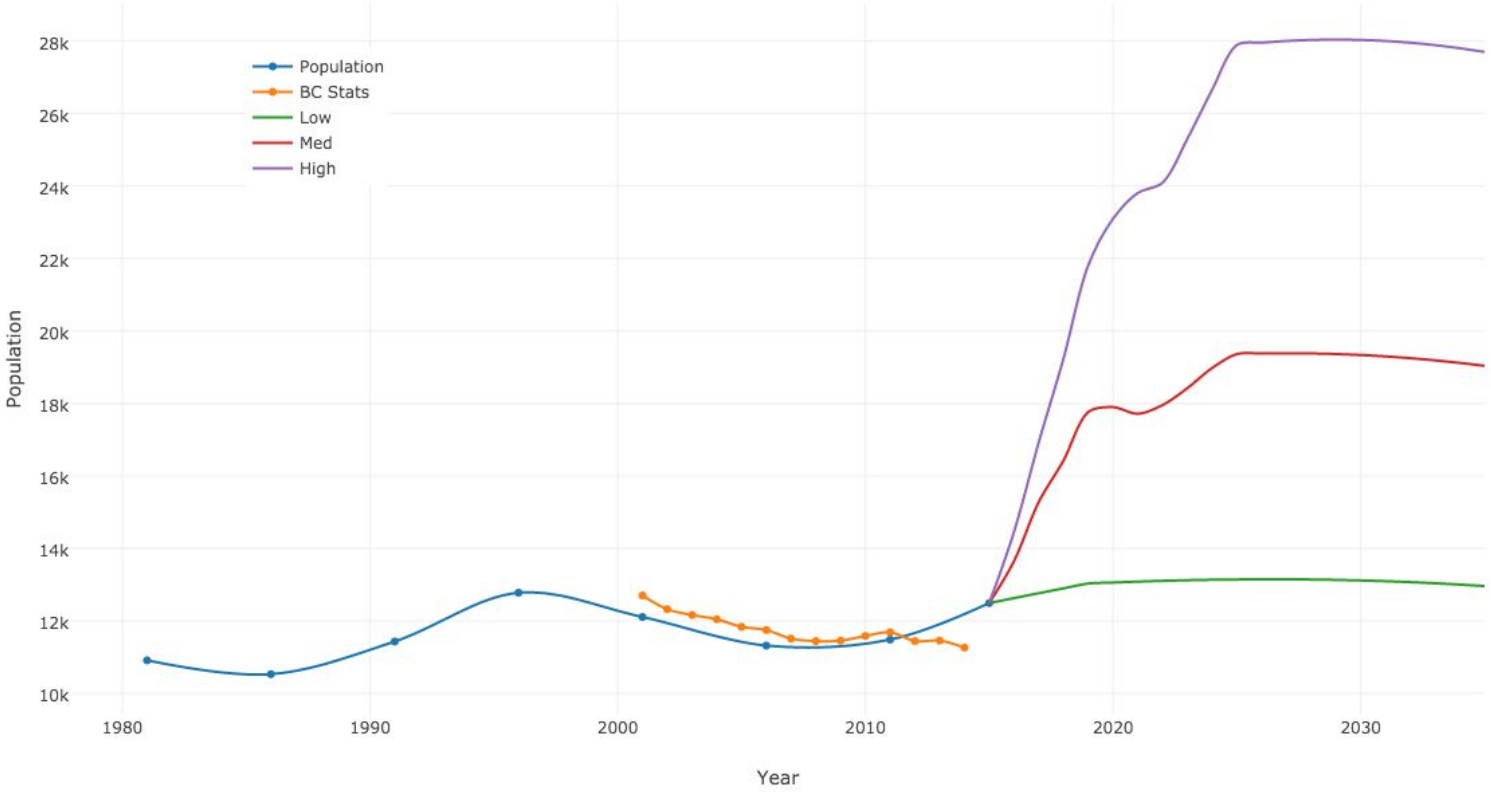
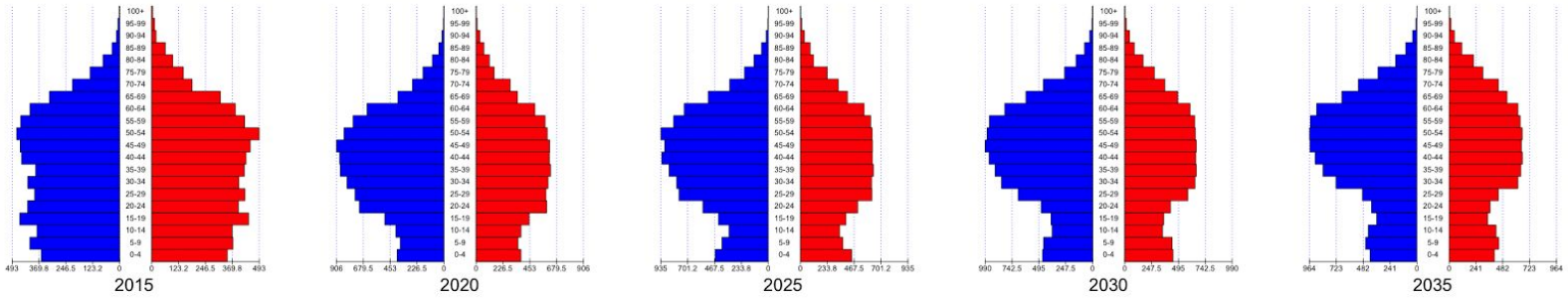


