



THE DISTRICT MUNICIPALITY OF MUSKOKA

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September 8, 2016

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CIF Project Number: 820
Project Title: GIS Collection Point & Service Level Mapping System

Please find enclosed the revised (September 8, 2016) Project Final Report dated August 19, 2016, the GIS Curbside Stops and Route Mapping dated September 8, 2016 and associated invoice. I will E-mailed you a copy of the revised PowerPoint presentation to replace the previously submitted presentation to adjust for minor amendment. The District Municipality of Muskoka thanks the Continuous Improvement Fund for supporting this project.

If you have any questions or concerns regarding the submission, please don't hesitate to contact me directly,

Warm regards,

Jamie Delaney
Manager of Environmental Compliance

Managing Our Legacy Together



With Funding from



FINAL REPORT AND PROJECT EVALUATION

FOR

**GIS COLLECTION POINT & SERVICE LEVEL
MAPPING**

IN

**THE DISTRICT MUNICIPALITY OF MUSKOKA,
CIF #820**

August 19, 2016

**THE DISTRICT MUNICIPALITY OF MUSKOKA
70 PINE STREET
BRACEBRIDGE, ONTARIO P1L 1N3**

1.1 Introduction

The District Municipality of Muskoka (the District) has successfully provided waste management services since January 1, 1996. At that time, the District assumed the responsibility to provide these services from the six (6) area municipalities that make up the regional municipality. Appropriate waste management is essential to preserving the natural environment for all residents, both permanent and seasonal. The area receives more than two (2) million visitors every year, who come to experience the District's world-renowned natural beauty. There are 1,600 lakes within its boundaries and roughly 50% of the residents are seasonal.

The District accesses waste management funding made available by the province through various funding organizations for residential components of the waste management service it provides. These include blue box, household hazardous wastes, tires, batteries and electronic wastes.

In order to access these funding programs, the District is responsible to annually report to Waste Diversion Ontario (WDO) detailed curbside and depot waste collection and disposal information. The District contracts to a third party provider for all of its curbside collection operations, its waste hauling operations, and its Household Hazardous and Special Wastes depot operations. The District operates: residential communal bin sites, residential waste depots, residential and industrial, commercial, and institutional (ICI) transfer stations and landfills.

This project was developed to address the need to report defensible data to the WDO, to address curbside limit administration by our contractor, and to justify the individual levies that are assigned to the Area municipalities for their specific mix of waste management services annually received. The WDO requires specific, defensible data on residential and ICI services provided by municipalities.

Annually determining the mix of residential and ICI tonnages for curbside and depot collected blue box, garbage, organics and large items is a challenging task. It must be undertaken with the thought of an auditor reviewing the assumptions used to determine these financial and tonnage data. Therefore, the database produced under this project provides the necessary detail and backup to provide the WDO suitable backup to the annual data reported with respect to curbside and depot collection services.

This report will outline the basic strategy that can be used to turn hardcopy curbside collection route maps, the Municipal Property Assessment Corporation's (MPAC) property fabric, and the Ontario Road Network into a Geographic Information System (GIS) for curbside stops and routes. These databases can be regularly updated with new data from the originating databases to represent year over year changes.

1.2 Description of Service Area

The following six (6) Area municipalities comprise the Area municipalities in the District:

[Town of Bracebridge](#)

[Town of Huntsville](#)

[Township of Georgian Bay](#)

[Township of Lake of Bays](#)

[Town of Gravenhurst](#)

[Township of Muskoka Lakes](#)

The services that are provided by the District to the Area municipalities vary mainly with respect to curbside services. In the case of the Township of Lake of Bays, all services are transfer station based. In the Township of Georgian Bay there are selected curbside routes in the three urban communities within the township and on some of the main year round and seasonal municipal and private roads but with a large portion of properties without road access bin site, depots and transfer stations service this population. In the Town of Bracebridge, the Town of Gravenhurst, the Town of Huntsville and the Township of Muskoka Lakes curbside collection services are provided on all provincial, upper and lower tier municipal roads and passable private roads. These towns and townships also have non-road access properties that are serviced outside of the curbside collection system. The seasonally maintained municipal and private roads are typically serviced curbside between May and October each year.

