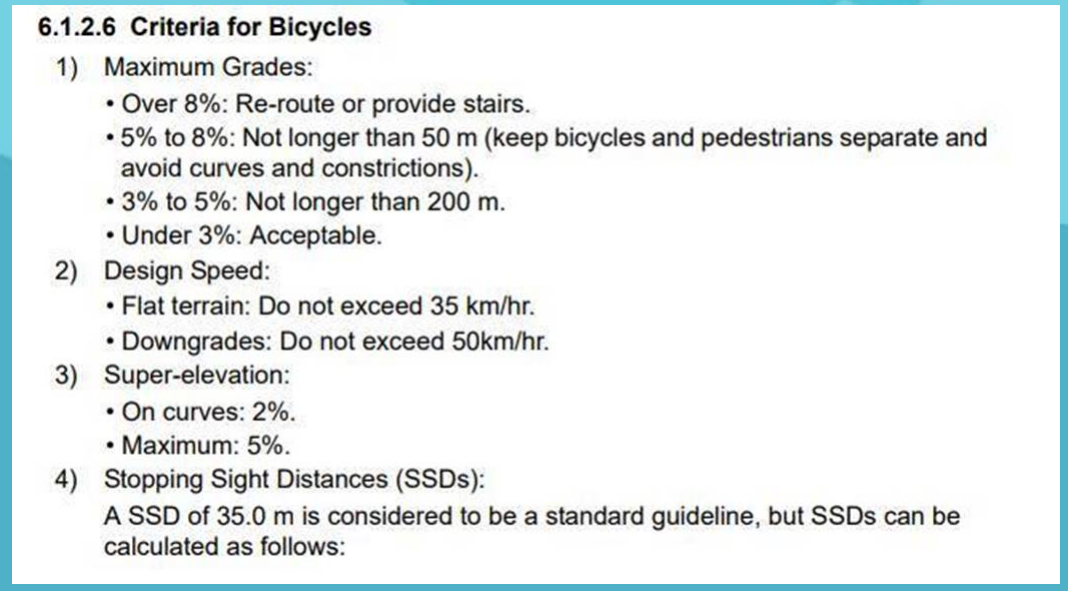
Bike Cochrane

Slopes of Pathways in Cochrane

March 2022

Slope Study on Pathways in Cochrane

- Many pathways in Cochrane are much more than 8% grade
- This study attempts to characterize the grades of a few well-known pathways



6.1.2.6 Criteria for Bicycles

1) Maximum Grades:
   - Over 8%: Re-route or provide stairs.
   - 5% to 8%: Not longer than 50 m (keep bicycles and pedestrians separate and avoid curves and constrictions).
   - 3% to 5%: Not longer than 200 m.
   - Under 3%: Acceptable.
2) Design Speed:
   - Flat terrain: Do not exceed 35 km/hr.
   - Downgrades: Do not exceed 50km/hr.
3) Super-elevation:
   - On curves: 2%.
   - Maximum: 5%.
4) Stopping Sight Distances (SSDs):

   A SSD of 35.0 m is considered to be a standard guideline, but SSDs can be calculated as follows:

METHODOLOGY

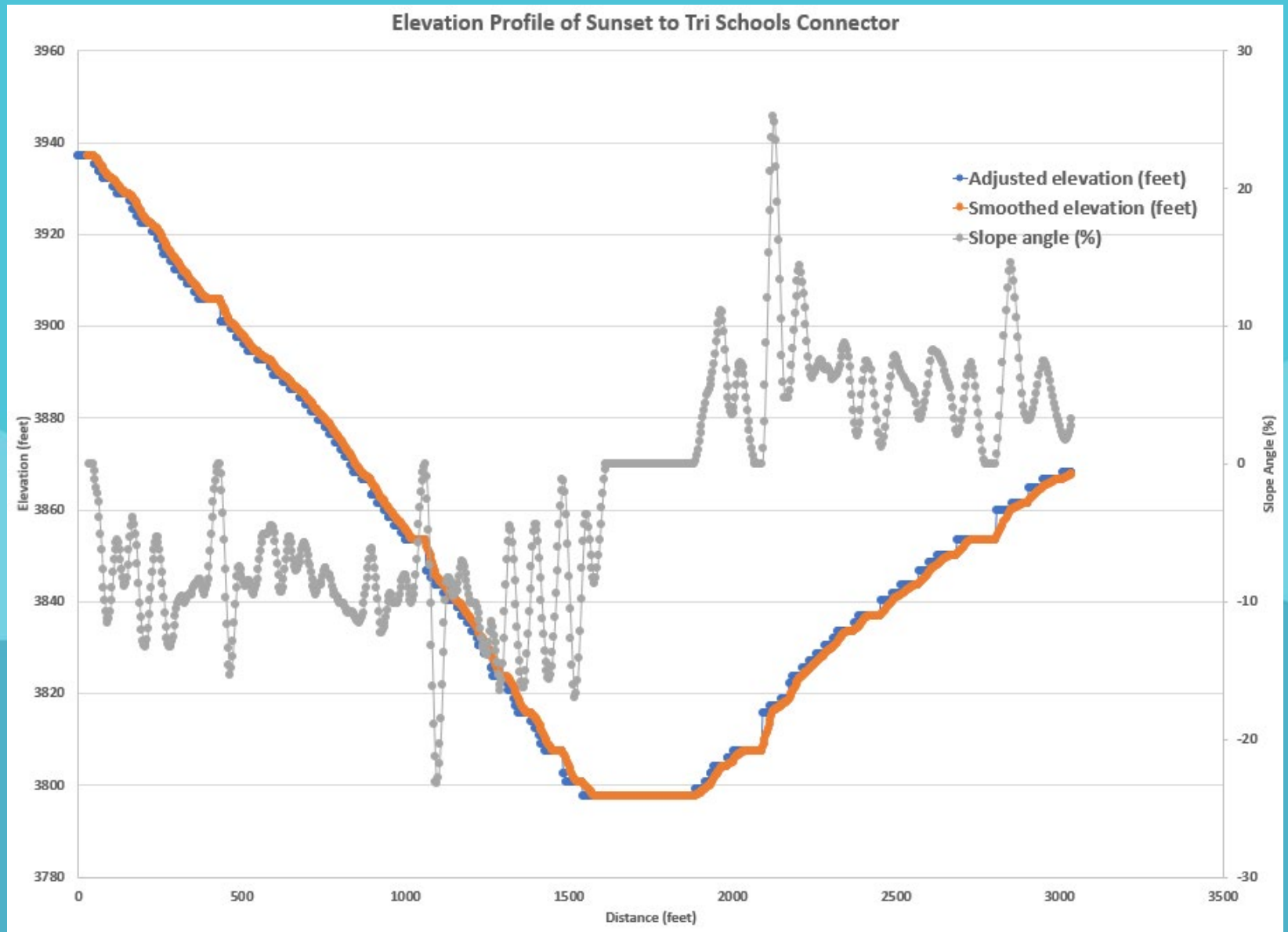
- Pull 50cm contour map from ToC's LIDAR data base
- Overlay that on top of the Open Street Map portion of Cochrane using QGIS
- Rasterize the contour map (use resolution of 1 both vertical and horizontal, choose ELEV_FEET as field to use for burn-in units, use output raster size units as georeferenced units, and EPSG.3780 output extent)
- Run profile tool by linking straight lines across the map to represent the pathway. Export the output to a CSV file and import it into Excel. (Use Georeferenced Units not pixels)
- In Excel, convert distance from metres to feet. Convert the 'nan' to previous elevation. Smooth the elevation over a 10 foot span. Use SLOPE function in Excel to deliver a slope angle. Plot it

Sunset to Tri-Schools Connector

- Biking or walking from Sunset to Tri-schools area without going through the Ranche (concerns with animals)

Sunset to Tri-Schools Connector

Average grade on descent (egress road) – **-7.8%**
Average grade on climb back up – **5.8%**