Figure 13: Terrace Age and Gender Dynamics, Medium Scenario, 2015-2035



Discussion

The preceding section summarizes the results of a population projection for the City of Terrace under three possible development scenarios. Aside from the dynamics of fertility and mortality, the assumed parameter inputs remain constant throughout each of the scenarios, and they are documented in the accompanying spreadsheet "BRA_CCM_Terrace.xlsx" and in the Appendix. Aside from respective differences in terms of the total number of people residing in the City of Terrace, a major difference among the three projections is the impact of construction on the population. Both the medium and high development scenarios see out-migration begin to occur as major project construction winds down near the end of the projection horizon. The population projections documented here show that the population of Terrace stands to grow substantially should local and regional economic development proceed. Even under the low development scenario, the population of Terrace is expected to exceed 13,000 residents. Under the highest development scenario, the population of Terrace is expected to peak at almost 26,000. Using the model developed in this report and detailed in the accompanying spreadsheet, it would be useful to continue to update Terrace's population projections as final investment decisions regarding the respective projects are made.

Works Cited

BC NREB. 2015. Housing Price. Accessed 2015/11/13 at http://bcnreb.bc.ca/files/1507Terrace.pdf

BC Stats. 2015. Sub-Provincial Population Estimates. Accessed 2015/10/18 at http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography/PopulationEstimates.aspx

BC Stats. 2015. Building Permits, Housing Starts and Sales. Accessed 2015/10/18 at http://www.bcstats.gov.bc.ca/StatisticsBySubject/Economy/BuildingPermitsHousingStartsandSales.aspx

BC Stats. 2015. Mobility. Accessed 2015/10/18 at http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography/Mobility.aspx

CMHC RMR. 2013. Canadian Home and Mortgage Corporation Rental Market Report 2013. Accessed 2015/10/18 at https://www03.cmhc-schl.gc.ca/catalog/productDetail.cfm?lang=en&cat=59&itm=19&fr=1445191618105

CMHC RMR. 2015. Canadian Home and Mortgage Corporation Rental Market Report 2015. Accessed 2015/10/18 at https://www03.cmhc-schl.gc.ca/catalog/productDetail.cfm?lang=en&cat=59&itm=19&fr=1445191618105

Edinger, Hannes. 2012. Stochastic Population Projections for Canada's First Nations. Department of Economics, Queen's University, Kingston, ON.

