PREVENTATIVE HEALTHCARE SERVICES FACILITY SITE LOCATION

ONTARIO HEALTHY LIVING AGENCY (OHLA)

USER MANUAL REPORT

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INTRODUCTION

Geographic barriers limit the accessibility and availability of healthcare services and personnel in rural areas. In addition to cultural factors that influence access, this is particularly true for Indigenous communities in Ontario. More specifically, Indigenous peoples in Ontario have inequitable access to preventative and primary health-care services. (Rud, 2021) This means that the, often poor, health care facilities that do exist in these areas are skewed towards emergency and specialized treatment. For example, in Ontario, compared to other people in the province, Indigenous people have an increased prevalence of diabetes. (Shah et al., 2020) Type 2 diabetes is preventable if proper actions are taken such as visiting the doctor frequently, losing weight and staying more physically active. (Shah et al., 2020) A study conducted by PubMed Central (PMC) found that Indigenous people were 12.4% less likely to have a regular family physician and had an overall lower continuity of care with that physician than other citizens in Ontario. (Shah et al., 2020) They were more likely to be admitted to the hospital for ambulatory-care conditions (2.4% vs. 1.2%) and have an emergency department visit for hypo- or hyperglycemia (1.5% vs. 0.8%). (Shah et al., 2020) Indigenous people with diabetes in Ontario, particularly those living in First Nations communities, had poorer access to and use of primary care than other people with diabetes in the province. Ultimately, the failure to provide Indigenous peoples with adequate and safe access to primary and preventative healthcare further exacerbates poor health outcomes for Indigenous populations in the province. (Rud, 2021)

BACKGROUND – THE ONTARIO HEALTHY LIVING AGENCY

The Ontario Healthy Living Agency (OHLA) seeks to determine a new site location for a preventative healthcare services facility in order to minimize health related issues within Ontario Indigenous communities. The organization seeks to create a user interface that allows healthcare

planners to determine a site location that can reach the greatest amount of people. Additional factors such as accessibility via walking and/or driving will also be taken into consideration. Unlike hospitals, the clinic's primary focus will be on preventative treatments and services. Despite not being their main focus, Ontario hospitals are able to provide these types of services to an extent, thus, the OHLA clinic will not be placed within a certain proximity to a pre-existing hospital. In addition to hospitals, fire stations have also been deemed an emergency response site and service so, the OHLA clinic will not be within a radius of any station. In addition to providing more equitable and personal health care to Indigenous communities, this will help to save lives and reduce hospital wait times.

CONTEXT

The primary purpose of the interface customization will be to investigate differences in accessibility to preventative health care facilities of different Indigenous communities in Ontario. Research suggests that making medical clinic locations convenient and accessible to residents is crucial. (Cich, 2017) The less convenient a clinic is to get to, the less likely an individual will visit and seek the resources that they need. (Cich, 2017) When choosing locations, others have often considered general accessibility and transportation, so the OHLA has decided to follow suit. (Gul & Guneri, 2021) Based upon the results, the interface customizations will provide the user with a recommendation for a new site that can be reached most efficiently by the greatest number of people. For our purposes, accessibility will be determined by both foot and car transportation access. Based upon the various factors that have been deemed most important – accessibility via foot and/or car and separation from emergency services such as hospitals and fire stations – the OHLA's model will determine potential site locations and quantify the results by producing an attribute table of distances from the potential clinic site to an Indigenous band.

OVERVIEW & INSTRUCTIONS

INPUT DATA & TEST DATA

Table 1

Links to Datasets

NAME	LINK
Bands	https://open.canada.ca/data/en/dataset/b6567c5c-8339-4055-99fa-63f92114d9e4
DAs	https://data.ontario.ca/dataset/public-health-unit-boundaries
Fire Stations	https://cdncompanies.com/fire-station/ontario/
Highways	https://open.canada.ca/data/en/dataset/c5c249c4-dea6-40a6-8fae-188a42030908
Hospitals	https://open.canada.ca/data/en/dataset/9ca53911-a284-416e-8a0e-9a74722b5b8f?wbdisable=true

