NORTHERN TRANSCONTINENTAL RAILROAD MOUNTAIN PASSES

Western Mountain Grade Profiles

Doug Welsh, Canadian Pacific Railway, retired
The following grade profiles of the most northerly transcontinental North American railroads were prepared for a day-long presentation during the annual meeting of the Lexington Group in Transportation History, held in Calgary from September 29 to October 2, 2010.

The original six railroads, in chronological sequence of last spikes, were Northern Pacific, Canadian Pacific, Great Northern, Chicago, Milwaukee, St. Paul and Pacific, Grand Trunk Pacific, and Canadian Northern. Their successors in modern-day operations are Montana Rail Link (operating most of the former Northern Pacific), Canadian Pacific, BNSF Railway (operating the former Great Northern and the Stampede Pass route of Northern Pacific), and Canadian National (operating the former Grand Trunk Pacific and Canadian Northern). There are no contemporary operations of the majority of the Milwaukee Road’s western lines.

Information for all six historic railroads was displayed in a uniform format. Detailed profile data was collected from many sources, some of it pertaining to routes abandoned more than 100 years ago. The profile data was entered into a spreadsheet program from which graphical representations could be prepared. These were passed to Trains Magazine which generously gave their time to prepare illustrator-quality profile charts.

Because most of the northern transcontinental railroads have examples of 2.2 percent grades, the first set of profiles attempt to trace a historic link to the Baltimore and Ohio’s original route through the Allegheny Mountains (now part of CSX Transportation). This too is supported by spreadsheet analysis and Trains Magazine charting. The connection between the Baltimore and Ohio and the northern transcontinental railroads was explored more fully in the September 2011 issue of Trains magazine, for which some of these grade profiles were reproduced.

Having the dozens of profiles in a common spreadsheet format facilitated comparisons. Both intra-railway and inter-railway mountain pass profile comparisons were included.

All 58 Trains Magazine-prepared charts utilized in the conference are reproduced here.

The broad groupings are B&O background, NP, CP, GN, MILW, GTP/CNo, and inter-railway comparisons.

Finally, a few more observations about this fascinating exercise: Selection of endpoints for each grade is arbitrary. The general rule was where the gradient dropped consistently below 1%, but there are exceptions. This affects the values shown for Approximate Total Rise + Fall. Profile information for the following have not yet been located, and their charting is omitted or incomplete: NP Mullan Pass – temporary surface route; CP Rogers Pass – detailed profile data of the eastern and western approaches to the summit of the original surface route; MILW Pipestone and Snoqualmie passes – temporary surface routes.

In closing, your understanding is sought for the inevitable errors that creep into an analysis of this scope. Enjoy!

Doug Welsh, Canadian Pacific Railway, retired
## CONTENTS
Grade Profiles

### BALTIMORE AND OHIO

- Seventeen Mile Grade (Allegheny Mountains) ................. 1
- Cranberry, Cheat River, and Newburg grades (Allegheny Mountains) ................. 2

### NORTHERN PACIFIC

- Bozeman Pass (Belt Mountains) .............................. 8
- Mullan Pass (Rocky Mountains) ................................ 9
- Homestake Pass (Rocky Mountains) .......................... 12
- Evaro Hill (Coriacan Defile) ................................. 13
- Stampede Pass (Cascade Range) ............................... 14
- Current mountain grades compared .......................... 17

### CANADIAN PACIFIC

- Kicking Horse Pass (Rocky Mountains) ....................... 18
- Rogers Pass (Selkirk Range) .................................. 19
- Eagle Pass (Gold Range) ..................................... 28
- Notch Hill ...................................................... 36
- Albreda Summit (Columbia/Thompson drainage divide) .... 58
- Tete Jaune Cutoff ............................................. 59

### GREAT NORTHERN

- Marias Pass (Rocky Mountains) ............................ 39
- Stevens Pass (Cascade Range) ................................. 40
- Current mountain grades compared ......................... 48

### CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC

- Loweth Pass (Belt Mountains) .................................. 49
- Pipestone Pass (Rocky Mountains) ............................ 50
- St. Paul Pass (Bitterroot Mountains) ......................... 51
- Saddle Mountains .............................................. 52
- Snoqualmie Pass (Cascade Range) ....................... 53
- Current mountain grades compared ......................... 55

### GRAND TRUNK PACIFIC/CANADIAN NORTHERN (CN)

- Yellowhead Pass (Rocky Mountains) ......................... 56
- Abbreda Summit (Columbia/Thompson drainage divide) .... 58
- Tete Jaune Cutoff ............................................. 59

### INTER-RAILROAD COMPARISONS

- Crossings of the Great Divide ................................ 60
- Crossings of the Cascades, Selkirks, and Columbia/Thompson drainage divide ........ 61
- Abandoned surface routes .................................... 62
- Abandoned surface routes and first Cascade Tunnel route .... 63
- B&O Seventeen Mile Grade vs. NP Mullan Pass ............ 64
- Current mountain grades compared ......................... 65
Baltimore and Ohio Railroad
10.96 miles averaging 116.17 feet/mile (2.200%)
Summit 1,856 feet

Stations
- Independence
- Newburg
- (Austen)
- Murray Tunnel: daylighted 1911
- Rodemer Tunnel: daylighted 1911

Tunnels
- cranberry grade: avg 2.148%, max 2.5%
- cheat river grade: avg 2.024%, max 2.45%
- newburg grade: avg 2.021%, max 2.18%

McGuire Tunnel: daylighted 1911
Second Kingwood Tunnel: 1919, 4,202 feet
Terra Alta (Salt Lick)
Mutual descent into Tunnel Blaser
Rowlesburg Cheat River bridge
McMillan
Rodemer
BALTIMORE AND OHIO RAILROAD
ALLEGHENY MOUNTAINS, CRANBERRY/CHEAT RIVER/NEWBURG GRADIENTS

Newburg Grade
5.03 miles averaging 106.73 feet/mile (2.021%)

Cheat River Grade
4.16 miles averaging 106.87 feet/mile (2.024%)

Cranberry Grade
8.55 miles averaging 115.46 feet/mile (2.197%)
Northern Pacific Railway
NORTHERN PACIFIC RAILWAY
BELT MOUNTAINS, BOZEMAN PASS, MT

Summits 5,714, 5,562 feet

Abandoned surface route

Stations

Tunnels

Bozeman

Livingston

1.8% comp; avg 1.778%

LC 1908 reducing grade from 2.2% comp to 1.9% comp; double-tracked

Formerly DT, singletracked 1962

LC 1945 for Second Bozeman Tunnel

Daylighted 1952

1.9% comp; avg 1.496%

LC 1907 reducing grade from 2.2% comp to 1.8% comp; double-tracked

Formerly DT, singletracked 1962

Approximate total rise + fall:
via surface line
2,211 feet
via 1st Bozeman Tunnel
1,913 feet
via 2nd Bozeman Tunnel
1,907 feet

Northern Transcontinental Railroad Mountain Passes
Approx. total rise + fall: 2,125 feet
Northern Pacific Railway
Rocky Mountains, Great Divide, Homestake Pass

Elevation (feet per railroad records)

- Summit 6,325 feet
- LC 1954
- Mtn Tran
- Butte
- Skokes
- Highview
- Homestake
- Welch
- Spire Rock
- MRL lease
- ballast pit
- Pipestone
- Whitehall

Approx. total rise + fall: 2,838

LC 1956 eliminated Homestake Tunnel

Mostly 2.2% comp; avg 2.029%

2.2% comp; avg 2.011%
**NORTHERN PACIFIC RAILWAY**
**CORIACAN DEFILE, EVARO HILL, MT**

- **Summit:** 3,915 feet
- **Approx. total rise + fall:** 1,608 feet

**Elevation (feet per railroad records):**
- 2.2% comp; avg 1.980%
- 2.2% comp; avg 2.142%

**Stations:**
- Arlee (Schley)
- Evaro
- Desmet (Nagos)
NORTHERN PACIFIC RAILWAY
CASCADE RANGE, STAMPEDE PASS, SWITCHBACK ROUTE