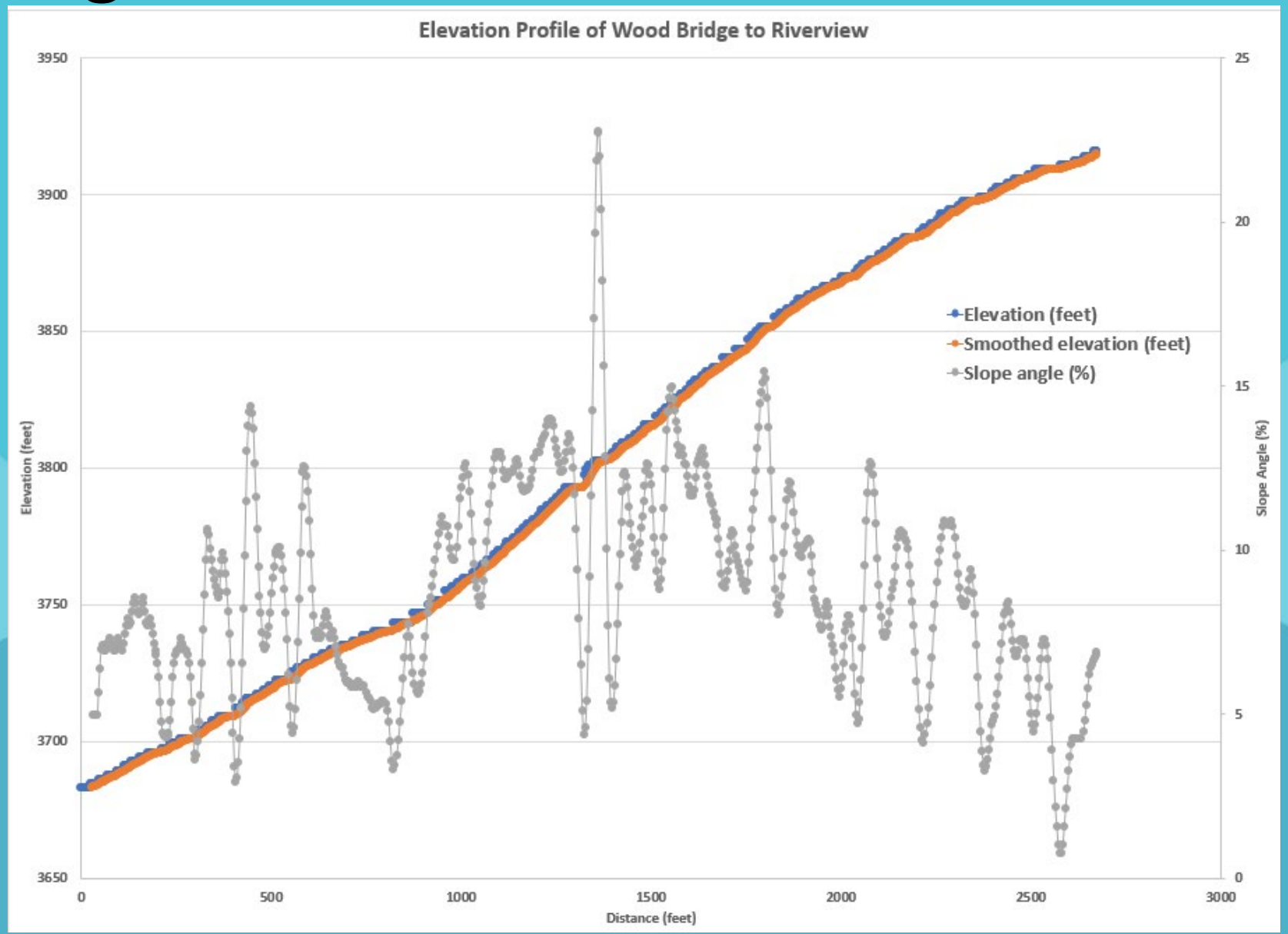
Wood Bridge to Riverview

- Connection from Bow River Pathway to Riverview without going through Riversong

Climb up the presently gravel road to St Mary's Church

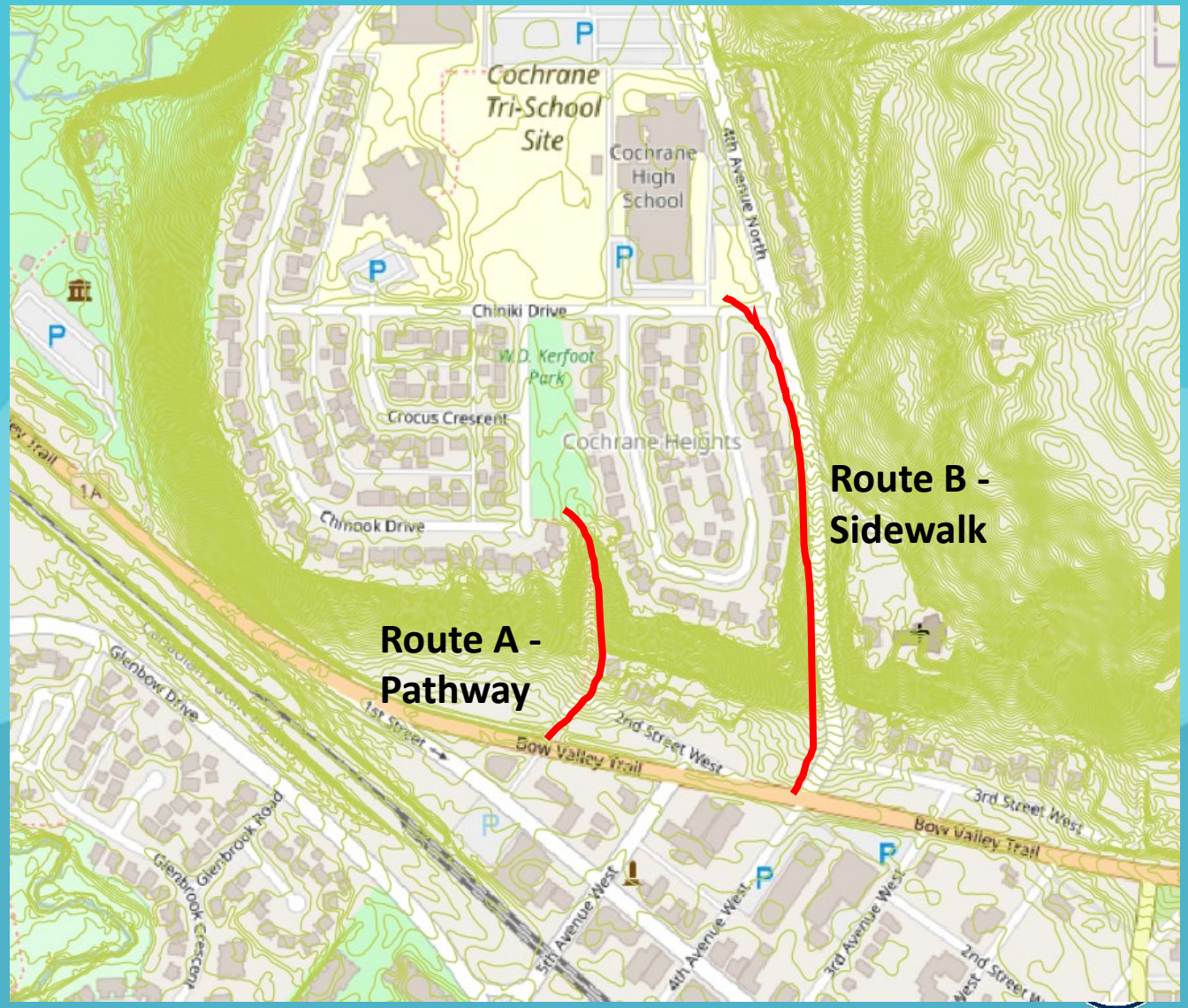
Wood Bridge to Riverview

Average grade – **9.8%**

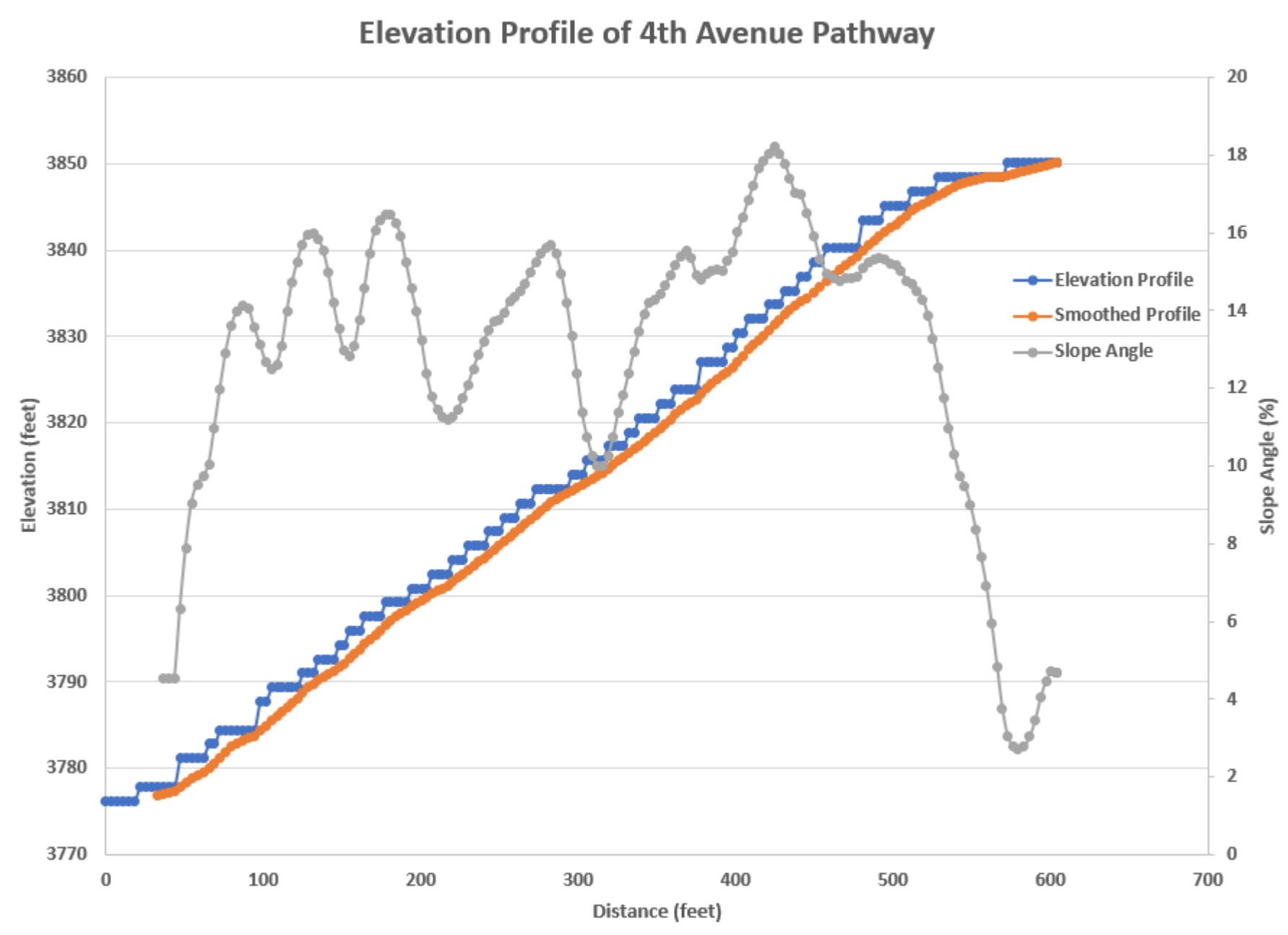


Tri Schools Area

