



# SESA

**S**ocial and **E**conomic  
**S**patial Analysis Unit

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A Genuine Approach to Using Geographic Information for More Effective Government

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Recipient of:  
2005 Newfoundland and Labrador  
Public Service Award of Excellence

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An initiative of the Newfoundland  
and Labrador Statistics Agency  
[www.stats.gov.nl.ca](http://www.stats.gov.nl.ca)

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## **Newfoundland and Labrador Statistics Agency: Advancing Public Policy During the Information Revolution**

The Newfoundland and Labrador Statistics Agency (NLSA) is the Province's legislated authority to plan, develop, collect, compile, analyze, integrate, publish and promote information as it relates to commercial, industrial, financial, social, economic and general activities and conditions of the province and its citizens. To do so, it is also mandated to establish and uphold appropriate standards, systems and procedures for data collection, analysis and dissemination. As part of this service, the NLSA identified the advance of an information revolution brought on by rapidly improving data technologies that would greatly influence the process by which Government steers the progress of Newfoundland and Labrador.

In preparation for this change, the NLSA has aided in broadening the capabilities of Government, stakeholders and citizens by first identifying barriers, second, developing solutions, and third, implementing new technologies to broaden capacity for data use in policy development and citizen engagement. One identified area of increasing stakeholder demand and public policy importance is the development and integration of social, economic and health data with participatory learning and geographical information science (GIS) methods.

## **Geographical Information Sciences: New Approaches to Public Policy Development**

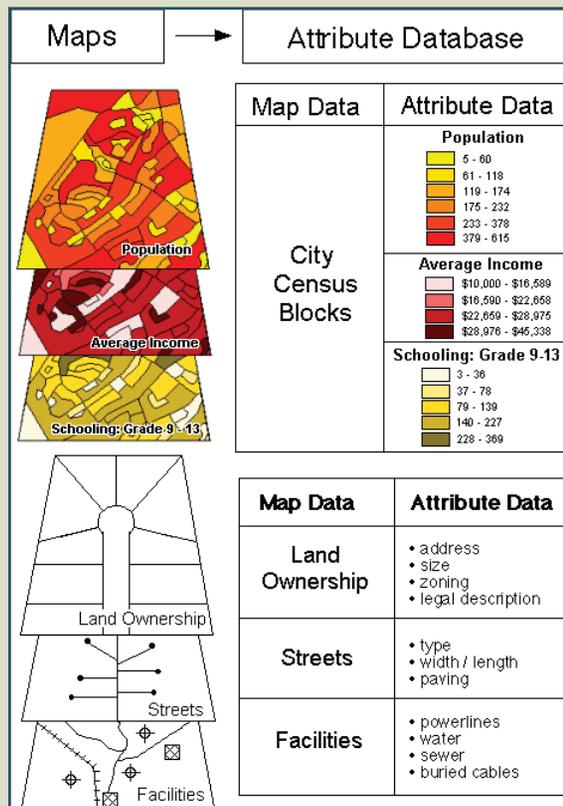
In the past, nearly all of our knowledge about our province has been classified by dividing separate subject matter into specific time periods. Moreover, this format has formed the foundation of most provincial data collecting systems. Less thought, however, has been given to the concept of geography and how it is dynamically linked to a vast array of physical, social and economic factors. Although the collection, analysis and dissemination of geographically related data are a standard product of most statistics agencies across Canada, it is often organized and released in a standard tabular format which lacks the desired level of geography (e.g., community) and the customization required by stakeholders to answer questions relating to specific social and economic issues. As a result, there has been little capacity for stakeholders to visualize and understand complex geographically related social and economic relationships or to accurately predict changes in social and economic landscapes. For example, to what extent are family incomes, labour markets or health care service demands a function of geographic characteristics and how is this relationship influenced by changes in the social and economic landscape of the province? Conversely, how can changing social and economic conditions influence the size and shape of provincial geographies (e.g., the decline or expansion of communities and regions)? To achieve a better understanding of these complex spatial relationships and, consequently, to enhance the development of social and economic policies, stakeholders required an innovative alternative that allowed for a more effective means for analyzing and visualizing data. In 1996, to aid stakeholders in achieving this, the NLSA developed the Social and Economic Spatial Analysis (SESA) Unit.

# Social and Economic Spatial Analysis (SESA) Unit

The Social and Economic Spatial Analysis (SESA) Unit provides provincial, federal and municipal government users and citizens with a method for organizing, analyzing and visualizing large collections of spatially related information through the use of GIS technologies. A major innovation of the Unit is the adoption of these methods to dynamically link large numbers of complex interrelated pieces of geographically related attributes that have social and economic relevance to stakeholders. Moreover, through the use of participatory learning techniques, the Unit works with stakeholders to custom develop data products to aid them in understanding the geographic patterns and interrelationships among the various physical, social and economic factors as it relates to their area of interest.

