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Final Report:

1. Project title and number: C1819-0977-Y3 NB Weather Mapping for Intensive Crop Management
2. Project leader and collaborators: Ray Carmichael, MSc. Ag., NBSCIA Club Agrologist managed project activities and reporting, with support from other NBSCIA regional coordinators. The NBDAAF collaborator is David Wattie, Integrated Pest Management Specialist, Wicklow Regional Office. Bill Jones, exp, Halifax, provides contracted GIS support

ABSTRACT/RÉSUMÉ:

NBSCIA has completed a series of projects: EMP15-003-3: NBSCIA Agricultural Geomatics Service, C1819-0557: Climate Mapping for Intensive Crop Production, C1819-0977 NB Agricultural Weather Network and C1819-0977-Y2 NB Agricultural Weather Network for Intensive Crop Management to expand the number of Davis weather stations throughout the Province and enable export of the PAT data from the NB Potato Crop, Weather and Pest Information portal (<http://agri.gnb.ca/010-001/WebServiceData.aspx>) in a GIS compatible format. The objective of this project activity is to establish a Province wide weather monitoring network to support environmentally sustainable crop production management practices through crop and variety selection and integrated pest management programs. Eight Davis Vantage Pro weather monitoring stations with soil temperature sensor sets were installed during the 2020 crop season, bringing the total number of available network stations to 60. However, due to the COVID-19 pandemic delivery and installation of the stations was delayed until September. NBSCIA members were provided station IDs enabling them to access the Davis Weatherlink app on smart phones and read real time weather conditions at a particular station location. This was a very popular feature, particularly for determining wind speed for spraying decisions. Significant technical issues related to coding for CHU accumulations remain with the PAT data from the NB Potato Crop Weather and Pest Information portal. Significant manual intervention on the part of NBDAAF is required to ensure accuracy. A Microsoft Access routine was developed to reduce the manual intervention by NBSCIA personnel to format the combined data from all NBSCIA managed stations for export to Arc GIS for interpolation and map presentations. Month ending accumulations for CHU, GDD and rainfall for all stations were posted in a map format to the NBSCIA website: <https://www.nbscia.ca/en/nb-weather-maps-2019.html>. Alternative presentation formats were developed and tested for user preference. As a result, the map presentations will be in a raster format for 2021. This enhanced weather station network will provide New Brunswick producers another valuable tool to remain competitive in an increasingly global market demanding environmentally sustainably produced commodities.

L'AASCNB a réalisé une série de projets (EMP15-003-3 : Service de géomatique agricole de l'AASCNB, C1819-0557 : Cartographie météorologique pour la production de cultures intensives, C1819-0977 : Réseau météorologique agricole du N.-B. et C1819-0977-Y2 : Réseau météorologique agricole du N.-B. pour la gestion des cultures intensives) afin d'accroître le nombre de stations météorologiques Davis dans la province et de permettre l'exportation des données PAT (agriculture de précision) du portail d'information sur les cultures, les conditions météorologiques et les parasites de la pomme de terre du N.-B. (<http://agri.gnb.ca/010-001/WebServiceData.aspx>) dans un format compatible avec les SIG. L'objectif de cette activité de