DESCRIPTION & RATIONALE OF DATASETS

The model includes five input datasets. The *Bands* dataset contains the geographic location of First Nations in Canada as points that identify where they live. Given that the OHLA clinic is intended to target Indigenous peoples, this is the source of data that will be used as the foundation for the analysis. The OHLA requires that the clinic be within walking distance of a band. The default setting for walking distance is 5km, however, this can be adjusted by the user according to their own criteria. The *DAs* dataset contains the geographic boundaries of the 34 Public Health Units in Ontario. By default, four DAs were selected as the study boundary: 4, 9, 10, 24. The user may wish to choose alternate DAs in order to create a different boundary. The *Fire Stations* dataset was created as a list of coordinates in a csv file. The fire stations' addresses were sourced from a website, converted into x and y coordinates, and inputted into a csv file. The *Hospitals* dataset includes geographical information about the organization name and address. The OHLA requires that the clinic be outside of a given distance from either a hospital or fire station. This is because both hospitals and fire stations provide medical services, thus, it would

be inefficient to place the clinic nearby. The default setting for distance away from a hospital or fire station is 10km, however, this can be adjusted by the user according to their preferences. The *Highways* dataset contains Canada's national highway system accepted by the Council of Ministers, mapping by Transport Canada. The OHLA requires that the clinic be within a given driving distance from any major highway. This will further help to ensure accessibility. The default setting for driving distance from the highway is 10km, however, the user may change this according to their criteria and preferences.

USER INSTRUCTIONS FOR DATASETS

This tool is for site selection purposes only and is not to be redistributed outside of the OHLA department for any other purposes. The data used in this model is not highly accurate and should be used with caution when applied at a large scale modeling. This model is to be used for Ontario only as the boundary has to be defined by a selection of Ontario health dissemination areas. Additionally, this model is to be used for highways only because it accounts for the high speed limits on these roads. This model is to be used for Indigenous bands only. This model is not relevant for other residential areas or populations since their needs are different and thus are not accounted for as factors in this model.

RIBBON CUSTOMIZATIONS

Table 2

Summary of Contents in the Ribbon

TAB	GROUP	CONTENTS
Load	Insert	• New Map • Add Data • Basemap
	Data Management	• XY Table To Point
Site Selection	Planning	• Clip • Select
	Proximity	• Buffer • Near
	Combine	• Intersect • Union • Spatial Join
	Locate Site	• Erase • Feature To Point
Navigate	Investigate	• Explore • Zoom In • Zoom Out • Attribute Table
	Experiment	• Locate
	Troubleshooting	• Undo • Redo • Save
Presentation	Design	• Symbology
	Share	• New Layout • Export Layout

DESCRIPTION OF ANALYSIS & RATIONALE FOR CUSTOMIZATIONS

The customizations are designed to make the interface as user friendly, logical, and efficient as possible. The *Load* tab is divided into two groups – *Insert* and *Data Management* – that contain the contents that the user will need to begin working on their project. This is where they should begin in order to set everything up. The contents in the *Insert* group allow the user to create a new map, select a basemap (a reference map on which you overlay data from layers), and add data to it. The contents in the *Data Management* group allow the user to convert data that is in coordinates from a table (in a csv file format) to a point feature class that can be used as points on the map.

The *Site Selection* tab is divided into four groups – *Planning, Proximity, Combine,* and *Locate Site* – that contain the bulk of the tools for analysis. This is where they should be to carry out the operations for determining eligible site locations. The contents in the *Planning* group allow the user to select a study boundary and clip their input data to that boundary. The *Proximity* group contains the tools that illustrate areas within a certain distance (buffer) of a given point and quantify the distances between two points. Quantifying the results allows the user to rank and validate the potential clinic sites based upon their distance from a band. The contents in the *Combine* group allow the user to merge results to view patterns quicker and easier. The *Locate Site* group contains the tools that allow the user to visualize potential polygons the site could lie within, and more specifically, an accurate point within the larger area.

