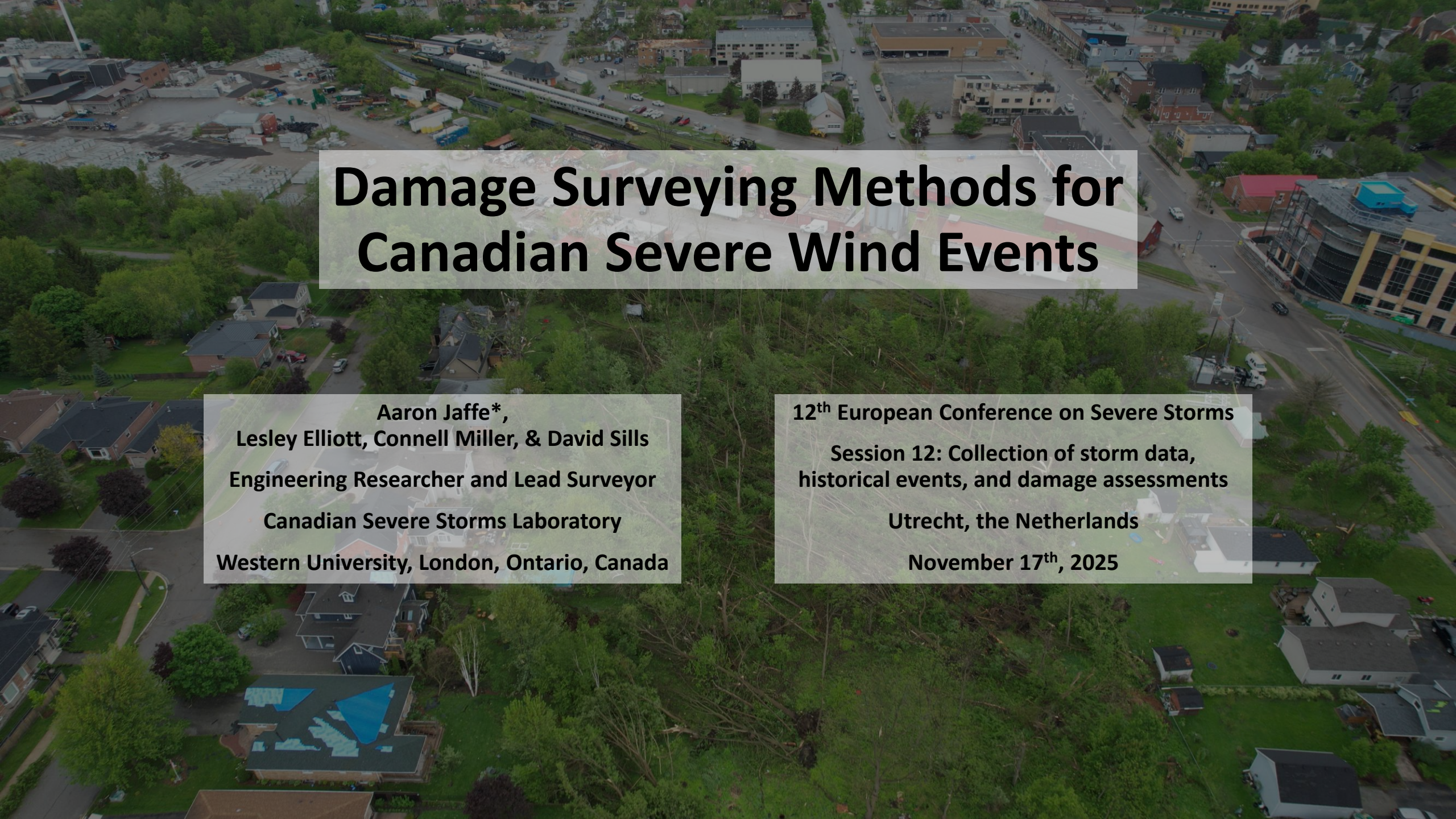

Damage Surveying Methods for Canadian Severe Wind Events

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Lesley Elliott, Connell Miller, & David Sills

Engineering Researcher and Lead Surveyor

Canadian Severe Storms Laboratory

Western University, London, Ontario, Canada

12th European Conference on Severe Storms

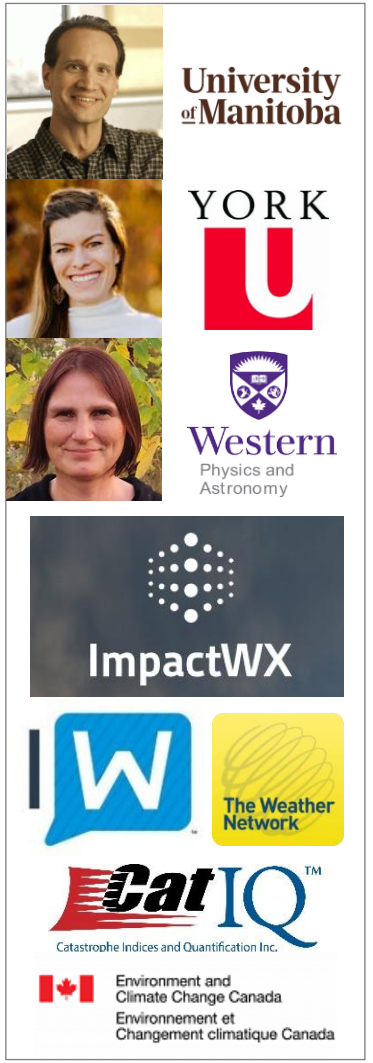
Session 12: Collection of storm data, historical events, and damage assessments

Utrecht, the Netherlands

November 17th, 2025

The Northern Tornadoes Project

- NTP founded in 2017 by Kopp and Sills at Western with support from ImpactWX.
- NTP detects, assesses and documents ‘all’ tornadoes in Canada, makes data publicly available, and uses this data to fulfill many research needs.
- Part of the Canadian Severe Storms Laboratory (CSSL) launched in 2024.