This is achieved by allocating each social, economic, health and physical attribute with a set of spatial coordinates (e.g., latitude and longitude) that are referenced on a digital map of the province. Organized by subject matter, each attribute is then stored as an individual map layer (similar to a transparency overlay) that can be accessed using a computerized mapping system (see Figure

1). To date, over 300 physical, social and economic map layers have been created. By referencing each layer to a common mapping coordinate system for the province, any combination of data that are associated with a location can be queried, allowing users to visualize the patterns of any combination of physical, social or economic factors with respect to location. In addition, the Unit has also incorporated advanced GIS techniques to allow users to statistically determine, with a high level of confidence, future demands for required services and outcomes for specific communities and regions. By integrating digital mapping technology and geographic data with available physical, social, economic and health data, users are better able to analyze, display and map, geographically, the characteristics of citizens, infrastructure and resources in the province. This “smart mapping” technology provides users with a new set of innovative tools for analyzing interactions and trends in economic growth, sustainable development, and social health as well as a new method for evaluating and predicting the progress of the province, its communities and citizens.



**Figure 1.** Schematic representation of map data and associated attribute data. Examples are shown for typical social, economic and infrastructure factors that can be geographically represented as map layers (e.g., municipal services, roads, land divisions, number of children enrolled in K-12, average income and population). Stored in a GIS database, these attribute data can be selected and combined to create custom feature of interest displays.

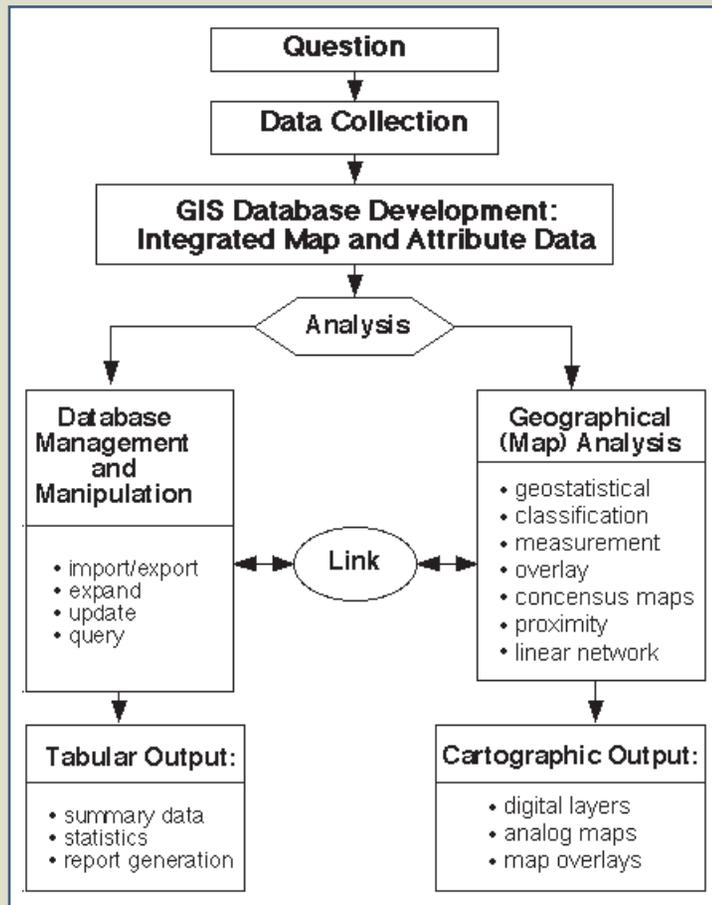
## What We Do.....

### Data Capture

- Purchase and collection of physical, social and economic data.
- Digitization and scanning of maps, remote sensing and global positioning system data (e.g., satellite positioning data, imagery and aerial photos, road and community infrastructure labeling).

### Data Storage, Data Sourcing and Accuracy Analysis

- Data cleaning, editing and documentation.
- Calculation of position accuracy for each attribute layer.
- Database tagging of spatial data to identify source and location.
- Creation of file management systems and linked databases.



**Figure 2.** Flow chart of analytical operations within the SESA framework. An initial geographic question drives the data collection. This includes, digitizing appropriate maps and attribute data (i.e., social, economic, health and physical), and referencing each dataset with a set of geographic coordinates that define their position. The data are entered into a database where they are stored as map layers (i.e., Integrated Map and Attribute Data). Through the use of spatial analytical software, map and attribute data are linked, enabling users to produce any combination of factors as a function of location in the tabular (summary data, statistics, reports) and/or cartographic form (maps, map files, and map overlays).



## Data Analysis

- Spatial Decision Making and Consensus Building Models (e.g., Multiple Criteria Evaluation (MCE) decision making tools).
- Location-Allocation Efficiency Modeling (e.g., optimizing placement of government services).
- Linear Network Analysis (e.g., estimation of shortest distance along street and highway networks).
- Time Series Analysis (e.g., social/economic prediction and simulation models).
- Surface Analysis (e.g., remoteness index).
- Point Pattern Analysis (e.g., population density)
- Cost/Benefit Analysis.

