Technical Report

GPR Survey at Father Mérer School, St. Albert

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William T. D. Wadsworth and Dr. Kisha Supernant

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6 St Vital Ave, St. Albert, AB T8N 1K2

INSTITUTE OF PRAIRIE AND INDIGENOUS ARCHAEOLOGY

UNIVERSITY OF ALBERTA

Credit Sheet / Acknowledgements

Responsibilities	Initials
Director	KS
Field Supervisor Data Analysis Report Writing	WW
Note-taking	MN, SMG
Fieldwork Assistants	MN, TB, SMG, LG

Dr. Kisha Supernant is Director of the Institute of Prairie Archaeology and an Associate Professor in the Department of Anthropology at the University of Alberta. Her research focuses on Indigenous archaeology, spatial analysis, and the deep history of Indigenous communities in western Canada. kisha.supernant@ualberta.ca | 780-248-2082

William T. D. (Liam) Wadsworth is a PhD student in the Department of Anthropology at the University of Alberta. He specializes in applying geophysics/remote sensing techniques to Canadian archaeology, primarily at the request of Indigenous communities. wwadswor@ualberta.ca | 613-276-4081

Volunteers/Field Assistants:

Solène Mallet Gauthier

Elizabeth (Libby) Goldberg

Maria Nelson

Taylor Brosda

Introduction

In July 2021, GPR/remote sensing work was requested by the Greater St. Albert Catholic School board to identify any potential graves in advance of a parking lot expansion. The site was a historic school (The Father Mérer School/brick school) and was not connected to the nearby residential school. The engineering firm employed to expand the parking lot has estimated that up to 63 cm of the ground will be disturbed by the expansion. If any burials were intact, this surface construction would likely not impact the graves (which would occur likely below this). Nevertheless, out of an abundance of caution the school board wanted to survey the nearby grounds in advance of the construction (Figure 1 and 2). A GPR survey was planned, and two rectilinear grids were used to cover the entirety of the requested area. The GPR survey seemed to have been successful and no reflections potentially indicative of graves were found. As a result, it is recommended that the school board proceed with their project as planned.