1.3 GIS Model - Solid Waste Collection System - Advantages

The District supports the use of Best Practices (BP) in providing waste management services including Blue Box services. The District understands that the funding stewards supporting the residential Blue Box system in Ontario expect municipalities to strive to adopt BPs where possible. This project is a “CIF Best Practices” Objective 1: ‘Provide data on specific performance indicators (e.g., collection and processing costs, revenues, marketed tonnes, net costs, recovery etc.) along with projections for the year to come best practice’.

The databases created by the project and used for managing and delivering curbside collection services will assist the District in adopting Continuous Improvement Fund (CIF) Best Practices Objectives in other area such as: Blue Box efficiency assessments, Blue Box System Optimization Initiatives, and Program Performance Outcomes given the detail information available about the nature of the collection stop and routing. The data can be used to provide WDO and other future waste management funding agencies with verifiable data related to curbside service levels.

The District has typically entered into multiyear contracts for the provision of waste management services including curbside collection. The contract wording must address items such as service level changes and contract price adjustments that result from additional curbside stops. The District’s varied curbside service level precludes simply using new development Occupation Permit totals to assign additional services as this new development may not occur in a curbside serviceable area. The GIS based curbside collection model maintains records of all addresses that are served curbside or by a depot.

Compiled data on the curbside collection system now includes: stop locations, 911 addresses for each stop, and the type of unit receiving service (residential vs. ICI). The collection route

data includes details such as: road name, the day of week, collection map number, and biweekly collection week numbers. This data is now available for incorporation into future service contract tenders and will serve to clearly define contractor requirements with respect to curbside collection services.

The District has successfully garnered sufficient interest in waste management contracts in the past however the description of the service requirements may have been too general. Incorporation of individual stop locations into future tender documents should allow bidders to predict their costs and thereby reduce uncertainty in tender submissions. Reduced uncertainty and risk typically leads to a more cost effective bid.

A review of the 2002 waste collection and disposal contract bid prices (the most recent information available) shows a range of \$1,457,795 or 18%. The second lowest bid was almost 15% more than the lowest bid. Given the difference of 18% between the three bids received, a more detailed tender document might have resulted in closer bids and therefore competition against the lowest bid.

CIF staff indicated to the District that bidders of the previous service contract reported that the lack of detail in the description of work required within the tender documents contributed to the variance between the lowest bid and the next lowest bid. The bidders indicated to the CIF that the street listing tables provided in the previous tender documents did not contain enough detailed stop and route information for bidders that were unfamiliar with the District's municipal and private road system. The distribution of stops along these roads was not provided and this likely limited competitive bidding somewhat and the prices may have reflected this.

The District is proposing to provide precise route and curbside stop information within its next tendering process that is planned for 2017. The data from this project will allow a detailed listing by individual 911 addresses and, if necessary, of the curbside collection service stops. This should reduce the risk bidders may take in setting their bid prices and therefore promote a competitive bidding process.

The Geographic Information System (GIS) model defines the curbside locations and routes and provides the ability to quickly and easily address enquiries as well as provide information on individual properties or in specific geographic areas. Having this detailed information available in an electronic GIS format allows the District to efficiently and effectively react to customer concerns, billing issues, program planning and contract issues related to curbside collections.

2. Project Component Descriptions

2.1 Project Equipment

The equipment used for this project consisted of: geographic position system (GPS) receivers, Windows based tablets and workstations. The GIS technology displays an overhead view of the database in the form of a symbol representing a stop and the various collected materials.

2.2 Curbside Stop Database Creation

The creation of an ESRI ArcMap representative curbside collection geo-database is dependent on access to the Municipal Property Assessment Corporation (MPAC) property fabric database, a road centerline database (adjusted Ontario Road Network in this case) and the municipal 911

civic addressing database.