## Data Display

- Thematic Mapping (e.g., population change, cost of living thresholds).
- Infrastructure Mapping (e.g., location and attributes of fish plants, medical and education services, manufacturing and retail services).
- Interactive Internet Based Site Selection Mapping Systems (e.g., BusinessSite Newfoundland and Labrador).
- Custom Interactive Aerial and Satellite Imagery (e.g., Google Earth Professional software).
- Digital and Tabular outputs (e.g., electronic and hardcopy cartographically correct maps)



## SESA: Leaders in Participatory Learning



Another innovative aspect of the SESA is the use of participatory learning techniques to facilitate the utilization of spatial data and analysis. As opposed to other statistical organizations that disseminate standardized data, the Unit maintains an open door policy where users have direct access to staff services and decision-making tools to aid them in understanding spatial techniques and to generate custom data products to answer specific issue and policy related questions. This means stakeholders, through an interactive process with Unit staff, are put at the forefront in generating, collating, and analyzing spatial data. They also become prime actors in defining the visual and graphic vocabulary of data products. For example, the selection of features to display and the way they are depicted and textually defined. This participatory process reinforces a culture of learning and plays a key role in determining intellectual ownership by stakeholders. Through this process of self-mobilization, users obtain a stronger capacity for data analysis and evidence based policy development. To ensure this process of participatory learning is successful, the provision of services by the Unit are based on the concept that data can only be transformed into information and knowledge through the use of people, process and technology.



By enabling this “community of practice” SESA has better enabled users to:

- Develop partnerships to facilitate advanced data utilization and sharing and improve policy development.
- Maintain existing knowledge of the province’s social and economic geography and continually build upon it.
- Empower others to share in the process of evaluation.
- Facilitate the practice of advanced root cause analysis.
- Improve measurement of evaluation inputs, outputs and the prediction of social and economic outcomes.



## Examples of Work to Date

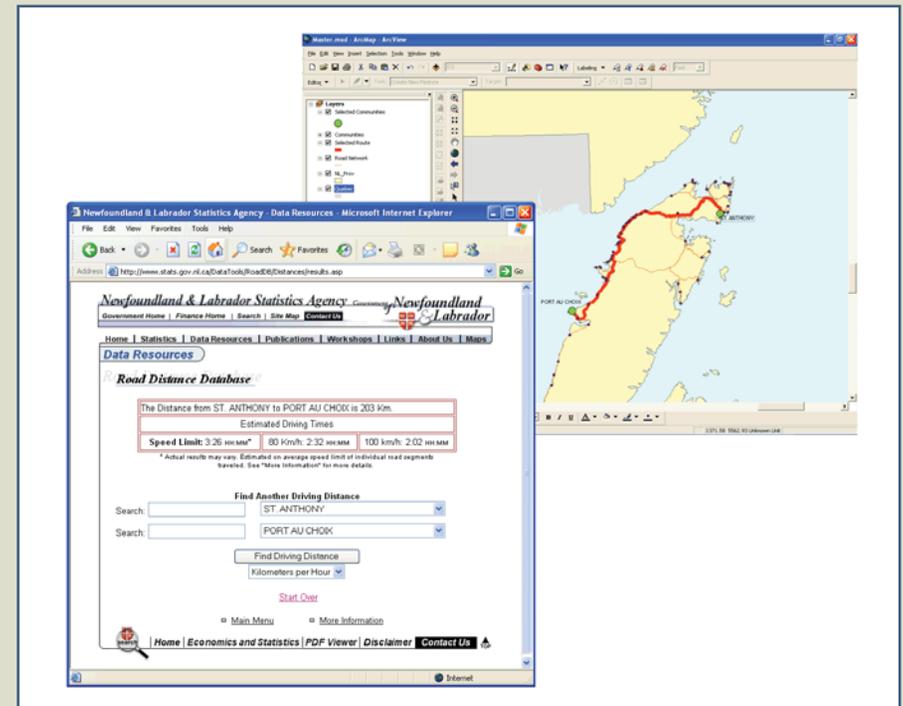
By combining GIS technology with new and existing social and economic data and working with stakeholders through a process of spatial analysis, users have a better understanding of complex geographic related issues in our province and are making more informed decisions. The following illustrate major examples of this collaborative effort.

### Road Distance Database

With the use of linear network analysis and digitized satellite imagery of road networks, SESA developed the Road Distance Database to provide users with measures of community to community distances and time to travel estimates based on set speed limits within each highway network. A recent example of the major utility of this system was its use in developing accurate transportation costs for the Newfoundland and Labrador Market Basket Measure of Low Income (NLMBM), a major initiative of the NLSA and Province's Poverty Reduction Strategy. As part of the process of measuring costs of living for over 700 geographies in the province, developers of the NLMBM were able to combine community to service center distances with regional Petroleum Products Pricing Commission fuel price data and rates of vehicle fuel consumption to estimate the cost of travel to basic needs service centers (i.e., major grocery outlets).

**Figure 3.**

Illustration of the Road Distance Database. This system provides accurate calculations of distance and time required to travel between communities for the entire province. Available for public use, it is used by ambulance operators, insurance companies, tourists and government users for policy decision making.



