REMOTENESS INDICATORS AND FIRST NATION EDUCATION FUNDING

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Moazzami Economic Consultants Inc. (MEC) is one of Northern Ontario's leading economic development, quantitative damage assessment and strategic management firms. As experts in quantitative evaluation of costs and benefits of any socio-economic phenomenon, MEC has prepared many economic assessment reports on behalf of communities that have incurred economic losses due to accidents, resource developments and government intervention. The Managing Director of MEC, Dr. Bakhtiar Moazzami, has taught Economics and Statistical Analysis of Data at Lakehead University since 1988. He specializes in labour market studies, socio-economic evaluations and damage assessment, cost-benefit analysis, investment analysis, and feasibility studies.

MEC offers clients a unique range of diverse, technical and professional expertise to fulfill the demands of a wide variety of projects such as labour market planning and forecasting, demographic and labour force forecasting and planning, social and economic impact studies, market studies, investment readiness studies, as well as negotiations. MEC provides economic damage assessments in personal injury, wrongful death and medical malpractice cases with Dr. Moazzami being called to testify in Ontario courts as an expert witness on many occasions.

Well-known for his analytical research activities particularly related to Northern Ontario, Dr. Moazzami has written many reports on Northern Ontario's economic development challenges and opportunities. He was commissioned by the Ministry of Northern Development and Mines to undertake a comprehensive study of Northern Ontario's economy as a part of the research conducted for the Growth Plan for Northern Ontario. He has also written extensively on Northern Ontario's Indigenous peoples and Northern Indigenous economy. Dr. Moazzami negotiated the Musselwhite agreement between Placer Dome Inc. and five Indigenous communities in 2001. This time-tested successful agreement is probably the only properly designed and implemented revenue sharing agreement between resource producers and Indigenous communities in Ontario.

MEC has recently finalized an economic impact multiplier estimation for Northern Policy Institute which calculates the economic impact (employment and income) of a potential investment in twenty different industries in 11 separate census districts in Northern Ontario. This model allows estimation of any potential investment in any of the existing industries in the region. It also allows us to examine which industry or sector produces the highest return to investment in terms of employment and income in a local area.

Dr. Moazzami is a member of the Expert Advisory Panel on Ontario's transition to the new economy examining the impact of technological change on Ontario's Workforce. As a member of the taskforce, Dr. Moazzami is currently researching the impact of automation on demand for workers in Ontario's economy. His focus is on the impact of automation on resource development in Northern Aboriginal communities. As a member of the research committee of Ontario Council for Workforce Innovation (OCWI), Dr. Moazzami was commissioned in 2017 by OCWI to research the changing profile of the unemployed, underemployed and marginally attached workers in Ontario. Dr. Moazzami used detailed microdata from labour force monthly survey during 1976-2016 to examine how the labour market in Ontario has changed during the past 30 years.

Dr. Moazzami's expertise and influence reaches beyond Lakehead University and Northern Ontario. He has written reports on socio-economic conditions in rural and urban British Columbia, Saskatchewan, Newfoundland & Labrador, and Northwest Territories and has been a regular guest speaker at the University of Waterloo's Economic Development Program.

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Executive Summary

The concepts of remoteness and accessibility have received significant attention in recent years. Many different approaches have been used to measure remoteness. These measures and indices differ from each other depending on how they define and measure remoteness. Each definition emphasizes different criteria and thus the choice of the indicator depends on the issue at hand and the specific policy the indicator is designed to influence. The main objectives of the present report are to:

1. Review various remoteness models and indices,
2. Review the newly published remoteness report by Statistics Canada (NPR),
3. Examine various educational cost drivers in First Nations schools and to propose an alternative remoteness index specifically designed for First Nation education funding,
4. Review the provincial approach to remoteness and rurality and First Nations comparability funding models,
5. Estimate remoteness indices for First Nations schools in Ontario and compare them to the newly published remoteness index (NPR index) and Geographic Zone index used by Indigenous and Northern Affairs Canada (INAC).

Review of Various Remoteness Models

This section reviews various remoteness indicators developed in Canada and other countries and evaluates their applicability to First Nations education funding in northern, remote and isolated communities. These measures and indices differ from each other depending on how they define and measure remoteness. For example, there are three variations of remoteness indicators that are applied at the national level in Australia. The difference between them stems from how they measure distance; whether they use population size and actual distance from the population centres; whether they produce discrete or continuous measurement indexes or whether they use minimum road distance to a service centre. We suggest that the choice of index must be based on the issue at hand and the specific policy the indicator is designed to influence.

Review of the Newly Published Remoteness Report (NPR index)

The newly published report by Statistics Canada entitled, "Measuring Remoteness and Accessibility – A set of Indices for Canadian Communities" released May 9, 2017 attempts to produce a general concept and approach applicable to all CSDs (census subdivisions) in Canada.[1] It is a general exercise with an objective of encompassing all communities in Canada. However, as a general concept, it suffers from a series of shortcomings that makes it inapplicable to any specific field of study such as education or health care.

[1] The authors claim that, "Although various measures have been developed at the local or regional level, in the Canadian context no methodology or measures exist that are applicable to all communities across the country. This research is intended to fill this gap." As we will discuss below, this claim is incorrect. Other remoteness indices have been developed that apply to all CSDs in Canada.

The main modifications necessary in order for the index to become applicable to the field of education funding for rural and remote communities are as follows:

1. The index must be calculated for each province separately. As it stands now, it overestimates access to service centres for the communities close to the provincial boundaries since it includes all potential service centres in the 200 km radius of a community irrespective of whether or not they cross provincial boundaries.

2. The choice of population centres as a point of potential service provision is not appropriate in the case of remoteness as it applies to accessing education services. Many small communities that fit the definition of a population centre (population of 1000 and 400 persons per square kilometer) do not have any post-secondary institutions from which communities can access resources and services. The index has to be recalculated using communities with a post-secondary institution as the point of service provision.

3. Combining communities with road access with those without road access results in serious bias in the estimated indices. In order to combine these communities, the authors have made a series of assumptions regarding travel costs. Those assumptions introduce serious errors in the indices as well as making the resultant indices very unstable as travel costs vary from month to month and from season to season.

4. The travel costs as calculated in the report underestimate the true cost of travel and therefore underestimate the degree of remoteness for the very remote communities. If travel cost is to be used, attempts must be made to obtain better information on the true cost of travel or using more sensible proxies.

5. Using travel cost as a proxy for distance also underestimates remoteness in the case of communities that have access to subsidized transportation such as those in northeastern Ontario.

6. Use of gross revenue in calculating access to services is inappropriate. Revenues can rise if prices increase while quantity of goods and services provided stay constant or even decline. Therefore, rising gross nominal revenue can indeed indicate higher cost of goods and services and lower quantity of goods and services provided. Thus, higher gross revenue can indeed signal lesser access not greater availability of goods and services. This applies not only to retail but all sectors of the economy including education and health care.

7. The remoteness and accessibility indices as are calculated presently are very volatile as the proxies used (travel cost and prices) change frequently and therefore does not allow for any long-term stable funding planning.

8. On a technical note, it is not clear why the authors have decided to take a logarithm of the indices and then normalize them to 0-1 interval. These mathematical transformations affect the size and relative magnitude of the indices and make interpretation of them difficult.

9. As a result of these mathematical transformations, the resultant indices are at best ordinal indices, which mean that they can be used to assign rankings to CSDs with respect to their

remoteness or accessibility of particular goods or services. Nothing can be said about the difference in cost of services among communities. For example, a CSD with a remoteness index of 0.7 is more remote than the one with an index of 0.5. But, one cannot say that the cost difference between those two communities is 0.7 – 0.5 =0.2 or 20%.[2]

10. In the case of education funding, one needs a cardinal index that shows the cost difference between communities. For example, Statistics Canada regularly publishes a Canadian Foreign Post Index which compares the costs of living of military and civilian expatriates in more than 400 locations outside Canada. If the index value of Moscow is 129, which is based on Ottawa=100, then it costs 29% more for a Canadian to live in Moscow relative to living in Ottawa to maintain the same standard of living.[3] The same is true for the Consumer Price Index which compares the cost of living in different communities. In other words, we need to calculate an index which not only ranks different communities based on their degree of remoteness, but also shows the relative cost of providing education services.

11. From the perspective of the schools, we can ask the question -- "What is the average capital and operating costs of providing educational services to children in one community compared to similar services in Toronto?" The answer requires the construction of a spatial producer price index. Ideally, the producer price methodology has to be followed for the purpose of assigning funding for education.

12. The first best approach is to construct a spatial price index for all of the 514 First Nations schools in Canada. The second best approach is to classify schools in each province into different categories according to their degree of rurality or remoteness and calculate spatial indexes for each category. The present report is an attempt in that direction without engaging in cost estimation which is beyond the scope of this report.

Examination of Various Educational Cost Drivers in First Nations Schools and Development of a Remoteness Indicator (RI) Specific to First Nation Education Funding

There are many factors that affect the cost of providing educational services to Aboriginal students in First Nations schools. In general, educational cost drivers in First Nations schools include socio-economic and demographic factors, limited resources, small enrolment, remoteness and lack of access to educational services. Many of the cost factors are not necessarily related to remoteness and rurality which is the main focus of the present report. To estimate a remoteness index, we have focused on the cost factors associated with remoteness. In general, we need to calculate an educational cost function using appropriate statistical techniques that calculate the impact of various cost factors on the level of funding required by different schools. In the absence of such cost measures, we propose remoteness indices that proxy those cost factors. Upon consultation with the Task Team and careful examination of the data, our research team came to the conclusion that the best approach to calculating a proxy for remoteness and lack of access to education services is to measure the following:

[2] Or (0.7-0.5)/0.5 = 40%.

[3] Statistics Canada (2018) "Canadian Foreign Post Indexes," available online at statcan.gc.ca.

1. The distance of each school from the nearest college and university since they provide complementary services.[4] If a community includes more than one college or university, then all those institutions will be included in the index.

2. The distance of each school from post-secondary institutions in the capital of each province as they are generally larger institutions and provide a more complete set of pedagogical services.

Our proposed model maintains the basic concept of the gravity model. From a theoretical perspective, it is a harmonic mean of the distances between various communities and the post-secondary institutions, weighted by the sizes of the institutions.

Review Provincial Approach to Remoteness and First Nations Comparability Funding Models

This section reviews how different provinces approach remoteness and rurality in their education funding models. We also review a report by the Parliamentary Budget Officer (PBO) that estimates the costs of First Nations education program spending and compares them with provincial education spending.[5] They find that INAC funding mechanisms:

1. Do not adequately take into account important cost drivers for band-operated schools;
2. Favour students living on reserves who attend provincial schools;
3. Put band-operated schools in remote northern regions at a significant disadvantage.

Estimating Remoteness Indices for First Nations Schools in Ontario

Using the data provided by the Task Team, we estimated remoteness indicators for 57 bands operating 55 First Nation schools with about 8,036 students in Ontario. We find that the NPR index and the Geographic Zone indicators used by INAC misrepresent the degree of remoteness to educational services in rural and remote communities. In fact, the major difficulties with the current approach used to fund remoteness in First Nations communities relates to the fact that INAC uses only the distance from a service center for education without consideration of pedagogical needs and requirements of schools. The same is true for the NPR index that measures distance from population centres. On the other hand, Health Canada uses the distance to the nearest physician services as a part of its remoteness index. The approach developed in this report can be applied to calculating access to health care and similar services as well.

Looking into the Future

Rather than using the newly developed Statistics Canada's remoteness indices in their present form, this report suggests an alternative approach that mitigates the theoretical and empirical shortcomings associated with the use of those remoteness indices. We suggest the following approaches that should be undertaken to improve the methodology and to reach a long-term stable funding formula.

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[4] Note, local and regional post-secondary institutions do not necessarily provide all the pedagogical needs required by individual schools.

[5] Office of the Parliamentary Budget Officer, "Federal Spending on Primary and Secondary Education on First Nations Reserves", Ottawa, Canada, December 6, 2016.

Short-Term to Medium-Term Strategy

1. Based on consultation with the Task Team, we have identified the main education cost drivers related to the degree of rurality and remoteness.