- For kids to bike to Tri-Schools area (Elizabeth Barrett, Manachaban, Cochrane High) from anywhere other than Sunset, they need to use one of these two routes

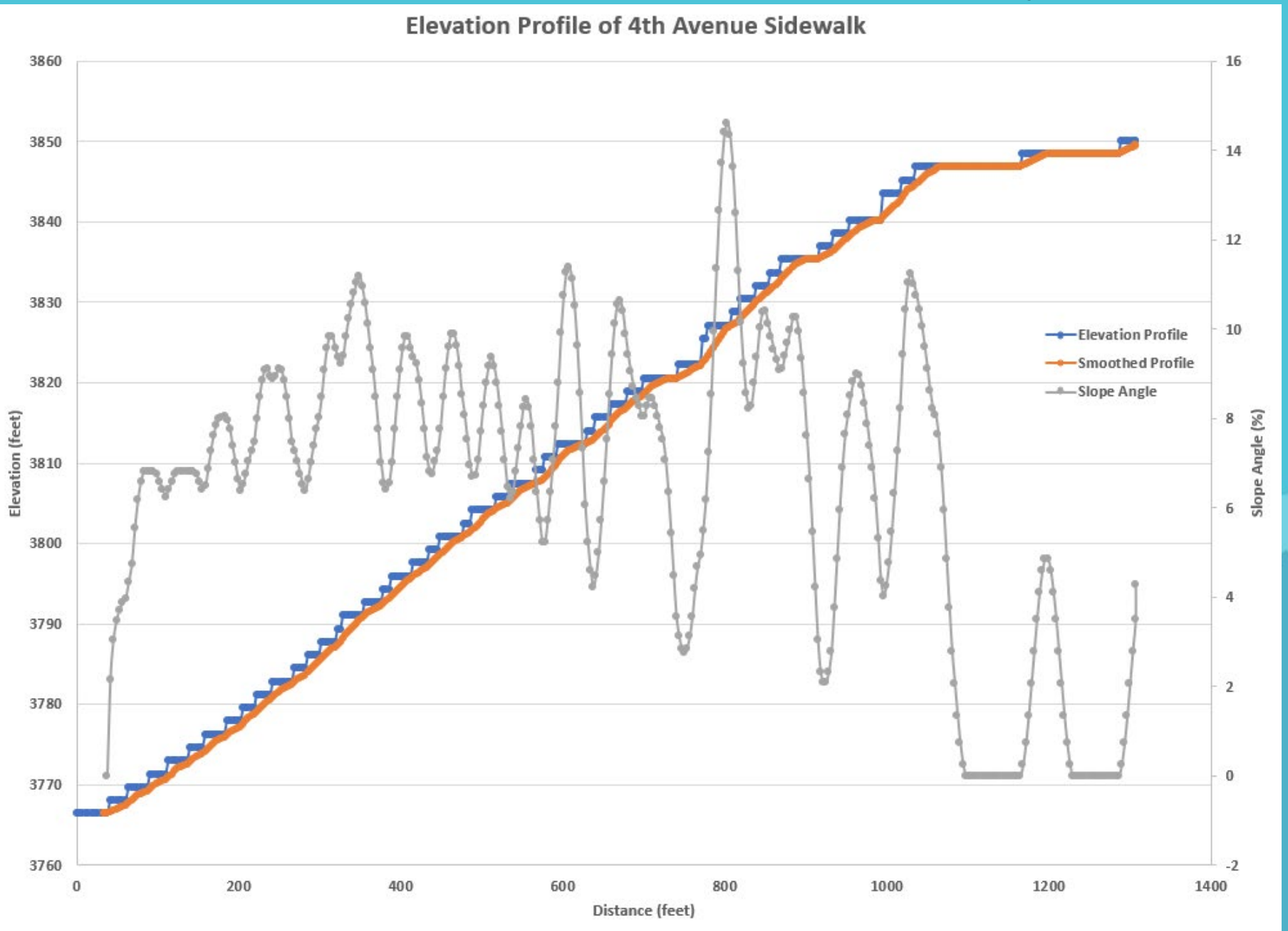


Route A - 4th Avenue pathway up to Tri-Schools



- Peak of 18% with mostly 10-16% grade
- **Average Grade 12.7%**
- City of Calgary pathway guidelines call out no more than 8%