## Remoteness/Accessibility Index for Newfoundland and Labrador

Through consultations with government stakeholders and the use of surface analysis techniques, SESA developed a measure of remoteness that provides stakeholders with an alternative to the typical grouping of rural and urban locations. The concept is based on the idea that rurality is not only relative to population but also to the distance a location is from required services such as health care and post-secondary education facilities and core need services such as major grocery outlets. For example, communities and regions can now be classified as either extremely remote (very rural), remote (rural), somewhat remote (somewhat rural), somewhat accessible (somewhat urban), accessible (urban) and highly accessible (very urban). The index provides a more precise description of the relative location of communities and regions in the province that better assists regional and community development.

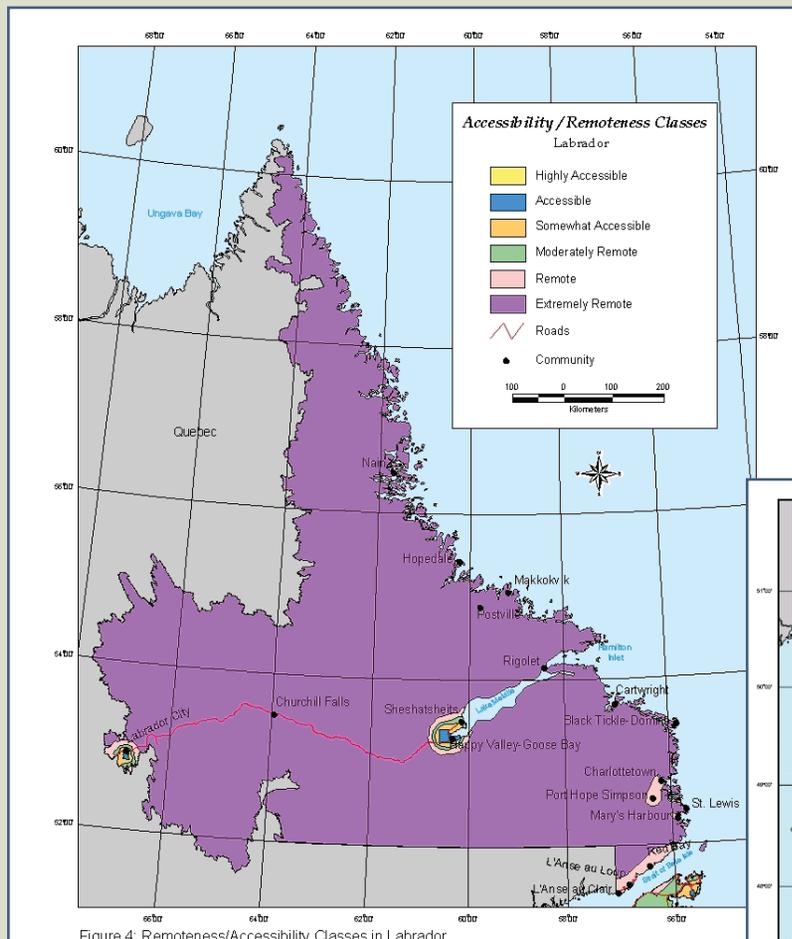


Figure 4: Remoteness/Accessibility Classes in Labrador

**Figure 4.** Map illustrating the boundaries of areas that are extremely remote to highly accessible based on the relationship of various social characteristics (i.e., population) and relative access to major services (i.e., healthcare, postsecondary education services and grocery outlets).