2. Each of the cost drivers should be scored for each community and the scores should be aggregated to arrive at a global remoteness score for each community. If enough observations are available, one can group schools into different categories based on their degree of rurality and thereby calculate a global remoteness index for each group.[6]

3. Using the global remoteness scores, communities are ranked based on their relative global remoteness scores.

4. The starting point or benchmark should be the provincial education funding for schools located in the provincial capital or other major urban centres since by definition they are located in urban centres whereby their global remoteness score equals zero.

5. Using the provincial education funding formula for urban schools and the global remoteness scores, one can adjust the education funding for rural and remote communities based on the benchmark in each province.

6. A report by the Parliamentary Budget Officer (PBO) suggests that tuition fees paid for First Nations students attending provincial schools meets the criteria for providing comparable provincial education programing. This information can be used to estimate dollar-based remoteness indices for various First Nations schools using the indicators developed in the present study.[7]

Long-Term Strategy

1. The precision of the funding calculations depends on how accurately the global remoteness score reflects the relative cost of education service delivery in various communities. Therefore, in the long-term, we need to estimate various cost drivers for each of the 514 schools and use them to arrive at a cost of education index for each school or community. This is equivalent to the producer price index that shows the relative cost of providing educational services in various schools or communities in Canada. Government of Canada has produced similar indices for Canadian foreign posts. Therefore, the same indicators can be produced for First Nation schools.
2. Alternatively, one can group First Nations schools in each province according to their degree of rurality and remoteness and estimate a producer price index (PPI) for each group. The estimated PPIs measure the cost of delivering educational services for each group.

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[6] Given enough schools in the sample, one can undertake regression analysis to estimate the impact of each cost factor on school funding requirements and using the regression result to forecast cost for other schools that are not in the sample.

[7] Unfortunately, the information on the tuition fees paid for First Nations students attending provincial schools was not available to our research team. This is an important gap that needs to be remedied in order to arrive at provincially comparable funding models.

3. If obtaining cost estimates for all schools is not feasible, one can obtain the cost of service provision for a diverse sample of schools in each province and estimate a regression equation linking cost of service delivery to various cost drivers. The estimated regression model can then be used to estimate the cost of delivery for all schools in various communities in each province based on their location and other cost factors.

PART I: INTRODUCTION, OBJECTIVE AND SCOPE OF THE STUDY

In September 2017 the Joint First Nations/Assembly of First Nations – Indigenous Services Task Team for the Unique Needs of Northern and Remote Communities began its work on First Nations education. One of the initial undertakings of this Joint Task Team was to address the underfunding of education in rural, remote and isolated communities. In December 2017 the Chiefs-in-Assembly resolved to support a new policy proposal for a new funding approach for First Nations on-reserve education as follows:

Phase 1: Regional funding allocations using the respective provincial funding formulas as a base allocation will take effect for the 2019-2020 fiscal year.

Phase 2: Regional Education Agreements will be concluded and supported by Regional Technical Tables between First Nations and the federal government.

The objective of the present study is to provide the following information in order to support the Regional Technical Tables:

1. To review various remoteness indicators as well as a newly published report, "Measuring Remoteness and Accessibility – A set of Indices for Canadian Communities" released May 9, 2017 by Statistics Canada. This review will investigate the applicability of the proposed remoteness indices to First Nations' education funding.

2. Identify potential areas for improvement of the newly proposed remoteness indices and propose ways that the index could be altered to be applicable to First Nations education funding in northern, remote and isolated communities.

3. To undertake research to investigate various remoteness calculations and models to support the work of First Nations in providing an objective basis for assessing and altering the regional funding models as well as the models developed through the Regional Education Agreements.

4. Identify various cost factors and how they impact education funding in rural and remote communities.

5. Propose techniques, models, calculations and approaches that best meet the needs of First Nations education in a northern, remote and isolated context.

6. Develop and estimate a new set of remoteness indicators for First Nation schools in Ontario.

7. Compare the estimated remoteness indices with the NPR index and the Geographic Zone indicators used by INAC.

8. Identify data gaps and propose approaches to close that gap.

9. Suggest short-term and long-term approaches to identify an appropriate education funding model for First Nation schools.

To achieve the above objectives, the present study reviews various remoteness indicators developed in Canada and other countries and evaluates their applicability to First Nations education funding in

northern, remote and isolated communities. Various cost factors are identified and approaches developed to incorporate those factors in the development of any specified remoteness indicator.

The concepts of remoteness and accessibility have received significant attention in recent years. Many different approaches have been used to measure remoteness. These measures and indexes differ from each other depending on how they define and measure remoteness. For example, there are three variations of remoteness indicators that are applied at the national level in Australia. The difference between them stems from how they measure distance; whether they use population size and actual distance from the population centres; whether they produce discrete or continuous measurement indexes or whether they use minimum road distance to a service centre.

In general, any remoteness and accessibility index should have the following properties:

1. Indices should be developed for the specific issue or policy under consideration. General approaches help conceptualizing the issue but are not applicable to any specific field of study;

2. Indices should have a clear practical purpose and allow policy makers and program evaluators to assess the impact of various policy measures on the socio-economic program or issue under consideration;

3. Indicators and their various components should be based on theoretical consideration. Proxies used should be sensible;

4. Indicators should allow for periodic updating and monitoring;

5. Indicators should be easy to calculate and intuitively appealing;

6. Ranking of various communities as urban, rural, remote, etc. must be stable so the planners can plan for the long-term rather than changing the funding plans as the ranking of the communities change.

The study is organized into seven parts. Part I is the introduction. Part II reviews various remoteness indicators developed in Canada and other countries. Part III assesses the applicability of the newly published report entitled, “Measuring Remoteness and Accessibility – A set of Indices for Canadian Communities” by Statistics Canada to First Nations education in northern, remote and isolated communities. Part IV examines various educational cost drivers in First Nations schools and develops a new remoteness indicator for First Nations schools that does not suffer from the shortcomings of the existing indices. Part V examines the provincial approach to remoteness and First Nations comparability funding models. This part also reviews a recent report by the Parliamentary Budget Officer (PBO) that attempts to estimate the cost of First Nations education program spending and compares them with provincial education spending. Part VI estimates remoteness indicators for First Nations schools in Ontario and compares them with other remoteness indicators used by INAC (Indigenous and Northern Affairs Canada) and Statistics Canada. Part VII provides concluding remarks.

PART II: REVIEW OF VARIOUS REMOTENESS INDICATORS

Geographic Proximity is one of the main factors shaping the socioeconomic opportunities of various communities. Remoteness and distance from the points of service provision results in reduced access to services and economic opportunities, higher cost of living as well as increased cost of service provision. Various measures have been used to mitigate or compensate rural and remote communities for the increased cost of service delivery resulting from their specific geographic locations.

For this reason, the concepts of remoteness and accessibility have received significant attention in recent years. Many different approaches have been used to measure remoteness. These measures and indexes differ from each other depending on how they define and measure remoteness. Each definition emphasizes different criteria and thus the choice of the indicator depends on the issue at hand and the specific policy the indicator is designed to influence. However, there are certain properties one expects the indicators to have in order to be useful for policy making. Ideally, we want to use an index which:

a. Is easy to calculate. It is often the case that simplicity reduces statistical errors and biases and results in more accurate indicators;
b. Results in stable ranking of communities over time and therefore enabling policy makers to make long-term plans;
c. Is intuitively appealing, theoretically-based and easy to understand;
d. Remoteness indicators must assign different degrees of remoteness or rurality to communities since remote communities have greater cost of providing services than those that are closer to service centres. Classifying communities as either remote or not remote is not adequate. Grouping must be based on empirical evidence;
e. Service centres must be selected based on the type of services the indicator is designed to measure.

The concepts of remoteness, rurality and accessibility have been the subjects of investigation by economists, geographers and health researchers and other social study groups. Remoteness is often interpreted as the lack of access to a range of services. In fact, the geographic proximity is the common element at the core of different remoteness concepts. The economics literature emphasizes remoteness in the context of countries trading with each other and focuses on how distance plays a role in determining trade flows and/or trade barriers. Economists have also been interested in the socio-economic impact of remoteness and isolation on rural population. The major theme of this literature is access or lack thereof of rural population to labour markets, healthcare, education and other services.[8] In practice, individual's health, education, income and other socio-economic conditions are influenced by where they live.[9]

The health study literature emphasizes accessibility to health services for individuals in rural and remote communities.[10] The literature points out the health outcome of not having access to health services in

[8] See B. Moazzami, "Strengthening Rural Canada: The Current and Future State of Rural Ontario", a report prepared for Essential Skills Ontario, 2014. Similar reports were prepared by the author for BC, Saskatchewan and Newfoundland and Labrador.
[9] See B. Moazzami, "It's What You Know (And Where You Can Go): Human Capital and Agglomeration Effects on Demographic Trends in Northern Ontario, Prepared for Northern Policy Institute, 2015.
[10] See for example, The Garvan Research Foundation, "A Rural Perspective: Cancer and Medical Research 2016".

remote rural areas. In general, this literature defines remoteness by distance from specific service locations such as hospitals, medical doctors, etc. and/or travel time required to access such services.[11]

Geography has been the common element of all remoteness and accessibility literature. In general, the geographic focus has been on physical distance and isolation from population centres. Various researchers have defined rurality and remoteness differently. In fact, there are various indices of rurality and remoteness used in Canada and other countries. One of the early remoteness and rurality indicators was developed by the Australian Institute of Health and Welfare in 2004.[12] The objective was to compare a wide range of health and welfare indicators across Australia's major cities, regional and remote areas. The report examined three major classifications that organized areas into different degrees of rurality.

The first and oldest classification that was developed in 1994 by the Department of Primary Industries and Energy in Australia is the Rural, Remote and Metropolitan Areas classification (RRMA). This approach classifies each Statistical Local Area (SLA) as either urban, rural or remote based on distance from the centroid of an SLA to the nearest urban centre (service centre) as well as the SLA's population density.[13] One potential shortcoming of the RRMA definition is the use of the centroid of the SLA as the reference point for calculating distance to urban or service centres. In practice, the SLA's population can live some distance from its centroid.

A refinement to the RRMA definition of rurality was developed in 1997 by the Department of Health and Aged Care. It is referred to as the Accessibility/Remoteness Index of Australia (ARIA) and is a strictly geographical classification. ARIA is based on the road distance as a measure of remoteness and on the population size of a service centre as a proxy for the availability of services. This approach results in a continuous index ranging from 0 indicating highest level of access to goods and services to 12 suggesting the highest level of remoteness. To calculate the ARIA index, service centres are classified into four categories based on their population size as:

Category 1: Population 5000 to 17,999

Category 2: Population 18000 to 47,999

Category 3: 48,000 to 249,999

Category 4: Greater than 250,000

Then the road distance between each SLA and each of the four nearest service centres are calculated and divided by the average distance of all SLAs from their four closest service centres. These four indexes measure the relative distance of a SLA to four types of service centres. Each of these four indexes are capped at three. Finally, an index of remoteness equals the sum of the relative distance of each SLA from the four service centres. Therefore, this overall index ranges from 0 to 12. It is clear that the lower the

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[11] See Simon, Howard, Arnold Reisman, Shahriar Javad, and Diane Sachs (1979), "An Index of Accessibility for Ambulatory Health Services", Medical Care, Vol. 17 (9):894-901.

[12] Australian Institute of Health and Welfare, "Rural, regional and remote health: A guide to remoteness classifications", March 2004.

[13] The SLA is the base spatial unit used by the Australian Bureau of Statistics (ABS) to collect and disseminate statistics other than those collected in Population Censuses' (ABS 2002). SLAs are based on the administrative areas of local government where these exist. Where there is no incorporated body of local government, SLAs are defined to cover the unincorporated areas. Service centre is defined as an urban area with a population of 5,000 or more.

index, the closer a SLA is to the four types of service centres compared to the average. Finally, the calculated remoteness indices are classified into the following five classes:

- Highly accessible: Index = 0 to 1.84,
- Accessible: Index>1.84 to 3.51,
- Moderately accessible: Index >3.51 to 5.80,
- Remote: Index > 5.80 to 9.08,
- Very remote: Index >9.08 to 12.

The ARIA methodology is simpler than RRMA since it measures remoteness only in geographical terms. The weakness of the approach is that it does not allow for differences in road conditions and road quality which might affect access to service centres. Similarly, not everyone has access to transport. Also, the cutoff points are rather arbitrary and can lead to different shares of people in remote areas.