- Summits at 3,678, 2,837 feet
- 1887 Switchback route
- 1888 Stampede Tunnel route

Elevation (feet per railroad records):
- 2,500
- 2,750
- 3,000
- 3,250
- 3,500
- 3,750

Tail track #1
- Max 5.6%; avg 5.050%

Tail track #2
- Max 5.2%; avg 4.987%

Tail track #3

Tail track #4

Tail track #5

Stampede Tunnel
- 841 ft
Canadian Pacific Railway
Day Tunnel
161 feet

1909 grade revision

-4.5% comp @ 0.03%/degree, avg -4.307%

-2.4% not corrected
Design Parameters:
2.2% compensated
Curves - 0.04%/degree
Curves in tunnels - 0.06%/degree
Tangents in tunnels - 0.02%

Upper Spiral Tunnel
10° left, 264°;
10° right, 61°
3,255 feet

Lower Spiral Tunnel
10° right, 262°
tangent
2,922 feet

Elevation (feet, per railroad records)
5,250 -
5,000 -
4,750 -
4,500 -
4,250 -
4,250 135 134 133 132 131 130 129 128 127 126 125 124

Day Tunnel
3rd 1909 Tunnel
Cathedral
Common point
3.992 miles

Partridge
Yoho

1884-1909 abandoned Big Hill
Stations
Tunnels

1909 Spiral Tunnels grade vision
Summit 5,298 feet

1884–1909 Profile

1981  1% grade revision - WB trains

1884-1909 abandoned Big Hill

Stations 2010

Tunnels

Field

Cathedral

Yoho

Partridge

Stephen

Divide

Lake Louise

Elevation (feet per railroad records)

Approx. total rise+fall: 1,551 feet
Northern Transcontinental Railroad Mountain Passes

**CANADIAN PACIFIC RAILWAY**
**COLUMBIA MOUNTAIN GROUP, SELKIRK RANGE, ROGERS PASS**

- **Summit**: 4,298 feet
- **1885-1916 profile**
- **Stations**:
  - Rogers Pass
  - Hermit
  - Bear Creek
  - Mountain Creek
  - Sturdee
  - Griffith
  - Six Mile Creek
  - Beavermouth
- **Bridges**:
  - Stoney Creek Bridge
  - Surprise Creek Bridge
  - Mountain Creek Bridge
  - Rogers Pass
  - Hermit

**Elevation (feet per railroad records)**
- 2,000
- 2,250
- 2,500
- 2,750
- 3,000
- 3,250
- 3,500
- 3,750
- 4,000
- 4,250
- 4,500

**Cambie**
- 2.2% comp; avg 2.083%

**Ross Peak**
- 2.2% comp; avg 2.081%

**Flat Creek**
- 2.2% comp; avg 2.107%

**Illecillewaet**
- 2.2% comp; avg 1.896%

**Downie**
- 2.2% comp; avg 1.799%

**Albert Canyon**
- Avg 1.493%
Summit 4,298 feet
1885-1916 surface route

Stations
Snowsheds under 1,500 feet
Snowsheds over 1,500 feet
Bridges

CANADIAN PACIFIC RAILWAY
ROGERS PASS, SURFACE ROUTE 1885–1916

Elevation (feet per railroad records)

Stoney Creek Bridge
Glacier
Rogers Pass
Hermit
Bear Creek
Stoney Creek Bridge

Summit 4,298 feet
1885-1916 surface route
Stations
Snowsheds under 1,500 feet
Snowsheds over 1,500 feet
Bridges
Summits 4,298, 3,745 feet
1885-1916 abandoned surface route
1916 Connaught Tunnel route
Stations (1955)
Tunnels
Bridges
Summits 4,298, 3,745 feet

1885-1916 abandoned surface route

1916-1974 profile

Stations - 1955

Tunnels

CANADIAN PACIFIC RAILWAY
ROGERS PASS, 1916–1974 PROFILE

Elevation (feet per railroad records)