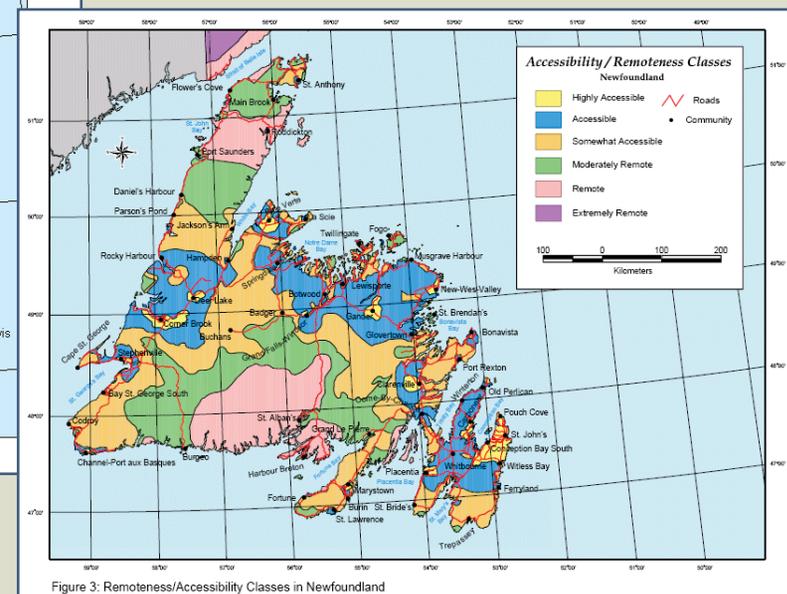
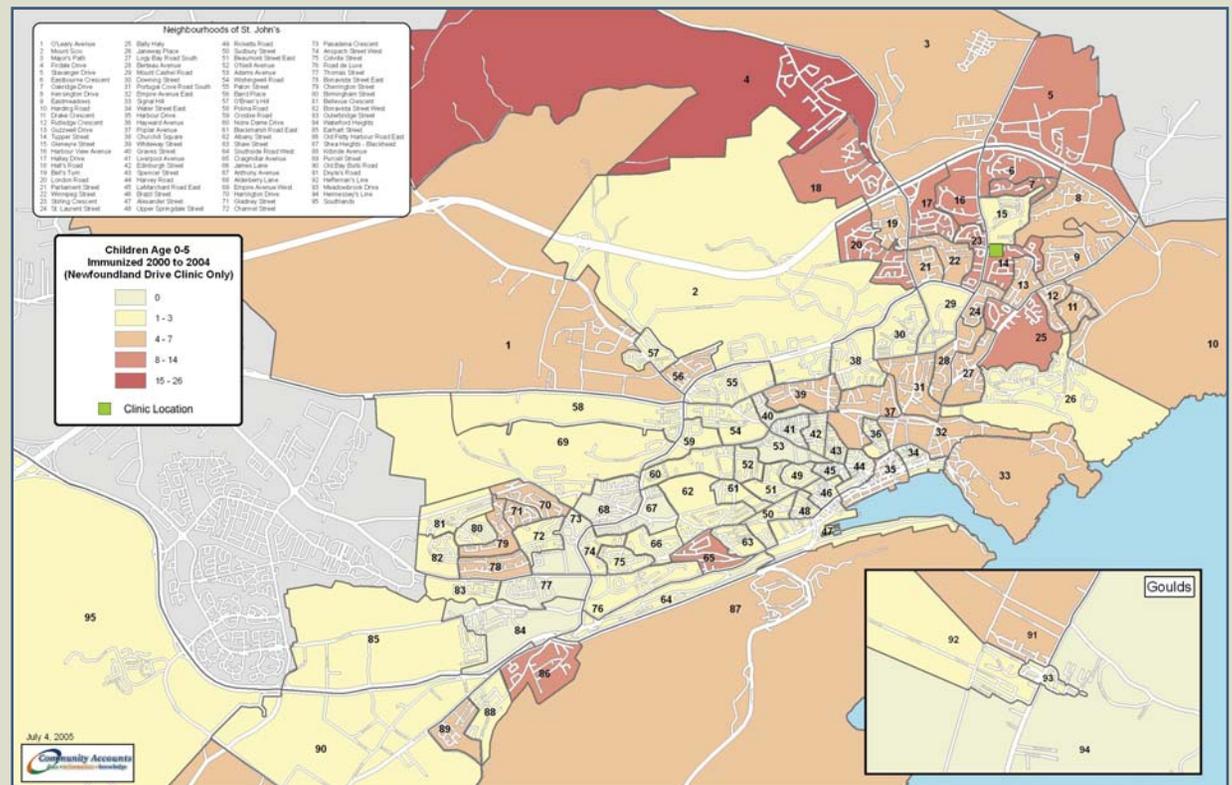


Figure 3: Remoteness/Accessibility Classes in Newfoundland

## Health Care Corporation of St. John's Thematic Mapping

To aid the Health Care Corporation of St. John's (HCCSJ) in evaluating the distribution of health care services in St. John's, SESA was able to develop a series of thematic maps to spatially display various health related factors at the neighbourhood level. For example, to assess gaps in clinic locations within the city, SESA developed maps to show the locations of medical clinics in relation to the households of clinic patients. Similarly, SESA was able to spatially represent the number of children in neighbourhoods that have undergone immunization by specific health clinics in the city. This allowed the corporation to access the best locations for immunization programs in the city.