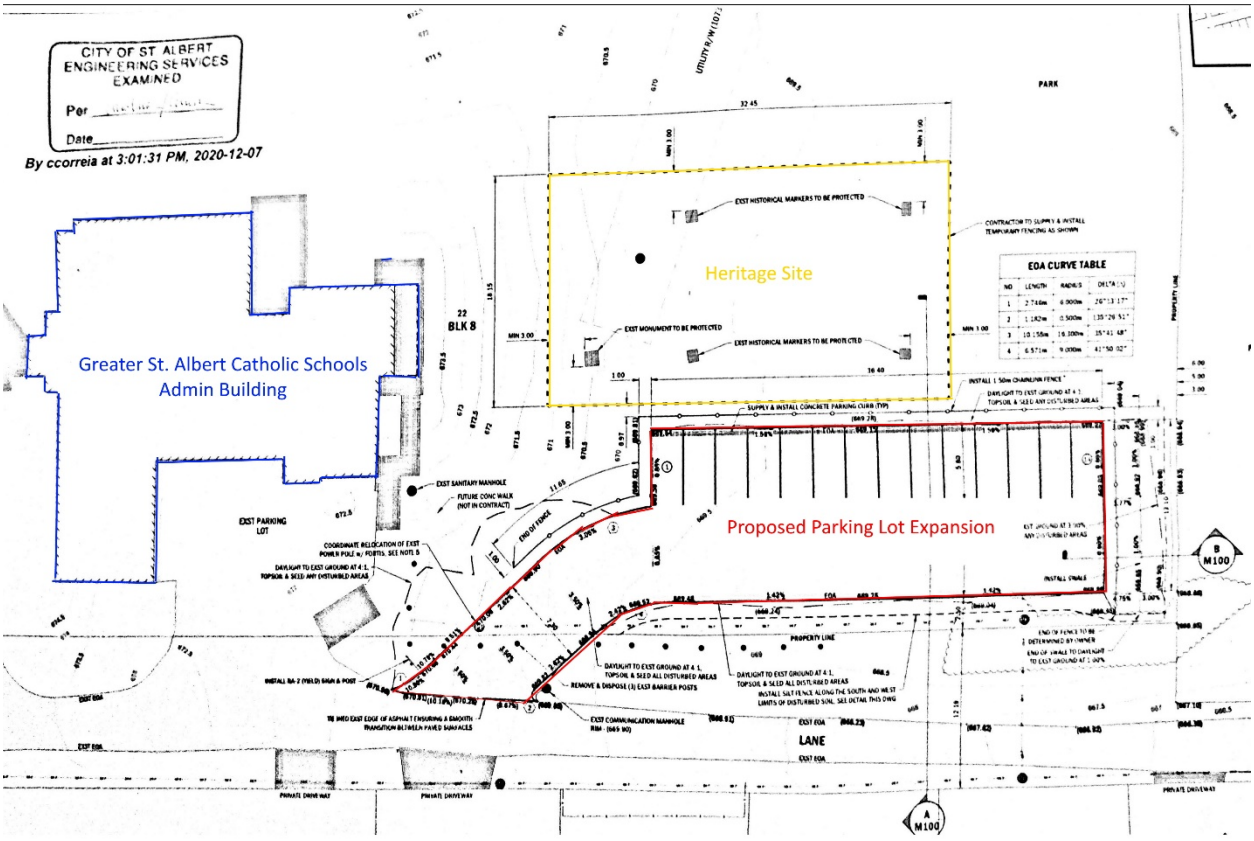

Figure 1 Altered Architectural drawing of the proposed parking lot expansion (red) to the south of the Greater St. Albert Catholic Schools Admin Building (blue). The Father Mérer School is outlined in yellow with the four concrete slab cornerstones noted.

Brief Historical Background

The Father Mérer School was a two-storey brick schoolhouse built in 1909 and was later demolished in 1960. The Father Mérer school (also known as the Brick School) was one of a number of Catholic schools that operated on or around Mission Hill in St. Albert, and is located near the old residential school (Youville). Figures 2 and 3 are historical photographs that show the school as the lone building near the top of the hill. The school was connected to the rest of the settlement by boardwalks and trails. Figures 4 and 5 show some of the students at the school standing on the front steps. The photos were obtained from the Musée Heritage Museum in St. Albert and accessed via [Alberta On Record].

Figure 2 The Father Mérer school

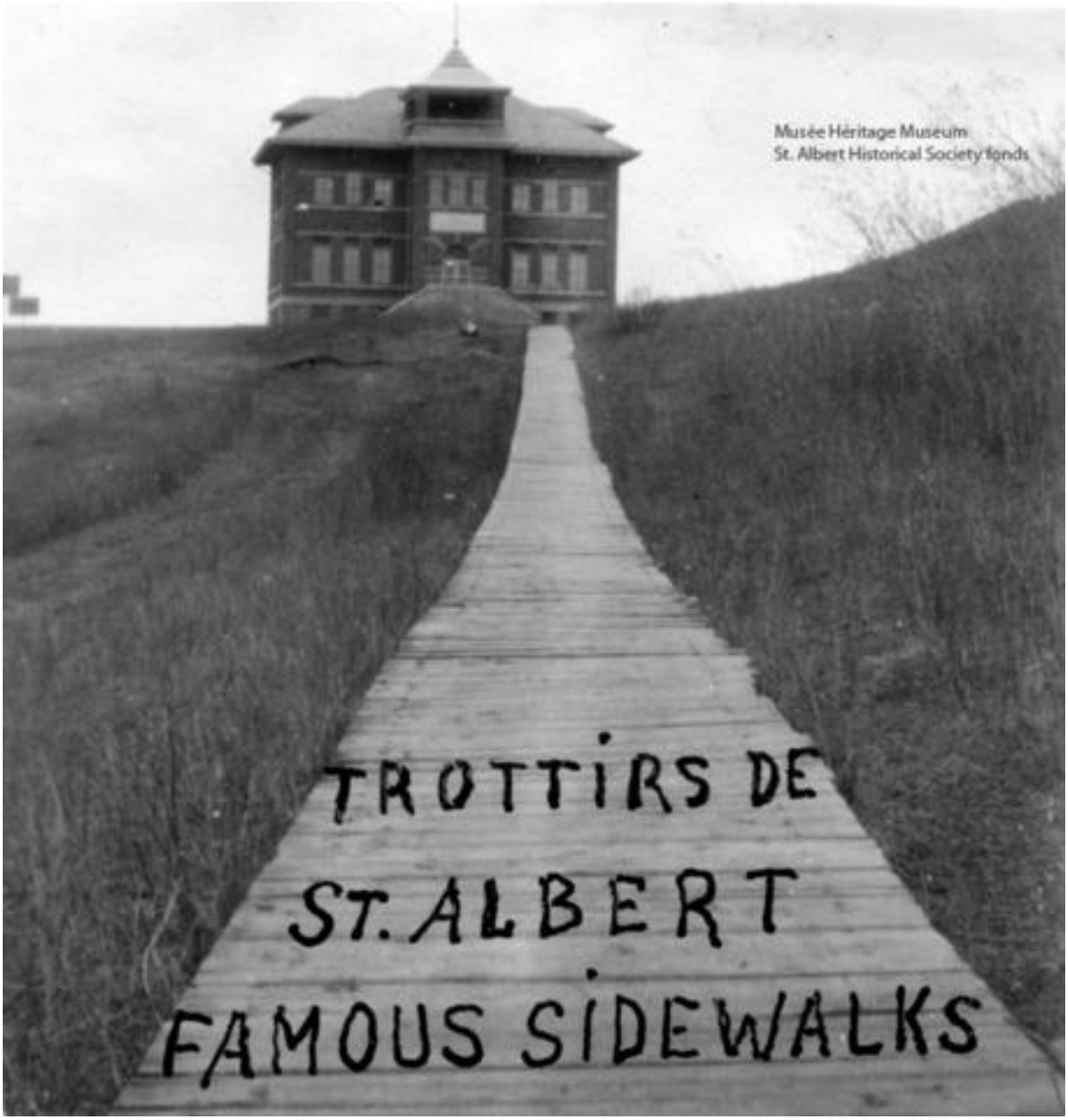

Figure 3 The Father Mérer school from a different angle. A boardwalk was constructed to the building.