The *Navigate* tab is divided into three groups – *Investigate, Experiment,* and *Troubleshooting* – that contain the tools to examine and investigate the results from analysis. This is where the user can determine which of the potential sites they want to select based upon other factors. Other factors may include nearby stores, neighborhoods, businesses, etc. that may change the

desirability of a location. The contents in the *Investigate* group allow the user to move around, explore, zoom in and out, as well as, view additional details about certain features in an attribute table. The *Experiment* group allows the user to find places and addresses on the map. For example, this could be used if the user wanted to ensure that the clinic was located close to a specific address. The contents in the *Troubleshooting* group contain the basic tools for working on a project such as undo, redo, and save.

The *Presentation* tab is divided into two groups – *Design* and *Share* – that contain the tools for distributing results and sharing findings with coworkers. The *Design* group contains a tool that allows the user to change the symbology of features. The contents in the *Share* group allow the user to select a layout and export their final product (i.e. map) into one of three file types.

ACCELERATORS	
Buffer	CTRL + B
Clip	CTRL + K
Locate	CTRL + L
Add Data	CTRL + A
Save	CRTL + S

QUICK ACCESS TOOLBAR
New
Open
Save
Undo
Redo
Symbology
Export Layout

The Quick Access Toolbar and accelerators have been customized to match the customizations of the ribbon and needs of the user. They intend to benefit the user by making the user interface more organized and straight-forward to use. Those placed in the Quick Access Toolbar have been deemed as the features/commands that the user will be likely use most frequently. Those set as accelerators have been deemed as the tools that the user will be likely to use most often.

MODEL DESCRIPTION

The Model can be used for the site selection of a new preventative healthcare facility catered to Indigenous people in Ontario. The model defines highways, fire stations, hospitals, and bands within a designated study boundary. It then illustrates the intersection and union between these buffers to further explore their relationship. The model erases the buffers that overlap so that the user can easily visualize the viable areas for the new site location that is efficient since it is not covered by other emergency services. Finally, the model determines the centroids of these areas, identifying them as potential sites, and measures the distance from each site to their closest band.

Table 3

Rationale for Methods in Model

TOOL DESCRIPTION	
Select	Used to determine the study boundary within Ontario. The study boundary is created by selecting pre-existing public health dissemination areas from the Public Health DAs input; the selection of DAs is a parameter in the model.
XY Table To Point	Used to convert the input of the fire stations' coordinates into points on the map.
Clip	Used three times on three different inputs – Bands, Highways, and Hospitals – to confine these variables to the study boundary.
Buffer	Used four times on four different inputs – Bands in Boundary, Stations, Highways in Boundary and Hospitals in Boundary – to determine the reach of these input variables. All of the buffers have a distance parameter on them and are set to dissolve all output features into a single feature.
Union	Used to determine the overlap between the Buffered Bands and the Buffered Stations outputs. This identifies regions that are already covered by some sort of medical service for the Bands and thus

	would not be efficient to place a site in. A parameter is set on this tool to join all attributes.
Intersect	Used to illustrate the area that is covered by the Union of Bands and Stations as well as Buffered Highways. This illustrates the areas that share these layers with a parameter of attributes to join set on them.
Erase	Used twice. First, to erase all areas that are covered by Buffered Stations within the pre-existing Intersect of Highways, Bands, and Stations. The second time the erase tool is used is to erase all areas that are covered by the hospitals' buffers within the pre-existing Intersect of Highways, Bands, and Stations. These provide potential site areas since it shows only the areas that are within a certain proximity (within the buffer) of the highways and bands but not any stations or hospitals.
Spatial Join	Used to combine these two separate outputs (Potential Site – No Hospitals and Potential Site – No Stations) into one. This illustrates all viable areas for a new site.
Multipart To Singlepart	used to create a feature class of singlepart features generated by separating the multipart input features.
Feature To Point	Used to determine the centroids of the areas that are singlepart features representing potential site locations since they are far enough away from any hospital or station. The resulting centroid in the output represents the exact location of the potential site for the new preventative health clinic.
Near	Used to determine the exact distance between the potential site and the nearest Band. A search radius parameter is set on this tool and the results are shown in the attribute table.