In 2001, the Australian Bureau of Statistics (ABS) released a new improved version of the ARIA index referred to as the ASGC (Australian Standard Geographical Classification) Remoteness classification or simply ARIA+ which added an additional classification to the above four types of service centres, i.e., centres with populations of 1000 to 4,999 persons. Therefore, the new index is referred to as ARIA + methodology. This index is calculated in a similar manner as ARIA except that ARIA + measures distance from five categories of service centres and ranges from 0 to 15. Again, the remoteness indices are classified into the following five classes:

- Major Cities of Australia: Index between 0 and 0.2
- Inner Regional Australia: Index >0.2 to 2.4
- Outer Regional Australia: Index >2.4 to 5.92
- Remote Australia: Index >5.92 to 10.53
- Very Remote Australia: Index >10.53 to 15

Adding another category to service centres improves the accuracy of the index. However, this new index is less stable since it is more likely that the population of the new category changes over time resulting in reclassification of service centres. The ABS has advised caution in using remoteness indexes alone to address policy issues and funding. There are other socio-economic indicators that need to be considered in conjunction with the remoteness indicators.

Statistics Canada has also developed and used various remoteness indicators to geographically classify census subdivisions (CSDs) into rural and urban areas. In the 1996 census dictionary, Statistics Canada defines rural areas as sparsely populated lands lying outside urban areas. Urban areas are defined as having a minimum population of 1000 and population densities of 400 or more people per square kilometer. Non-urban areas are referred to as rural areas that are places of 1000 people or less or have densities of less than 400 people per square kilometer. The building blocks for the census rural area are the enumeration areas which are geographic areas canvassed by one census enumerator, ranging in size from a maximum of about 440 dwellings in large urban areas to a minimum of about 125 in rural areas.

A 2002 report by Plessis, Beshiri, Bollman and Clemenson discussed six different definitions of rurality.[14] They show that different definitions generate a different number of rural and urban populations. The authors advise that the appropriate choice of a definition be determined by the question being addressed. The choice depends on which geographic dimensions are most relevant to the issue at hand. Is it the population size, population density, labour market or settlement context? They suggest using "rural and small town" definition as the starting point. This is the population living in towns and municipalities outside the commuting zone of larger urban centres defined as centres with a population of 10,000 or more.[15] This definition incorporates the degree to which a given CSD is socially and economically integrated with an urban core. This is measured by commuting flows which appears to be a more empirically-based and sensible definition of access than distance used in other studies.[16] The authors state that (p.9): "In broader terms, commuter flows proxy "access" of a population to services such as health and education facilities, financial institutions, shopping centres, cultural centres and sports facilities. They reflect the relative influence of an "urban centre" on a rural area." Since this definition is based on commuter flows, it reflects access to labour market and other social and economic opportunities.

Using the size of the commuting flows, all CSDs in Canada are classified as urban or rural with different degrees of rurality or remoteness depending on the degree of commuting flows and are assigned a Statistical Area Classification Type (SACtype) ranging from 1 to 8 signifying their degree of rurality or remoteness:

- All CSDs within CMAs and CAs are classified as urban areas and are assigned an index of 1 to 3.
- All CSDs outside CMAs and CAs with a strong metropolitan influence zone (Strong MIZ) are those with 30% or more of their employed workforce commuting to work in an urban centre. These CSDs are rural areas in proximity to urban centres and are assigned an index of 4.
- All CSDs outside CMAs and CAs with a moderate MIZ are those with at least 5% but less than 30% of their employed labour force commuting to work in any urban centre. These CSDs are rural areas with limited or moderate access to urban centres and are assigned an index of 5.
- All CSDs outside CMAs and CAs with a weak MIZ where more than 0% but less than 5% of their employed labour force commutes to work in an urban centre. These CSDs are considered remote rural regions and are assigned an index of 6.
- All CSDs outside CMAs and CAs with no MIZ suggesting they have a small employed labour force and have no commuters to a CMA/CA urban core. These CSDs are considered very remote rural areas and are assigned an index of 7.[17]

[14] Valerie du Plessis, Roland Beshiri, Ray D. Bollman and Heather Clemenson, "Definition of Rural", Statistics Canada, Research Paper, 2002, Cat.# 21-601-MIE – No. 061.

[15] More specifically, the population living outside Census Metropolitan Areas (CMAs) and Census Agglomerations (CAs).

[16] Commuter flows are calculated using place of work data from the census. See Chuck McNiven, Puderer Henry and Darryl Janes, "Census Metropolitan Area and Census Agglomeration Influenced Zones (MIZ)", Statistics Canada, Geography Working Paper Series No. 2000-2, 2000, Cat. No. 92F0138.

[17] Census subdivision within the territories, outside of census agglomeration are assigned a SACtype of 8.

There are a number of reasons why the authors of the 2002 report prefer using the rural and small town definition of rurality and remoteness. Their reasons include:[18]

1. Use of census subdivision (CSD) as the main building block of rural and small towns approximates a community and many rural issues are community-level issues.
2. Each building block is assigned according to a functional criteria, its degree of integration with a larger urban centre. The degree of integration that is measured by commuting flows is a good proxy for many rural issues such as the access to health care, to education facilities, to government services, etc. Commuting flows are highly correlated with the other measures of integration such as shopping patterns or access to major health facilities, etc.
3. The use of metropolitan influenced zones refines the degree of integration and the degree of access of rural populations to larger urban centres and provides a good measure of the degree of remoteness or rurality.

Definition of rurality and remoteness matter significantly as it determines the share of population with low or no access to service centres as compared to those living in urban centres. For example, depending on the definition selected, Canada's rural population may vary between 22% and 38% of Canada's total population.[19]

Focusing on the socio-economic characteristics of the population living in rural and small towns and census rural areas, Plessis et. al. find that those living in rural areas have an average family income that is substantially lower than the Canadian average and have higher incidence of low income. Similarly, in studying rural and small town population in various Canadian provinces, Moazzami (2014) finds that those living in relatively remote and very remote regions of the country have much lower income, lower labour force participation rate, higher unemployment rate, lower level of educational achievement and higher incidence of poverty.

There were 5,162 census subdivisions in Canada according to the 2016 census. Census subdivision is the general term for municipalities (i.e., incorporated towns, rural municipalities, cities, etc. as determined by provincial legislation) and their equivalent for statistical purposes such as Indian reserves, Indian settlements and unorganized territories. Each of the 5,162 CSDs in Canada is assigned a Statistical Area Classification (SAC) type that shows its degree of remoteness or access to urban or service centres.

Finally, INAC uses a different classification system to rank First Nations schools as located in urban, rural or remote areas. According to the Band Classification Manual used by INAC about 31.5 percent of First Nations Schools are considered Urban, 46.9 percent are Rural, 2.5 percent are Remote and 19.1 percent are Isolated and require Special Access.[20]

INAC geographical classification takes into account the distance from the nearest service center, which is defined as the nearest community where a First Nations school can access government services, banks

[18] Plessis et. al. page 35.
[19] Plessis, et.al., page 18.
[20] Ibid, p. 10-11

and suppliers.[21] Using the above definition of a service centre, First Nations schools are classified geographically into the following zones:

Zone 1: *The First Nation is located within 50 km of the nearest service centre with year-round road access.*

Zone 2: *The First Nation is located between 50 and 350 km from the nearest service centre with year-round road access.*

Zone 3: *The First Nation is located over 350 km from the nearest service centre with year-round road access.*

Zone 4: *The First Nation has no year-round road access to a service centre and, as a result, experiences a higher cost of transportation.*

The INAC remoteness and isolation indicators are not necessarily relevant for accessing educational or health care services. As mentioned, in the Simon Management Services' study (2006), the INAC remoteness and isolation factors do not consider:

- The distance to access provincial pedagogical services for the school.
- The distance to the nearest provincial school with the same language of instruction.
- The additional costs of hiring qualified replacement teachers.
- The distance to the nearest First Nation School within the same Nation for language and cultural sharing.
- The distance to be traveled to a city to recruit teachers or professional services for the school.
- Road access that also affects the ability to hire teachers who may not want to travel the road or the distance, and the additional cost of maintaining boarding for teachers and other professionals.
- Access to library resources particularly for remote communities, available in the working language of the community.
- Cost of moving teachers to the community for the school year.

As mentioned above, there are about 514 First Nation schools in Canada. Therefore, the best case scenario is to develop producer price indices to measure the cost of producing educational services for all 514 First Nations schools. These indices can be easily updated to reflect changes in the cost of producing educational services. The second best scenario is to group First Nations schools in each province according to their degree of rurality and estimate producer price indices for each group. A regression model can be estimated for each group based on various cost factors and used to calculate the cost of producing educational services for individual schools.

[21] INAC (2005). Band Classification Manual. Corporate Information Management Directorate Information Management Branch. May 2005.

PART III: REVIEW OF THE REPORT TITLED, "MEASURING REMOTENESS AND ACCESSIBILITY – A SET OF INDICES FOR CANADIAN COMMUNITIES."

A recent report by Statistics Canada proposes a new set of remoteness and accessibility indices (hereinafter referred to as "the remoteness index") for Canadian communities.[22] The authors claim that their study "was undertaken in response to the need to update and upgrade the current measures of remoteness. The objective was to conceptualize and implement a method that takes into account the most recent literature on the subject, as well as taking advantage of new computational opportunities provided by the integration of official statistics with data from non-official statistical sources."[23]

The authors set a series of guiding criteria for designing a remoteness index as:

1. The index should be able to cover the entire country at a small geographic scale. For this, they use CSD as their basic building block for the remoteness index. This makes it easy to compare it to the rural and small town index discussed above.

2. They envisage a continuous Index as opposed to categorical measures. It is not clear why a continuous measure is preferred to a categorical one especially since one has to select some ad-hoc cutoff points to differentiate between different levels of remoteness.

3. The focus of the remoteness index is on physical proximity as in the other indexes discussed above.

4. The authors preferred a method that accounted for proximity to multiple points of service provision (or agglomeration), as well as the different population sizes of these multiple points. As a result, methods based on a gravity model approach were preferred.[24] As discussed above, ARIA and rural and small town indexes are also based on proximity to multiple points of service provision.

5. As a general index, they used proximity to population centres as their point of reference. As mentioned above, population centre is defined by statistics Canada as an area with a population of at least 1,000 and a density of 400 or more people per square kilometer.

6. They distinguish between two types of CSDs; those that are connected to a population centre through the national road and ferry network and those that are not connected through the national road and ferry network.[25] The authors tried to combine the two types of CSDs using

[22] A. Alasia, F. Bedard, J. Belanger, E. Guimond and C. Penney, "Measuring remoteness and accessibility –A set of indices for Canadian communities", Statistics Canada, Cat. No. 18-001-X, May 9, 2017.
[23] Ibid, p. 4.
[24] For a discussion of the gravity model see Head, Keith (2003) "Gravity for Beginners," Faculty of Commerce, University of British Columbia.
[25] Authors state that (p. 9-10): "There are 149 CSDs that had population reported in 2011 and were not connected to a population centre through the main road or ferry network. Some of these geographic units can only be reached by air transportation, while others can be reached by a combination of transportation means, including regular flights, charter flights, railway, regular ferry or charter boats. For the purpose of this analysis, any CSD

proxies for cost and distance that introduced additional complications and measurement errors in their calculations.

One of the main issues the authors attempt to quantify is the concept of proximity. As we saw above, ARIA type indexes use distance to multiple service centres as a proxy for proximity. The rural and small town index uses commuting flows as a proxy for proximity. The authors of the "remoteness index" state that (p.10): "there are multiple units of measures that could be used (including network distance, travel time and travel cost). In addition, various options could be used in order to identify the representative points from which distance can be calculated." The authors decided to use travel costs as a measure of proximity. As we see below, there are serious problems with their choice of a proxy for proximity.

Another issue the authors discuss relates to selection of a representative point in a CSD. The methodology used is summarized in the following three typical cases (page 11-12):

1. For CSDs with one or more population centres, the representative point is placed in the centre of the largest population centre of the CSD. This point is located no more than 100 metres from a major road or highway.
2. For CSDs with one or many small dwelling clusters (between 100 and 400 people per square km), the representative point is placed in the centre of the largest cluster of population, no more than 100 metres from a major road or highway.
3. For remote CSDs that do not have any population clusters with a population density of less than 100 people per square km, the representative point is placed at the geographic centre of the polygon (geographic centroid), no more than 100 metres from a major road or highway. If there are no roads in the CSD, the point is placed near an airport, railway station or sea port.