Enhanced Fujita (EF) Scale

*Canadian Version

EF Rating	Wind Speed (km/h)	Damage
EF-0	90 – 130	Minor
EF-1	135 – 175	Moderate
EF-2	180 – 220	Considerable
EF-3	225 – 265	Severe
EF-4	270 – 310	Devastating
EF-5	315+	Incredible

EF-0

EF-1

EF-2

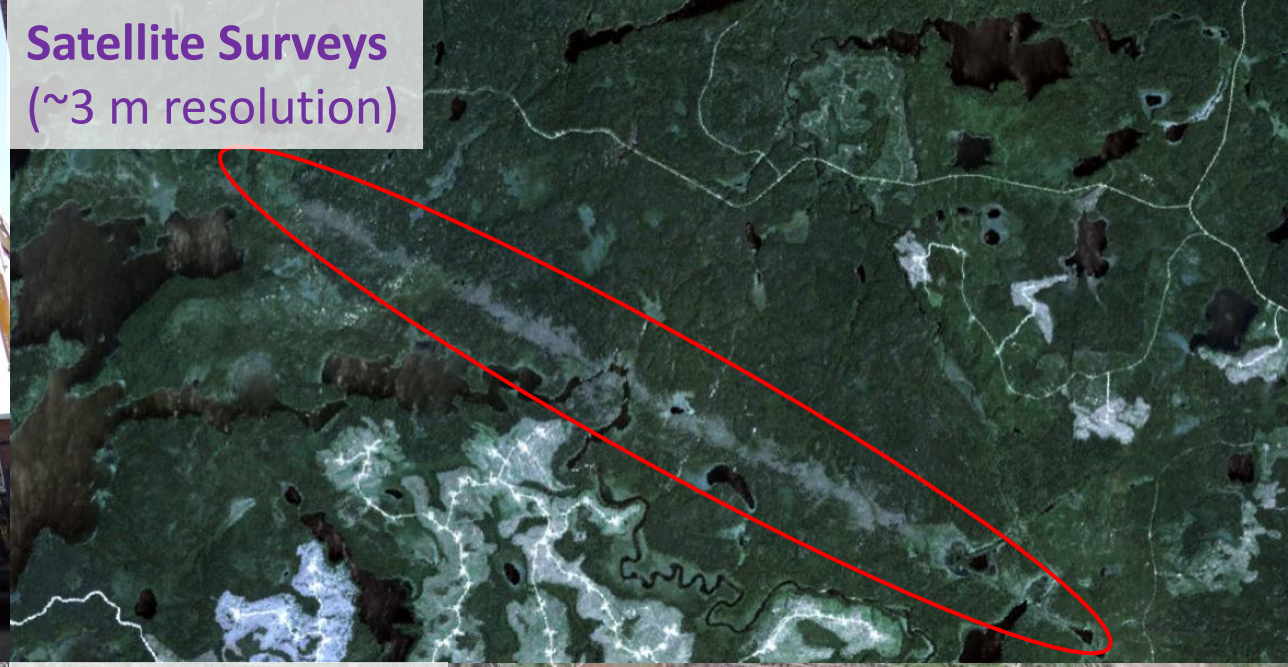
EF-3

EF-4

EF-5

Ground Surveys

Satellite Surveys
(~3 m resolution)

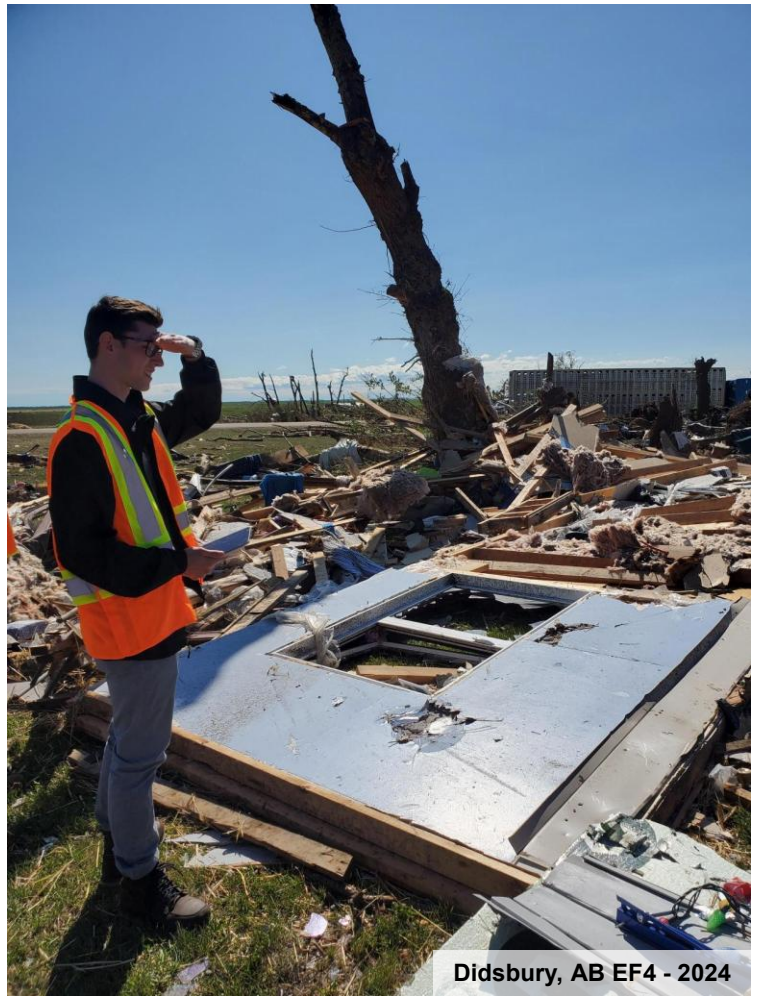


Aircraft Surveys
(~5 cm resolution)

Drone Surveys
(~2 cm resolution)

Why do we Conduct Ground Surveys?