projet est de mettre en place un réseau de surveillance météorologique à l'échelle de la province afin de soutenir les pratiques de gestion de la production agricole écologiquement durables par le biais de la sélection des cultures et des variétés et de programmes de gestion parasitaire intégrée. Huit stations de surveillance météorologique Vantage Pro de Davis dotées d'ensembles de capteurs de température du sol ont été installées pendant la campagne agricole 2020, portant à 60 le nombre total de stations de réseau disponibles. En raison de la pandémie de COVID-19, la livraison et l'installation des stations ont toutefois été retardées jusqu'en septembre. Les membres de l'AASCNB disposaient de codes d'accès pour consulter sur leurs téléphones intelligents les conditions météorologiques en temps réel à des stations particulières au moyen de l'application Weatherlink de Davis. Cette fonctionnalité s'est avérée très populaire, notamment pour déterminer la vitesse du vent dans le cadre des processus de pulvérisation. D'importants problèmes techniques liés au codage des accumulations des UTM subsistent dans les données PAT du portail d'information sur les conditions météorologiques et les ravageurs des cultures de pommes de terre du Nouveau-Brunswick. Le MAAP est appelé à effectuer des corrections et vérifications manuelles afin d'assurer l'exactitude des données. Une procédure au moyen de Microsoft Access a été élaborée afin de limiter les interventions manuelles du personnel de l'AASCNB pour formater les données combinées de toutes les stations gérées par cette dernière en vue de leur exportation vers Arc GIS aux fins d'interpolation et de représentation cartographique. Les accumulations de fin de mois pour les UTM, les DJC et les précipitations pour toutes les stations ont été diffusées sous forme de carte sur le site Web de l'AASCNB : <https://www.nbscia.ca/en/nb-weather-maps-2019.html>. D'autres formats de présentation ont été élaborés et testés afin de satisfaire les préférences des utilisateurs. Ainsi, les présentations cartographiques seront sous forme matricielle en 2021. Ce réseau amélioré de stations météorologiques procurera aux producteurs du Nouveau-Brunswick un autre outil de pointe qui leur permettra de demeurer concurrentiels dans un marché de plus en plus mondialisé où la production écologiquement durable est de mise.

3. Summary: NBSCIA has completed a series of projects (EMP15-003-3: NBSCIA Agricultural Geomatics Service), C1819-0557: Climate Mapping for Intensive Crop Production and C1819-0977 NB Agricultural Weather Network and C1819-0977-Y2 NB Agricultural Weather Network for Intensive Crop Management to expand the number of Davis weather stations throughout the Province and enable export of the PAT data from the NB Potato Crop, Weather and Pest Information portal (<http://agri.gnb.ca/010-001/WebServiceData.aspx>) in a GIS compatible format.

The objective of this project activity is to establish a Province wide weather monitoring network to support environmentally sustainable crop production management practices through crop and variety selection and integrated pest management programs.

Eight Davis Vantage Pro weather monitoring stations with soil temperature sensor sets were installed during the 2020 crop season, bringing the total number of available network stations to 60. However, due to the COVID-19 pandemic delivery and installation of the stations was delayed until September.

NBSCIA members were provided station IDs enabling them to access the Davis Weatherlink app on smart phones and read real time weather conditions at a particular station location. This was a very popular feature, particularly for determining wind speed for spraying decisions.

Significant technical issues related to coding for CHU accumulations remain with the PAT data from the NB Potato Crop Weather and Pest Information portal. Significant manual intervention on the part of NBDAAF is required to ensure accuracy. A Kutools routine was developed to reduce

the manual intervention by NBSCIA personnel to format the combined data from all NBSCIA managed stations for export to Arc GIS for interpolation and map presentations.

As a consequence of the COVID-19 restrictions two deliverables were not accomplished as planned: 1) improved definition and understanding of the heat unit rating for corn and soybean, in relation to physiological maturity in New Brunswick and 2) assessment of existing models for forecasting occurrence and severity of crop pests.

Month ending accumulations for CHU, GDD and rainfall for all stations were posted in a map format to the NBSCIA website: <https://www.nbscia.ca/en/nb-weather-maps-2019.html>. Alternative presentation formats were developed and tested for user preference. As a result, the map presentations will be in a raster format for 2021.

This enhanced weather station network will provide New Brunswick farmers another valuable tool to remain competitive in an increasingly global market demanding environmentally sustainably produced commodities.

4. **Introduction:** In areas of significant crop production where demand warrants, there are commercial service providers for climate monitoring and pest risk forecasting such as Weather INnovations Consulting LP (WIN), Chatham, ON. WIN's environmental monitoring network encompasses Ontario, Manitoba, Saskatchewan, Michigan and Western Europe. The New Brunswick agricultural community and diverse microclimates are not large enough to attract commercial service providers such as WIN.