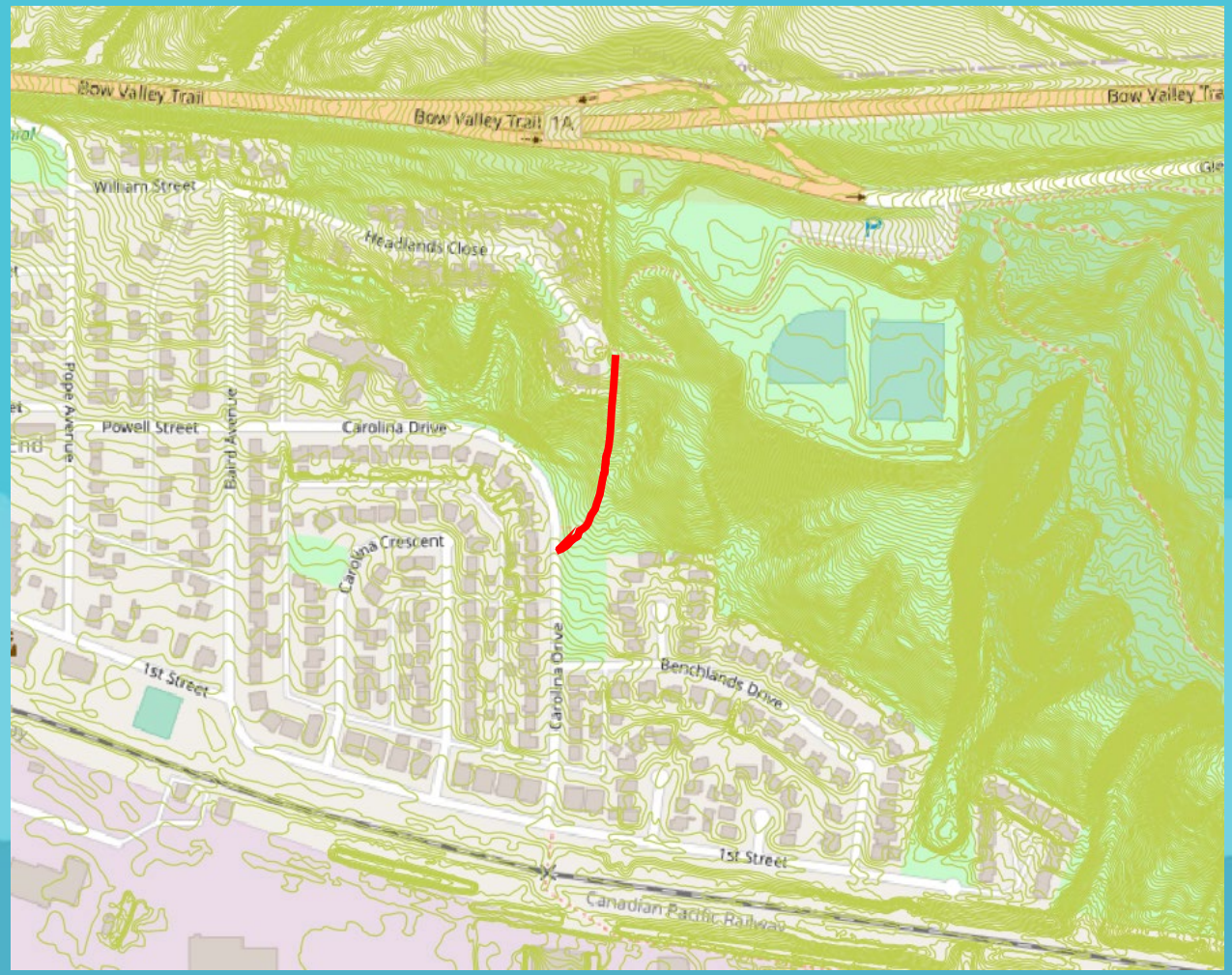
Route B - 4th Avenue Sidewalk up to Tri-Schools



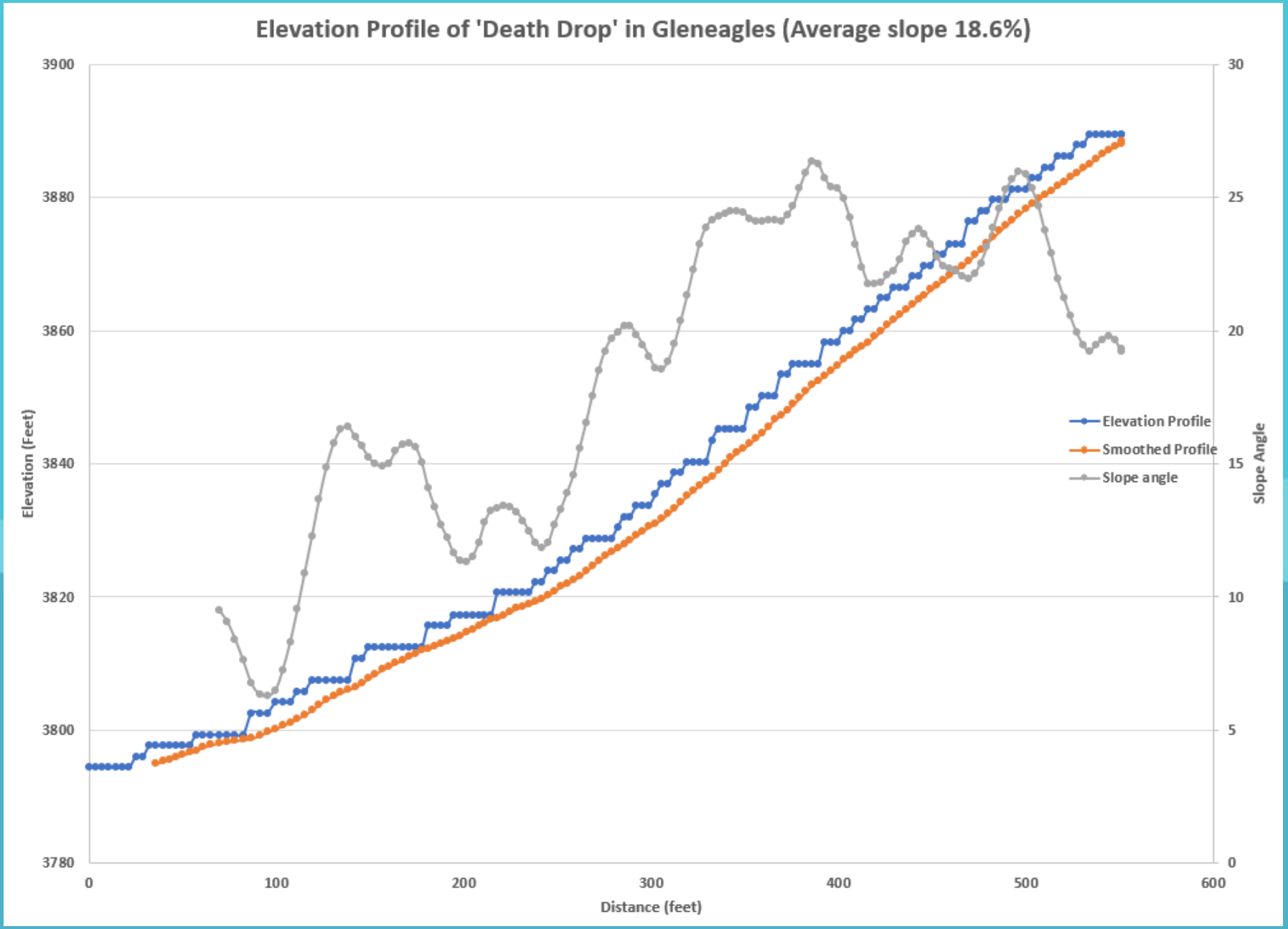
- Peak of 14% with mostly 6-10% grade
- **Average grade 6.5%**
- City of Calgary pathway guidelines call out no more than 8%

Gleneagles Hill

- Section of pathway from Gleneagles to East End (Carolina Drive)
- Called ‘Death Drop’ in Strava segments



Gleneagles Hill



- Peak of 26% with **18.6% average grade**
- City of Calgary pathway guidelines call out no more than 8%

Testing with Power Meters

Background

- Some of Cochrane's bike pathway network is **much steeper than what is useful and safe** for bikes, strollers, wheelchairs, and other users

- How does this affect users?

City of Calgary Guidelines*

6.1.2.6 Criteria for Bicycles

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REVISED!

6.1.2.1 Surface Materials and Pathway Widths

1) Regional and local pathways are hard-surfaced, typically of asphalt pavement, to accommodate multiple users.

REVISED!

2) Width shall be:
   a) 2.5 m minimum for local pathways.
   b) 3.0 m minimum for regional pathways, 2.5 m where constrained.
   c) 4.0 m minimum for river pathways, 3.5 m where constrained.
   d) 3.0 m minimum pedestrian pathways and 3.0 m minimum bicycle pathway for twinned pathways, 2.5 m where constrained.