- Main goal is to obtain comprehensive field data from damaging wind events to support the rating, classification, and documentation of those events.
- Much higher quality of data than relying on social media posts, satellite, etc.
- More cost-effective than aircraft aerial surveys.


Didsbury, AB EF4 - 2024

Survey Training

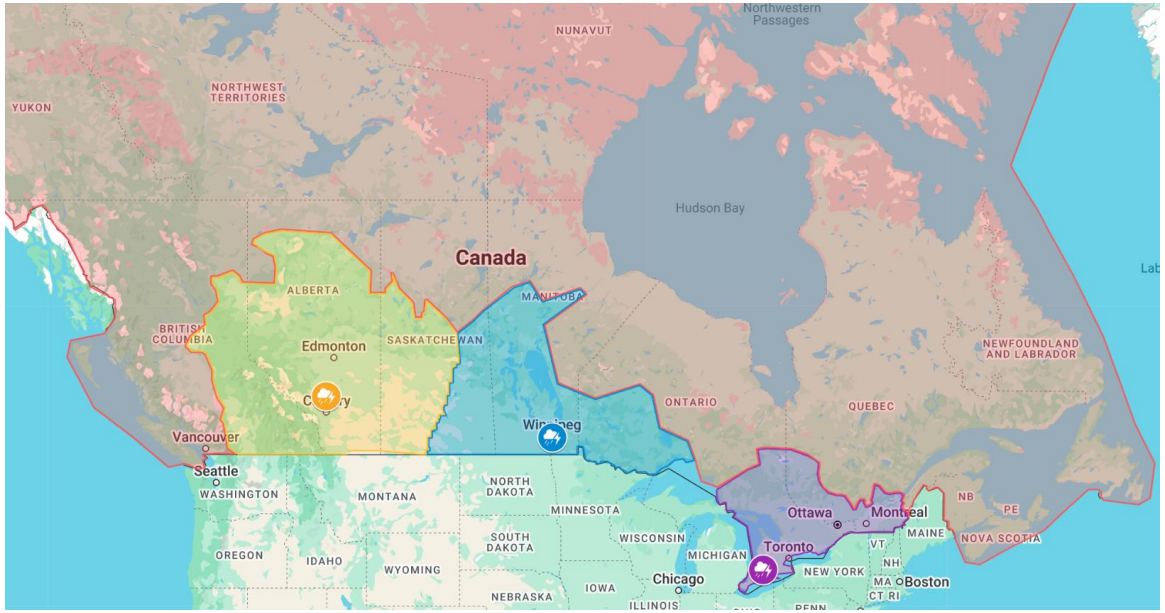
- Once per year, NTP interns and other surveyors undergo thorough training to prepare them for the field season.
- This training includes sessions on multi-hazard damage surveying, field safety, drone operations, sensitivity training, and GIS.

Hybrid Week	Monday Day 1	Tuesday Day 2	Wednesday Day 3	Thursday Day 4	Friday Day 5
09:00 - 10:00	Welcome / Introductions	Damage Survey Training *Precipitation*	Severe Stoms Meteorology *(Part 1)*	Severe Stoms Meteorology *(Part 2)*	Severe Stoms Meteorology *(Part 3)*
10:00 - 11:00	What is Research?		Administrative Practical Exercise	Drone Operation Basics *(Part 1)*	Intro to GIS
11:00 - 12:00	Administrative Training				
12:00 - 13:00	Get-To-Know-You Lunch				
13:00 - 14:00	Fieldwork Safety Training	Damage Survey Training *Wind*	Research Project Meetings	Drone Operation Basics *(Part 2)*	GIS Practical Exercise
14:00 - 15:00			Sensitivity Training		
15:00 - 16:00	Health & Safety Training				
16:00 - 17:00		Measuring Impact to Communities			GIS Recap

Tornado Week	Monday Day 6	Tuesday Day 7	Wednesday Day 8	Thursday Day 9	Friday Day 10
09:00 - 10:00	Introduction to Tornado Week	Damage Survey Recap	Drone Recap	First Aid Training	Advanced Tech Recap
10:00 - 11:00	Damage Survey Field Exercise	Drone Field Exercise	Streetview Field Exercise		
11:00 - 12:00					
12:00 - 13:00					End-of-Training Lunch *Tornado / Research Interns*
13:00 - 14:00					
14:00 - 15:00	Drone Practice Flight	Advanced Technology Training Streetview, LiDAR	LiDAR Field Exercise		
15:00 - 16:00					
16:00 - 17:00					
Hail Interns	Pack for trip to Olds, AB		Fly to Olds, AB	First Aid Training	Equipment Preparation