The NBDAAF Potato Analysis Tool (PAT) network was established to provide data collection from a series of weather stations that monitor temperature, relative humidity, rain, wind, solar radiation, leaf wetness and soil temperature and moisture to better manage late blight in potatoes. The NBSCIA has a number of like stations (make and model) located outside the "potato belt" area with similar capability that can be incorporated with the NB Potato Crop Weather and Pest Information to provide a Province wide network to assist in production management decisions and benchmark climate changes going forward.

NBSCIA has completed a series of projects (EMP15-003-3: NBSCIA Agricultural Geomatics Service), C1819-0557: Climate Mapping for Intensive Crop Production and C1819-0977 NB Agricultural Weather Network and C1819-0977-Y2 NB Agricultural Weather Network for Intensive Crop Management to expand the number of Davis weather stations throughout the Province and enable export of the PAT data from the NB Potato Crop, Weather and Pest Information portal (<https://www.nbscia.ca/en/central-2018.html>) in a GIS compatible format.

Additional stations have been purchased by the NBSCIA to provide total coverage for locations on the extreme eastern margins of the "potato belt" area and add stations throughout the Province to establish an initial NB Agricultural Weather Network.

An enhanced weather station network will provide New Brunswick farmers another valuable tool to remain competitive in an increasingly global market demanding environmentally sustainably produced commodities.

5. **Project Objective:** To establish and maintain a Province wide weather monitoring network to support environmentally sustainable crop production management practices through crop and variety selection and integrated pest management programs.

6. Project Deliverable(s): An expanded weather station network, upgraded station capability, improved annual and in-season maintenance to support the establishment of an NB Agricultural Weather network.

Specific deliverables for this project activity will be to:

- provide real time access to all individual stations, using the Davis Weather Link delivery model for the georeferenced climate maps (<https://www.weatherlink.com/>) by producers to facilitate local real time weather checks to support crop growth and pest modeling for crop scouting and IPM programs.
- improve definition and understanding of the heat unit rating for corn and soybean, in relation to physiological maturity in New Brunswick.
- assess existing phenology models for forecasting occurrence and severity of crop pests.
- provide rainfall and heat unit bench mark maps to monitor climate change.

Project results will assist producers in evaluating the environmental and climate change risks associated with their operations, acquire knowledge and technical resource tools to address these risks and help them implement adjustments to manage such risks.

Accurate predictive models for pest alerts to a field scale will enable the farmers to undertake more timely pesticide applications, therefore reducing the environmental load and improving sustainability.

7. Results and Discussion:

Eight additional Davis Vantage Pro weather monitoring stations, compatible with the NBDAAF Potato Analysis Tool (PAT) and NBSCIA network, with soil temperature sensor sets were installed during the 2020 crop season bringing the total number of available network stations to 60, as illustrated below (Illustration 1). However, due to the COVID-19 pandemic delivery and installation of the stations was delayed until September.

The proposed upgrades by NBDAAF to the NB Potato Crop, Weather and Pest Information portal to accommodate the additional stations was not accomplished as proposed. Consequently, in-season monitoring of all stations in the network was not provided by NBDAAF Potato Development Center staff. Alternatively, a routine was programmed using an .xlsx add, on Kutools, to import the individual station data downloaded by a NBSCIA coordinator from the Davies cloud link. The Project Leader downloaded the Web Service data, combined it with data from the NBSCIA stations and formatted the collective data for export to the Arc GIS for interpolation by the GIS contractor and map presentation in .pdf format posted on the NBSCIA website.

The manual manipulation by NBDAAF to verify and format the station data for download in the Web Service is cumbersome, tedious and very time consuming. Combined with the manual input still required on the part of NBSCIA the process is unsustainable in the long-term and essentially renders the output useless for time sensitive intensive crop management predictive modelling.