Calgary Parks Development Guidelines 2020.pdf -
https://www.calgary.ca/content/dam/www/pda/pd/documents/urban-development/publications/landscape-2020.pdf

City of Vancouver guidelines*

Rule #9 **Keep grades below 3% as much as possible**

Local Street Bikeway

Protected Bike Lane

Off-Street Pathway

Steep hills can be very challenging, particularly for young riders, seniors, people who are new to cycling, and some people with disabilities. Most people can maintain a speed of 10 km/hr—a speed that helps to maintain balance—on a grade of 4% or less. Other research suggests a grade of 3% or less is desirable for longer distances. For grades between 4% and 8%, people are more likely to weave to maintain balance on a bike. At grades above 8%, speed drops to a point where many people have a hard time keeping their balance and have to dismount.[5]

Image: Chris and Melissa Brunklet

Some people have to weave to get up steeper hills

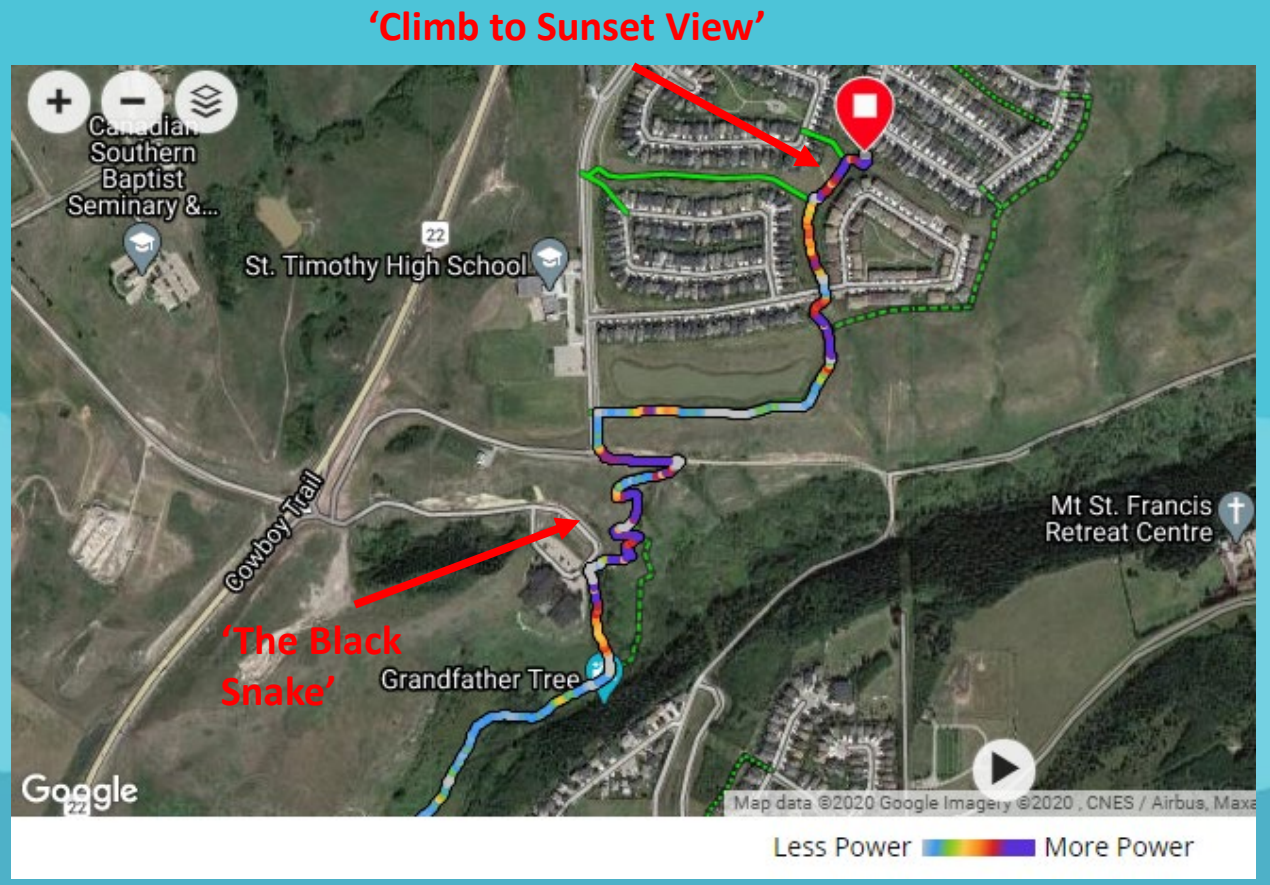
Considerations:

- For new bridges and ramps, start with concepts using a 3% grade. If the concepts are not feasible, grades up to 5% may be acceptable.
- Since it is not always possible or practical to avoid a hill, routes with grades up to 5% may be considered AAA and above 5% for short distances:
  - i. Less than 500m, for grades between 5% and 7% .
  - ii. Less than 150m (about a block), for grades between 7% and 8%
  - iii. Less than 30m, for grades above 8%.
- For routes with grades of 5% or higher:
  - i. Consider mitigation measures for people riding uphill, such as flat landings at regular intervals (-every 100m) for resting and a wider bike path to accommodate weaving.
  - ii. Consider mitigation measures for people riding downhill, including higher design speeds, improved sightlines, and other safety measures.
  - iii. Sign a flatter alternate route if possible.
  - iv. Identify hills on cycling route maps.

**** Vancouver design-guidelines-for-all-ages-and-abilities:*** https://vancouver.ca/files/cov/design-guidelines-for-all-ages-and-abilities-cycling-routes.pdf

Bike Cochrane testing of Cochrane's pathways

- Climbing from Ranche House to Sunset was tested using a set of Garmin Vector 3 Power Pedals
  - Measuring power exerted in Watts allows a sense of 'how hard is it' to bike
  - Competitive cyclists train using power rather than heart rate
- Tested with a mountain bike pulling a Chariot with a 40 lb 3 year old



Test setup

Standard 29 inch mountain bike (GT Karakoram)

MEC chariot stroller carrying 40 lbs of 3 year old

Tested in late December 2020

Power benchmarking to Pro Cyclists

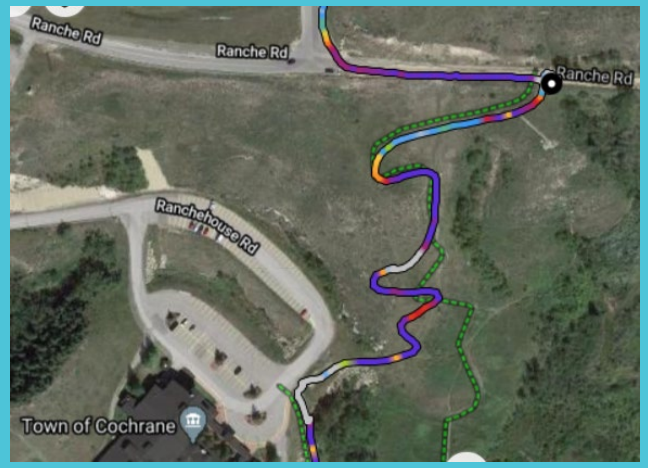
- Average Tour de France rider generates ~350-375W on big climbs*
  - Big climbs average >10% grade

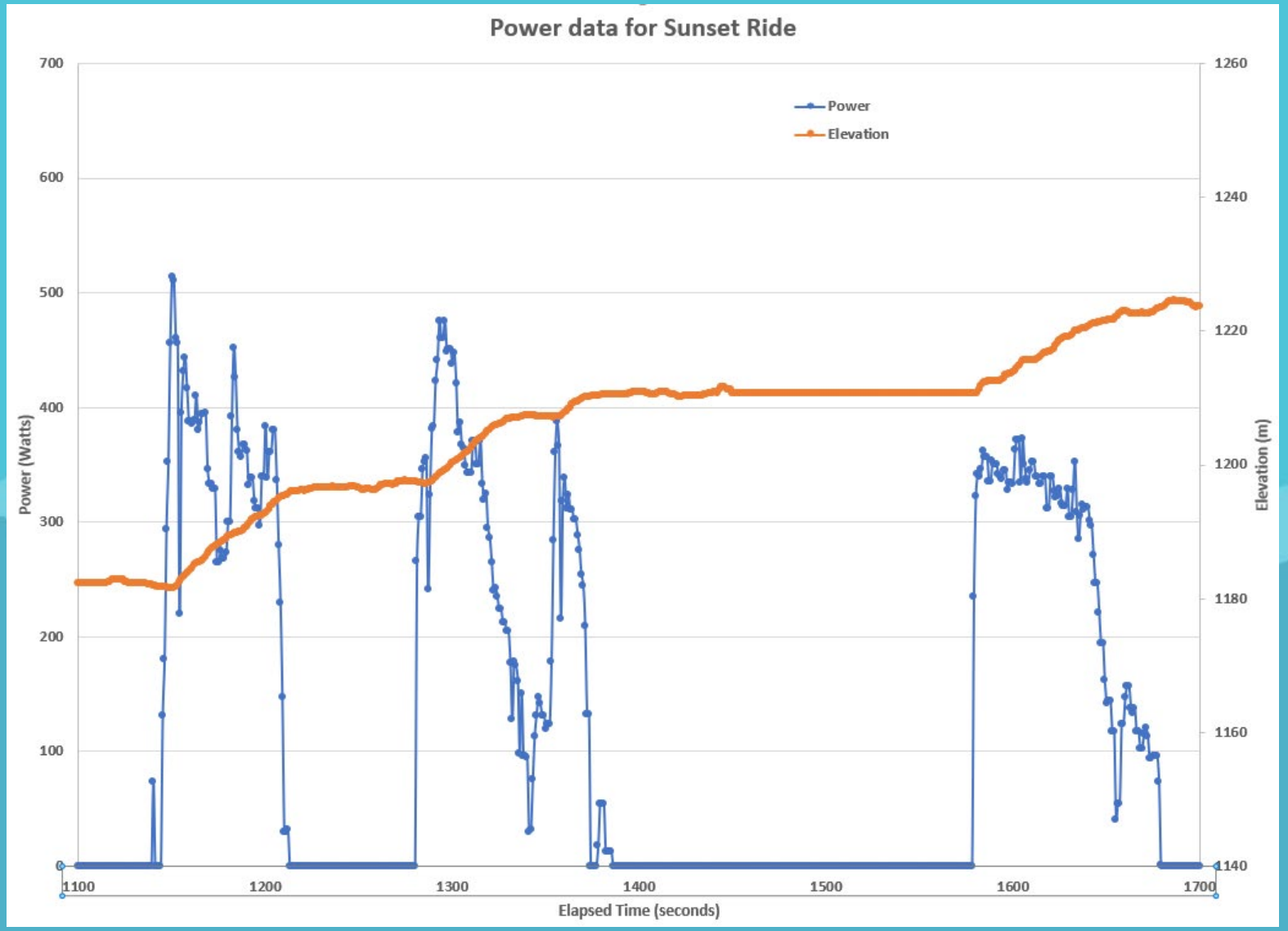
- An ordinary rider on the same hill climb averages ~175-200W*