Figure 4 Students on the stairs of The Father Mérer school

Figure 5 Additional historic photographs showing students outside the The Father Mérer school

It is interesting that at some point in the development of the school, additional buildings were constructed in its direct vicinity. This can be seen in the following historical photographs taken from the old Perron St. bridge and from across the Sturgeon river (Figures 6 and 7). Three or four additional structures were present at/directly adjacent to the project location. Some of these buildings as well as extensive trails/compacted areas can be seen in 1950s aerial photographs (Figure 8).

Figure 6 Historic photograph from the Perron St. Bridge. The Father Mérer school is denoted with a black arrow, the Youville school is shown with a black dot, and additional structures behind and near the school are shown with the arrow outlines.

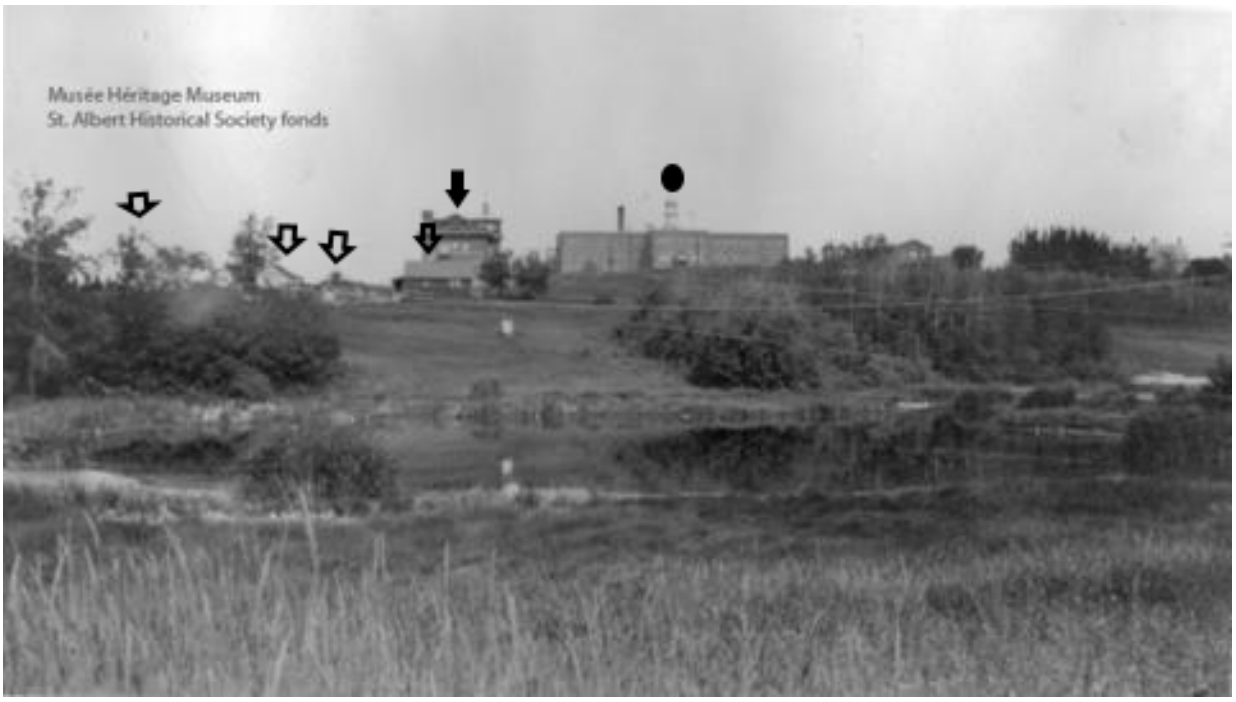

Figure 7 Historic photograph from across the sturgeon river. The Father Mérer school is denoted with a black arrow, the Youville school is shown with a black dot, and additional structures behind and near the school are shown with the arrow outlines.

Figure 8 Aerial photo of St. Albert taken during between 1949-51 by the Aerial Survey Section, Technical Division, Alberta Department of Lands & Forest to create an orthomosaic of the province. Seen here are at least two other buildings with the labelled 'second building' occurring near the project location. Also seen are trails radiating out from The Father Mérer school (denoted with dotted lines for orientation). Historic aerial photo mosaic available here: Search Results - University of Lethbridge Digitized Collections (uleth.ca).