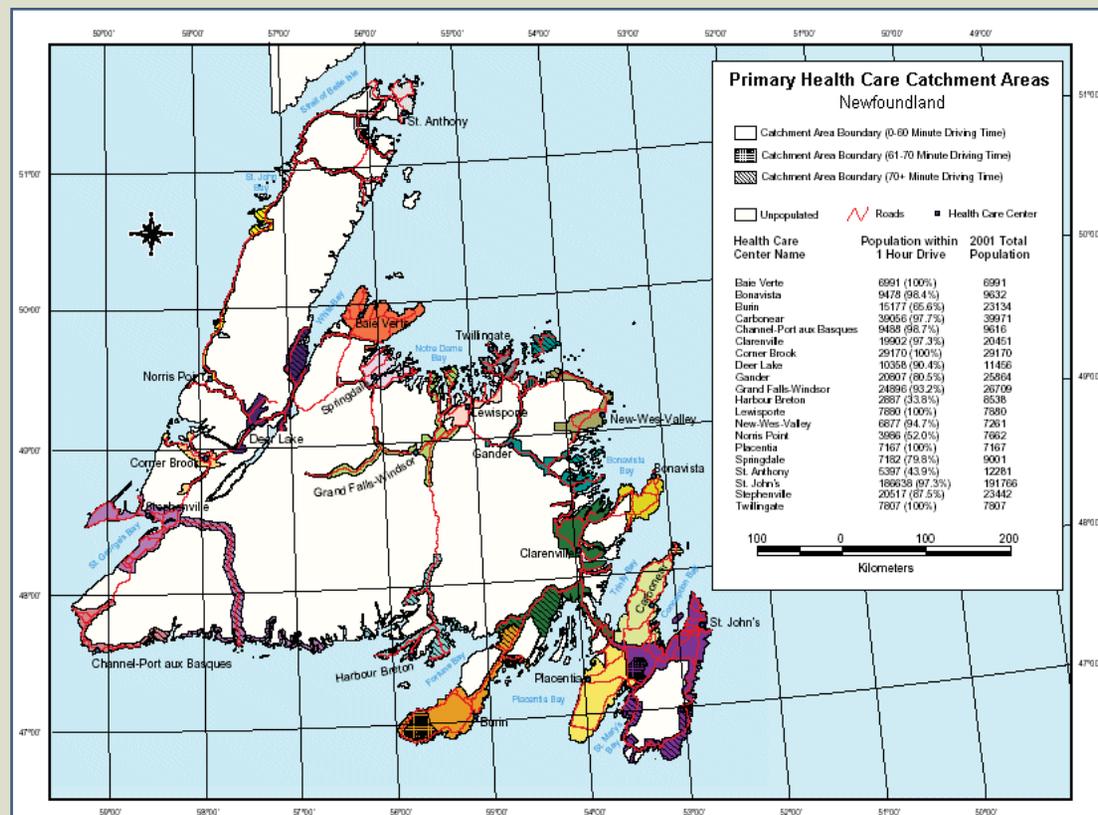
**Figure 5.** Thematic map showing the number of children (ages 0-4) by St John's neighbourhoods that have undergone immunization at the Newfoundland Drive Health Clinic.





## Primary Health Care Efficiency Modeling and Catchment Area Description

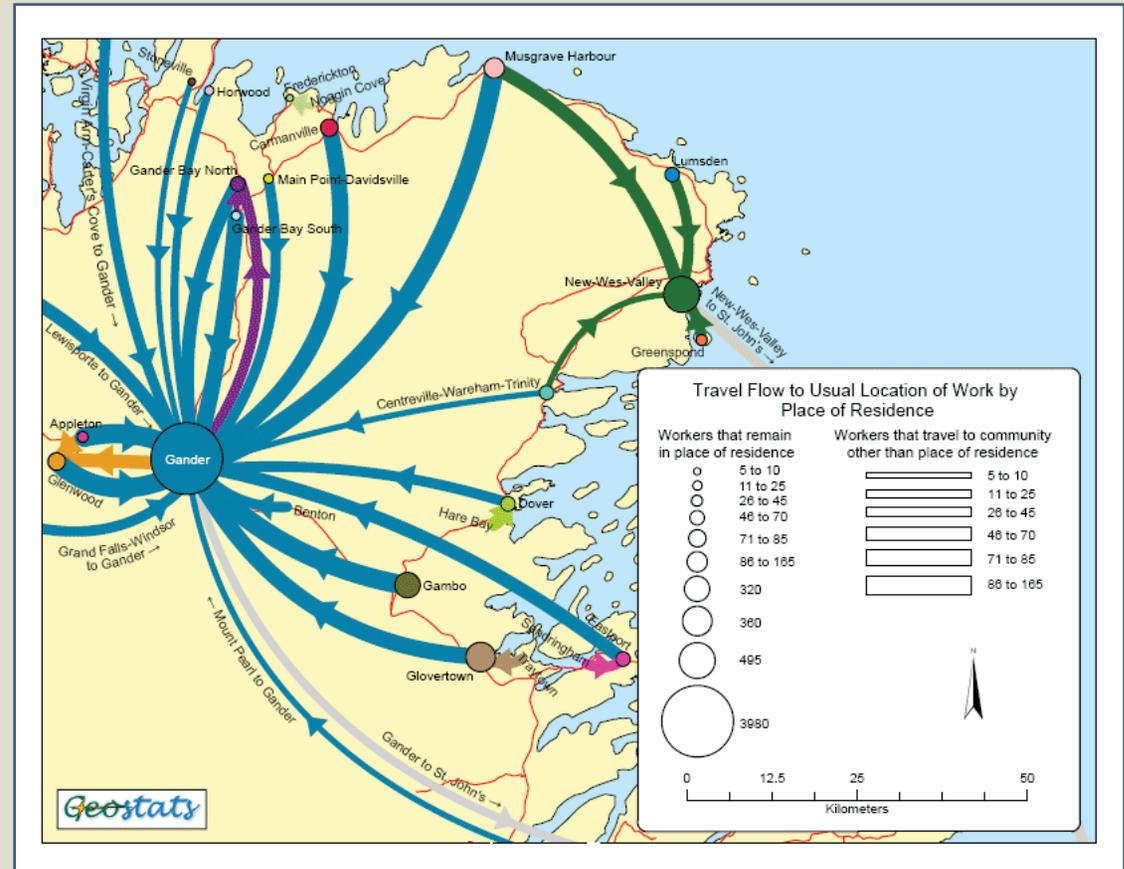
SESA aided the Department of Health and Community Services to analyze the state of current primary health infrastructure and to offer suggestions for system improvements relative to anticipated population changes in communities. Designed through location-allocation efficiency modeling, time series analysis and collaborative forums, where doctors and health administrators provided input, the Unit implemented “what if scenarios” to determine the state of health care up to 2010. For example, if the population of the Northern Peninsula ages, what kind of increase in geriatric care can be expected?