Tim de Waele Getty Images

* Bicycling.com review of Tour Cyclists: https://www.bicycling.com/racing/a20037750/you-versus-a-tour-de-france-pro-cyclist/

Sunset – ‘The Black Snake’ segment





- **Peak power output 400-500W** with highest peak power at highest slope angles of pathway (range of **6-13%**)
- Pathway had been cleared of snow/ice
- Plotted power/elevation vs time

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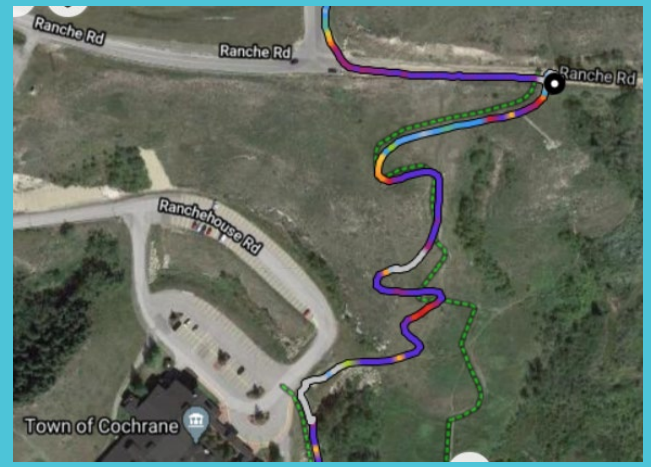