Common point

Glacier

Ross Peak

Stoney Creek

Connaught Tunnel

5.03 miles

Cutbank

Sturdee

Griffith

Rogers (Six Mile Creek)

Beavermouth

Albert Canyon

Downie

Illecillewaet

Flat Creek

Ross Peak

2.2% comp

2.2% comp

2.2% comp

1.0%

1.0%
CANADIAN PACIFIC RAILWAY
ROGERS PASS, 1974 BEAVERMOUTH LINE CHANGE

Elevation (feet per railroad records)

1885-1974 abandoned due to Mica Dam

Stations

Avg 0.760%
Avg 1.537%
CANADIAN PACIFIC RAILWAY
ROGERS PASS, 1974-1988 PROFILE

Summits 4,298, 3,745 feet
1885-1916 abandoned surface line
1885-1974 abandoned Beavermouth line
1974–1988 profile

Stations
Tunnels

Elevation (feet per railroad records)

1885 LC 1974 1885 LC 1916

2,250 2,500 2,750 3,000 3,250 3,500 3,750 4,000 4,250 4,500

2.2% comp

2.2% comp

2.2% comp

2.2% comp

Albert Canyon
Downie
Illecillewaet
Flat Creek
Ross Peak
Stoney Creek
Sturdee
Griffith
Common point
Connaught Tunnel 5.03 miles

Rogers (Six Mile Creek)
Beavermouth

Northern Transcontinental Railroad Mountain Passes
Summits 4,298, 3,745, 3,462 feet
1885-1916 abandoned surface route
1885-1974 abandoned Beavermouth line
Connaught track, EB trains
Macdonald track, WB trains
Stations
Tunnels

CANADIAN PACIFIC RAILWAY
ROGERS PASS, 1988+ PROFILE

Elevation (feet per railroad records)

Approximate total rise + fall: via surface line 3,978 feet
via Connaught Track 2,872 feet
via Macdonald Track 2,306 feet
CANADIAN PACIFIC RAILWAY
SHUSWAP LAKES, NOTCH HILL GRADE REVISION

Elevation (feet per railroad records)

Common point
2.02 miles

Notch Hill

Avg 1.12%,
max 1.6%

1% WB 1980

1,100
1,200
1,300
1,400
1,500
1,600
1,700

82 80 78 76 74 72 70 68

1885 profile - EB trains - Avg 1.12%, max 1.6%
1980 1% grade revision - WB trains
Stations

Northern Transcontinental Railroad Mountain Passes
Great Northern Railway
GREAT NORTHERN RAILWAY
ROCKY MOUNTAINS, MARIAS PASS, 1891

Approx. total rise + fall: 1,800 feet

Elevation (feet per railroad records)

| Summit 5,215 feet | 1.1% comp; avg 1.072% |
| 1.0% comp; avg 0.895% |
| 1.8% comp; avg 1.678% |

Middle Fork Flathead River (778 feet long, 150 feet high)
Sheep Creek (464 feet long, 117 feet high)

Double-tracked 1923
Double-tracked 1924

BNSF true mileposts

Essex
Java West
Java East
Blacktail

West Bison
East Bison
Glacier Park
West

Stations
Bridges
Snowsheds
**GREAT NORTHERN RAILWAY**
**CASCADE RANGE, STEVENS PASS, 1893-1900**

- **Summit**: 4,027 feet
- **1893–1900 profile**
- **Stations**
  - Drury
  - Tumwater Dam
  - Tumwater
  - Powerhouse
  - Cleaverworth
  - Peshastin
  - Madison
  - Corea
  - Embro
  - Wellington
  - Skykomish
- **Tunnels**
  - Nason Creek
  - Cascade Tunnel
- **Major bridges**
  - Last Spike
  - Tonga
- **Snowsheds (1894)**

**Elevation (feet per railroad records)**
- 750
- 1,000
- 1,250
- 1,500
- 1,750
- 2,000
- 2,250
- 2,500
- 2,750
- 3,000
- 3,250
- 3,500
- 3,750
- 4,000
- 4,250