The property fabric database typically contains a record for each “unit” in the District. Therefore, a single family dwelling represents one (1) record in the database and a twelve (12) unit apartment represents twelve (12) records. It is known that the MPAC property fabric database has inconsistencies therefore the MPAC data is matched to the District’s 911 Civic Address database at the unit level thereby confirming each unit’s validity and eligibility for curbside collection. To allow unit to unit matching between database tables, a common key field was created for each record consisting of a nineteen (19) digit number that is the concatenation of the property number and the sub-unit numbers of the property which is essentially a Roll number.

2.3 Curbside Route Database Creation

The creation of a GIS database using ESRI’s ArcMap to represent the curbside collection routes depended on having access to hardcopy collection route maps and the District’s Ontario Road Network (ORN) database. Centerlines are selected in ArcMap and are saved as specific routes from the roads database using the hard copy collection route maps. The resulting database contains the streets and roads that are collected or travelled to complete the curbside routes. The roads database includes the ability to categorize the roads into various types such as: Township; private; District; and Provincial. It also provides: road/street names, any name aliases; their lengths; and route designations.

2.4 Mapping Curbside Stops

Individual stop locations are displayed on the tablet’s screen and the tablet uses a separate GPS receiver for positioning information. The points representing the curbside stops are displayed against geo-reference aerial photographs that provide visual cues to locate the collection point’s location. This allows a spatially located point to be saved as a stop. For rural areas, assigning stop locations was done in the field due to obstructions on the aerial photographic views. For urban areas where the street grid patterns and lack of foliage lent to desktop mapping, the spatial locating of stops was completed in the office on an office computer.

2.5 Managing Curbside Route and Stops

The associated data tables for the stop and route databases allows viewing and reporting through ArcMap or exporting tables to other software such as Microsoft Excel and MapInfo. A desktop computer manages data in and out of the database for field editing on the mobile tablets. This Check-in / Check-out procedure for ESRI’s ArcPad software allows detailed scheduling and monitoring of the field survey work activities.

The “ArcPad” application running on Intel based (I5 processor or greater recommended) Windows 10 tablets collects the data in the field. A vehicle mounted tablet with an external GPS receiving device serves as the mobile data collection platform. In the summers of 2013, 2014 and 2015, rural collection routes were traveled and mapped whereas the remaining urban stops were mapped from the desktop in 2015.

3. Deliverables

The GIS databases for stops and routes created at the conclusion of this project have replaced the hard copy street lists and handwritten route maps that have been used and maintained by the District since 2003. A “file geodatabase” or **Structured Query Language (SQL)** database is created from the shapefiles used to create the starting databases for the stops and routes. The shapefiles are converted to a geo-database format for ground-truthing and allows the use of the Check in / Check out procedure, which is not available when the databases are in a shapefile format.

This also allows updating the routes and stop data to the most current data available. The ownership, location, frequency, and service level for each property and their occupied units, tracked and documented. The stops in the database will represent the latest MPAC data and 911 addressing in terms of occupied units across the District.

4. Project Accomplishments

The collection model accomplishes the issues targeted at the beginning of this project. These include:

- Documenting and providing staff electronic access to curbside stop locations and schedules that support BPs and increase efficiencies and improve system performance.
- Collection route data includes seasonality of provided services.
- Baseline data sets created with three common GIS layers that are also found in many municipalities in Ontario.
- Geo-databases represent the service level for any occupied property. The project's geo-database model of the curbside collection system includes the current collection schedule information and road names. The data is maintained using GIS systems for property, road and service level changes overtime.
- Data from the project is available for preparing curbside collection procurement documents and day to day customer service. Future contract documents can include the information available from this project in the form of route maps, street lists and curbside stop lists created solely from these databases.
- Data from the project will assist in the reviewing of tendered collection quotations and it is anticipated that savings resulting from tender specification improvements will be noted in future service procurements.

4.1 Project Overview and Database Development

The GIS Collection Point and Service Level Mapping Project builds on work completed in 2009 that used the following GIS databases. The stops begin as the centroids of each property polygon in the MPAC database. The points contain the basic MPAC data on individual properties including: individual unit use; property access type (year round, seasonal, water); and

centroid point for each unit in the District. The stops receiving curbside service were selected by filtering for the units known to be occupied as indicated in the District's 911 Database and MPAC database. Based on the units location and usage curbside service level are assigned.