Survey Team Organization

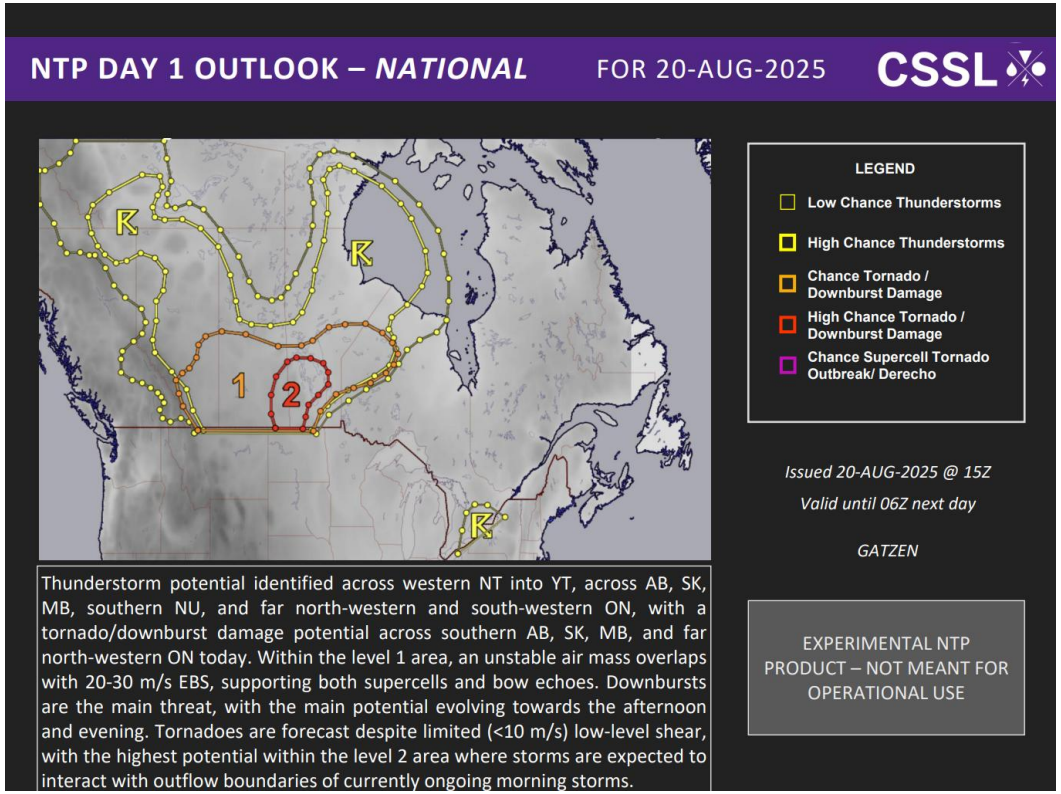
- Three survey roles:
  - Survey Director – Makes major decisions and handles most media requests.
  - Survey Lead – Puts the survey team together and leads them in the field.
  - Surveyor – Collect ground data, drive vehicles, and talk to homeowners.
- Three teams across Canada:
  - London, ON (Western University)
  - Winnipeg, MB (University of Manitoba)
  - Calgary, AB (NHP at Olds College)
- Rotating schedule of Survey Leads and Surveyors



NTP Canadian Survey Jurisdictions

Before a Survey

- NTP/CSSL Outlooks provide survey teams with daily updates on when and where damaging winds are likely to occur.
- A wind event must meet certain criteria to warrant a ground survey.
- A survey team can range from 2 to 5 members, and multiple teams can be sent out, depending on the severity of an event.



NTP Daily Outlooks

When an Event Happens

- The Survey Lead will organize a team and prepare for the upcoming survey which includes:
  - Grabbing all needed items and equipment for the survey.
  - Checking drone flying restrictions and upcoming weather near the damage site(s).
  - Contacting local emergency managers.