**BNSF true mileposts**
- 1,665
- 1,705
- 1,715
- 1,695
- 1,735
- 1,725
- 1,715
- 1,705
- 1,695
- 1,685
- 1,675
- 1,665

**Switchback surface route**
- max 4.0%; avg 3.28%
- 2.2% comp; avg 2.065%

**Switchback surface route**
- max 3.5%; avg 2.72%

**Switchback surface route**
- max 4.0%; avg 3.28%
- 2.2% comp; avg 2.024%
GREAT NORTHERN RAILWAY
STEVENS PASS, 1893-1900, SWITCHBACK SURFACE ROUTE

- Summits 4,027, 3,350 feet
- 1893–1900 switchback surface route
- 1893 2.2% approaches
- 1900 First Cascade Tunnel route
- Stations
- Tunnels
- Snowsheds (1894)

Elevation equation: 3313.34 W = 3345.76 E

- 1900, First Cascade Tunnel
  - 13,183 feet, 1.695%
  - 342-foot extension
  - 349-foot extension

- West slope
  - Max 4.0%; avg 3.278%
- East slope
  - Max 3.5%; avg 2.720%

Common point: 6.865 miles

Wellington (Tye after 1910)

BNSF true mileposts

Elevation (feet per railroad records)
Summits 4,027, 3,350 feet
1893–1900 abandoned switchback surface route
1900–1929 profile using First Cascade Tunnel
First Cascade Tunnel, 2.6 miles

- Stations
- Major bridges
- Snowsheds (1894)

Summits 4,027, 3,350 feet
1893–1900 abandoned switchback surface route
1900–1929 profile using First Cascade Tunnel
First Cascade Tunnel, 2.6 miles

- Stations
- Major bridges
- Snowsheds (1894)
GREAT NORTHERN RAILWAY
CASCADE RANGE, STEVENS PASS, 1928 CHUMSTICK LINE CHANGE

Elevation (feet per railroad records)

Winton (new)
Winton (old)
Winton Tunnel (4,059 feet, 0.82%)
Chiwaukum
Chumstick Tunnel (2,601 feet, 1.53%)
Drury
Tumwater Dam
1.6 comp; avg 1.544%
2.2% comp; avg 2.151%
1.245 miles

BNSF true mileposts

Common point
Winton Tunnel (Plains)
Chumstick Tunnel (Chumstick)
Powerhouse
Leavenworth
Peshastin
Leavenworth
Winton Tunnel (4,059 feet, 0.82%)
Chiwaukum
Drury
Tumwater Dam
1.6 comp; avg 1.544%
2.2% comp; avg 2.151%
1.245 miles

1,000 1,050 1,100 1,150 1,200 1,250 1,300 1,350 1,400 1,450 1,500 1,550 1,600 1,650 1,700 1,750 1,800 1,850 1,900 1,950 2,000 2,050 2,100 2,150 2,200 2,250

Northern Transcontinental Railroad Mountain Passes
Summit 2,894 feet

1893–1900 abandoned switchback surface route
1900–1929 abandoned First Cascade Tunnel route
1929–present Second Cascade Tunnel route

Stations

Tunnels

Snowsheds (1894)

Bridges

#7
#5, #6
#4
#3
#2a, 2b
#1

Wellington/Tye

First Cascade Tunnel, overall 2.63 miles, 1.695%

Second Cascade Tunnel, 7.79 miles, 1.57%

Martin Creek Tunnel, 1,492 feet
Martin Creek bridges

Corea

Tye River bridge

Scenic (old)

Scenic (new)

Elevation equation

BNSF true mileposts using first Cascade Tunnel

Elevation (feet per railroad records)
Summits 4,027, 3,350, 2,894 feet

1893–1900 abandoned surface switchback line

1893–1928 abandoned Tumwater Canyon route

1900–1929 abandoned Frst Cascade Tunnel line

1929–present using Second Cascade Tunnel

Stations

Tunnels

Approximate total rise + fall: via surface line 6,081 feet
via 1st Cascade Tunnel 4,590 feet
via 2nd Cascade Tunnel 3,816 feet

