Retracement and Expansion of the University of Calgary High Precision Survey Network

with specialized focus on High Precision Surveying Methods and Network Design

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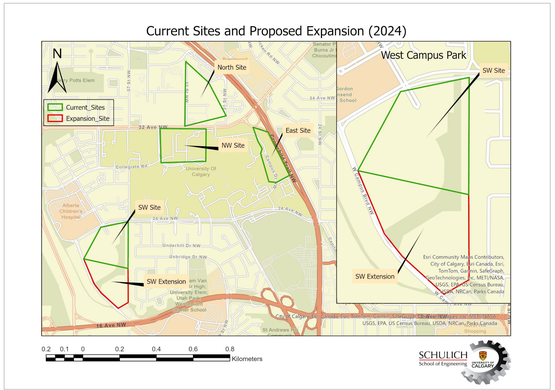
Overview

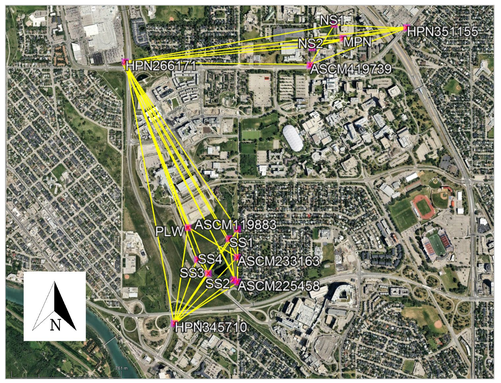
Objectives
- Retrace and confirm existing control
- Expand network to new area

Applied Survey Techniques and Instruments Used
- Static GNSS - Trimble R10
- High Precision Traversing - Leica TS30
- Precise Leveling - Leica LS15

Main Constraints
- Time/Personnel Availability
- Instrument Accuracy
- Point Precision



Network Design



- Baseline vectors are observations in a least-squares adjustment
- Robust estimate of static precision: Cx
- Robust network quality: redundancy numbers
- Static baseline blunder detection and removal

Static GNSS

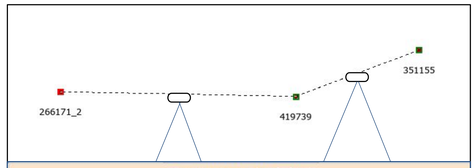
Calibration
- Phase centre confirmation using a baseline consisting of two HPN points.

	Northing [m]	Easting [m]	Height [m]
Average Error	-0.0073	0.0025	0.0035

Methodology
- Observations performed using four receivers at a time, with two set up on HPNs at all times to establish two baselines to each point to increase redundancy

Precise Leveling

Calibration
- Princeton Test was performed on LS15
- Angle of collimation error estimated



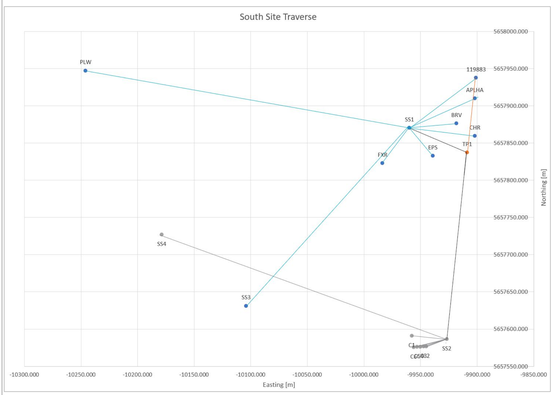
ASCM 419739 (Porkchop)		
Type	Elevation	Misclosure Published (mm)
Static?	1110.236	-1.99
Published (2023)	1110.238	N/A
LD-PC	1110.241	2.69
MM-PC	1110.237	-0.79
Average (MM-LD)	1110.239	0.95

Methodology
- Ran two loops beginning on HPNs 351155 and 266171_2 respectively, both loops ended on ASCM 419739. Each loop setup had two independent rounds of observations. Closure was checked by combining loops and comparing the result to published HPN heights.

High Precision Traverse with Total Station

Calibration
- The Springbank Baseline was used to find the Zo error and β scale factor

Zo (m)	Scale (unitless)
-0.000847646	0.999984561

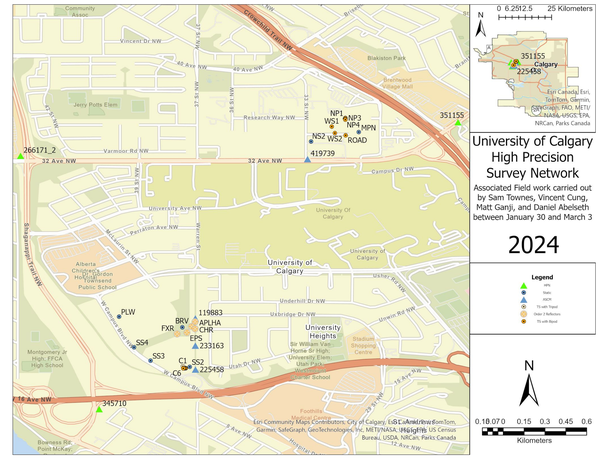


Methodology
- A traverse was done on the south site.
- New points shot in at north site and south site.
- One observer/booker and two rodmen.
- Precision estimates were done by combining random errors in reading, pointing, levelling, height measurement, centering. The combined value was used in error propagation to each point.

Final Coordinate List

Order	Description	Colour
0	HPN	
1	Static	
2	TS (precise)	
3	TS with Bipod	
4	Tower	

- Different orders represent groups of points with similar precisions
- Quality decreases with increasing order



Conclusions and Future Implications

- Center punch of spikes, rebar, mag nails (pictured) will ensure repeatability
- Estimated coordinate precisions will aid students in surveys to determine what checks are expected

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