# SKI HILL PROJECT

## SKI RUN WIDTH ASSESSMENT BY DRONE SURVEYING: A CASE STUDY

GREY COUNTY REGION, ONTARIO

LOCATION INTELLIGENCE & DESIGN

YOUR UAV SPECIALISTS

**THE MARVEL ABOUT USING A DRONE TO CAPTURE IMAGERY IS THE EXTREMELY HIGH QUALITY THAT CAN BE CAPTURED COMPARED TO OTHER METHODS AT A LOWER COST.**

**14** acres of land

**2.4** cm/pixel resolution

**27** minute flight

## INTRODUCTION

It is important for ski hill operators to know:

- where landslides can or have occurred
- changes in the slope of the hill that have occurred
- where drainage issues might be
- the profile of a hill to be able to install the correct amount of automated snowmaking guns
- identify and evaluate current & future infrastructure
- width of runs to make sure they meet race standards for the next ski season
- condition of ski lift towers and other property infrastructure

Traditionally Outside Operations would use satellite imagery, such as Google Earth, or hire an aircraft to conduct an aerial survey of the ski hill property. These traditional methods can be both costly and time consuming. With the introduction of drone technology the same insight can be provided at a lower cost, making it far more beneficial to a ski hill operator.

Using a drone to capture the data allows the ski hill operator to receive up-to-date information on the status of the ski hill property for planning purposes. The high quality bird's eye view of the entire property or select areas can provide insight into potential areas for future expansion, areas which may be susceptible to soil erosion and other general property maintenance issues.

## BACKGROUND

This project involved a ski hill located in the Grey County region of Ontario. The project was completed during the summer when the hill was shut down for maintenance and construction. This allowed for surveys to take place to gather the most information as there was no snow cover obstructing the view of the hill. The Outside Operations Division's priority was to map a ski run that was due to be widened in order to meet FIS Homologation requirements for the new downhill race season.

ORTHOMOSAIC

## THE FLIGHT

For this project, a Mavic 2 Pro was used to conduct the flight over the ski hill. The total flight area covered approximately 14 acres of land, which included the ski run to be assessed for width and some of the surrounding land where additional assessments could be done.

The entire onsite project took approximately one(1) hour. This included speaking with the Director of Outside Operations about the needs of the project, the areas to pay attention to and drone setup. In total the Director of Outside Operations was looking for width measurements around 2 sets of tree stands to determine how many would need to be removed and how much land would need to be graded.

Once this initial information was obtained, the drone setup could begin. This involved finding a clear and flat 'take off' area, setting the safety perimeter, identifying obstacles that might come up during flight and identifying an emergency landing area. Total flight time was approximately 27 minutes.

Approximately 2.5 gigabytes of imagery was captured during the flight. The resolution of imagery collected was 2.4 cm/pixel, which is a higher resolution than most satellite imagery. For example Google Earth imagery is usually between 15 and 30m/pixel. High resolution imagery makes width measurements clearer, provides the ability to check soil and slope conditions and assess infrastructure use over time.


ORTHOMOSAIC WITH CONTOURSV

## The Analysis Process

The imagery from this project was processed using photogrammetry software in order to create an Orthomosaic, a Digital Surface Model and a 3D model of the project site.

With the use of GIS mapping software, detailed measurements were created at intervals down the run being assessed to determine how many trees would need to be removed. Knowing the amount of changes that would need to occur to meet FIS standards is helpful when submitting a formal Niagara Escapement Commission submission to get approval for the proposed changes to trees and slope of the hill. A detailed contour map, created using the Digital Terrain Model, can be used to track changes over time as soil moves and as water causes erosion.

33.21

32.59

35.32

35.89

32.28

RUN WIDTHS

SLOPE MOVEMENT MONITORING

TOPOGRAPHIC MAPPING

ORTHOMOSAIC WITH RUN WIDTHS

## WHAT DO YOU DO WITH ALL THAT DATA?

Using the drone to collect the data is the easy part! Knowing what to do with it requires detailed skill and knowledge. Processing and understanding the data becomes complex when dealing with large datasets.

The Digital Surface Model (DSM) contains the elevation data from which operators can see the elevation and track changes over time to the slope of the ski hill. A DSM is different than a Digital Elevation Model (DEM) or Digital Terrain Model (DTM) as it includes elevation of trees and structures on property site. The data within the DSM can be "cleaned up" to create more accurate elevation information.

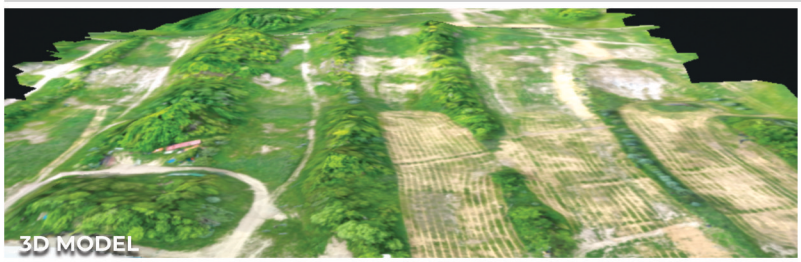
The 3D model can be used for operators who would benefit from viewing their site at different angles. This would allow them to see the shape of the hill as it is instead of just a 2D image.

The Orthomosaic or high detailed aerial view can provide a more current image of the ski hill. This allows the operator to get a better understanding of what hill conditions are like and how much maintenance and changes would need to occur before the next ski season. Satellite imagery, such as Google Maps, is updated infrequently in many regions making drone imagery more accessible and more beneficial.

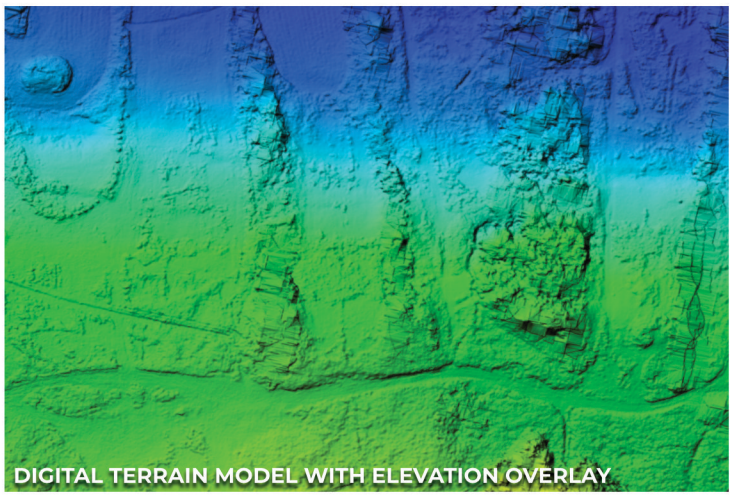
## Benefits to Ski Hill Operator

Once the new width of the ski run was determined, a report was generated with detailed information regarding what areas would be impacted by the change in width. This report can be used as a supporting document for formal submissions to the Niagara Escarpment Commission.

The data including the orthomosaic, the DSM, contours and width measurements were delivered to the client to be able to use in their systems for planning purposes.



3D MODEL



DIGITAL TERRAIN MODEL WITH ELEVATION OVERLAY


**WILLIE CARROLL, C.E.T.**

UAV PILOT CERTIFICATE - ADVANCED OPERATIONS

RESTRICTED OPERATORS CERTIFICATE - AERONAUTICS

B.A., HON. MAJOR PHYSICAL GEOGRAPHY MINOR GEOMATICS

HON. GEOGRAPHIC INFORMATION SYSTEMS GRADUATE CERTIFICATE PROGRAM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