2.2% comp; avg 2.069%

2.2% comp; avg 2.101%

First Cascade Tunnel overall 2.623 miles, 1.695%

Common point 6.865 miles

Common point 8.961 miles

Elevation equation

2044.35 W = 2080.7 E (+0.815 miles)

GREAT NORTHERN RAILWAY
CASCADE RANGE, STEVENS PASS
GREAT NORTHERN RAILWAY
COMPARISON OF MOUNTAIN PASSES

Elevation (feet per railroad records)

-2,250 -2,000 -1,750 -1,500 -1,250 -1,000 -750 -500 -250 0

Marias Pass
Rocky Mountains

Stevens Pass
Cascade Range

1.6% comp
2.2% comp
2.2% comp
1.8% comp
1.57% comp

West of summit Miles East of summit
Chicago, Milwaukee, St. Paul and Pacific Railroad
Northern Transcontinental Railroad Mountain Passes

Butte Yd

Blacktail Tunnel 1

Blacktail Tunnel 2

Penfield

Donald

Pipestone Pass Tunnel

Newcomb

Janney

Grace

Fish Creek Tunnel

Cedric

(Vendome)

Piedmont

Approx. total rise + fall: 2,892

Elevation (feet per railroad records)

1,480 1,485 1,490 1,495 1,500 1,505 1,510 1,515 1,520 1,525

4,000 4,250 4,500 4,750 5,000 5,250 5,500 5,750 6,000 6,250 6,500 6,750

1.66% comp; avg 1.505%

2.00% comp; avg 1.87%

Summit 6,347 feet

CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC RAILROAD
ROCKY MOUNTAINS, GREAT DIVIDE, PIPESTONE PASS

2.00% comp; avg 1.87%

1.66% comp; avg 1.505%

Constructed 1908

Substations

Stations

Tunnels
CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC RAILROAD
ROCKY MOUNTAINS, BITTERROOT RANGE, ST. PAUL PASS

- Avery
- Stetson
- Kyle
- Falcon
- Adair
- Roland
- Bryson
- Saltese
- Haugan

Elevation (feet per railroad records)

- 1.50% and 1.65% comp; avg 1.493%
- 1.70% comp; avg 1.493%
- 1.70% comp; avg 1.534%

Approx. total rise + fall: 2,794

Summit 4,170 feet

St Paul Pass Tunnel

Constructed 1909
Northern Transcontinental Railroad Mountain Passes

Elevation (feet per railroad records)

- Kittitas
- East Kittitas
- Bolyston (Cheviot)
- Rye (Beverly)
- Doris
- Johnson Creek Tunnel #45

Approx. total rise + fall: 2,774

Summit 2,460 feet

1.60% comp; avg 1.560%

2.20% comp; avg 2.186%

Constructed 1908
CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC RAILROAD
COMPARISON OF MOUNTAIN GRADES

- Snoqualmie Pass, Cascade Range
- St Paul Pass, Bitterroot Mountains
- Loweth, Belt Mountains
- Pipestone Pass, Rocky Mountains
- 22% compensated

Miles

25 20 15 10 5 0 5 10 15 20 25

Feet below summit

0 250 500 750 1,000 1,250 1,500 1,750 2,000 2,250

West of summit

Northern Transcontinental Railroad Mountain Passes
Grand Trunk Pacific Railway, Canadian Northern Railway (CN)
Northern Transcontinental Railroad Mountain Passes

Legacy Grand Trunk Pacific 1912
Legacy Canadian Northern 1915
Stations
Tunnel, 315 feet
Summit 3,718 feet

Approx. total rise + fall, Jasper-Grant Brook: 516 feet

Elevation (feet per railroad records)

-0.4% slope
-2.2% slope
+2.2% slope
+0.4% slope

0510152025303540

Jasper
Wynd
Geike
Decolone
Lucerne
Fitzwilliam
Grant Brook
Yellowhead

CANADIAN NATIONAL RAILWAY
ROCKY MOUNTAINS, GREAT DIVIDE, YELLOWHEAD PASS
Stations:
- Summit 2,866 feet
- Lempriere
- Clemina West
- Clemina East
- Albreda
- Canoe River
- Canoe River bridge (624 feet)
- Valemont