**Figure 7.** Sample output from primary health infrastructure analysis showing health care centers in the province and the population they served, based on time required for patients to travel to each (i.e., less than 60 minutes, 60-70 minutes and greater than 70 minutes). Coloured areas refer to distinct geographies that are serviced by health care centers (i.e., service catchment areas).

## Labour Market Description and Commuting Flows Estimation

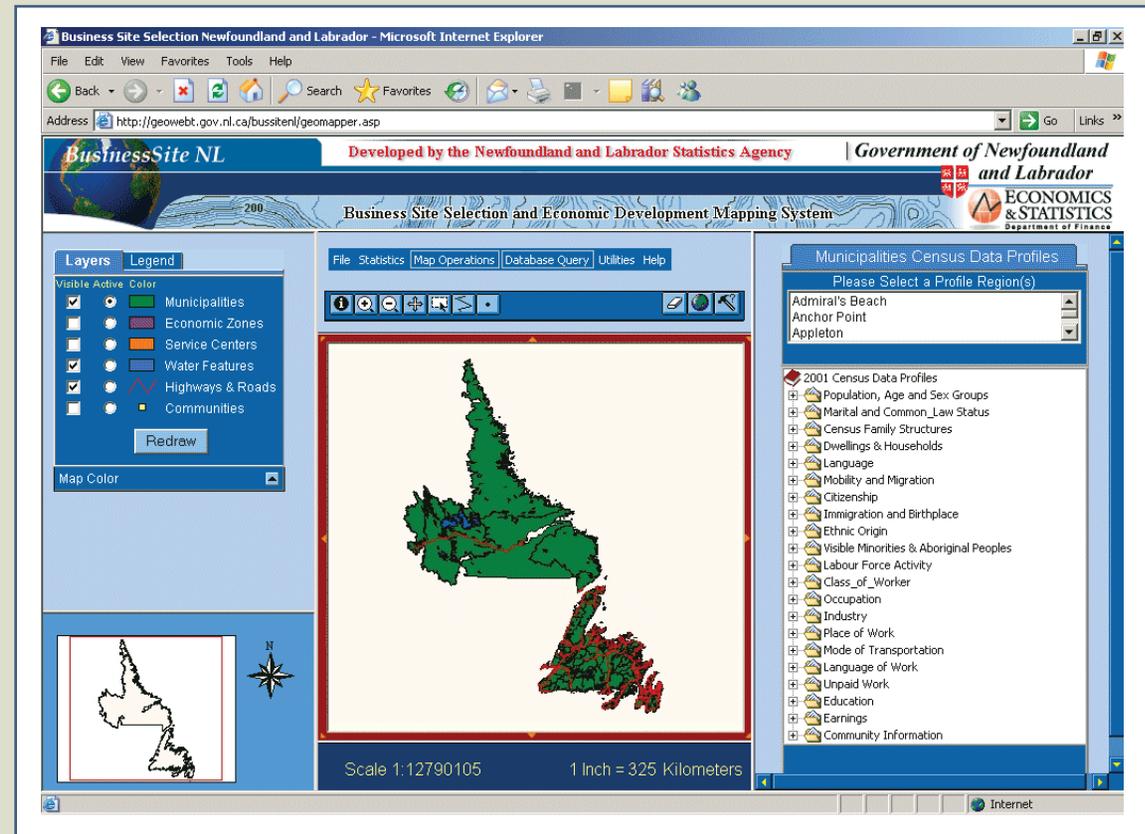
SESA, in collaboration with the Department of Human Resources and Employment, generated workflow maps through the use of surface and linear network analysis to determine stable commuting patterns around the major labour market centers in the province. Once identified, the socio-economic characteristics of these areas were determined to enable the prediction of skill gaps, labour shortages and for informing citizens of training and educational choices to gain successful employment in their area as well as for other economic policy initiatives. This information was recently presented at public forums across the province where it gathered positive and constructive feedback from users based on their knowledge of labour patterns in their regions.