Hoekstra, G. Accessed 2015/10/18 at http://www.vancouversun.com/Northwest+economy+surging+ticket+natural+resource+projects/8822905/story.html?__lsa=4369-c35b

Monte, F., Redding, S., Rossi-Hansberg, E. (2015) Commuting, Migration, and Local Employment Elasticities. Accessed 2015/10/18 at https://www.princeton.edu/~erossi/CMLEE.pdf

Moretti, E., 2010. Local Multipliers. American Economic Review: Papers & Proceedings 100 (May 2010): 1–7.

Patterson, David. 2015. Stratified Sampling. Accessed 2015/10/18 at http://www.math.montana.edu/~parker/PattersonStats/Stratified.pdf

Statistics Canada. 2012. Terrace, British Columbia (Code 5949011) and Kitimat-Stikine, British Columbia (Code 5949) (table). Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. Accessed 2015/09/28 at http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E

Appendix - Detailed Assumptions

The following list summarizes the major assumptions underlying the preceding population projections:

1. All local jobs result in additions to the usual resident population (as opposed to the shadow population). The rationale being that local jobs are treated as permanent jobs. Terrace is a relatively remote community and people moving to Terrace for a local job are assumed to stay and Terrace becomes their usual place of residence.
2. Regional jobs result in additions to the usual resident and shadow populations. Specifically, 40% of regional jobs that end up in Terrace are assigned to the shadow population, while 60% are assumed to become usual residents. This allocation is informed by the proportion of growth seen in Terrace between 2011 and 2015 that is respectively composed of the shadow population and usual residents.
3. Local manufacturing jobs produce local indirect jobs at a rate of 1.6 indirect jobs per local manufacturing job in a tradeable goods industry. This multiplier is informed by the 2010 study: Local Multipliers, Enrico Moretti, accessed at: http://eml.berkeley.edu//~moretti/multipliers.pdf
4. Local jobs taken up by usual residents support 1.78 people. This is estimated using data from the 2011 National Household Survey. Specifically, it is the ratio of the total population in Terrace to the number of household maintainers.
5. We assume that the Regional District of Kitimat Stikine receives 30% of all local and regional jobs and associated in-migrants. This is informed by internal City of Terrace documentation.
6. Terrace receives a 7% spillover of all the jobs created in Kitimat related to the modeled projects. This estimate is informed by conversations with respective unions that provided skilled labour during the Kitimat Modernization Project (KMP), and in conversation with the Haisla Shuttle, a company that provided daily transportation from Terrace to Kitimat during the KMP. The operational spillover effect after construction is 20%.
7. Terrace receives a 2.5% spillover of jobs created in Prince Rupert. This estimate is informed by the literature indicating that spillover effects decline exponentially as a function of distance. This makes sense because Kitimat can be considered a reasonable daily commute for people staying in Terrace, while Prince Rupert may not be considered a reasonable daily commute from Terrace. This assumption is further supported by the work of Monte, *et al*. (2015). The operational spillover effect after construction is 5%.
8. Terrace receives a 25% spillover for mines located close to Terrace, where Terrace would be considered the major service provider in the vicinity of that mine. The operational spillover effect after construction is 50%.
9. Terrace receives a 10% spillover for mines located further from Terrace, where Terrace would be considered one of several service providers in the vicinity of that mine. The operational spillover effect after construction is 20%.

10. Assume 170 jobs in the traded goods sector for any manufacturing facility built in Terrace. This number is informed by the estimated job creation from the single planned manufacturing facility.
11. The total number of person-years detailed in the respective project descriptions is equal to the cumulative number of person-years that will take place over the construction horizon of any project.
12. The distribution of person-years associated with a proposed project is defined by the identified peak employment level, the number of person-years, and the construction time estimate detailed in the respective project descriptions.
13. Shadow populations are only in Terrace during the project construction horizon and they do not reproduce or die during their time in Terrace.
14. Usual residents become integrated into Terrace's population and they are included in the usual population dynamics of the city (reproduction and mortality).
15. In the calculation of natural growth and decline, we assume that births come before deaths.
16. The age and gender profile of in migrants to Terrace for regional jobs will have the same age and gender profile of in migrants to the Wood-Buffalo region in Alberta between 2000 and 2015.