Elevation (feet per railroad records):
- Avg 0.321%
- Avg 0.579%
- 1.014%
Legacy GTP 1912 from Prince Rupert - Higher gradient route
Legacy CNo 1915 from Vancouver - Portion of lower gradient route
Legacy CN 1983 connects GTP and CNo forming lower gradient route

Stations: Lubin, Spicer, Morey, Taverna

Elevation (feet per railroad records):
- 2,450
- 2,550
- 2,650
- 2,750
- 2,850
- 2,950
- 3,050
- 3,150
- 3,250
- 3,350
- 3,450

Avg 0.607%
Avg 0.924%

14.48 miles
1,216 feet, plus attached snowsheds 148 and 288 feet
361 feet

332 feet

Red Pass

Inter-railroad comparisons
### Northern Transcontinental Railroads
### Abandoned Summit Lines, Surface Routes

<table>
<thead>
<tr>
<th>Railroad</th>
<th>Mountain Range</th>
<th>Pass</th>
<th>Elevation (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP</td>
<td>Belt Mountains</td>
<td>Bozeman Pass</td>
<td>-1250</td>
</tr>
<tr>
<td>NP</td>
<td>Cascade Range</td>
<td>Stampede Pass</td>
<td>-1000</td>
</tr>
<tr>
<td>CP</td>
<td>Selkirk Mountains</td>
<td>Rogers Pass</td>
<td>-750</td>
</tr>
<tr>
<td>GN</td>
<td>Cascade Range</td>
<td>Stevens Pass surface route</td>
<td>-500</td>
</tr>
</tbody>
</table>

#### Graph:
- **NP, Belt Mountains, Bozeman Pass:** Max 4%
- **NP, Cascade Range, Stampede Pass:** Max 4%
- **CP, Selkirk Mountains, Rogers Pass:** Max 5.6%
- **GN, Cascade Range, Stevens Pass surface route:** Max 3.5%
NORTHERN TRANSCONTINENTAL RAILROADS
ABANDONED SUMMIT LINES, SURFACE ROUTES AND FIRST CASCADE TUNNEL ROUTE

<table>
<thead>
<tr>
<th>Elevation (feet per railroad records)</th>
<th>West of summit (Miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2,250</td>
<td>0</td>
</tr>
<tr>
<td>-2,000</td>
<td>2</td>
</tr>
<tr>
<td>-1,750</td>
<td>4</td>
</tr>
<tr>
<td>-1,500</td>
<td>6</td>
</tr>
<tr>
<td>-1,250</td>
<td>8</td>
</tr>
<tr>
<td>-1,000</td>
<td>10</td>
</tr>
<tr>
<td>-750</td>
<td>12</td>
</tr>
<tr>
<td>-500</td>
<td>14</td>
</tr>
<tr>
<td>-250</td>
<td>16</td>
</tr>
</tbody>
</table>

- GN, Cascade Range, Stampede Pass
- NP, Cascade Range, Stampede Pass
- CP, Selkirk Mountains, Rogers Pass
- NP, Belt Mountains, Bozeman Pass

GN, Stevens Pass, first Cascade Tunnel approaches

2.2% comp
B&O 17-MILE GRADE VS. NP MULLAN PASS
2.2% AVERAGE VS. 2.2% COMPENSATED

Elevation (feet per railroad records)

<table>
<thead>
<tr>
<th>East of summit</th>
<th>Miles</th>
<th>-2,000</th>
<th>-1,750</th>
<th>-1,500</th>
<th>-1,250</th>
<th>-1,000</th>
<th>-750</th>
<th>-500</th>
<th>-250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helena</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piedmont</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- NP Mullan Pass east slope, 2.2% compensated
- B&O 17-Mile Grade
- B&O 11-mile segment averaging 2.2%
- Stations