Preliminary Event Maps

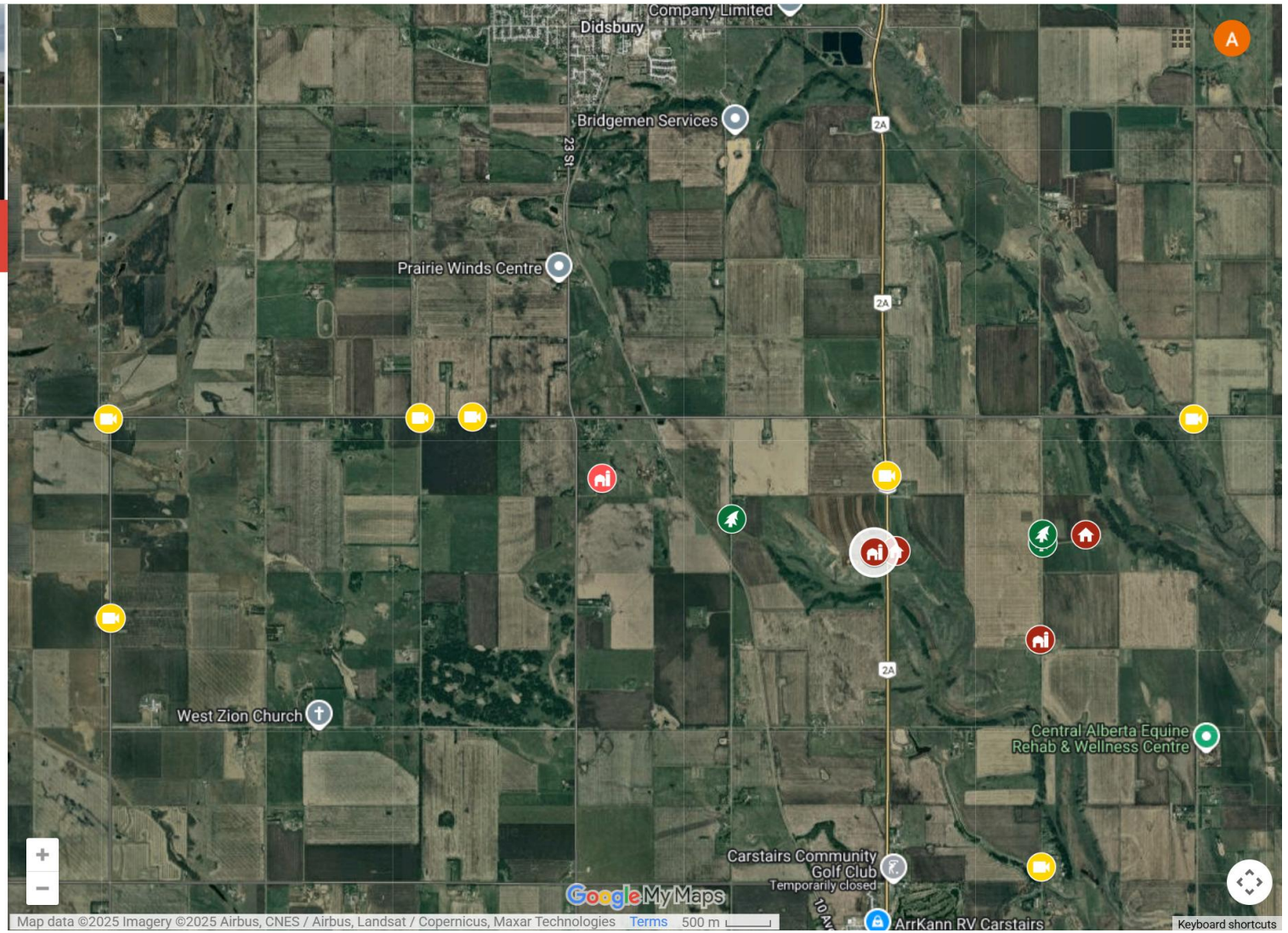
Carstairs - structural, trees

name
Carstairs - structural, trees

Damage Summary
Property hit by tornado - multiple farm buildings destroyed, house damaged, sig tree damage

Information Source
https://www.youtube.com/watch?v=ii46SWfIrZA; https://twitter.com/CTVMarkVillani/status/1675289720534827008; https://twitter.com/Washed_Up/status/1675328953417072640