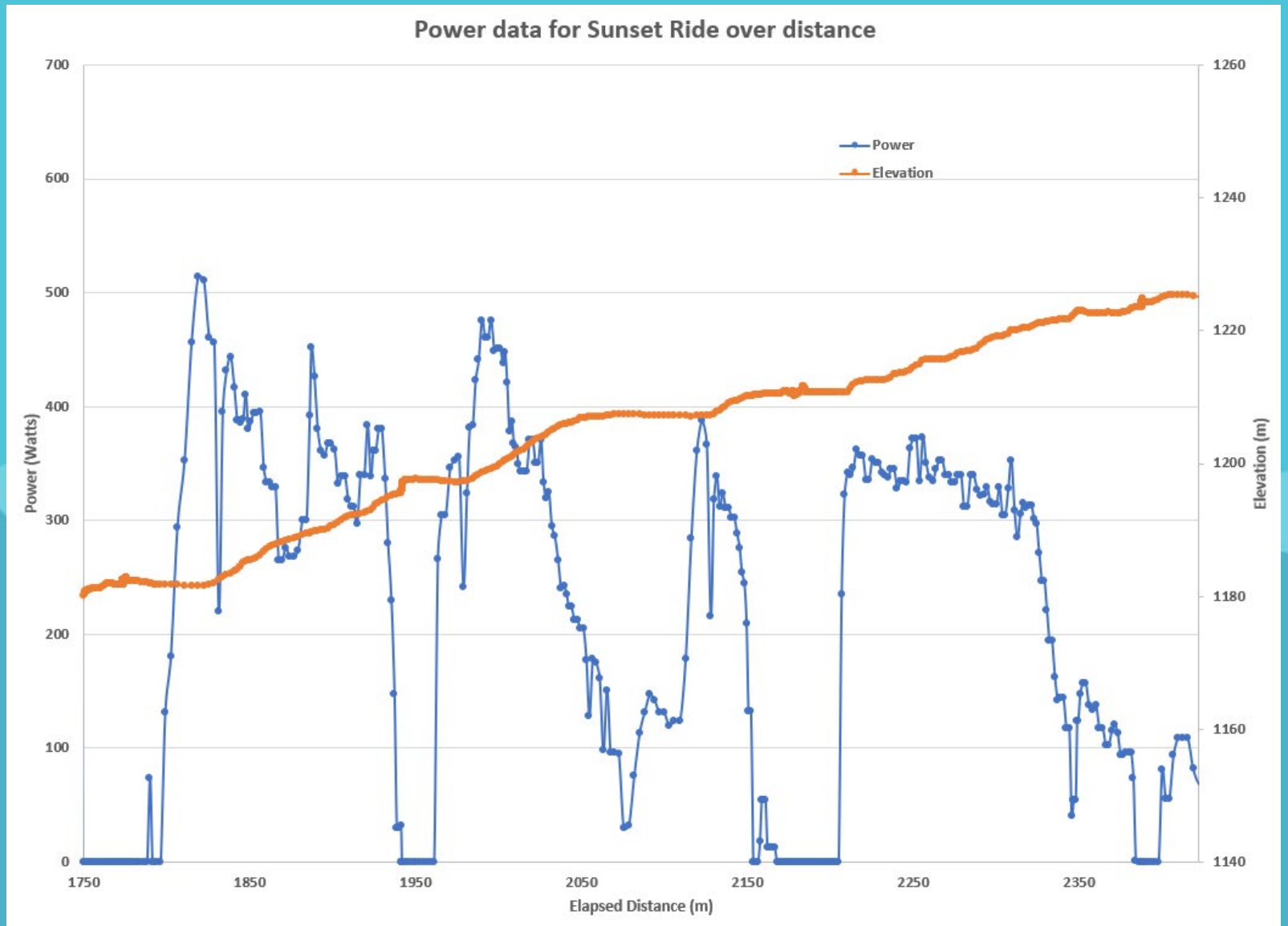

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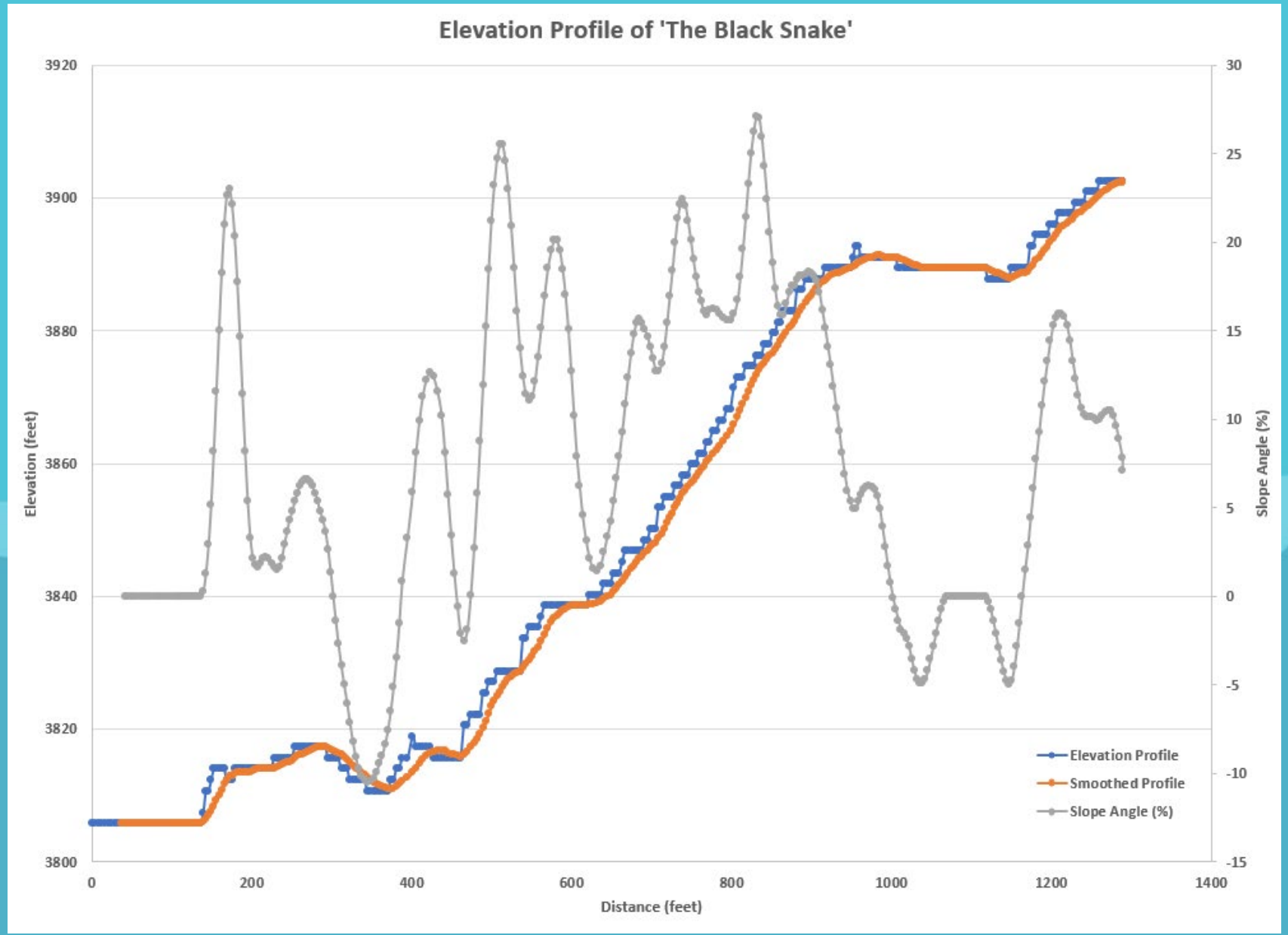
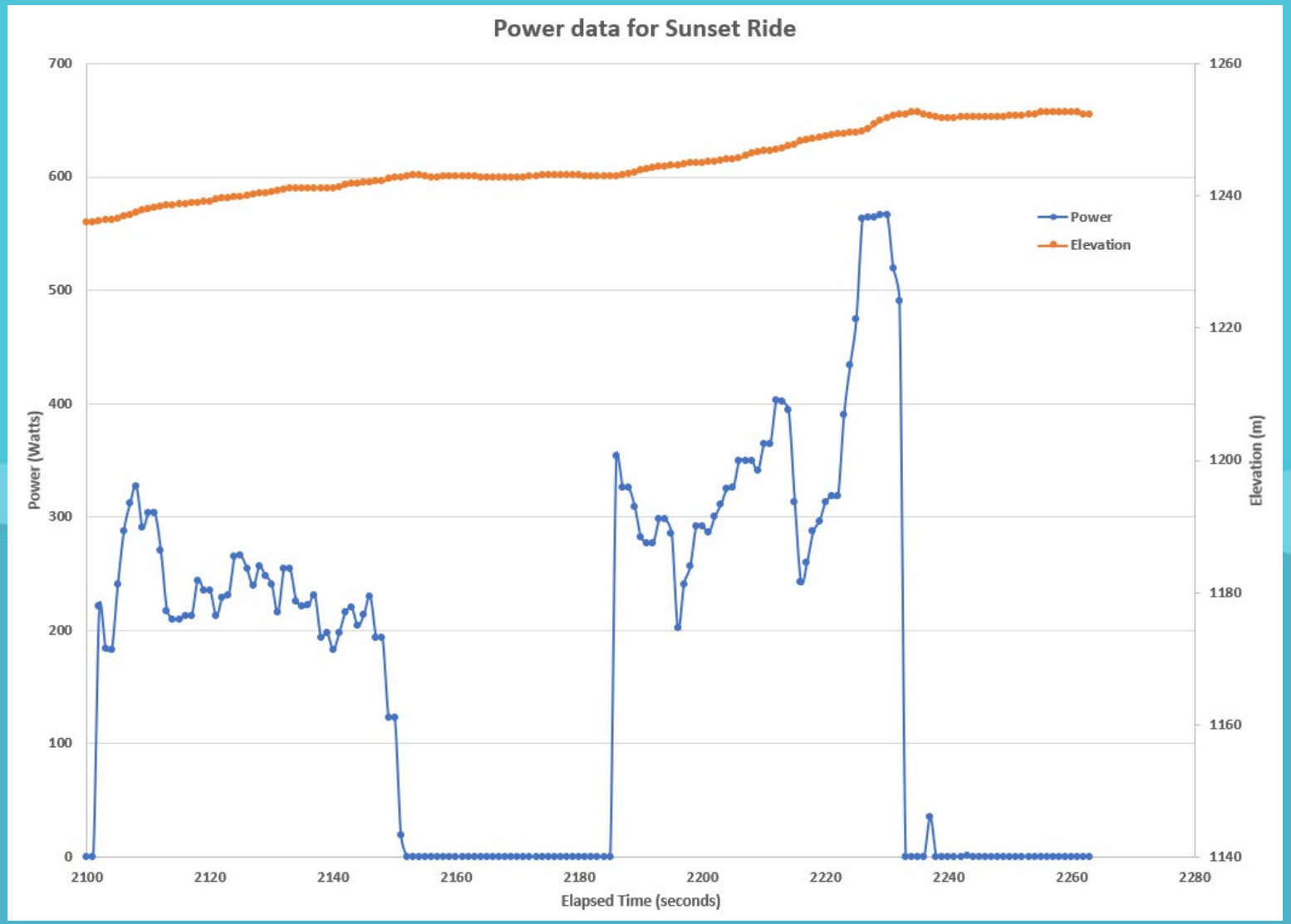
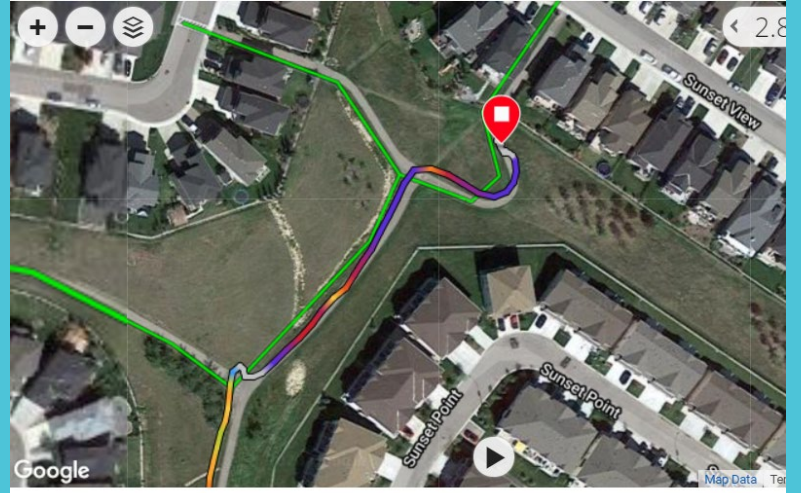
Sunset ‘The Black Snake’ on QGIS