The choice of the reference point is dictated by the objective of generating a general index of remoteness. None of the choices of the reference point relates to the points of providing education or health care services and thus any application of the resultant indices to access to education or health care services is not warranted.

Having defined a representative point of a CSD, the next question relates to the unit of measure of distance. As mentioned above, the authors consider three units of measure, namely network distance, travel time and travel cost, but decided to use travel cost as a common metric of proximity in order to generate a continuous index of remoteness. They point out that travel distance may not accurately represent proximity if the available modes of transportation are different. Similarly, travel time may not accurately measure proximity if comparing a fly-in community with a road-accessible community. This complication has arisen due to their attempt to combine all types of CSDs. Therefore, authors state that (p.14): "Since the index of remoteness was intended to reflect the socioeconomic conditions of a community, travel cost was used as a common metric of proximity for all CSDs in Canada. The calculations of travel costs used in this analysis are based on the cost for one individual traveling between two locations using the most accessible and less expensive travel option. All travel time values were converted to a cost for communities connected to a population centre through the road network, and individual

which did not have full year-round access to a population centre through the main road network was flagged as community not connected to the main road network."

travel costs for communities not connected to a population centre through the road network were retrieved from various sources."

For CSDs that were connected to population centres by road or ferry, the travel duration is converted to cost using the average cost of $0.17 per km based on driving a vehicle in Canada taken from the Canadian Automobile Association, 2012. Travel times between CSDs were taken from Google Maps API at an average travel speed of 80 km/h or $13.60 per travel hour. They also set a 200 km or 2.5 hour threshold as a limit for accessing services on a daily basis. Applying the same $0.17 per km to all CSDs irrespective of their degree of rurality is obviously incorrect. For example, gasoline prices are much higher in northern rural communities than in southern population centres. Assigning lower cost of travel to northern communities reduces their travel cost and underestimates their degree of remoteness.

For CSDs not connected to a population centre through the road network or regular ferry service, the authors sought the lowest cost for one individual traveling one-way by train or by air to the closest and/or most accessible population centre. Again, there are serious problems with their choice of travel cost. Using the lowest cost of one-way travel underestimates the true cost of travel that often includes accommodation and other costs. As a result of underestimating travel cost, the remoteness index underestimates the degree of rurality.

For CSDs that do not have any regular service by air or boat, a linear model was used to convert linear distances into costs. The linear model was estimated based on data from 184 non-connected CSDs that had regular air service to a population centre.[26] The authors do not report any of the statistical properties of the estimated model. Thus, one cannot assess the accuracy of the model or attach a precise level of confidence to the cost predictions of that model.

In general, using cost based on travel time taken from Google Maps API makes the index very unstable. Travel time changes from day to day and season to season depending on road and weather conditions. Similarly, the travel cost per km is much higher in northern communities. Thus, applying an average cost per km underestimates the true travel cost in northern CSDs. Also, in some cases, such as in Northeastern Ontario, rail and bus transportation services provided by Ontario Northland to remote northern communities are subsidized by the province and thus the least cost travel option underrepresents the true distance between northern CSDs and nearest population centres and therefore underestimates the degree of rurality and remoteness.

Any application of the remoteness index to education, health care or any other specific services is problematic since the index does not measure the proximity to any of the specific service provision centres. For example, education services can often be accessed through post-secondary institutions. Not all population centres have post-secondary institutions. The use of this index becomes even more problematic when attempts are made to apply it to health care services. The reason is that there are various types of services and no single point of reference provides all the necessary services. Therefore,

[26] The estimated linear model used appears to be: cost = 0.7684 * km + 42.178. The authors also state that (p. 14): "Cost for transportation by boat is highly variable, and depends on boat size, weight, and the conditions on the water (currents, wind, tide, size of waves). It is difficult to obtain precise average costs for traveling by boat. As a result, for CSDs with boat as the only travel option, the boat section of the itinerary was converted from distance to time using 30 km/h as the average speed (average speed for boat or ferry), and then converting to the cost of $13.60 per hour as would be for travelling on the road network."

using population centres to measure access or proximity to education or health care services is not appropriate. Note that the rural and small town index uses proximity to CMAs and CAs that are more likely to have post-secondary educational institutions.

The true measure of proximity must be based on the number of people who can and do actually travel from each CSD to various population centres. It is obvious that the best indicator of proximity is the number of individuals who actually commute to service centres on a regular basis. If a centre is accessible, then one should observe many individuals traveling to receive services on a regular basis. The actual number of commuters is a significantly better proxy for proximity than setting a limit and assuming that individuals would commute within that limit irrespective of road and weather conditions. This is the unit of measure of distance used in the rural and small town index.

The authors also present a set of accessibility measures. They argue that those measures are highly correlated with the remoteness index which is to a large extent expected. The accessibility measures are also calculated based on the same gravity model as the remoteness index with two exceptions:[27]

1. Travel time is computed from census subdivision (CSD) to CSD, instead of CSD to population centre as in the remoteness index.
2. Total revenue by CSD for selected business types accounts for the availability and size of services, instead of population size.

The authors used business microdata from the 2012 Business Register (BR) to obtain the total revenue data. They claim that the accessibility measures, or similar variations of these measures, could be used to fine-tune the remoteness index or to differentiate between degrees of rurality or remoteness.

There is a major problem with the use of the gross revenue data as a measure of accessibility. Gross revenue equals prices multiplied by the quantity of goods and services sold or purchased by users. Therefore, gross revenue can rise if quantities of goods and services provided stay unchanged but the prices increase and make the goods less affordable for users. In this case, the accessibility index shows increased access when in reality the quantity of services has not changed. Similarly, gross revenue can rise if quantity of goods and services provided decline but prices rise significantly. Again, the index shows increased accessibility while in practice, users face declining services and rising prices.

Data Used and the Computational Model

Population counts are based on the 2011 Census of Population. In cases of the incompletely enumerated CSDs, the authors used other supplementary population information from other official sources. The travel distance and travel time were calculated by the Google Maps Distance API. The model used is based on the gravity model and takes into account access to multiple points of service provision. In this sense it is similar to the ARIA and rural and small town indexes. The remoteness index (RI) of the ith CSD from multiple population centres is expressed as the sum of the population size (POP_k) of each population centre within the distance and travel time thresholds divided by the travel cost (C) of the ith CSD from the respective population centres as:

$$RI_i = \ln \sum_{k=1}^{n} (POP_k / C_{i,k}) \qquad (1)$$

[27] A. Alasia, F. Bedard, J. Belanger, E. Guimond and C. Penney, "Measuring remoteness and accessibility –A set of indices for Canadian communities", Statistics Canada, Cat. No. 18-001-X, May 9, 2017, pages 4-5.

Where the summation is over n potential accessible population centres. ln is a natural logarithm meant to scale down the index. It is not clear why the authors apply the logarithmic transformation to the sum of the ratios. This non-linear transformation makes the comparison of the resultant indices problematic. Also, having travel cost or distance in the denominator suggests that the index increases indefinitely as distance to population centres declines. Moreover, the index becomes indeterminate when distance approaches zero. In other words, one cannot calculate the value of the remoteness index as we get very close to population centres. To remove this inconsistency, the authors have made an ad-hoc assumption that $C_{i,k}$ = \$3 if the distance from a population centre is less than 5 km.[28] As we will see below, there is a more sensible formulation of the remoteness index that avoids this inconsistency and thus removes the necessity for making ad-hoc assumptions.

Model (1) shows that the remoteness index is calculated based on the proximity of a CSD to all population centres within the set radius and the population size of each population centre. The remoteness index as formulated above suggests that the higher the index, the less remote the community. However, the indices reported by the authors equal 1- RI_i, which can potentially create confusion for the reader of how the relationship has been reversed.[29]

The accessibility index follows the same structure but uses different proxies. The index attempts to measure access to the supply of services in other CSDs or population centres. Therefore, the accessibility index measures distance from a CSD to another CSD. Communities with no access to road network and did not have access to a specific service were flagged as "no direct access" to the service. Thus, there has not been any need to calculate travel cost for non-connected communities and simple travel time ($T_{i,k}$) taken from Google Maps Distance API is used as a measure of distance. Gross business revenue (TotRev) is at the CSD level for specific businesses grouped based on their NAICS code is used as a measure of service availability. In formal terms, the accessibility index of ith CSD to each type of service/product is specified as:

$$AM_i = \ln \sum_{k=1}^{n} (TotRev_k / T_{i,k}), \qquad (2)$$

Gross revenue is used as a proxy for the presence and size of a specific service or product provision. Travel time from the ith CSD to all other CSDs within the 2.5 hour threshold ($T_{i,k}$) is used as a measure of distance. Again, caution should be taken in comparing different CSDs and different types of services. Some services like education and healthcare are publicly funded and subsidized and the calculation of the gross revenues becomes problematic. The gross revenue, irrespective of how it is calculated, is not proportional to the true quantity of the goods and services provided. Comparison of the gross revenue of some other sectors, such as the retail sector, are also problematic. Since prices are different in different CSDs, the gross revenues cannot represent access to those products or services since greater revenue does not necessarily imply greater quantity of goods or services.[30]

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[28] Assumption c on page 16 and 17.

[29] Note that as an alternative specification, the authors could have used a harmonic index, defined as $RI_i = [\sum POP_k C_{ik}^{-1}]^{-1}$ which represents a harmonic weighted sum of the travelling cost C_{ik}, using the population POP_k as the weights. It is a direct measure of the remoteness instead of an inverse measure as used by the authors.

[30] Note, the same mathematical problem is present in the accessibility index. It becomes indeterminate as one gets closer to the population centres.

Finally, the remoteness index is based on the weighted sum of travelling costs, while the accessibility indices are a weighted sum of physical distances between CSDs. Both types of indices go through two mathematical transformations, namely a logarithmic function and a rescaling. The resulting indices are at best ordinal indices, which means that they can be used to assign rankings to CSDs with respect to their remoteness or accessibility of particular goods or services. Nothing can be said about the numerical differences between the indices. As mentioned above, one needs to develop cardinal indices that can be used to rank as well as measure the differences in the costs of service provision related to the degree of remoteness.

PART IV: EDUCATIONAL COST DRIVERS & DEVELOPMENT OF REMOTENESS INDICATORS FOR FIRST NATIONS SCHOOLS

There are many factors that affect the cost of providing educational services to Aboriginal students in First Nations schools. A study of educational cost drivers in First Nations schools was undertaken in 2006.[31] The study identified the following factors as the main cost drivers in First Nations schools:[32]

1. Social, demographic and economic inequalities, as well as cultural and pedagogical needs of First Nations students.

2. Unlike provincial schools, First Nations secondary schools are funded in the same manner as the elementary schools, without consideration of the need to provide streaming within the major core subjects, and additional options for certification. Most schools can only provide basic courses. In many cases, students have to spend a transitional year in a UCEP program to get the extra mathematics or science options that the community could not afford to give.

3. The average class size for First Nations schools is smaller.

4. The composition of a First Nations classroom is unique to First Nations schools due to:
   a. the prevalence of special needs students and students at risk in the classroom population,
   b. the number of students requiring a second language approach due to dialectical spoken English or French,
   c. the unique Language and Culture curriculum being taught in addition to the provincial curriculum,
   d. the learning style difference of the students,
   e. the teaching style difference of a First Nations teacher,
   f. the distinctive social context of a First Nations classroom,
   g. the location of the school.

The above cost factors are not necessarily related to remoteness and rurality which is the main focus of the present report. To estimate a remoteness index, we need to take into account the cost factors associated with remoteness. In general, we need to calculate an educational cost function using appropriate statistical techniques that calculate the impact of various cost factors on the level of funding required by different schools. In the absence of such cost measures, we provide remoteness indices that proxy those cost factors. A discussion of cost factors in a recent meeting with a joint task team on unique needs of northern and remote communities on March 1, 2018, identified the following cost factors related to remoteness and isolation:

1. Community has no road access. The remoteness indices for these communities have to be calculated separately from those with year-round road access. The weights used in calculating remoteness indices for communities with no road access have to incorporate the higher cost of services in those communities.