Judging by historic photographs, the number of buildings that are on or directly adjacent to the project location, suggests a lower-than-average chance of burials at this site. This is especially true given that there was a Roman Catholic cemetery attached to the Youville residential school (which is just across St. Vital Street), and any burials would have likely occurred in the existing cemetery. That being said, the GPR survey was carried out to proactively assess the area to see whether burials could be a concern for the upcoming parking lot expansion.

Ground-penetrating Radar

Archaeologists are increasingly called upon to use geophysical techniques to identify graves, and ground-penetrating radar (GPR) has been found to be the most consistent in this application (Conyers, 2012, 2013; Gaffney et al., 2015; Wadsworth, Bank, Patton, & Doroszenko, 2020; Wadsworth, Supernant, Dersch, & The Chipewyan Prairie First Nation, 2021). A GPR system is comprised of a transmitting source that propagates radiowaves through the subsurface (Figure 2). When radiowaves pass through the ground, any physical change in the subsurface will cause some energy to reflect back towards the surface, while the remaining energy is refracted or propagated deeper (Conyers, 2013). A receiver collects the reflected data and stores the information in the computer console (Conyers, 2013; Reynolds, 2011). The received signal is recorded in two-way time (measured in nanoseconds), which is the time it takes for the wave to travel from the source, reflect off the buried property, and travel back to the surface. During data processing, two-way time is then converted to depth, so that as analysts, we can see where there are changes in subsurface composition and breaks in stratigraphy (Conyers, 2013). Although a GPR collects data in profiles, when the data is collected in a grid, 3D cubes of data can be constructed using computer programs or scripts. This is particularly useful as it allows the interpreter to see a ‘bird’s eye’ view of the area and look through depth layers known as ‘timeslices’ or ‘amplitude maps’.

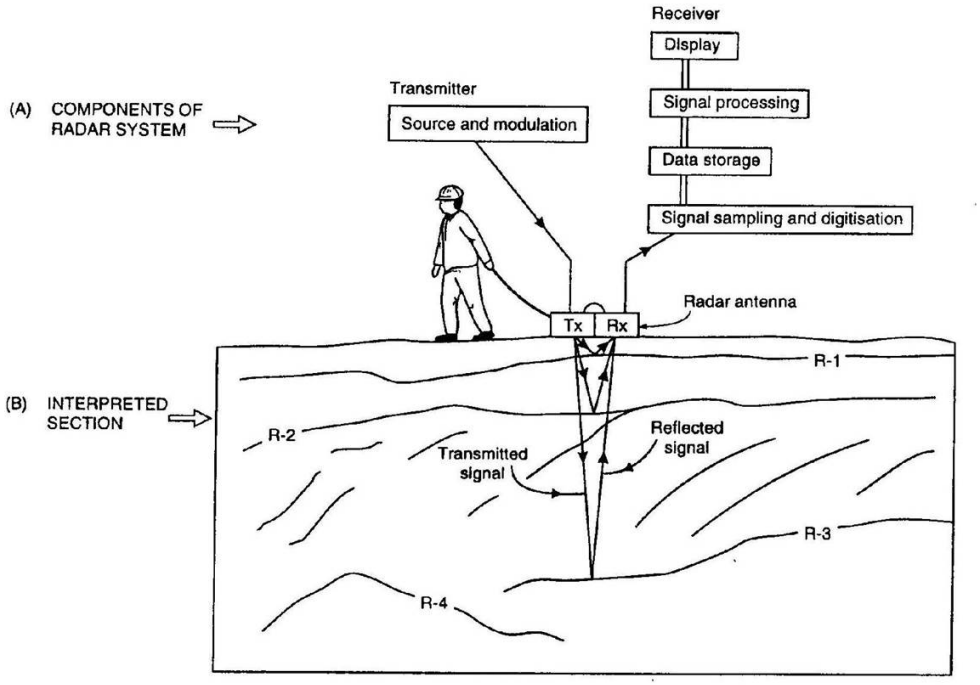

Figure 9 Schematic Diagram of a ground-penetrating radar (GPR) system. Taken from the open source website: https://gpg.geosci.xyz/

When seeking to identify buried features, it is useful to know the parameters of those features and the practices they might reflect. Taking into account the potential worries for burials of children at the site, smaller graves buried in the Catholic tradition (up to 6 ft and in rows) were expected.

Survey Methods

The survey area consisted of close-cut lawn on Mission Hill in St. Albert. Conditions were dry and clear (approximately 15 degrees Celsius around noon). The soil appeared fairly sandy, but this could have been a result of the dryness. There were no obstructions beyond a few survey stakes, which were easily maneuvered around.