The data to be updated spatially is loaded onto the tablets and then Checked-in to the geo-database after the stop locations are updated which completes the update. A Visual Basic script was developed for the ArcPad application that date stamps the stop record in the database when stop locations are saved and thereby allowing management of the ground-truthing process. This is a key feature to use in the field software to track and manage the large number of stops.

The curbside collection routes originate from hand drawn, not to scale, maps provided by the District's collection contractor in 2003 and manually maintained since that time. These maps were used to select the road segments from the ORN Roads database that represent the collection routes in the District. These GIS routes use the same format and indexing as the original hand drawn maps but also include the ORN baseline data.

The criteria for selecting the streets, roads, and highways that make up the collection routes include these items:

- Distance, in meters, from the centerline of the collection routes to the property centroids or 911 stop GIS location.
- Property codes, unit (use) codes, and property access codes, as defined by MPAC, that allow for assessment of serviceable units curbside.

ESRI shapefiles were created from the baseline data selection criteria using the ArcMap software to perform the logical/spatial selections to produce the final route database. These shapefiles are also converted to a geo-database (or SQL database) once the base databases is completed.

The resulting geo-databases contain the data from the originating MPAC, 911 Civic Address and ORN databases. Fields for indicators and qualifiers of service levels or scheduling also are added to the database and allow the defining and tracking of collection system information. Fields for future use, not populated at this time, allow for future customization of the database for special uses such as defining "winter season" curbside collection stops. These are typically residential waste drop zones where snow plows turn-around and these areas replace curbside service at driveways along some private roads from April to October. Varying seasonal service levels must be considered when developing the fields and information contained in the databases.

This methodology was developed by staff for the purposes of data reporting in the annual Datacall to the WDO. The project used student labour and fleet vehicles to drive the curbside routes and confirm, spatially, each stop's location. As this was a one-time drive by of the collection points, geo-referenced point-of-view video was used as backup to the survey data should questions along the routes arise after the field surveying is complete.

The use of geo-referenced point of view video recording cameras provided a test bed for other applications of the technology such as asset management and other road based surveys. Unfortunately, the retail equipment that was available at a reasonable price (< \$1,000) for this

project had difficulties with extended recording times in hot weather. The geo-referenced video cameras malfunctioned after extended record times from what appeared to be heat buildup. This limited their usefulness when outside temperatures were hot.

The project did capture several hundred streets and roads on video before it was deemed too unreliable to continue using. The cameras used are suitable for non-continuous surveys where a cool down period between recordings can be allowed as needed. There are commercial GIS enabled video recording systems available that provide a more robust system for geo-referenced point-of-view video recording that can be purchased if necessary.

5. Project Reporting

5.1 CIF Project Reporting

As part of the agreement between the District and the CIF, the District agreed to prepare a report that outlines this project and provides a summary of the project results. Both the cost of the project and an estimated projected savings that would accrue as a result of the successfully producing the project deliverables are to be included in the report. The following summarizes these items.

5.2 Project Budget

The District's Waste Reduction Strategy to improve the efficiency of managing stops and routes includes a GIS based information system. A formal application was submitted to the CIF and administered by WDO in 2013. The District, in association with WDO, CIF and Stewardship Ontario entered into an agreement for partial funding of this project in October 2013. The following are the estimated budget costs versus the actual costs of this project.

CIF #820 MUSKOKA GIS COLLECTION POINT & SERVICE LEVEL MAPPING		
Expenses	Budget	Actual
Labour/ Fleet	\$59,985	\$58,732
Equipment/software/training/communications	\$24,828	\$9,647
District IT	\$7,350	\$10,220
Drafting/Design	\$0	\$18
Supervision	\$16,000	\$7991
Third Party Consultant	\$11,200	\$0
Total	\$119,363	\$86,608

Upon completion of this project, budget costs were significantly less than predicted. Post processing of data and consulting work were deemed un-necessary as the database was usable as developed.

Roadside survey costs were as expected as mainly seasonal roads received field surveys.

Desktop surveying was successful in much of the urban areas where driveway placement patterns are consistent and curbside stops are easily determined using geo-referenced aerial photographs. Consumer based tablets, GPS receivers and storage devices were used to lessen project costs. Existing District workstations proved satisfactory for this project and therefore there was no need for high-end workstations.