Location
30512 AB-2A,
51.60753, -114.09735

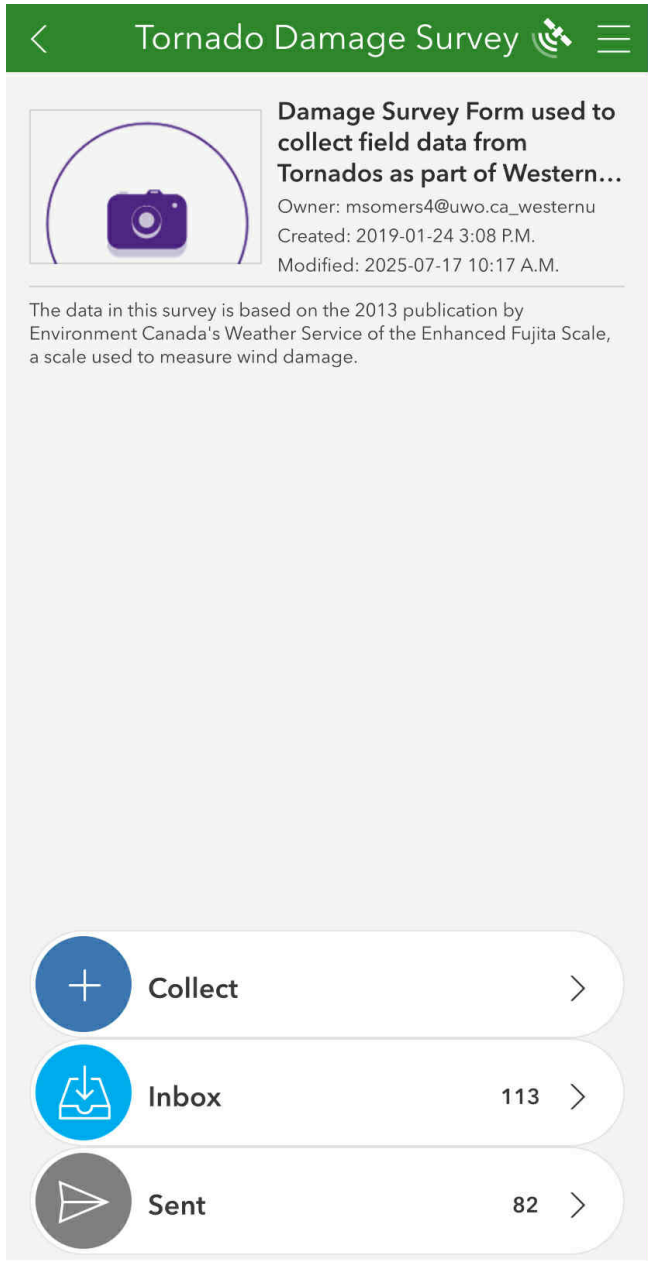


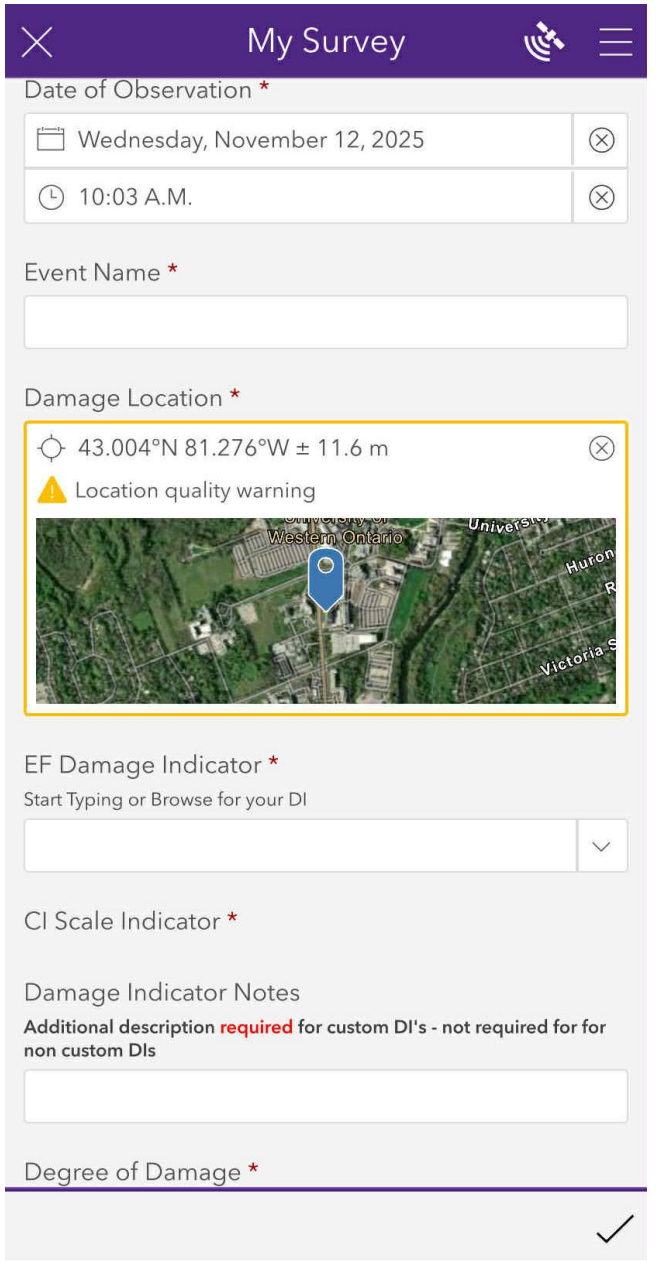
On a Survey

- Take geotagged ground photos of wind damage.
- Make notes of specific damage and overall patterns.
- Look for classification clues (tornado vs. downburst).
- Assess damage indicators using the EF scale.
- Interact with homeowners and locals.
- Conduct media interviews, when necessary.

Survey123

ArcGIS Survey 123 is a customizable data collection app that our teams use to document damage in the form of geotagged points, photos, EF-scale info, and other parameters.