Not only did the Public Health Guidelines for public safety during the COVID-19 pandemic delay delivery and installation of the additional stations, project staff were unable scout the NBDAAF/NBSCIA trial sites and commercial fields throughout the crop season to record the crop growth stage and compare that to the corresponding heat unit accumulation as mapped. As a

consequence, two deliverables were not satisfactorily accomplished: 1) improved definition and understanding of the heat unit rating for corn and soybean, in relation to physiological maturity in New Brunswick and 2) assessment of existing models for forecasting occurrence and severity of crop pests.

Various ArcGIS file presentation formats, such as Illustration 2 (below) were prepared and circulated for opinions on the preferred layout to improve the graphic presentation of the weather maps. The raster format, presented in Illustration 3 (below), was the overwhelming preference and will be the presentation of choice in 2021.

NBSCIA host members were provided station IDs enabling them to access the Davis Weatherlink app on smart phones and read real time weather conditions at a particular location. This was a very popular feature for many and particularly for determining wind speed for spraying decisions.

The resolution or scale of interpolated surfaces generated from the weather station data varies with: (1) the locations of the weather stations, and (2) the spatial distribution of the stations. The further apart the stations are and/or the more unevenly they are spaced the greater the grid cell size required (or the smaller the scale). In season maintenance of the NBDAAF stations remains troublesome. Station by station recording varies during the course of the season impacting the integrity of the interpolated maps from month to month and year to year. As of October 30, 2020 nine of the twenty-nine NBDAAF stations were not exporting data from the web-portal, compared to only four stations in 2019.

8. Conclusions: The project objective to install additional station locations to support establishment of a NB Agricultural Weather network was met.

Given the manual effort involved on the part of NBSCIA and NBDAAF staff the preparation of weather maps more frequently than monthly is unsustainable in the long-term and essentially renders the output useless for time sensitive intensive crop management for predictive pest modelling.

After interpolation the mapped data has the potential to improve the definition and understanding of the microclimatic heat unit ratings applied to significant agricultural crops and improve integrated pest management and environmentally sustainable production practices.

Over time an expanded NB Weather Network will serve as a reference or bench mark for monitoring extreme weather events, attributed to climate change, within New Brunswick.

Providing open access to all sixty stations will enable real time decision making by producers in support of environmentally sustainable crop production.

Additional project work will be necessary to provide:

- a) improved definition and understanding of the heat unit rating for corn and soybean, in relation to physiological maturity in New Brunswick;
- b) assessment of existing crop and pest growth models for forecasting occurrence and severity of crop pests; and,
- c) rainfall and heat unit bench mark maps to monitor climate change.

9. Required next steps

a) The NBDAAF, Wicklow Office continues to manage the Potato Analysis Tool (PAT) central network and provide ongoing operational overview, data verification for all 60 stations currently

available and undertake a database upgrade to accommodate a minimum of 75 stations by May 1 2021 on the <http://agri.gnb.ca/010-001/WebServiceData.aspx> portal. Effectively creating a real time weather monitoring network for New Brunswick.

b) Preparation of a formal working arrangement between NBSCIA and NBDAAF to ensure timely and effective maintenance and operation of all network stations.

c) Development of an improved (less manual intervention) electronic delivery model for the georeferenced climate maps and predictive pest models to enable weekly publication and or custom requests.

d) Identification and assessment of various existing phenology models for forecasting crop growth and the occurrence and severity of crop disease and insect pest infestations.

d) Provide real time access to all individual stations, using the Davis Weather Link (<https://www.weatherlink.com/>), by producers to facilitate local real time weather checks to support work planning and intensive crop management practices.

e) Install additional stations in the Northeastern and Southeastern regions to provide a greater resolution of weather data for those areas.

f) Adjust the CHU accumulation formula start date to May 1 to be consistent with Ontario for corn and soybeans.