The 2021 unmarked grave survey was limited to one day in July. Ground-penetrating radar was used in an attempt to characterize any burials at the site. The entire area requested was surveyed, and detailed survey specifics can be found in the Appendix 1. The only portion of the proposed expansion that was not surveyed was the ramp, however this portion already looked disturbed by previous construction, such as the road. Two rectilinear grids of 22 x 33 m (A) and 20 x 13 m (B) were surveyed (Figure 10). A 400 MHz antenna attached to a GSSI SIR-3000 controller with a survey wheel was used to conduct the GPR survey. All GPR survey transects were unidirectional, travelled west to east, spaced at 25 cm intervals, and originated at the

northwest corner of the two grids. Readings were logged at a rate of 50 scans/m, samples were set to 1024, and three gain points were set automatically and used consistently over the course of the survey (Appendix 1). Two-way time was later converted to depth using a hyperbola fitting analysis in GPR Viewer (Conyers and Lucius 2016), and the average dielectric permittivity was determined to be about 12-13 (which is appropriate for mixed dry sand/silt soils) (Conyers 2013).

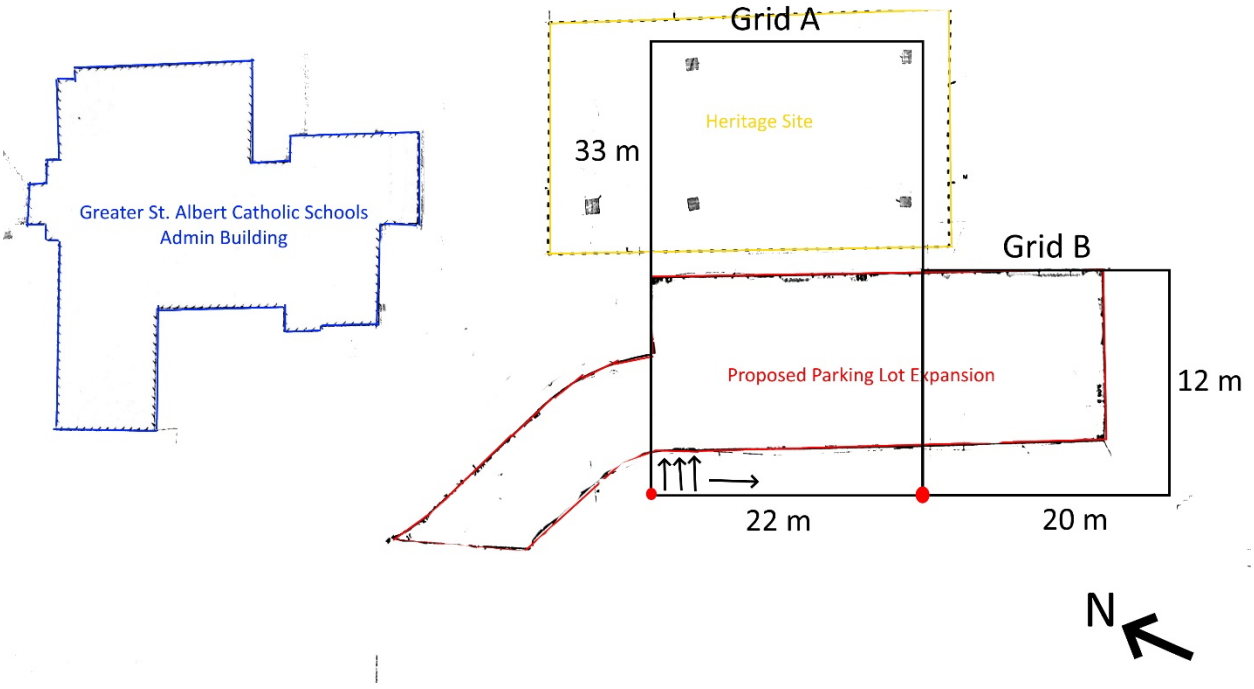

Figure 10 Sketch map of the GPR grids that occurred over the proposed parking lot expansion. GPR grids in black. Red dots denote the start position on each grid, and black arrows show the direction of travel (W->E) across the both grids.

Beyond field collection, the data was processed at the University of Alberta. The GPR data was processed and 'sliced' using GPR Process an open-source program developed out of the University of Denver (Conyers and Lucius 2010). To analyze the reflections in the profiles, the complimentary program, GPR Viewer, was also used (Conyers and Lucius 2016). Basic processing techniques such as time zeroing and background removal were used. The data was also inputted into Golden Software's Surfer 19 to construct 3ns thick contour/amplitude maps. I used a similar workflow/characterization method to locate potential graves, which developed from my undergraduate and master's theses (Conyers, 2012; Wadsworth, 2020; Wadsworth et al., 2020). While reflections are usually identified as either possible or probable graves (with a list of criteria for each), the unlikelihood of graves at the site necessitated a new strategy. Any

reflection looking remotely like a grave was to be flagged for further investigation. Examples of potential graves in profile and time-slices/amplitude maps are seen in Figure 11.