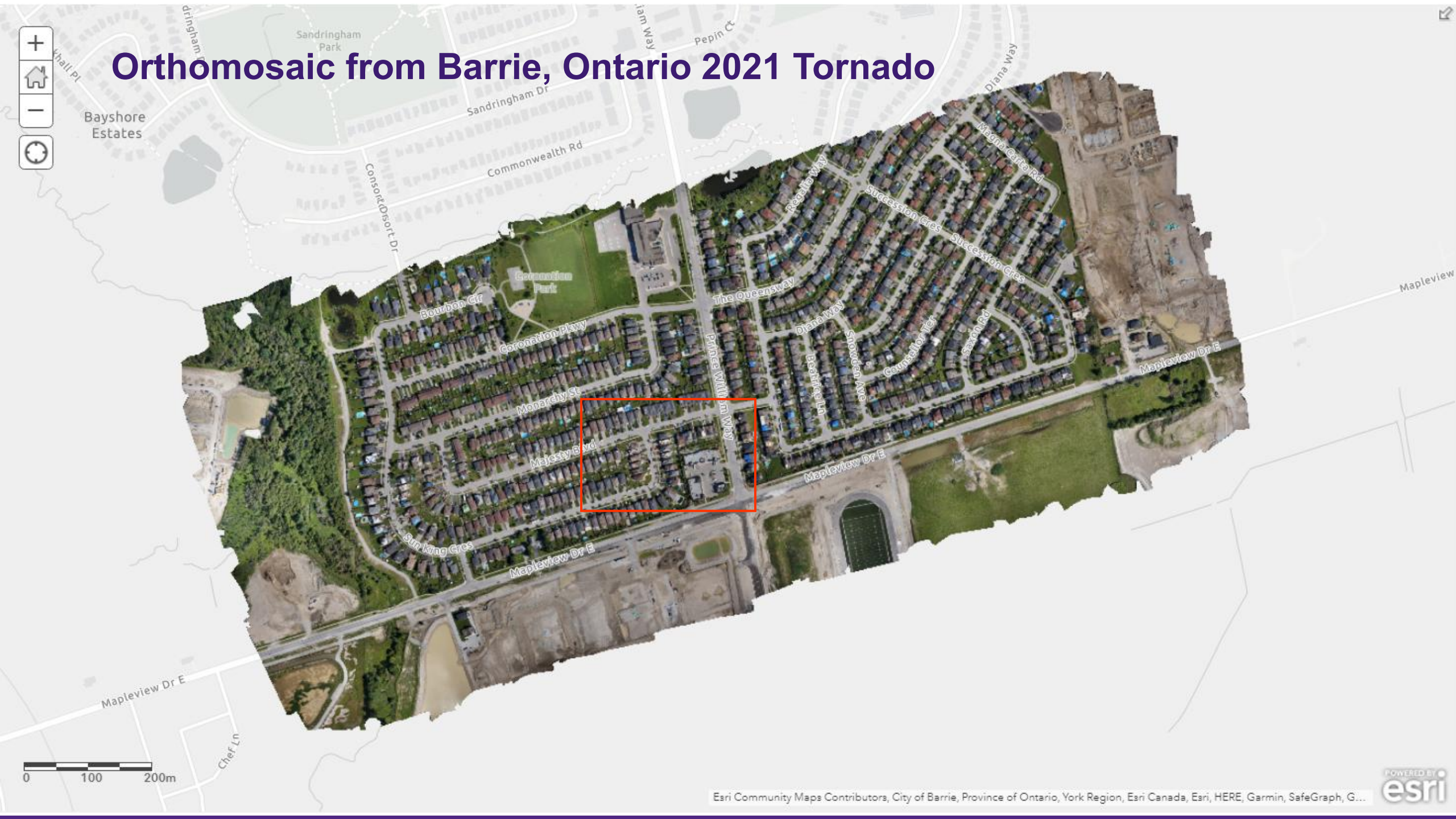


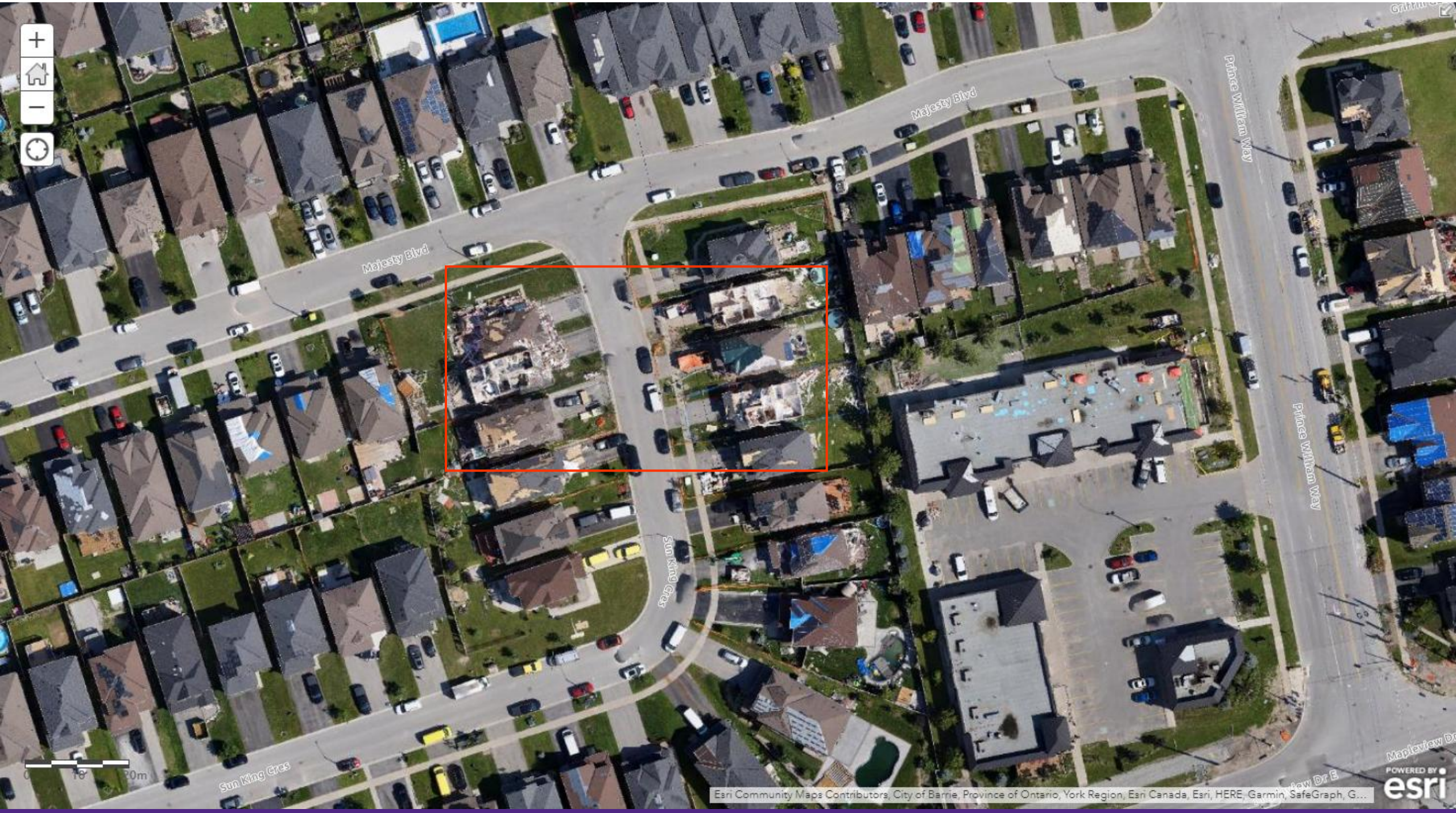
Drone Surveys

- Determining tornado path lengths on site by getting an aerial view of where the start / end points might be.
- Using drones to take pictures of inaccessible areas to help map the path of the tornado.
- Gathering aerial photography for an overhead view of the damage, or detailed photos of roof to wall connections.

<- [illegible] 2021

Orthomosaic from Barrie, Ontario 2021 Tornado




Majesty Blvd
Majesty Blvd
Prince William Way
Prince William Way
Sun King Cres
Sun King Cres
Esri Community Maps Contributors, City of Barrie, Province of Ontario, York Region, Esri Canada, Esri, HERE, Garmin, SafeGraph, G...
POWERED BY esri

Sun King Cres
6m
Esri Community Maps Contributors, City of Barrie, Province of Ontario, York Region, Esri Canada, Esri, HERE, Garmin, SafeGraph, G...
POWERED BY esri