**Figure 8.** An example of the commute to work flows in the Gander region by number of citizens and place of residence.

## BusinessSite Newfoundland and Labrador

In partnership with Memorial University of Newfoundland and government stakeholders, SESA developed the interactive, web-based GIS software BusinessSite Newfoundland and Labrador. This website provides users with online access to an array of socio-economic mapping tools as well as location-allocation and spatial decision making models. A specific example of this is the Multiple Criteria Evaluation (MCE) component. Designed as an interactive participatory tool, it enables members of a decision group to apply a “give and take” or consensus building method of decision-making. With the guidance of a facilitator, each group member has the ability to both quantitatively and qualitatively weigh the importance of a number of factors that are commonly related to business site selection and economic policy development. Based on the type of factors (i.e., social and economic, infrastructure availability) and their selected level of importance, the MCE produces a list of best-fit geographies (e.g., communities). The flexibility of the system allows each participant to understand and appreciate the viewpoints and opinions of others in a fully collaborative decision environment and to immediately view an output of their decisions.



**Figure 9.** BusinessSite NL socio-economic mapping tool. The panel on the right shows examples of the approximate 300 social, economic and infrastructure layer attributes that users can select to enable them to design custom spatial maps for any layer of geography in the province. On the left is a sample interactive map that allows users to custom select any level of geography and visual an area’s social, economic and infrastructure attributes.

**Figure 10.** BusinessSite NL Multiple Criteria Evaluation (MCE) tool. The MCE component is an interactive participatory site selection tool. It allows stakeholders to select and set the relative importance of various business and economic related factors through a process of consultation and consensus. Once this process is complete, the MCE provides a complete list of best fit geographies that meet stakeholders' business/economic criteria.

The screenshot displays the Business Site Selection Newfoundland and Labrador web application. The main interface is titled "Step 1: Generate Pairwise Comparison Matrix". It features a table for comparing various factors. The factors listed are Pop. 2000, Lbr\_Force, Unemp., Dem20\_30, Dem40\_50, House\_Inc, Retail, Min\_Educ, UnivGrad, College, and Call\_Sat. The diagonal cells of the matrix are highlighted in yellow and contain the value '1'. To the right of the matrix is a "Relative Importance" slider control with a scale from Extreme to Extreme, passing through Very Strong, Strong, Moderate, and Equal.

Below the matrix is "Step 2: Calculate Variable Weights and Consistency Ratio". This section includes a "Calculate" button and a table for the resulting weights:

	Pop. 2000 Weight	Lbr_Force Weight	Unemp. Weight	Dem20_30 Weight	Dem40_50 Weight	House_Inc Weight	Retail Weight	Min_Educ Weight	UnivGrad Weight	College Weight	Call_Sat Weight
Calculate	<input type="text"/>										

Below the weight table, there is a "Consistency Ratio" field and a "Reset" button. A note states: "Note: Consistency Ratio should be <= 0.10".

The application footer shows a scale of 1:12790105 and a conversion of 1 Inch = 325 Kilometers. The browser address bar shows the URL: http://geowebt.gov.nl.ca/bussitenl/geomapper.asp.

## What People Are Saying.....

*“This group (SESA) has played and will continue to play an integral role in the development of high-level provincial strategies. Their ability to geographically display information key to policy and strategic planning initiatives has assisted not only informing Government, but also key stakeholders.”*

**LYNN BRYANT, DIRECTOR  
POLICY AND PLANNING DIVISION  
DEPARTMENT OF TRANSPORTATION AND WORKS  
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR**

*“SESA has developed an innovative geographic information system that enables stakeholders to access a myriad of socio-economic and local infrastructure information for both communities and economic zones that allows users to explore policy issues and answer specific development questions that are critical for promoting endogenous growth.”*

**ROB GREENWOOD, DIRECTOR  
THE LESLIE HARRIS CENTER OF REGIONAL POLICY AND DEVELOPMENT  
MEMORIAL UNIVERSITY OF NEWFOUNDLAND**

*“Our data has extended beyond typical subject analysis such that geographically interpreted data is necessary. The adaptability and expertise of the Social and Economic Spatial Analysis Unit has provided a solution to this problem. Working with us to identify and assess our data needs, the unit has been able to represent information of interest in a more significant fashion”*

**DORIS HANCOCK, REGIONAL PARTNERSHIP PLANNER  
CORNER BROOK-ROCKY HARBOUR REGION  
RURAL SECRETARIAT  
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR**

*“The GIS group (SESA) continues to provide a level of service and professionalism that others in the public service and private sector would be wise to emulate. The work produced by the group and their positive attitudes is a good example of cooperation and excellence within the public service that should be recognized and acknowledged.”*

**BRIAN DELANEY, DIRECTOR  
POLICY AND PLANNING  
DEPARTMENT OF FISHERIES AND AQUACULTURE  
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR**

*“The ability of SESA to implement “what if” scenarios enabled members of the Primary and Secondary Health Care Service Advisory Group to fully participate in the decision making process, regardless of their level of understanding of statistics or GIS. The result of this collaborative research brought a degree of insight and clarity into my understanding of the dynamics of health care services and enabled the advisory group to realize that most health data are inherently spatial. This is a paradigm that should be applauded”*

**JOY MADDIGAN, ASSISTANT DEPUTY MINISTER  
POLICY AND PLANNING  
DEPARTMENT OF HEALTH AND COMMUNITY SERVICES  
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR**



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