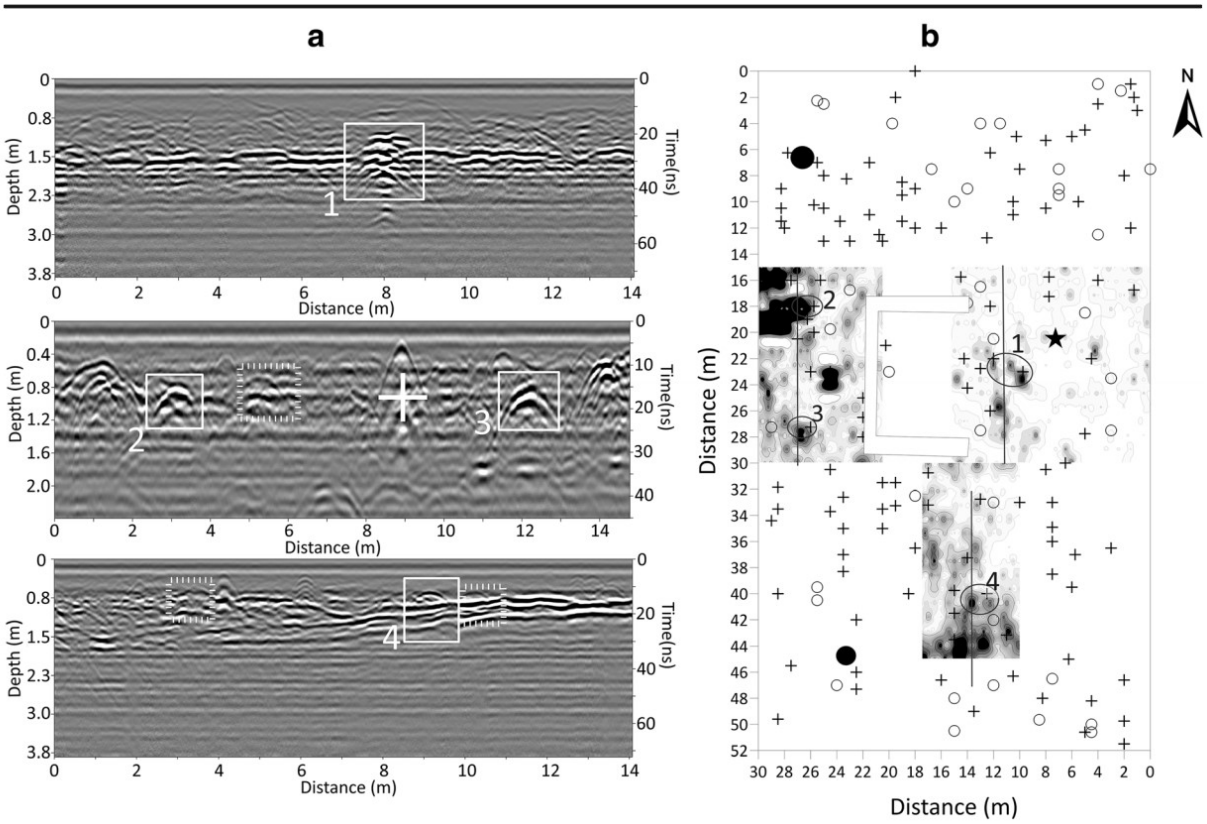

Figure 11 (Taken from Wadsworth et al. 2020:figure 5) A) Graves identified in profile.Solid white squares denote the hyperbolas that were identified as probable coffins or grave shafts (for more examples, see (Conyers, 2012)). The dashed white squares denote possible graves. B) Is a map of the cemetery, with some amplitude maps included for each of the graves identified in profile (as numbered). The circles (○) denote "possible" graves haped anomalies, and crosses (+) denote "probable" grave shaped anomalies identified in profile. The black star (★) indicates a likely grave-shaped reflection that was identified with two geophysical techniques.

As a final note, magnetic gradiometry (another geophysical technique) was attempted however the presence of metal in this urban context prohibited any useful data collection. As a result, collection was halted part way through Grid A, and the in conclusive results are not included here.

Results

The ground-penetrating radar survey at the Father Mérer school proved to be successful. The boundary of interpretable data in the profiles appeared to be approximately 1.2 m (or approximately 4 ft). This depth is fairly typical for soils in Alberta (where the maximum effective depth is often 0.5-2 m). While Christian graves are typically thought of as occurring at