Didsbury, AB - July 1, 2023 - Event Summary Map

Legend | Layer List

Worst Damage Area

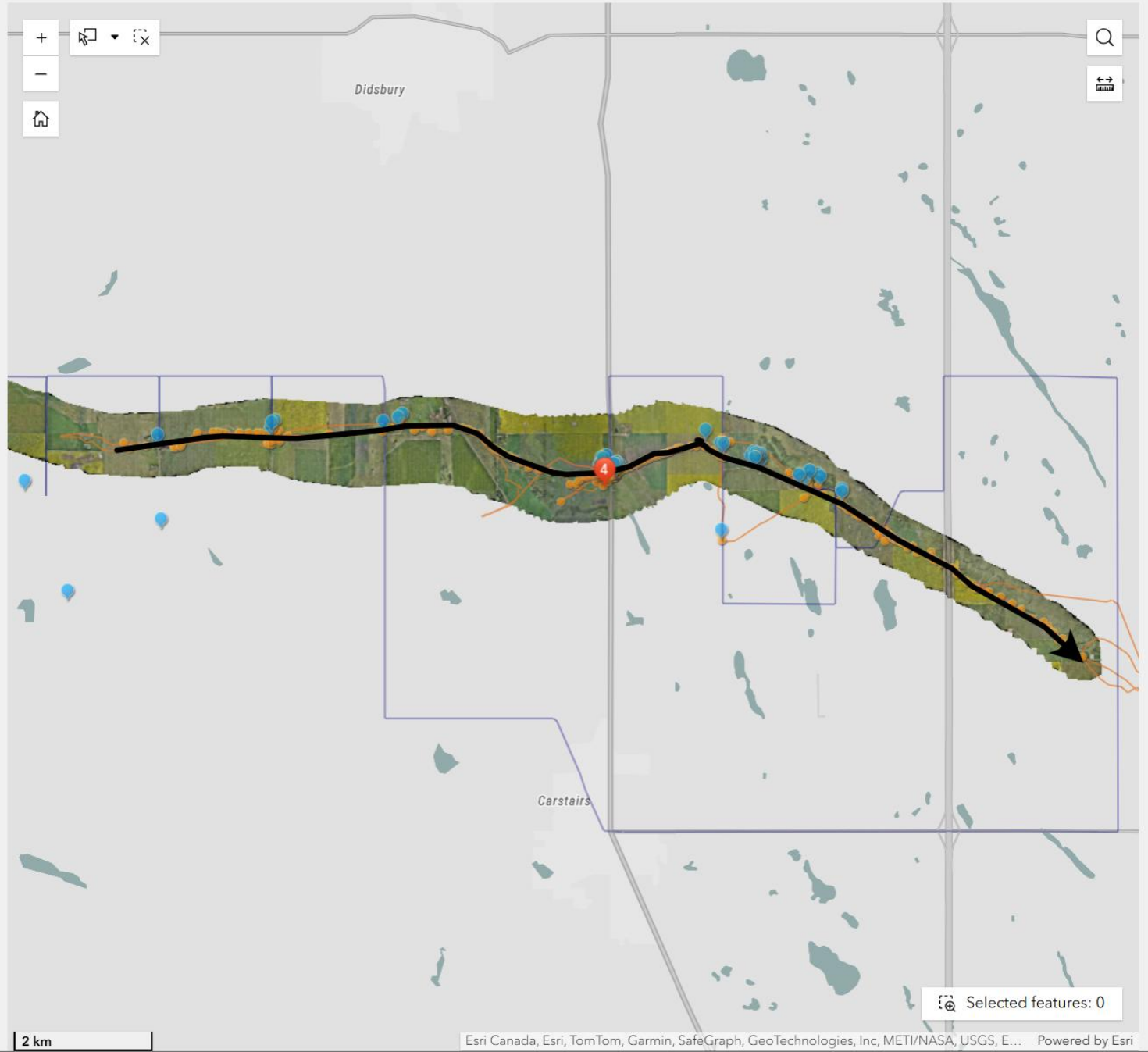
Tornado Centreline

Ground Photos

Drone Photos

Survey Route

Ground Photos | Drone Photos



Event Summary for Didsbury

Province: Alberta
Local Date: 1/7/2023
Local Time: 1345
Time Zone: MDT
Classification: Tornado (Over Land)
Path Length: 15.30 km
Max Path Width: 620 m
Motion From: W (280 degrees)
EF-scale DI/DOD: FR12/DOD-9 (EXP)
EF-scale rating: ef4
Max Wind Speed: 275 km/h
Surveys: satellite,ground,drone
Status: Final classification completed
Parent Storm Type: Supercell
Fatalities: 0
Injuries: 1
Damage Cost: unknown

Witnesses captured video of a tornado that developed southwest of Didsbury and tracked eastward to north of Carstairs. The tornado caused significant damage to multiple properties, destroying several houses and farm buildings. Notable tree damage occurred, and power poles and vehicles were also damaged. One minor injury was reported, and several dozen farm animals were killed. NTP ground and drone survey teams investigated along the damage track on July 1-3, 2023. Damage assessed as EF4 tornado, with an estimated max. wind speed of 275 km/h, track length of 15.3 km and max. path width of 620 m. Tornado motion was from the W (approx. 280 degrees). Satellite imagery review revealed damage to crops and some trees in the path.

Download Data

A variety of datasets are maintained for NTP events. These are organized as 'layers' and can be downloaded through the NTP Open Data Main Page or through one of the links below:

- The **Event Summaries** layer contains summary information for all NTP events. Click on 'data', apply desired filters, then click on 'download options'.
- The **Damage Tracks** layer contains location data for all tornado start/worst/end points, tornado centrelines, and downburst extents. Work on this layer is in progress.
- To access **Event-Specific Files**, select the layer you want to download, then click on 'download options'.

Additional Resources

- Radar Viewer

Closing Thoughts

- Wind damage survey organizations and teams across the world differ in structure, size, budget, and various other aspects.

- Hopefully, some of how damage surveys are carried out at NTP and the CSSL can be applied to other tornado research groups outside of Canada.

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