- **Peak slope of 27%**
- **Average slope of 7.6%**

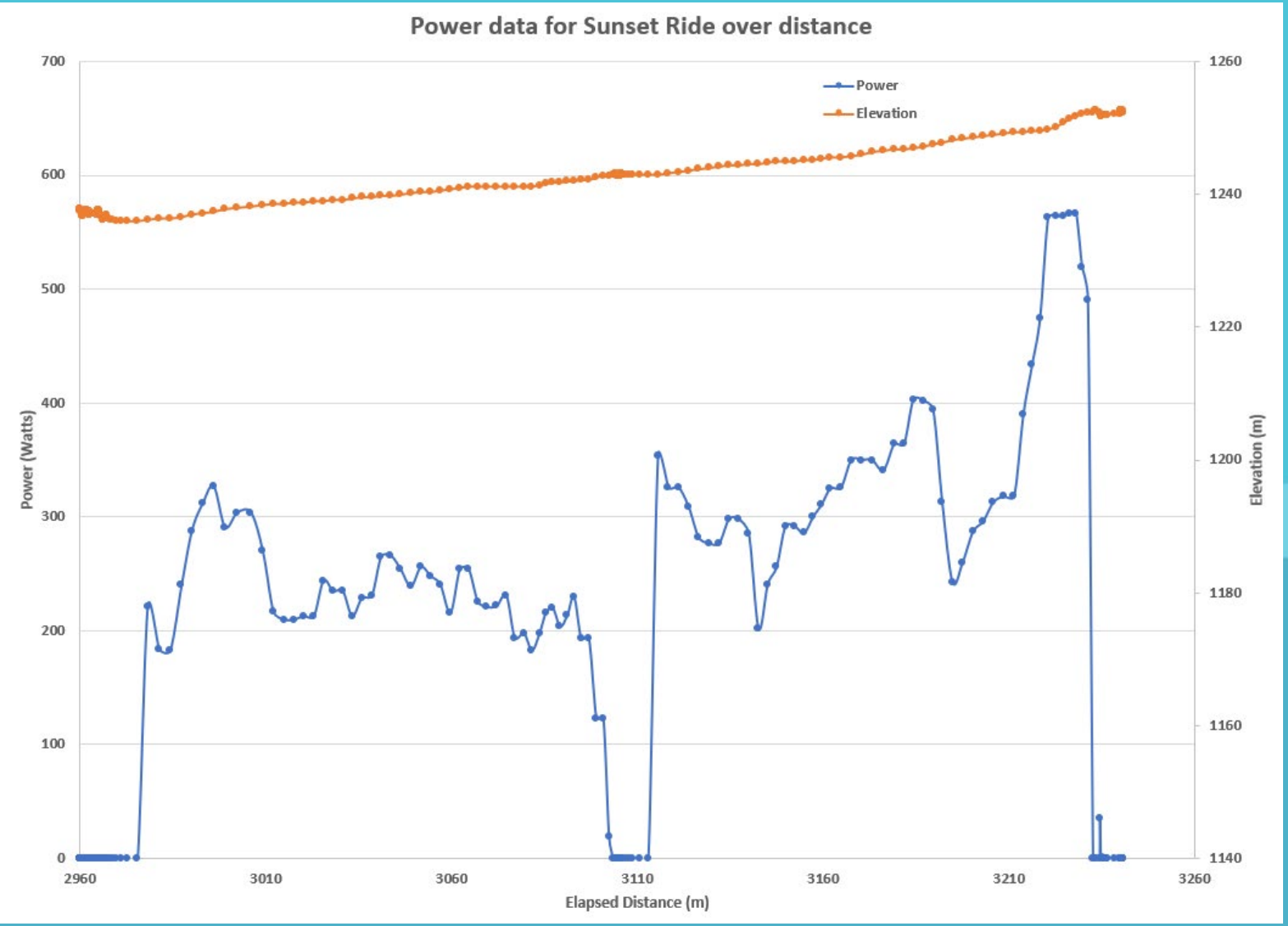
Sunset – ‘Climb to Sunset View’ segment

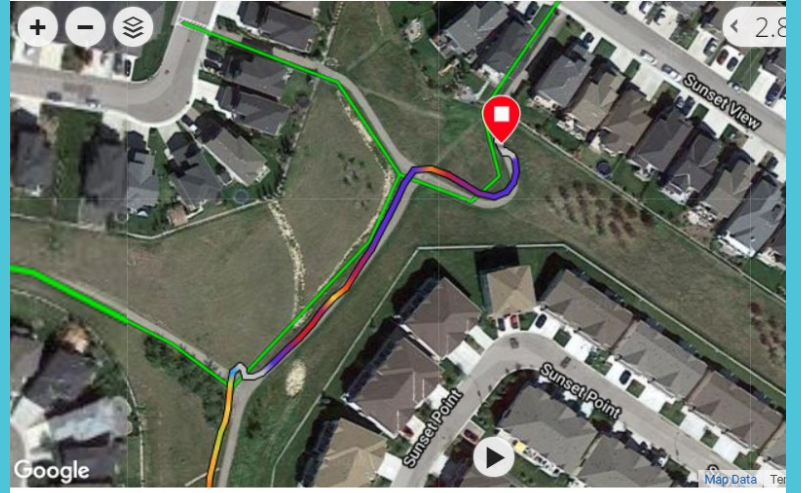




- **Peak power output 560W** with highest peak power at highest slope angles of pathway (**range of 6-20%**)
- Pathway had been cleared of snow/ice
- Activity didn’t complete as **Power Output BROKE the test bike** and sheared the metal derailleur hanger
- Plotted power/elevation vs time

Sunset – ‘Climb to Sunset View’ segment





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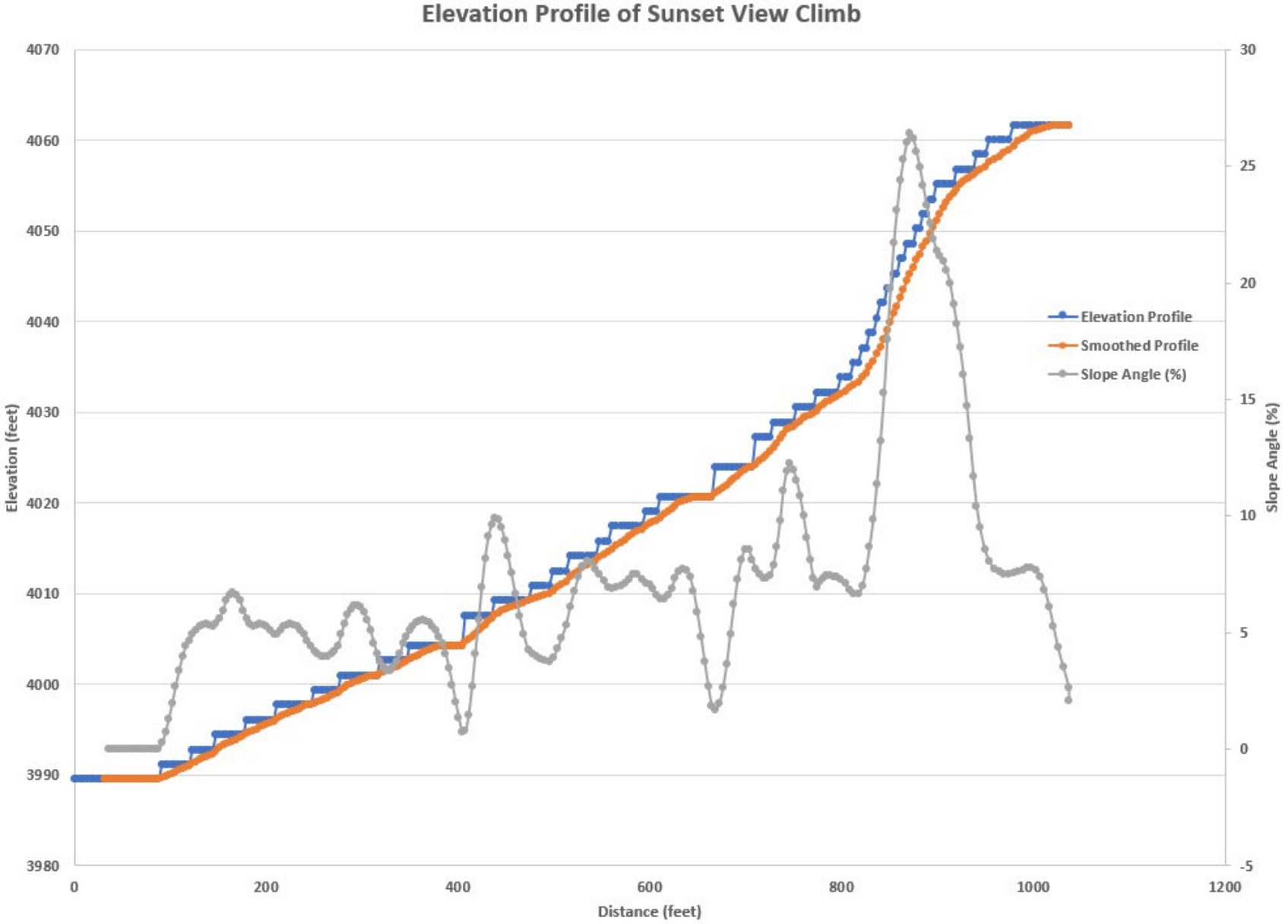

- **Peak slope of 26%**
- **Average slope of 7.2%** but hard finish to the climb

Results of Testing

- Snapped rear derailleur hanger on last section of climb to Sunset View
- Had to carry bike and trailer