MODEL USER INSTRUCTIONS

The following parameters can be adjusted according to the user's own research, preferences and discretion.

Table 4

Parameter Instructions in Model

PARAMETER	DESCRIPTION
Selected DAs	Extracts features from an input feature class, using a select expression, and stores them in an output feature class. This is used to determine the study boundary. By default, four DAs were selected: 24, 9, 4 10. The user is able to adjust this list of DAs to make their study boundary smaller, larger, or a different area within Ontario according to their own research and preferences.
Bands Distance Buffer	The distance and unit for the buffer analysis. By default, this tool is set to 5km. This is because research suggests that 5km is considered to be walking distance. Therefore, it is important that a site be located within this area to be considered accessible via foot. The user is able to adjust this measurement according to their own research and preferences.
Stations Distance Buffer	The distance and unit for the buffer analysis. By default, this tool is set to 10km. This is because research suggests that 10km is considered to be the average distance covered by each fire station, therefore, it would be inefficient and redundant to place a site within this area. The user is able to adjust this measurement according to their own research and preferences.
Highways Distance Buffer	The distance and unit for the buffer analysis. By default, this tool is set to 10km. This is because research suggests that 10km is considered to be the average drive distance from the highway that people are willing to go. Therefore, it is important that a site be located within this area to be considered accessible via car. The user is able to adjust this measurement according to their own research and preferences.
Hospitals Distance Buffer	The distance and unit for the buffer analysis. By default, this tool is set to 10km. This is because research suggests that 10km is

	considered to be the average distance covered by each hospital, therefore, it would be inefficient and redundant to place a site within this area. The user is able to adjust this measurement according to their own research and preferences.
Join All Attributes	Joins attributes from one feature to another based upon their spatial relationship. By default, this is set to join all attributes, for both the 'Intersect' and 'Union' tools. This can be used to identify which areas the buffers of the hospitals, fire stations, bands and highways intersect with one another. The user can select whether they want all or only some of these features to be highlighted. This can be used to quickly eliminate areas that would be redundant or inefficient to place a new preventative healthcare site based pre-existing infrastructure. Therefore, at a quick glance, the site planner can know where to place the new clinic to provide care to the most bands in the most efficient way possible.
Search Radius	Specifies a distance and a minimum number of points required for analysis. By default, the this parameter is set as a RadiusVariable of 1000km. The search radius measures the distance between the potential site locations and the bands within the given radius. The user is able to adjust this measurement according to their own research and preferences.

SCRIPT & SCRIPT TOOL INSTRCUTIONS

The script tool ultimately has the same functionality as the model builder. However, the only addition is the function named "countStations". It takes the fire stations path as a parameter. It opens the csv file and uses a while loop to iterate through each line in the csv file so that each

fire station is counted toward the total number of cities. Meanwhile, conditional logic is used to determine which fire stations are in which cities. Stations are stored in variables representing various cities accordingly and the user is told the frequency of total fire stations as well as the number of fire stations in key cities.

DISCUSSION & CONCLUSION

Indigenous communities in Ontario are disproportionately marginalized as a result of their limited accessibility to healthcare facilities. Our customizations will be beneficial to all parties since it determines the most efficient site both accessibility and monetarily wise.

Interpreting raw data can be challenging, therefore, to determine areas for a potential site, the model constructs two visuals, a map, and an attribute table. The map visualizes where the viable areas are based on their distance from certain features. The attribute table quantifies the results by producing a table that measures the distance between the centroid of each of the areas (i.e. the specific potential site location within the area) and the bands. This can be used to help better, and potentially save the lives of Indigenous people in Ontario. Additionally, this will assist in alleviating the current stress on the emergency health care facilities (i.e. hospitals) in the country. This is because access to preventative healthcare facilities catered to Indigenous people will decrease their risk of health emergencies and, overall, improve the lives of citizens.

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