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[31] Simon Management Services, "A Study of Educational Cost Drivers to First Nations Education", Final Report, prepared for the joint AFN/INAC BOFF Working Group, April 2006.
[32] Ibid, pages 7-10.

2. Community is accessed by logging road.
3. Community has access to lodging for teachers within 30 km of community.
4. Community is linguistically isolated (Francophone communities outside Quebec).
5. Presence of another First Nation or Provincial school within 50 km radius for language and cultural sharing.
6. Community has no cell service.
7. The connectivity of the community is less than 50 Mbps and transmitting capacity is 10 Mbps for fixed band width.
8. Distance from the nearest post-secondary institutions

Members of the Task Team for the Unique Needs of Northern and Remote Communities we communicated with emphasized the importance of proximity to post-secondary institutions. One of the members states that the list of educational services are long and diverse from speech and language specialists, occupational therapists to legal experts to mechanical system control experts, etc. Another member suggests that close proximity to a post-secondary institution may provide various services/supports including cultural supports, peer support, disability service, student advocates, counselling/mental health, tutoring, social interactions, sports/recreation, practicum placements, job placements, potential employer networks, employment opportunities while studying (student and spouse), expanded world view, etc. In addition they argue that:

> a) Access to educational services is a combination of both the awareness of the service, and the availability of the service either through in-person interaction or electronic interaction. While post-secondary institutions may provide services directly related to academic support, indirect support may be provided by the broader community in which the institution is located. (job/practicum placements, health services, financial services etc.)
>
> b) Proximity to a college would be just as relevant as proximity to a university. Within the regional context, the urban centres in which colleges are located provide most, if not all, of the services available to university students. Furthermore, one could argue that First Nation colleges are even more sensitive to the specific learning needs of their students by providing a more holistic approach to education.
>
> c) As with all professions, on-going professional development is imperative in keeping abreast of recent developments within the respective field. Therefore, the ability to access post graduate offerings from an institution, or a professional association, are critical. As an educator, increasing your repertoire of skills and abilities allows you to reach those students who are under-achieving or whose learning is hampered by socio-economic factors or learning exceptionalities.

The fact that must be taken into account in a calculation of the remoteness index measuring proximity to education services or lack thereof, is that the nearest educational service centre may not have enough service providers to provide the services required by a given school. In other words, the nearest educational institution might itself be relatively small compared to the major educational institutions in the respective province. Therefore, in calculating the index, one must take into account the size of the nearest post-secondary institutions as well as their distances from each community.

Remoteness factors 1 to 7 take binary values of zero or one. The value one should be assigned if the community does not have the service or access to it or is only accessed by logging road. The value of zero should be assigned otherwise. The sum of the binary values is one measure of relative remoteness.

Calculation of the remoteness factor 8, which is the focus of the present study, is more demanding. We need to allow for the fact that not all post-secondary institutions have all the services required by the communities. In other words, the bigger the institution, the greater the possibility of having the needed services. In addition, colleges and universities provide complementary sets of service that are not necessarily substitutable. We use the number of students as a proxy for the size of the post-secondary institutions. We also need to take into account the distance of each community from their nearest post-secondary institutions. For this we use the actual road distance for communities with road access and flying distance for communities with no road access. As mentioned before the remote communities with no road access have to be treated as a class of their own and this index simply ranks their remoteness within that group of communities. To compare the index for no road access communities with the others, one needs to apply a remoteness factor to the index to account for the higher cost of transportation and therefore service delivery.

To quantify factor 8, we adopted different strategies. Following Statistics Canada's recent report on remoteness indices, we first set the threshold for proximity to post-secondary institutions at 200 km distance. It turned out that the distance from the nearest post-secondary institution for many First Nations schools in northern Ontario was significantly greater than 200 km. Therefore, we had to adopt a different approach. Upon careful examination of the data, our research team came to the conclusion that the best approach is to measure the following:

1. The distance of each school from the nearest college and university since they provide complementary services.[33] If a community includes more than one college or university, then all those institutions will be included in the index.

2. The distance of each school from post-secondary institutions in the capital of each province as they are generally larger institutions and provide a more complete set of pedagogical services.

Our index maintains the basic concept of the gravity model. From the theoretical perspective it is a harmonic mean of the distances between community i and the post-secondary institutions weighted by the sizes of the institutions. The harmonic mean is a popular index formula in the price index literature.[34] It calculates proximity (PR) of each school to post-secondary educational services as the inverse of the summation of the number of students registered in the nearest post-secondary institutions as well as those in the provincial capital divided by a distance (D_{ik}) from school i to each of the respective institutions.

In formal terms, the index can be written as:

$$PR_i = \frac{1}{\sum_{k=1}^{n}\left[\frac{Number\ of\ Students\ in\ kth\ Post-secondary\ Institution}{Dik}\right]} \qquad (3)$$

[33] Note, local and regional post-secondary institutions do not necessarily provide all the pedagogical needs required by individual schools.

[34] Diewert, W. Erwin (2004) "Elementary Indices," in Consumer Price Index Manual: Theory and Practice, Geneva: International Labour Office, Chapter 20, 355–371.

The above proximity indicator is intuitively appealing. It will be large for schools in rural and remote regions and small for those close to urban centres with post-secondary institutions. Moreover, the proximity index equals zero for schools in the provincial capital as they are not remote and have full access to educational services. It would be useful to rescale the above indicator to range from 0 to 100. This is done by subjecting the above indicator to the following linear scaling:

$$RI_i \text{ Index} = \left[\frac{\text{PRi} - \text{Minimum value of PRi}}{(\text{Maximim value of PRi} - \text{Minimum value of PRi})}\right] x\ 100 \qquad (4)$$

Note in the above normalization, the minimum value of the proximity index, PR_i, is zero representing schools in the provincial capital.

Remoteness index (as presented in equation 4) for school i (RI_i) ranges from 0 to 100, 0 assigned to schools in the provincial capital and 100 representing the schools that are most remote from pedagogical services. RI_i index rises as the degree of remoteness increases. In addition, RI_i index as calculated in (4) maintains the relative remoteness of schools. In other words, a school with a remoteness index of 40 is twice as remote as the one with the remoteness index of 20. In that sense, RI_i index is a cardinal index.

PART V: PROVINCIAL APPROACH TO REMOTENESS AND FIRST NATIONS COMPARABILITY FUNDING MODELS

Education is a provincial domain in Canada with the exception of education for First Nations students living on reserve where the responsibility falls with the Minister of Indigenous and Northern Affairs (INAC). A recent report by the Parliamentary Budget Officer (PBO) attempts to estimate the costs of First Nations education program spending and to compare those estimates with provincial education spending.[35]

In general, INAC provides funding for K-12 programs through a combination of Core and Proposal based mechanisms. Core funding which amounts to about 80 percent of total education program funding is used to pay for instructional, professional, supplies, student support services, transportation and tuition fees for students attending provincial schools. The proposal-based funding that requires submitting an application comprises about 20 percent of education program spending and is for time-limited projects and for students with special education needs.

Upon examination of the data, the PBO (2016) report concludes that (p.3):

1. PBO found evidence that INAC funding mechanisms:
   a. Do not adequately take into account important cost drivers for band-operated schools;
   b. Favour students living on reserves who attend provincial schools;
   c. Put band-operated schools in remote northern regions at significant disadvantage.

2. PBO estimates that in 2012-13, the per-student funding rate for band-operated schools in Ontario would have been between $21,000 to $25,000, if band schools had been funded using the Ontario provincial funding formula. This range is well above the INAC per-student rate of $14,500 and the Ontario provincial per-student rate of $11,500. These averages are for program spending and do not include estimates for capital amounts.

3. The funding shortfall – the difference between INAC funding and funding that would occur under the provincial formula – is the result of INAC not adequately costing for operating small schools in remote northern regions. Many band schools are located in remote, northern regions with small student populations. In addition, band schools face higher costs because of higher incidence of socio-economic disadvantage; commitments to provide culturally relevant instruction in indigenous languages; and large numbers of students for whom English or French is a second language. The incidence of children requiring special education support is also higher.

The PBO (2016) report also states that "The Auditor General, in her 2004 Report to the House of Commons, recommended that INAC obtain reliable and consistent information on the actual costs of delivering education and compare these costs with those of the provinces."[36] This is in fact the best first option for funding First Nation education. It is equivalent to obtaining a spatial producer price index for First Nations schools as the government of Canada has done for its diplomatic posts around the world.

[35] Office of the Parliamentary Budget Officer, "Federal Spending on Primary and Secondary Education on First Nations Reserves", Ottawa, Canada, December 6, 2016.
[36] Ibid, p. 6.

Comparing per-student funding for First Nations students in band-operated and provincial schools in Ontario, the PBO report finds significant gaps between funding of students who attend band-operated schools and those who attend provincial schools. For example, they find that INAC pays about $22,000 in tuition for every First Nations student living on reserve attending one of the Superior Greenstone board schools. In contrast, the core allocation for students attending band-operated schools in Ontario was roughly $11,600 per student in 2008-09 and remained flat through 2014-15.[37] The proposal-based funding has partially closed the gap. However, not all First Nations schools have the administrative capacity to apply for such funding on a regular basis. The PBO report suggests that the Proposal-based funding can potentially increase the per-capita student funding from $11,500 to $15,500 which is still below the PBO's estimate for the per-student rate for band operated schools calculated using the province's formula.[38]

Applying a provincial funding formula to band-operated schools in Ontario, PBO estimates that band-operated schools would have received funding in the range of $21,000 to $25,000 per student. They mention that these estimates take into account the fact that band-operated schools are likely to be located in remote northern communities and tend to be small.[39]

The PBO report suggests that tuition fees paid for First Nations students attending provincial schools meets the criteria for providing comparable provincial education programing. This is what can be used to estimate dollar-based remoteness indices for various First Nation schools.

In contrast to the INAC funding approach, provinces use comprehensive funding formulas that take into account various costs drivers such as geographic location, number and size of schools within the board, language and culture, percentage of students whose first language is not English or French (ESL/FSL), socio-economic circumstances, climate and percentage of students with special needs, etc. However, formulas used vary by province.

The Government of Canada has developed provincially-comparable funding models that apply the provincial formulas to First Nations on a province-by-province basis. The plan is to consult with various First Nations regarding the appropriate formulas and their implementations. The proposed funding formulas approximate how much funding First Nations would receive if provincial formulas were applied to on-reserve education. Our main focus in this section is on formulas related to various cost factors that are due to remoteness and rurality.

Remoteness Factor in First Nations Comparability Funding Model

Indigenous Services Canada has developed provincially-comparable funding models that apply the provincial formulas to First Nations on a province-by-province basis. The provincially-comparable funding models approximate how much funding First Nations would receive if provincial formulas were applied to on-reserve education in each province. This is intended to be a starting point for a discussion on what specific enhancements are required to address the unique context and specific needs of First Nations schools and students.

[37] Ibid, p. 21.
[38] Ibid, p. 22.
[39] Ibid, p. 25.

A report prepared by the Northern and Remote Task Team titled, "Provincial Approaches to Northern & Remote Calculations: Kindergarten to Grade 12" summarizes provincial funding approaches to northern and remote schools and school boards.[40] The report outlines education allocation formulas each province uses to fund rural schools. In general, funding formulas take into account various cost factors including enrolment, distance or remoteness, density and geographical circumstances. In what follows, we briefly outline funding approaches that are directly linked to the remoteness factor in the provinces included in the above-mentioned report.

Ontario[41]

About 34 percent of First Nations students or approximately 7,083 full-time equivalent students attend provincial schools in Ontario. The rest or 14,153 full-time equivalent students attend First Nation schools.[42] The Ministry of Education allocates funds to each school board in Ontario based on a formula taking into account student enrolment, as well as the unique needs of the students, in each board. School boards, then, allocate funding to the local schools. In what follows, we focus on the aspects of the funding formula that relates to rurality and remoteness.

School Foundation Grant

This grant supports administrative costs and provides funding for outlying schools. Outlying schools are defined by their distance from the next closest school of the board. This component of the funding formula also takes into account the average daily enrolment (ADE). The formulas are clearly defined and can be directly applied to First Nation schools. In applying the formulas, the proposed comparability model measures proximity to the nearest school whether First Nation or provincial.