6 ft deep, this is rarely the case in our experience (with burials often occuring around 3-4 ft; Wadsworth et al., 2020; Wadsworth et al., 2021). Nevertheless, other indications of a grave should be present in the top of 4 ft, including the burial shaft, disturbed matrix, slight surface depression or mounding, or other grave-shaft contents. While a full analysis of the GPR profiles and depth amplitude maps occurred, there were no clear indications that any burials were present in either Grid A or Grid B (Figure 12). Interestingly, Grid A also included the Father Mérer school which shows up exceptionally well. Many hyperbolic reflections were found to be present in the data (which is a type of GPR reflection that we associate with burials); however, these were concentrated in the top 30 cm, less than 50 cm in width, and never occurred at the same location in successive profiles. This suggested these reflections were not burial related. One clear feature occurring within the proposed parking lot area was identified. This feature was linear and highly reflective in nature, which lead to the interpretation that this was one of the trails from the former school. Many of the point source features previously mentioned occurred on or below this interpreted trail feature (perhaps stones pressed into the trail). Additionally, these interpreted trail features were seen in the amplitude maps and also seen in the aerial photo from the 1960s. While few GPR reflections were found below this feature (~30 cm to 40 cm), there were many other GPR reflections found below this depth within or directly adjacent to the school foundations. The presence of these features suggests that the homogenous subsurface below the trail is likely just that and there are no additional features of interest. Since identifying the school was not the objective of the survey, many of these features were left uninterpreted; however, future historical research could hold greater insights here.

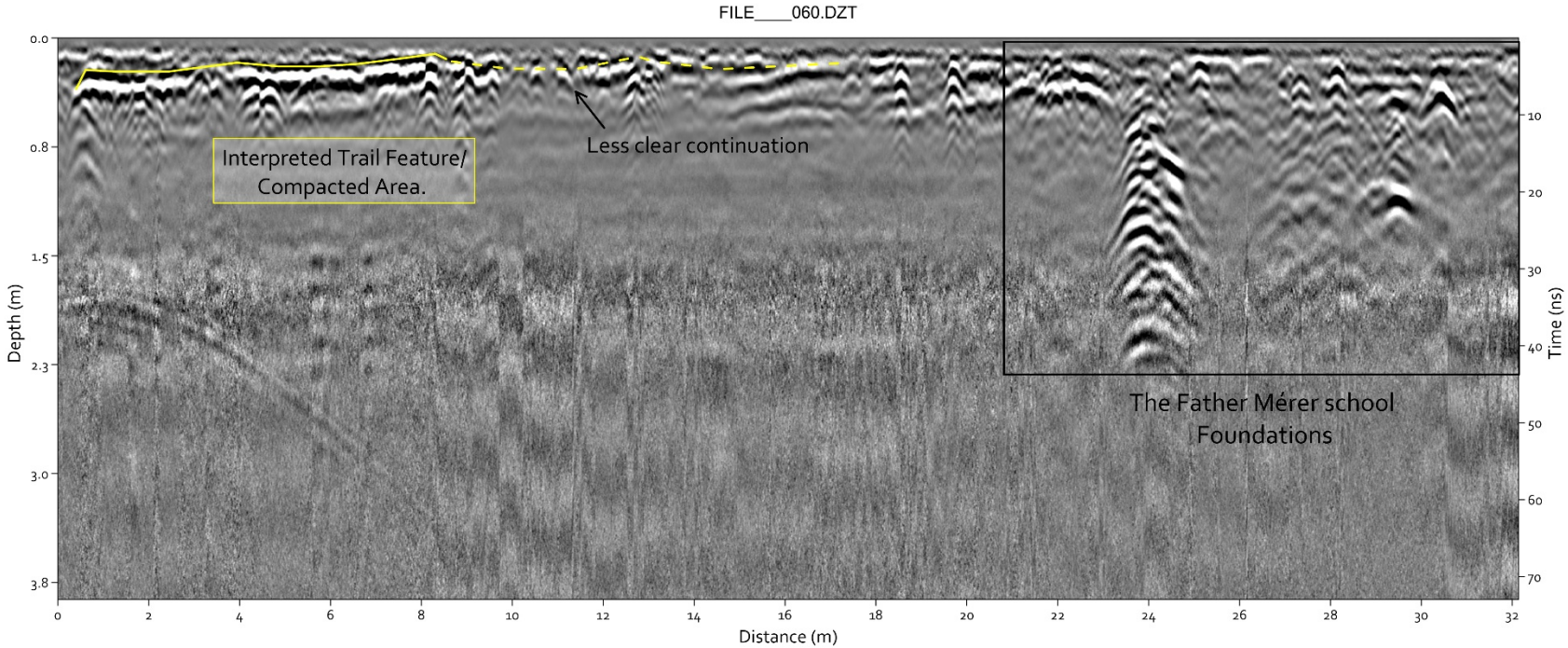

Figure 12 Example GPR reflection profile from the Father Mérer school survey. Shown here is the interpreted trail/compacted feature as well as features associated with the old school's foundations.

