



Survey Control for Conservation Practices

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Overview

- **Most, if not all project work requires some level of survey control.**



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Presentation Topics

- **Survey Control Overview**
- **Benchmarks**
- **Relative vs. Absolute Vertical Control**
- **Geodetic Monuments**

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What is Survey Control and Why is it Important?

Survey Control

Establishing and maintaining both horizontal (x,y) and vertical (z) control throughout the life of the project to provide more effective project:

- *Design*
- *Implementation*
- *Monitoring*
- *Management, Maintenance, and Repair/Replacement*

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Survey Control

Horizontal control - spatial reference of collected survey data.

Vertical control - referenced datum for site elevations. An essential component of most surveys.

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Survey Control

Good Survey Control:

- Assures consistent and reproducible elevation/location data.
- Reduces the possibility of errors.
- More easily allows for troubleshooting to resolve discrepancies that may occur before, during, or after the survey. (e.g. typographical errors, lost or compromised TBM's)

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Survey Control



Establishing control is typically one of the first survey functions to be performed on a project.

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Benchmarks – Permanent, Temporary, and Construction

Permanent Benchmarks

Generally speaking, the MNDOT system of Geodetic monuments is used as reference for permanent benchmarks on most BWSR construction projects across Minnesota.

This, in combination with GPS and VRS, has made recovering site TBM's and site elevation control much easier than in the past.

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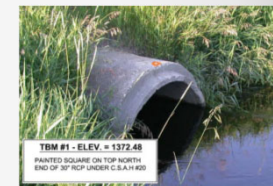
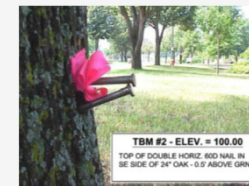
Temporary Benchmarks

- TBMs Should be set for every project.
- They should be durable and available for easy reference during project establishment as well as for a semi extended period of time.
- A minimum of 2 Benchmarks should be set for every project and located as near as possible to any construction areas.
- TBMs will help verify accuracy of the project's vertical control, and numerous TBMs will help maintain control if one is damaged or moved.
- Create construction benchmarks that can be utilized with other survey equipment (i.e. Total Station; Laser Level) (as needed).

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Temporary Benchmarks



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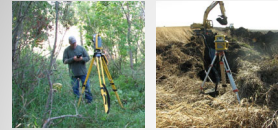
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Construction Temporary Benchmark



(Often referred to as 'hubs') – used for giving reference elevations for individual embankments and/or when there are no other permanent structures available on site to use as TBMs.

Total Station and Laser Level



GNSS Survey



VRS



Relative vs. Absolute Vertical Control

Relative Control

Pros

- No computer planning to find geodetic control before survey
- Can utilize any survey equipment

Cons

- Control can be lost/destroyed or unknowingly moved (i.e., culvert replaced)



Geodetic Monuments

Define what they are – ex. 1st or 2nd order control points established/maintained by others for use to maintain consistent and reliable datum reference across the country.

Vertical elevation from these monuments is often referred as to “Mean Sea Level (MSL)” datum

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Absolute Vertical Control = Mean Sea Level

- Assuming your VRS has a referenced projection and Geoid set up.
- A Defined vertical datum most often used is the NAVD88.
- VRS is usually pretty close to MSL on startup without calibration.
- Correlating a site survey to an established 1st or 2nd order geodetic MSL datum is fairly straightforward. This has many benefits and in some cases may be necessary/required.

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Calibrating To Geodetic Control Points with VRS

Some Information Above My Head – But . . . (BLAH, BLAH, BLAH)

VRS:

- Practically eliminates the ionospheric errors inherent in GNSS measurements and therefore significantly improves your measurement accuracy
- Requires no base station set up – the base stations are provided by the service (in our case MNDOT)
- Creates actual vectors between your rover and physical base stations – the “virtual” term is in reference to the ionospheric error elimination process
- Still requires you to maintain proper surveying techniques such as verifying the received data by doing a site calibration
- Can greatly improve efficiency and productivity within your survey.

<http://www.can-net.ca>

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Using Geodetic Control Points with VRS

Reasons to Tie-in:

- Notice and correct human errors before survey begins.
- Confidently tie into other projects that have been calibrated to MSL.
- Verify the accuracy of LiDAR data that may be supplemented with project.

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Summary

- Setting Survey control on a site is crucial.
- Different types of survey equipment create different limitations.
 - VRS equipment can alleviate many limitations.
 - Can convey Mean Sea Level to most locations.
 - Can be utilized to mesh with LiDAR Data for extended information.
- MnDOT Geodetic Database allows a local calibration for the VRS to a project site.
 - Recommended to tie in all projects regardless of size, simplicity, or scope

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Site Staking



1. No mandatory way to do it.
2. Discuss options with contractor at pre-con meeting and/or on site when construction begins.
3. Site conditions may dictate staking methods/materials used.