Special Purpose Grants

The Special Purpose Grants account for a significant share of funding for school boards. It consists of various grants including one for geography and remoteness referred to as the Geographic Circumstances Grant. This grant recognizes the additional costs of operating: [43]

1. Small school boards that are isolated and distant from major urban centres;
2. School boards with relatively low enrolment;
3. Schools in rural areas.

Distance to urban centres are measured by road distance from the central board office to the nearest city with a population of at least 200,000 based on the 2011 census, namely Toronto, Ottawa, Hamilton, London, Windsor, Brampton, Kitchener, Mississauga, Markham or Vaughan. In other words, unlike the Geographic Zone indicator and NPR index, the remoteness factor in the special purpose grants measures distance from major educational service centres.

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[40] The Northern and Remote Task Team report only covers Alberta, Ontario, BC, Saskatchewan and Manitoba.
[41] Information in this section is mainly based on a report by Indigenous Services Canada titled, "Ontario First Nations K-12 Comparability Funding Model Overview", December 2017.
[42] If kindergarten is provided as a full day program.
[43] Ministry of Education, Education Funding Technical Paper, 2017-18, p. 55.

The enrolment factor recognizes the higher per-student costs in small schools and provides funding per student based on enrolment numbers. Smaller school boards receive higher per student funding than larger boards. The urban factor takes into account the population size of the CSD where the school is located. The smaller the size, the greater the urban factor index and the associated funding. Similarly, per-student funding rises as the school dispersion increases.

Another special purpose grant that incorporates the remoteness factor is the Trustee Honoraria that provides funding for travel to two committees of the board per month as well as travel to one board meeting per month. There is also funding for other expenses under the Internal Audit allocation that recognizes the relative size of the region in which the school board is located compared to the province. In addition, northern and remote schools receive some additional funding for data management. Also, school facility operations and renewal grant incorporates a geographic adjustment factor that recognizes regional variations in the construction and renewal costs of school facilities. Finally, starting in September 2017, the ministry is providing additional funding for school boards in rural regions based on the number of rural students as well as the density of rural student enrolment in the board.

Alberta[44]

The Alberta funding model consists of 25 different grants, some of which are related to the remoteness factor as outlined below.

Inclusive Education

This grant is to ensure school jurisdictions have the flexibility to support the unique needs of their students. It recognizes geography as one of the cost modifiers. These modifiers are research-based indicators that take into account the impact of geography as well as socio-economic conditions.

Northern Allowance

This grant aims at offsetting the higher operation cost of schools located in rural and remote regions. The further north the school, the higher the per-student rate. Schools are grouped based on their geographical zones defined as:

a. Lower zone: Schools located between 55th and 56th parallels of latitude receive $471.24 per FTE enrolment.
b. Intermediate zone: Schools located between 56th and 57th parallels of latitude receive $705.84 per FTE enrolment.
c. Upper zone: Schools located north of the 57th parallel of latitude receive $1,060.80 per FTE enrolment.

Small Schools by Necessity and Small Board Administration

These grants provide additional funding for schools and boards with low enrolment. These grants apply to rural and remote schools since they often have small class sizes.

[44] Information provided in this section is primarily based on a report by Indigenous Services Canada titled, "Alberta First Nations, K-12 Funding Model Overview", December 2017.

Equity of Opportunity

This grant provides funding based on density (areas with less than 5000 population) as well as additional funding for schools that are farther than 40 km from a major service centre defined as Calgary, Edmonton, Grande Prairie, Lethbridge, Medicine Hat and Red Deer. We note that all of the above service centres have post-secondary institutions. In other words, the remoteness factor used in the provincial funding model measures the distance from locations that provide post-secondary education. More importantly, the greater the distance, the higher the funding rate.[45] We note that this formulation of remoteness funding is similar in spirit to the remoteness indicators developed in this report.

Plant Operations and Maintenance

This grant acknowledges the higher cost of maintenance due to increased maintenance staff travel time as distance increases. It also factors in the sparsity and distance as well as low enrolment factors in each region.

Transportation

This grant provides additional funding for schools that are in rural areas defined as areas with less than 10,000 population. Formulas are based on detailed data on bus route kilometres and load rates.

Saskatchewan[46]

There were 82 First Nation operated schools in Saskatchewan during the 2015-16 school year. The main areas of the Saskatchewan funding model where remoteness and distance affects funding include the following.

Governance

This component allocates funding for governance functions such as elections, membership fees, negotiating fees, etc. It provides funding for travel between schools and their school board office. Governance funding =Base funding + school funding + student funding + distance funding.[47]

Administration (dispersion and northern factors)

Administration funding makes an adjustment for dispersion within the school division. It includes allowance for distance calculated as the sum of the distance from the school board office or band office to each school in the school board or First Nation and the distance from each school board office or band office to Regina and Saskatoon. Dispersion funding equals distance in km x per km rate.

Adjustment Instructional Units: Small Schools of Necessity

This component recognizes the higher cost of operating small schools. It applies to First Nation schools since the majority of those in rural and remote areas are small. It includes schools that are 40 km or further away from a “like” school and have an average of 14 FTE students per grade or less.

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[45] Distance allocation = (one-way distance of school from closest service centre– 40 km) x FTE enrolment x $1.45.

[46] Information provided in this section is primarily based on a report by Indigenous Services Canada titled, “Saskatchewan Region K-12 Funding Model Overview”, December 2017.

[47] Distance funding = 2 x (average distance from division office to CSD borders + distance from division office to funded schools) x mileage rate x standard number of board meetings.

Support for Learning: Geographic Distance

This component of learning acknowledges the additional cost of providing supports and services in remote or rural areas. Distance is measured as a round-trip from the main school division office to each rural school in the division. Schools located in urban areas with a population of 5000 or more and those within 18 km of the division office are excluded.

Rural Transportation

This component allocates funding based on the number of rural students transported and the total km distances travelled to transport rural students to and from school. It equals total distance of rural routes x per km rate.

Northern Transportation

In order to account for the higher cost of providing transportation in the north, a northern factor of 1.3 is applied to school divisions in the north.

Manitoba[48]

The Frontier School Division with 39 schools and a total enrolment of about 6,658 covers about 75 percent of the province and the entire northern Manitoba. It provides services to 14 First Nations in Manitoba. About 50 percent of the school division's revenue comes from the federal government since many of the students identify as First Nation or Metis.

The funding formulas are classified into various categories. The categories that include rurality and remoteness factors are outlined below.

Sparsity Support

This funding category acknowledges the higher cost related to sparsely populated rural and northern school divisions. The sparsity or density factor is calculated by dividing the number of eligible enrolment in the board by the area of the school division in square kilometres. To receive funding, boards must meet the following conditions:[49]

a. Have a dispersion factor of less than 10;
b. Have a population of less than 10,000 residents or located in a rural area;
c. Have an average of less than 50 students per grade in each school.

Professional Development

In addition to the base allocation of $39 per student, this category allocates $7 per student for school boards whose central office is 100 to 350 km from Winnipeg or $12 per student for boards whose central office is more than 350 km from Winnipeg.

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[48] Information provided in this section is primarily based on a report by Indigenous Services Canada titled, "Manitoba Region K-12 Funding Model Overview", December 2017.

[49] Sparsity support = (50-average No. of students per grade) x $11 x eligible enrolment of the school.

Small Schools

This category provides funding to eligible rural schools with small enrolment per grade. Tables specify funding per student per grade. Almost all First Nation schools are considered rural and thus eligible for funding under this category.

Northern Allowance

This category provides funding for the Frontier School Division and for schools north of the 53rd parallel at a rate of $670 per FTE enrolment.

Student Transportation

This category of funding acknowledges higher transportation costs associated with schools in remote and rural areas. Funding is provided per km rate and the total km traveled to transport students to and from school for two roundtrips per day for 190 school days. The remoteness factor based on the Band Classification Manual is applied to each First Nation school.

British Columbia

As in other provinces, British Columbia also provides additional funding for schools based on low enrolment, distance, density and location.

Small Community Supplement and Low Enrolment Factor

This supplement is provided when a student population in a defined area is less or equal to 250 elementary and/or 635 secondary students. Defined area is the number of students in a single school or the combined total of FTE of all schools within 5 km distance for elementary schools and 25 km for secondary schools.

Small Remote Schools

Rural and remote communities with 75 or fewer elementary school-aged FTEs students are eligible for additional funding if they are:

a. Located 40 km from the next elementary school,
b. Located at least 5 km from the next elementary school which can only be accessed by gravel road or logging road or by water.

Rural and remote communities with 635 or fewer secondary school-aged FTEs students are also eligible for additional funding. In addition, there is extra funding for low FTE enrolment in grade 11 and 12.

Low Enrolment Factor

This factor applies to schools with 2,500 or fewer and those between 2,500 and 15,000 district school-age FTEs students.

Rural Factor

This factor is calculated based on:

a. Population of city in which the board office is located.
b. Distance from board office to Vancouver and the nearest regional centre. Regional centre is defined as areas with at least 70,000 population. Additional weight is assigned where access is by water.
c. The board office must be at least 100 km from Vancouver by road.

Sparseness Factor

This factor recognizes the higher cost associated with increased travel requirements resulting from the separation of schools from the board office. Schools are eligible for this funding if they are more than 40 km from their respective board office or separated by water.

Student Location Factor

This category provides supplementary funding for small communities as well as funding for school-age population density for each community cluster.

Salary Differential

This category includes a supplement for salary differential for teachers related to geographic factors calculated as base salary plus isolation allowance.

In general, there are various cost factors associated with rurality and remoteness. These cost factors relate to the fact that rural schools are often small and therefore have a higher per student operating cost; they are often far from education service centres and thus have greater cost of accessing services, due to their remoteness; they have a higher cost of attracting teachers and other staff; and many socio-economic factors affecting rural students necessitate additional resources which translate into higher cost.

Many of the cost factors influencing the operation cost of rural and remote schools are not directly measurable. Therefore, it would be ideal to calculate a remoteness index that summarizes some of the costs associated with the degree of rurality. This is the objective of the next part of this report.

Best Approach to Fund First Nations Schools in Rural and Remote Areas

Canadian provinces have developed funding formulas and models in order to adequately fund schools in rural and remote regions. These funding formulas take into account various cost factors including enrolment, distance from urban centres or remoteness, density and geographical circumstances. **Table 1** on the following page summarizes funding approaches that are directly linked to the remoteness factor in the provinces included in the above-mentioned report.

Table 1: Summary of Funding Models for Remote and Rural Schools

Province	Degree of Remoteness	Population Size (Urban Factor)	Average Daily Enrolment (ADE)	Density of Rural Students & Transportation Cost
Ontario				
School Foundation Grant	Distance from the next closest school of the board.		ADE	
Special Purpose Grants	Road distance to nearest City with 200,000+ population	Population size	ADE	Density
Alberta				
Inclusive Education				
Northern Allowance	Based on Geographic Parallels			
Small Schools by Necessity			ADE	
Equity of Opportunity	More than 40 km from service centre (major cities)	CSDs with less than 5,000 population.		
Plant Operations and Maintenance	Distance		ADE	Sparsity
Transportation		Population of less than 10,000		
Saskatchewan				
Governance	Distance Funding			
Administration	Dispersion, Distance from Major centres			
Small schools of necessity	Distance (40 km or more) from like school		ADE	
Support for learning	Distance from main school division office			
Rural Transportation				Sparsity and No. of students transported
Northern Transportation				Northern factor of 1.3
Manitoba				
Sparsity Support		Population less than 10,000	ADE	Sparsity factor
Professional Development	Distance from Winnipeg			
Small schools	North of 53rd Parallel			Transportation based on Band classification
Student transportation				

British Columbia				
Small community supplement & Low enrolment factor			Small No. of students	
Small remote schools			Small No. of students	Sparsity
Low enrolment factor			Small No. of students	
Rural factor	Distance from regional centre, Access by water only,	Population size		
Sparseness Factor				Transportation cost
Student location factor		Low CSD population		Low Student density
Salary differential	Degree of rurality			

Table 1 shows that each province adjusts funding allocations to meet the needs of northern and remote communities in some way. The type of model used and the number of components vary province by province. However, as **Table 1** shows, all provinces aim at tackling some common elements including:

1. Remoteness measured by the degree of latitude, distance from a population centre and other geographical circumstances.
2. Rural factor as measured by the area's population size.
3. Student enrollment as measured by the number of students in a school or in a school board.
4. Density and sparsity as measured by the number of students or population per area which influences the cost transports significantly.
5. Other factors such as socio-economic circumstances.