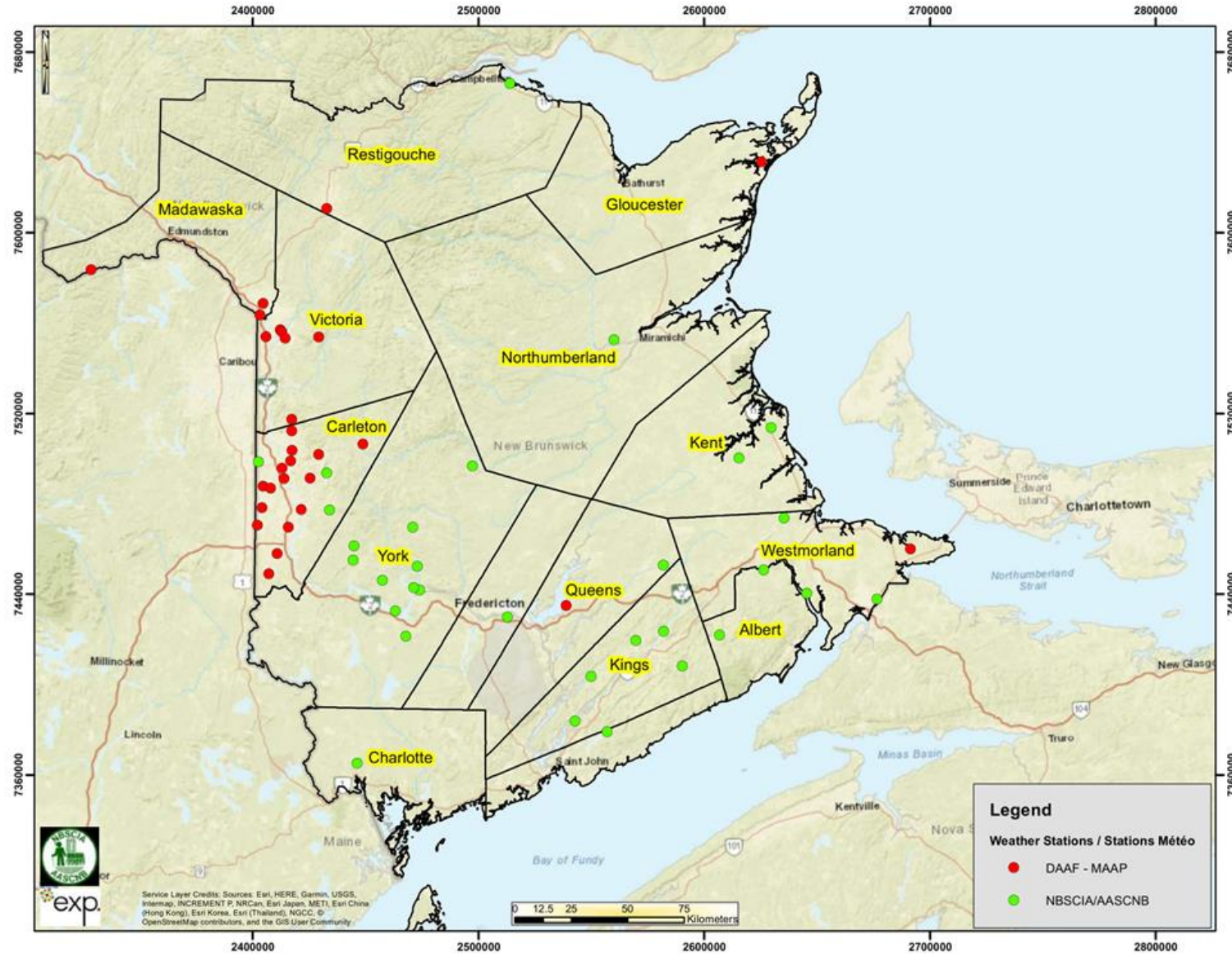
10. Communication: Provincial weather maps for CHU, GDD and rainfall were posted to the NBSCIA website and delivered by email upon request.

Customized maps for individual growers can be prepared and forwarded directly by email from the NBSCIAA Geomatics Centre.