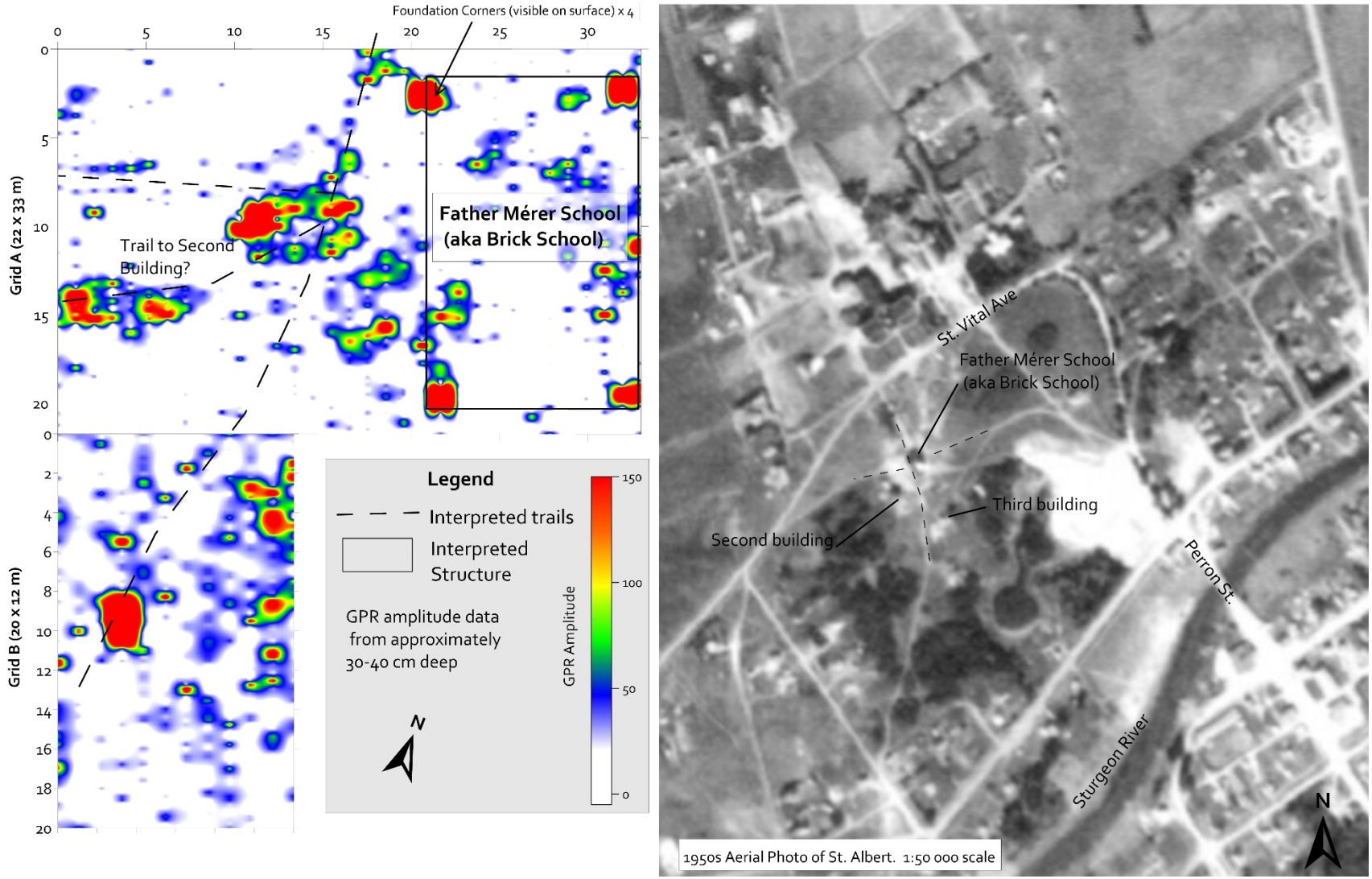

Figure 13 GPR Interpretation of the proposed area for parking lot expansion. Area behind the school likely consists of old trails and compacted areas, judging by GPR and aerial/historic photos. No possible indications of unmarked graves were present within either grid.

Conclusion/Recommendations

As a result of the GPR findings, it is suspected that no burials are at risk of being disturbed by the upcoming parking lot expansion. While GPR cannot be 100% accurate, the addition of aerial photos and historic pictures show that this area likely had trails and other additional structures. Furthermore, the presence of a nearby Catholic cemetery (as a better alternative to burying individuals behind the school) further supports the negative GPR results. If the school board is still concerned, we would recommend hiring an archaeologist to monitor the area during construction.

Appendix 1: Instrument Settings

Instrument	**GSSI SIR 3000 GPR**
Grid 1 Size	22 m x 33m
Grid 1 Files	File 1-88
Grid 2 Size	20 x 12 m
Grid 2 Files	File 89-169
Antenna	400 MHz
Data Collection Mode	Distance (Survey Wheel)
Direction	Unidirectional (W->E)
T-Rate	100 KHz
Samples	1024 samples
Format	16 Bit
Range	80 ns
Scans/Unit	50
In-field Dielectric Constant	8
Post-field Dielectric Constant	~11-12
Gain Points (GP)	3
GP1	-20
GP2	61
GP3	63

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