As **Table 1** shows each province uses a different set of elements that makes comparison of the models difficult. In the end, different models can result in comparable and similar funding if the funding allocated to each element is comparable. However, the question that can be asked is which approach best meets the needs and requirements of the First Nations schools in rural and remote communities? Can one apply one unified funding model? The answer is affirmative.

In general, the school enrollment and density factors can be easily calculated based on the existing census and school information. Therefore, any of the provincial formulas as they pertain to these two factors can be used in a unified funding model. The main difficulty in using the existing provincial models is that each of them uses a different definition of rurality and remoteness. Their formulas as they pertain to remoteness and rurality or urban factors are different. Therefore, to apply a unified approach, we need to develop a model which maintains the spirit of the existing provincial funding models but simplifies calculations.

Therefore, based on the remoteness indicator developed in the present study, our research team proposes the following unified approach in developing funding formulas for all provinces.

1. Using the existing provincial formulas, estimate the funding requirements of schools related to enrolment and density.
2. Estimate remoteness indicators for each First Nation school in Canada based on the methodology developed in the present study.
3. Use the calculated remoteness indicator to estimate the necessary funding related to rurality and remoteness based on comparable provincially funded schools. This significantly simplifies the funding calculations related to the degree of rurality and provides useful information on the cost of providing education in different provinces.

The above approach can be applied to all other elements of education funding such as teacher's salaries that are linked to the degree of rurality. The above approach can be applied to all First Nation schools. Note that implementing step 3 requires information on a sample of provincially funded schools in rural and remote areas. In essence, based on the provincially comparable schools, one is estimating multipliers that would be multiplied by the remoteness indicator to arrive at the necessary funding related to the degree of rurality.

PART VI: ESTIMATING REMOTENESS INDICES FOR FIRST NATION EDUCATION FUNDING WITH APPLICATION TO ONTARIO SCHOOLS

This part of the study estimates the remoteness index developed in part IV of the present report and compares it with the NPR index and the INAC Geographic Zone indicator as well as the Rural and Small Town index referred to as Statistical Area Classification (SAC type) developed by the Geography department at Statistics Canada. For this, we selected 66 First Nation bands operating primary and secondary schools with 9,250 students in Ontario. Data was not available for 4 of the bands. Therefore, our sample consists of 62 First Nation Bands operating about 57 First Nations schools with 8,913 students in northern Ontario. In other words, our sample represents about 50 percent of the band-operated schools with 78.1 percent of First Nation students attending band-operated schools in Ontario.

As mentioned above, our remoteness index ranges from zero for communities and schools in and around the province's capital and 100 for the most remote First Nation Bands in Ontario. We have defined remoteness as the degree to which a community does not have access to post-secondary education services. The larger the index, the greater the remoteness of a community and therefore its lack of access to educational services. The remoteness index (RI) developed in this study maintains relative remoteness of various communities. In other words, a community with an RI of 80 is twice more remote than the one with an RI of 40. For the sake of exposition, and following Australia's ARIA geographical classification, one can group communities with different RI indices into 5 groups. Those with RI index of 0 to 20 are relatively close to education services; communities with an RI of 20 to 40 can be considered rural; those with an RI of 40 to 60 are relatively remote and those with 60 to 80 and 80 to 100 are considered remote and very remote respectively.

Statistics Canada's Statistical Area Classification (SAC) classifies various CSDs into urban defined as those within a CMA (SAC type=1) or a CA (SAC type=2) and rural defined as those that are outside CMAs and CAs. Rural CSDs are further classified as those with a strong link to CMAs and CAs (SAC type=3), those with a moderate link to urban areas (SAC type=4), relatively remote CSDs (SAC type=5) and very remote CSDs with no link to urban centres with a SAC type of 6 and 7.

In order to make the presentation consistent and precise, we classified different bands and CSDs into two groups:

1. CSDs that are road connected,
2. CSDs that have no year-round road access and, as a result, experiences a higher cost of transportation and accessing educational services.

To measure distance, we utilized Google Earth.[50] For communities without a year-round road access, the distance to the nearest college and nearest university was calculated manually with the ruler feature to calculate the distance in kilometres from Point A to Point B in a straight line distance. Community locations were visualized for accuracy and road access visualized and confirmed. For communities with year-round road access, exact driving distance from Point A to Point B was calculated and recorded in kilometres. We also assumed that each full-time student is equivalent to two part-time students. Finally, for the sake of comparison, we classify the road connected CSDs based on the INAC Geographic Zones classification.

[50] This is an established methodology used by geographers and geologists.

As mentioned above, we have focused on communities and post-secondary institutions within the province of Ontario to demonstrate the application of the proposed methodology. However, it is entirely possible that some of the educational services are more accessible from institutions in the neighboring provinces. In applying our methodology, the Task Team has to take this possibility into account, since that would impact the estimated remoteness indices and their ranking.

Table 2 shows the Bands located in CSDs with the Geographic Zone of 1. These are road connected CSDs. As mentioned earlier, zone 1 represents First Nations that, according to the INAC classification, are located within 50 km of the nearest service centre and are considered not remote.

Table 2: Comparison of Remoteness Indicators for First Nations within Geographic Zone 1 in Ontario

Band Name	CSD	Geographic Zone	RI Index	SAC Type	NPR Index	Parallel
Lac Seul	Lac Seul 28	1	87.08	6	0.5772	50
Couchiching First Nation	Couchiching 16A	1	82.30	6	0.4608	49
Eagle Lake	Eagle Lake 27	1	84.38	6	0.4866	50
Constance Lake	Constance Lake 92	1	52.50	6	0.5467	50
Long Lake No.58 First Nation	Long Lake 58	1	57.67	7	0.5486	50
Ginoogaming First Nation	Ginoogaming First Nation	1	58.08	7	0.5588	50
Garden River First Nation	Garden River	1	30.49	2	0.3278	47
Nipissing First Nation	Nipissing First Nation	1	17.31	4	0.3024	46

There are eight bands with a geographic zone index of one in our sample. They account for nine First Nation schools with 1,673 students. **Table 2** shows that based on the RI index, six of the First Nation bands are very far from post-secondary institutions, three of which are considered very remote based on the RI index as well as the SAC type indicator. In fact, SAC type classifies six of the bands as very remote with almost no link to urban centres. On the other hand, the newly developed remoteness index (NPR index) appear to underestimate the degree of remoteness in most cases.[51] On average, the adjusted value of the newly developed index equals 47.61 compared to the RI index of 63.86.[52] Overall, it appears that the NPR index and the INAC Geographic Zones indicators significantly under-estimate the degree of remoteness of various communities as evident by the RI index as well as the SAC type indicator developed by Statistics Canada.

[51] Note, due to various transformations of the data, the absolute values of the NPR index have no significant meaning. They can at best be used for ranking different communities. Also, the NPR index ranges from 0 to 1. Thus, in order to compare the NPR index with our RI index, one has to multiply the NPR index by 100 to make it range from 0 to 100 rather than 0 to one. We refer to the 100 x NPR index as the adjusted value and use it to compare the two indices.

[52] The adjusted average = NPR index x 100.

Table 3 shows various Bands located in CSDs with the Geographic Zone of 2. These are road connected CSDs. As mentioned earlier, zone 2 represents First Nations that according to the INAC classification are located between 50 and 350 km from the nearest service centre with year-round road access.

Table 3: Comparison of Remoteness Indicators for First Nations within Geographic Zone 2 in Ontario

Band Name	CSD	Geographic Zone	RI Index	SAC Type	NPR Index	Parallel
Wabauskang First Nation	Wabauskang 21	2	91.95	7	0.5516	50
Mishkeegogamang	Osnaburgh 63B	2	95.37	7	0.734	51
Ojibway Nation of Saugeen	Ojibway Nation of Saugeen (Savant Lake)	2	85.65	7	0.6758	50
Gull Bay	Gull River 55	2	63.74	5	0.4809	50
Animbiigoo Zaagi'igan Anishinaabek	Lake Nipigon	2	57.43	6	0.606	50
Biinjitiwaabik Zaaging Anishinaabek	Rocky Bay	2	56.66	7	0.4364	49
Big Grassy	Big Grassy River 35G	2	91.40	6	0.6204	49
Lac La Croix	Neguaguon Lake 25D,	2	83.51	7	0.7139	48
Naicatchewenin	Rainy Lake 17A, 17B	2	84.42	6	0.5867	49
Nicickousemenecaning	Rainy Lake 26A	2	79.04	7	0.5115	49
Rainy River First Nations	Unorganized Rainy River District	2	85.92	6	0.5894	49
Ojibways of Onigaming First Nation	Sabaskong Bay (Part) 35C	2	89.92	7	0.5525	49
Seine River First Nation	Seine River	2	76.84	6	0.5694	49
Grassy Narrows First Nation	Asubpeeschoseewagong First Nation (formerly known as)	2	97.86	6	0.5894	50
Wabaseemoong Independent Nations	Wabaseemoong Indian Reserve	2	100.00	n.a.	0.5867	50
Northwest Angle No.37	Northwest Angle No. 37 First Nation	2	93.16	7	0.8279	49
Shoal Lake 39 First Nation	Iskatewizaagegan #39 Independent First Nation	2	97.86	7	0.3068	50
Wabigoon Lake Ojibway Nation	Wabigoon Lake 27	2	82.12	7	0.5152	50
Naotkamegwanning	Whitefish Bay First Nation	2	93.16	7	0.5173	49

Ojibways of the Pic River First Nation	Pic River 50	2	55.77	6	0.5593	49
Pic Mobert	Pic Mobert North, Pic Mobert South	2	57.23	6	0.5749	49
Biinjitiwaabik Zaaging Anishinaabek	Rocky Bay 1	2	56.66	7	0.4364	49
Dokis	Dokis 9	2	20.36	5	0.3903	46
Mattagami	Mattagami 71	2	27.45	6	0.4822	48
Aroland	Aroland 83	2	60.93	7	0.6651	50
Ojibway Nation of Saugeen	Ojibway Nation of Saugeen (Savant Lake)	2	86.77	7	0.6758	50
Shawanaga First Nation	Shawanaga 17	2	14.05	6		45

There are 27 bands in our sample with a geographic zone of 2. They account for 21 First Nation schools with 1,864 students. Based on the SAC type indicator, two of them are relatively remote (SAC type 5) and the rest are very remote with almost zero link to the urban centres. Based on the RI index, eight of the bands have the highest degree of remoteness from educational service centres registering a remoteness index of greater than 90. Another seven bands are very remote registering an RI index of greater than 80. On the other hand, the NPR index underestimates the degree of rurality in most cases. On average, the adjusted value of the NPR index equals 56.43 compared to the average of 75.36 for RI index. In general, the NPR index and the INAC's geographical zone classification indicator do not adequately rank bands and CSDs based on their degree of access to the education service centres.

In the data set of bands provided to us by the Task Team, there was only one band, namely Taykwa Tagamou Nation in Cochrane with a Geographic Zone index of 3. The RI index for this band equaled 35.60 and the associated SAC type equaled 6 which represents very remote regions. The RI index is moderate since the band is relatively close to Timmins and Sault Ste. Marie with two colleges and one university. In addition, its distance from Toronto is shorter than many other bands.

Table 4 shows the Bands located in CSDs classified as geographic zone of 4. These are First Nations that have no year-round road access. These are communities that have significantly higher transportation costs and should be treated separately. An adjustment factor has to be applied to the remoteness indices for these communities to make them comparable to those calculated for road-accessible communities.

Table 4: Remoteness Indicators for First Nations within Geographic Zone 4 in Ontario

Band Name	CSD	RI Index	Parallel	SAC Type
Kitchenuhmaykoosib Inninuwug	Kitchenuhmaykoosib Aaki 84 (Big Trout Lake)	89.74	54	7
Fort Severn	Fort Severn 89	100.00	56	7
Wapekeka	Wapekeka 2	89.03	54	7
Kasabonika Lake	Kasabonika Lake	85.29	54	n.a.
Bearskin Lake	Bearskin Lake	93.17	54	n.a.