The Information Technology (IT) budget was underestimated due to support costs not being included in the original budget estimate. Charges for hard copy field maps and supervision costs were not expected and very low in cost. Pre-planning of the daily routes to be surveyed was integrated with existing field supervision of the student workload in the District's Solid Waste Division help keep supervision cost lower than expected. This provided supervision of the project work together with their routine duties.

Overall, the project was successful in setting up databases for routes and curbside stops representing the District's curbside collections. In addition, the non-curbside service level is also mapped allowing for accurate service levy allocations and WDO Datacall submissions.

The date of substantial completion for the project is December 31, 2015.

5.3 Savings

The focus of this project is to provide detailed curbside waste collection information. The District's current waste collection contract expires in 2017. The procurement process for the future service contract will incorporate the information on the detailed routes and stop locations developed by this project to promote a more competitive procurement process.

The potential savings to future contracted services has been estimated with the assistance of CIF staff. As noted in Section 1.2, the District saw a 15%-18% variance in the prices submitted to its last collections service/tender call. The CIF has indicated that discussions between itself and past bidders of the District collection tender suggested that the variance was, in part due, to the lack of detailed information on the District's collection routes included with the tender. The CIF also indicated that this assertion is consistent with its experience in working with other rural and/or seasonal based municipalities where provision of accurate data has increased competition and lowered bid prices by as much as 10%.

CIF staff also indicated that while it is not possible to show a definitive, causal relationship between any reductions in bid prices on future collection services tender's, a reduction in the range of bid prices is a reasonable indicator by which to assess the value of this data to prospective bidders. Ultimately, a reduction of just 1% would cover the initial investment in this project over the lifespan of a standard 7 year collection contract making the project a worthwhile investment.

A secondary savings in staff time can also expected as using GIS methods to search and respond to service level or location questions is a faster and more accurate method when compared to using 'hardcopy methods'. The information contained in the geo-databases is also useful for public education, finance and waste system review exercises. Staff now has access to information at the property unit level and displayed on their computer screen to quickly respond to queries related to curbside collections.

To estimate time saving as a result of using the GIS Collection model consider it takes staff

about sixty (60) seconds to lookup in the hard copy binder a street address to find out collection details. This information is provided within ten (10) few seconds by entering a street address into a search box or by clicking on a stop on the computer screen map.

If on average two thousand (2,000) calls per year are received that require referencing this information and there is a fifty second savings of time per call, 2,000 enquires like this each year equates to about twenty-seven hours saved over the manual look-up method per year.

These savings will, however, have to be balanced against the time required to complete periodic updates that are required to maintain the database. This cost will be in proportion to new development within the District. The current residential unit growth rate in the District is 0.9%; therefore about 319 updates can be expected each year. As it takes about 5 minutes to create a new point in the database and populate the appropriate metadata, budgeting about 30 hours a year for a GIS technician and/or Solid Waste staff to complete data management tasks would be appropriate. At current staff rates maintenance costs are estimated to be \$1,300 per year.

Other District staff that may need information for contract and financial purposes will also benefit from the quick and easy access to the whole data set and the tallying ability of the software. The dollar savings for these types of inquiries will vary from year to year but it is expected to show even greater time savings for complex enquiries. This data is also used for the Waste Diversion Ontario's annual Datacall.

6. Conclusion

The completion of CIF #820 demonstrates an efficient and effective method of curbside collection administration. Previously, the District's manual approach required the curbside contractor to provide stop counts every second year during the contract. Now, with each release of MPAC data, revised curbside service level can be determined and the database updated to reflect the changes. As new roads are built, associated new property units are added to the database to ensure customer service information is up-to-date.

The route maps and stop counts produced will be part of the waste management contract procurement process in 2017. A draft of our tender document will be provided to the CIF for confidential comment before it is released.

The potential savings in contract cost cannot be estimated until the collection tender closes and the bid analysis is complete. The District will review the upcoming tendering process to see if savings are realized because of the additional details included with new tender documents.

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