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Service Layer Credits: Sources: Esri, HERE, Garmin, USGS,



Legend

Weather Stations / Stations Météo

- DAAF - MAAP
- NBSCIA/AASCNB

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Illustration 2: October 30, 2020 CHU Presented with Contour Lines Only

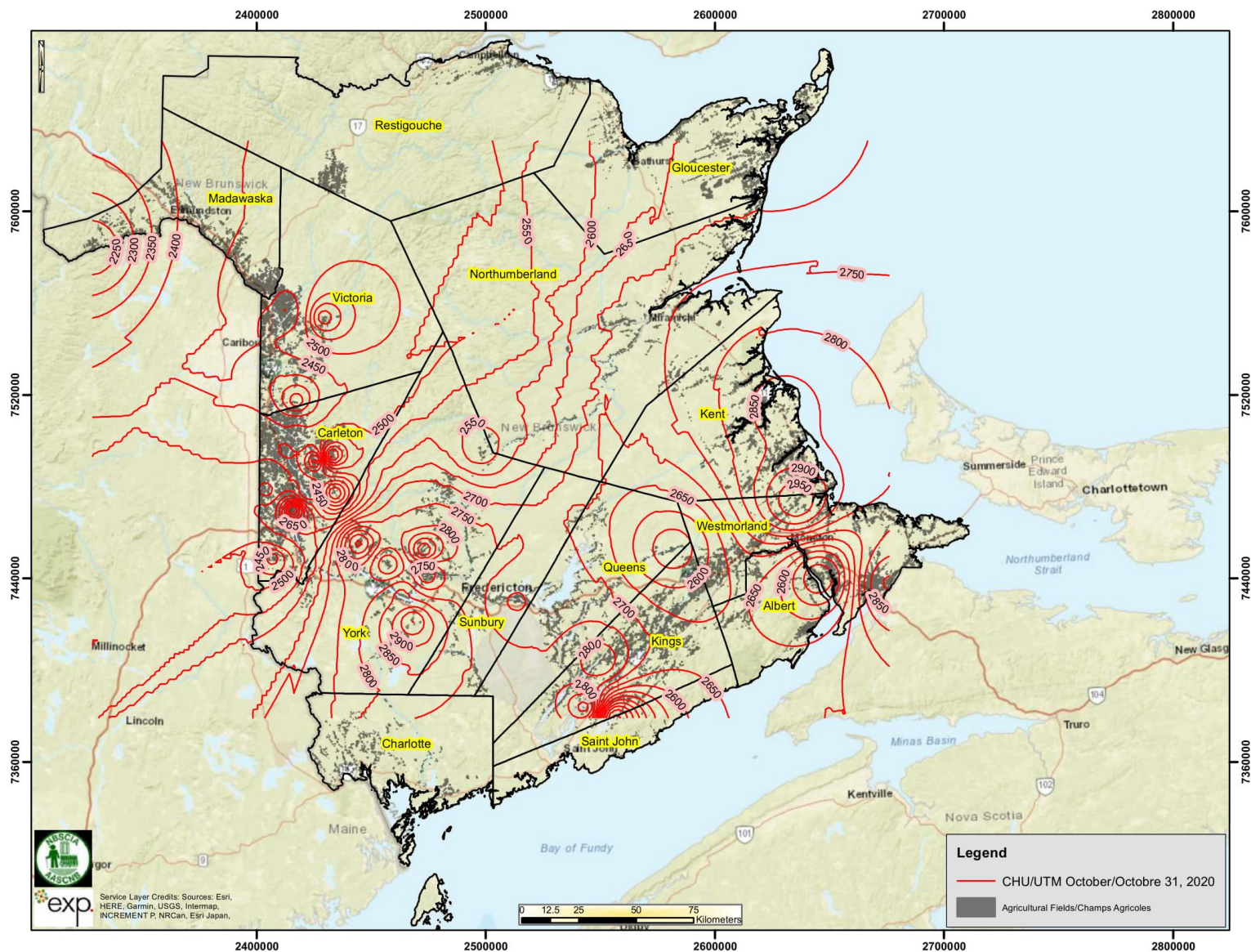


Illustration 3: Raster Image of October 30, 2020 CHU