Wawakapewin	Wawakapewin (Long Dog)	94.02	53	n.a.
Sachigo Lake	Sachigo Lake 1	96.46	54	n.a.
Webequie	Webequie	78.23	53	n.a.
Kingfisher Lake	Kingfisher Lake 1	84.24	53	n.a.
Muskrat Dam	Muskrat Dam Lake	92.44	53	6
Sandy Lake	Sandy Lake 88	95.50	53	n.a.
Kee-Way-Win	Kee-Way-Win	95.22	53	7
North Caribou Lake	North Caribou Lake	87.98	53	n.a.
Wunnumin Lake	Wunnumin 1	82.22	53	n.a.
Nibinamik First Nation	Summer Beaver	56.57	53	n.a.
North Spirit Lake	North Spirit Lake	90.92	52	7
Deer Lake	Deer Lake	95.49	53	7
Attawapiskat	Attawapiskat 91A	68.51	53	n.a.
Poplar Hill	Poplar Hill	93.80	52	n.a.
Pikangikum	Pikangikum 14	91.02	52	n.a.
Cat Lake	Cat Lake 63C	82.00	52	7
Neskantaga	Neskantaga	74.19	52	n.a.
Eabametoong	Fort Hope 64	55.29	52	n.a.
Marten Falls	Marten Falls 65	57.39	52	7
Kashechewan	Fort Albany (part) 67	62.19	52	6

There are 25 bands in our sample with the geographic zone of 4. There are 26 First Nation operated schools with 5,329 students in this group. They are all located in the north of 52nd parallel. The available SAC types rank all communities as very remote. Eleven communities register an RI index of greater than 90. Another seven communities have an RI index of between 80 and 90. In other words, 18 of the communities in zone 4 are very remote according to the RI index.

Unlike the Geographic Zone index that ranks all the above communities as having the same degree of remoteness, the RI index shows that there are different degrees of remoteness among the remote communities. That needs to be taken into account when ranking communities according to their access to education services.

As we mentioned above, the RI indices for the non-road access bands are not comparable to the ones for communities with road access as the transportation cost for the remote bands are much higher than the other ones. In fact, there is a need for assigning a greater weight in terms of dollar cost to the RI indices for non-road access communities to make them comparable with those for road-access communities. For example, Saskatchewan applies a northern factor of 1.3 to schools in the north to account for the higher cost of providing transportation services and therefore accessing educational services.

To make the RI index for non-road access communities comparable to road access communities, we use the same northern factor of 1.3 used in Saskatchewan. We note that the northern factor needs to be based on empirical data and estimated for each province. Results of applying the northern factor are shown in **Table 5.**

Table 5: Comparison of Remoteness Indicators for First Nations within Geographic Zone 4 in Ontario

Band Name	CSD	Adjusted RI Index	NPR Index
Kitchenuhmaykoosib Inninuwug	Kitchenuhmaykoosib Aaki 84 (Big Trout Lake)	116.66	0.8209
Fort Severn	Fort Severn 89	130.00	0.8489
Wapekeka	Wapekeka 2	115.74	0.8286
Kasabonika Lake	Kasabonika Lake	110.88	0.8217
Bearskin Lake	Bearskin Lake	121.13	0.8209
Wawakapewin	Wawakapewin (Long Dog)	122.23	0.867
Sachigo Lake	Sachigo Lake 1	125.40	0.8303
Webequie	Webequie	101.70	0.5822
Kingfisher Lake	Kingfisher Lake 1	109.52	0.8217
Muskrat Dam	Muskrat Dam Lake	120.18	0.8209
Sandy Lake	Sandy Lake 88	124.15	0.8202
Kee-Way-Win	Kee-Way-Win	123.79	0.8263
North Caribou Lake	North Caribou Lake	114.38	0.8171
Wunnumin Lake	Wunnumin 1	106.89	0.8224
Nibinamik First Nation	Summer Beaver	73.54	0.8179
North Spirit Lake	North Spirit Lake	118.20	0.8331
Deer Lake	Deer Lake	124.14	0.8325
Attawapiskat	Attawapiskat 91A	89.06	0.9451
Poplar Hill	Poplar Hill	121.94	0.8283
Pikangikum	Pikangikum 14	118.32	0.8202
Cat Lake	Cat Lake 63C	106.60	0.7927
Neskantaga	Neskantaga	96.45	0.6218
Eabametoong	Fort Hope 64	71.87	0.5683
Marten Falls	Marten Falls 65	74.61	0.5832
Kashechewan	Fort Albany (part) 67	80.85	0.9221

Table 5 shows that in most cases, the NPR index underestimates the degree of remoteness. On average the RI index equals 108.73 compared to the adjusted NPR index of 77.17. Nineteen communities have an adjusted RI index of greater than 100. Assuming that the adjustment factor of 1.3 is correct, one can compare the remoteness indices for road connected communities with those of non-road connected CSDs. For example, comparing the adjusted remoteness RI of 130 for Fort Severn with a SAC type of 7 with the RI index of 85.65 for Ojibway Nation of Saugeen with the same SAC type suggests that the cost of access to education for schools in Fort Severn is about 1.52 times greater than in Savant Lake.

PART VII: CONCLUDING REMARKS

The main objective of the present report has been to highlight the shortcomings of the recently proposed remoteness indicators (NPR index) developed by Statistics Canada as well as those used by INAC and to develop and propose an alternative approach and formulation that does not suffer from the limitations of the existing remoteness indices. We achieved this objective by developing an index which is based on the Harmonic mean concept used in calculating price indexes in the economic literature. Because of its mathematical properties, there has been no need to make ad-hoc assumptions and unrealistic manipulation of the underlying data. Moreover, the remoteness index developed in this report maintains the relative degree of remoteness and thus can be used to estimate cost of access to education services.

Rather than measuring access from population centres as used in the recently developed remoteness indicators by Statistics Canada or service centres as defined by INAC, the indices developed in this study measure access to post-secondary educational services. In fact, the major difficulties with the current approach used to fund remoteness in First Nations communities relates to the fact that INAC uses only the distance from a service center for education without consideration of pedagogical needs and requirements of rural and remote First Nation schools. On the other hand, Health Canada uses the distance to the nearest physician services as a part of its remoteness index which is obviously a step in the right direction. The approach developed in this report can be applied to calculating access to health care and similar services as well. The remoteness indices calculated in this study not only maintain the relative ranking of communities but also show the differences among communities in terms of remoteness and lack of access to education services. As mentioned above, one can classify various communities into five groups based on their degree of remoteness as follows:

Group I (Not remote): $RI \leq 20$

Group 2 (Rural): $20 < RI \leq 40$

Group 3 (Relatively remote): $40 < RI \leq 60$

Group 4 (Remote): $60 < RI \leq 80$

Group 5 (Very remote): $80 < RI \leq 100$

Table 6 below lists road access communities according to their degree of remoteness:

Table 6: Road-Access Communities and remoteness Indicators

Band Name	CSD	Geography Zone	RI Index
Nipissing First Nation	Nipissing First Nation	1	17.31
Dokis	Dokis 9	2	20.36
Mattagami	Mattagami 71	2	27.45
Garden River First Nation	Garden River	1	30.49
Taykwa Tagamou Nation	New Post 69	3	35.60
Constance Lake	Constance Lake 92	1	52.50
Ojibways of the Pic River First Nation	Pic River 50	2	55.77
Biinjitiwaabik Zaaging Anishinaabek	Rocky Bay	2	56.66
Biinjitiwaabik Zaaging Anishinaabek	Rocky Bay	2	56.66

Pic Mobert	Pic Mobert North, Pic Mobert South	2	57.23
Animbiigoo Zaagi'igan Anishinaabek	Lake Nipigon	2	57.43
Long Lake No.58 First Nation	Long Lake 58	1	57.67
Ginoogaming First Nation	Ginoogaming First Nation	1	58.08
Aroland	Aroland 83	2	60.93
Gull Bay	Gull River 55	2	63.55
Seine River First Nation	Seine River	2	76.84
Nicickousemenecaning	Rainy Lake 26A	2	79.04
Wabigoon Lake Ojibway Nation	Wabigoon Lake 27	2	82.12
Couchiching First Nation	Couchiching 16A	1	82.30
Lac La Croix	Neguaguon Lake 25D,	2	83.51
Eagle Lake	Eagle Lake 27	1	84.38
Naicatchewenin	Rainy Lake 17A, 17B	2	84.42
Ojibway Nation of Saugeen	Ojibway Nation of Saugeen (Savant Lake)	2	85.65
Rainy River First Nations	Unorganized Rainy River District	2	85.92
Ojibway Nation of Saugeen	Ojibway Nation of Saugeen (Savant Lake)	2	86.77
Lac Seul	Lac Seul 28	1	87.08
Ojibways of Onigaming First Nation	Sabaskong Bay (Part) 35C	2	89.92
Big Grassy	Big Grassy River 35G	2	91.40
Wabauskang First Nation	Wabauskang 21	2	91.95
Northwest Angle No.37	Northwest Angle No. 37 First Nation	2	93.16
Naotkamegwanning	Whitefish Bay First Nation	2	93.16
Mishkeegogamang	Osnaburgh 63B	2	95.37
Grassy Narrows First Nation	Asubpeeschoseewagong First Nation (formerly known as)	2	97.86
Shoal Lake 39 First Nation	Iskatewizaagegan #39 Independent First Nation	2	97.86
Wabaseemoong Independent Nations	Wabaseemoong Indian Reserve	2	100.00

Table 6 shows that the Geographic Zone index is not consistent with the RI index calculated in this study. Some of the communities ranked as close to service centres such as Lac Seul and Eagle Lake are in fact very distant from education services.

Table 7 shows the ranking of non-road access communities that are classified as Geographic Zone 4.

Table 7: Non-Road Access Communities and Remoteness Indicators

Band Name	CSD	RI Index
Eabametoong	Fort Hope 64	55.29
Nibinamik First Nation	Summer Beaver	56.57
Marten Falls	Marten Falls 65	57.39
Kashechewan	Fort Albany (part) 67	62.19
Attawapiskat	Attawapiskat 91A	68.51
Neskantaga	Neskantaga	74.19
Webequie	Webequie	78.23
Cat Lake	Cat Lake 63C	82.00
Wunnumin Lake	Wunnumin 1	82.22
Kingfisher Lake	Kingfisher Lake 1	84.24
Kasabonika Lake	Kasabonika Lake	85.29
North Caribou Lake	North Caribou Lake	87.98
Wapekeka	Wapekeka 2	89.03
Kitchenuhmaykoosib Inninuwug	Kitchenuhmaykoosib Aaki 84 (Big Trout Lake)	89.74
North Spirit Lake	North Spirit Lake	90.92
Pikangikum	Pikangikum 14	91.02
Muskrat Dam	Muskrat Dam Lake	92.44
Bearskin Lake	Bearskin Lake	93.17
Poplar Hill	Poplar Hill	93.80
Wawakapewin	Wawakapewin (Long Dog)	94.02
Kee-Way-Win	Kee-Way-Win	95.22
Deer Lake	Deer Lake	95.49
Sandy Lake	Sandy Lake 88	95.50
Sachigo Lake	Sachigo Lake 1	96.46
Fort Severn	Fort Severn 89	100.00

As mentioned above, the RI indices for non-road access communities are not comparable with those estimated for road access communities as the transportation cost is significantly greater for the non-road access communities. Therefore, there is a need for applying a remoteness factor to the indices for these communities.

Table 7 shows that there exists a significant variation in the degree of remoteness of non-road access communities. In other words, education funding models should take the existing differences into account.

The remoteness indices calculated in this study are mostly consistent with the rural and small town indicators (SAC type) developed by Statistics Canada and show the fallacy of using INAC's geographic zone indicators or the NPR indices as a measure of access to educational services.

In an ideal world, one needs to develop spatial producer price indices for First Nation schools in Canada. Given the relatively small number of such schools, the task of developing such indicators is very feasible.

In the absence of such an effort, we can still develop relatively accurate cost estimates, if we have information on a representative sample of First Nation schools in each province. One needs information on various cost drivers namely geographic location, enrolment, sparsity, language, socio-economic circumstances, climate and percentage of students with special needs, etc. and information on tuition fees paid for First Nations students attending provincial schools in proximity of the First Nation schools. Based on the above information, one can develop a statistical model that relatively accurately estimates the education cost of various First Nation schools in different provinces.

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