WIRELESS BROADBAND

Supplemental Broadband Solution

Our Public Power: The Next Generation

April 3, 2017

NO BOARD ACTION REQUESTED

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CHELAN COUNTY
POWER
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WHY ARE WE HERE?

- Follow-up on our 2015 Strategic Planning recommendation to research viable alternative broadband technologies
- Specifically, to review cost and quality of service from wireless broadband for consideration in serving areas that were previously declared as too expensive to serve with fiber
- Seek guidance from the Board on next steps

WHAT WE WILL COVER

- Fixed Wireless technology for Broadband application
- Wireless operating considerations
- What we learned from the Wireless “Proof of Concept,” including an example build
  - Capital and Operating considerations
- Conclusion – Wireless is not a good alternative to fiber

BROADBAND BASICS

- Federal Communication Commission (FCC) defines Broadband as download speeds of 25 Mbps and upload speeds of 3 Mbps
  - District's fiber to the home download speeds up to 1Gbps
    - Capacity for even higher speeds
  - Wireless retail service providers advertise speeds up to 100 Mbps
  - Cellular (mobile)
    - 4G-LTE speeds of 5-12 Mbps average
    - 5G 100 Mbps with real world speeds of 40-50 Mbps

BROADBAND BASICS (con't)

- User Experience:
  - Not dependent on how broadband is delivered
  - Maximum, peak, average, actual, download, upload, and up-to speeds
  - What does it all mean, does it matter?
    - What matters, is the customer perceives the service fulfills their needs

BROADBAND CHARACTERISTICS

- Bandwidth demand expectations:
  - Cisco predicts video traffic will be 82 percent of residential traffic by 2020. Much of this video is going to come from cell phones (but will still use landline WiFi networks)
  - Web browsing and email use is less bandwidth demanding than video
    - Can tolerate some disruption in the delivery of the signal
  - Video is very bandwidth demanding. Requires a high quality, constant stream of data, and lots of it
    - Will not tolerate disruptions or delays in the delivery of data

WIRELESS COMPARED TO FIBER

- It's all about the signal quality across the system:
  - FTTH uses high-capacity fiber as the medium
  - Wireless (Radio Frequency) uses the atmosphere
- Similar cost drivers, but on a different scale:
  - Long distances
  - Low population density (rural locations)
  - Bandwidth requirements

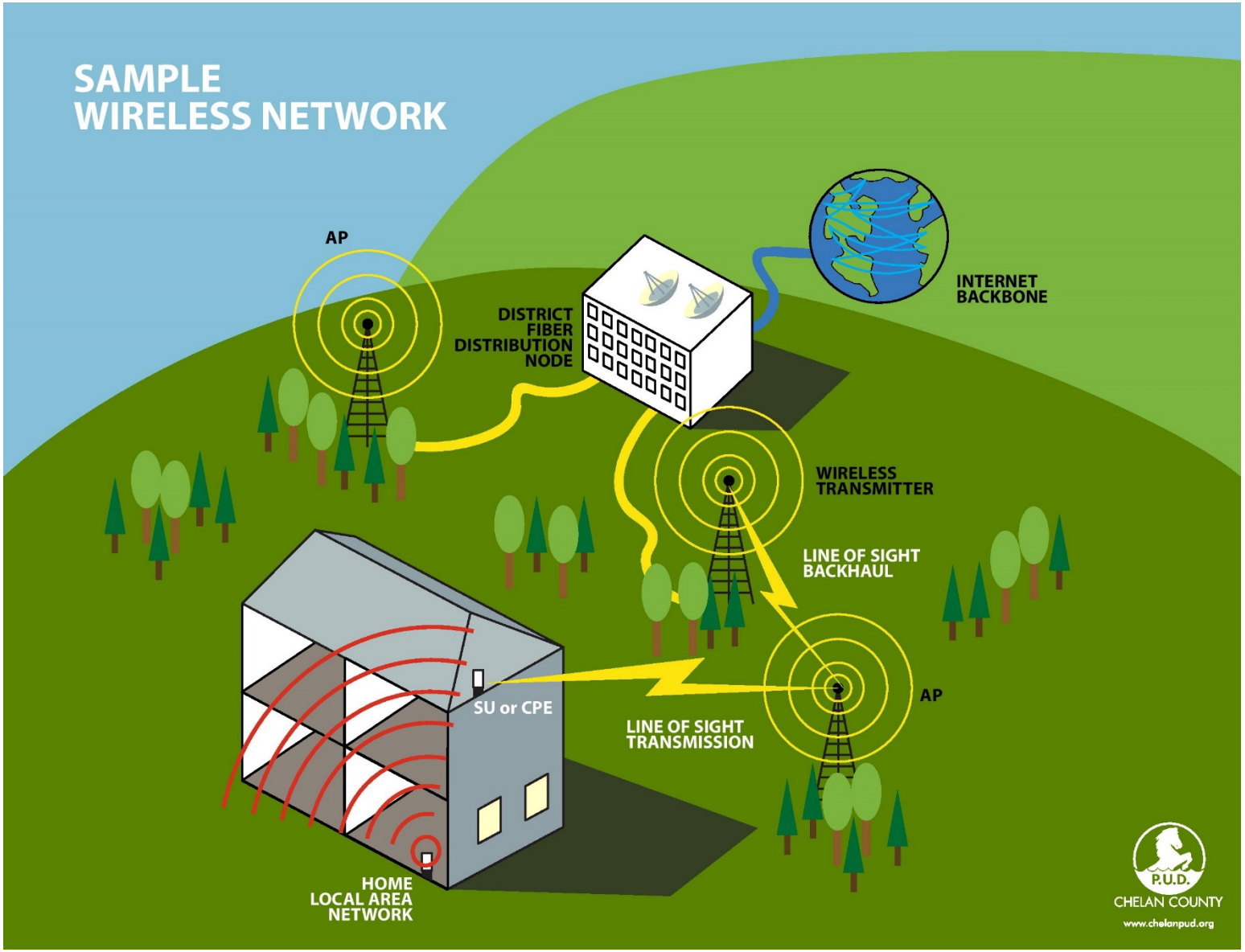
WIRELESS COMPARED TO FIBER

- Fiber systems have ultra-high bandwidth capacity
  - Fiber itself has capacity to support all future needs
  - Upgrade of electronics
- Fiber has a 30-plus year life expectancy
  - Industry is seeing even higher life expectancy
- Fiber is immune to interference
  - Longer distance
  - Higher speeds
  - Stable and predictable performance over time

WIRELESS NETWORK COMPONENTS

- Access Points (AP)
  - One to many end-users (subscribers) connect with the AP
- Subscriber Units (SU)
  - Subscriber or end-user device
- Backhaul (BH)
  - Connects one to several APs to the “system”
  - Wireless or fiber
- Network Management System
- What impacts the performance of Wireless Networks?
  - Distance and Distance
  - Obstructions
  - Radio Frequency noise and interference
  - Technology selected
    - Pros and cons for each different technology

SAMPLE WIRELESS NETWORK



WIRELESS DEPLOYMENT DRIVERS

- What drives up the cost of a wireless broadband deployment?
  - Lower density
  - Longer distances
  - Bandwidth demand
  - Obstructions
  - Backhaul requirements
  - Maintaining end-user expectations
    - Meeting increasing bandwidth demand

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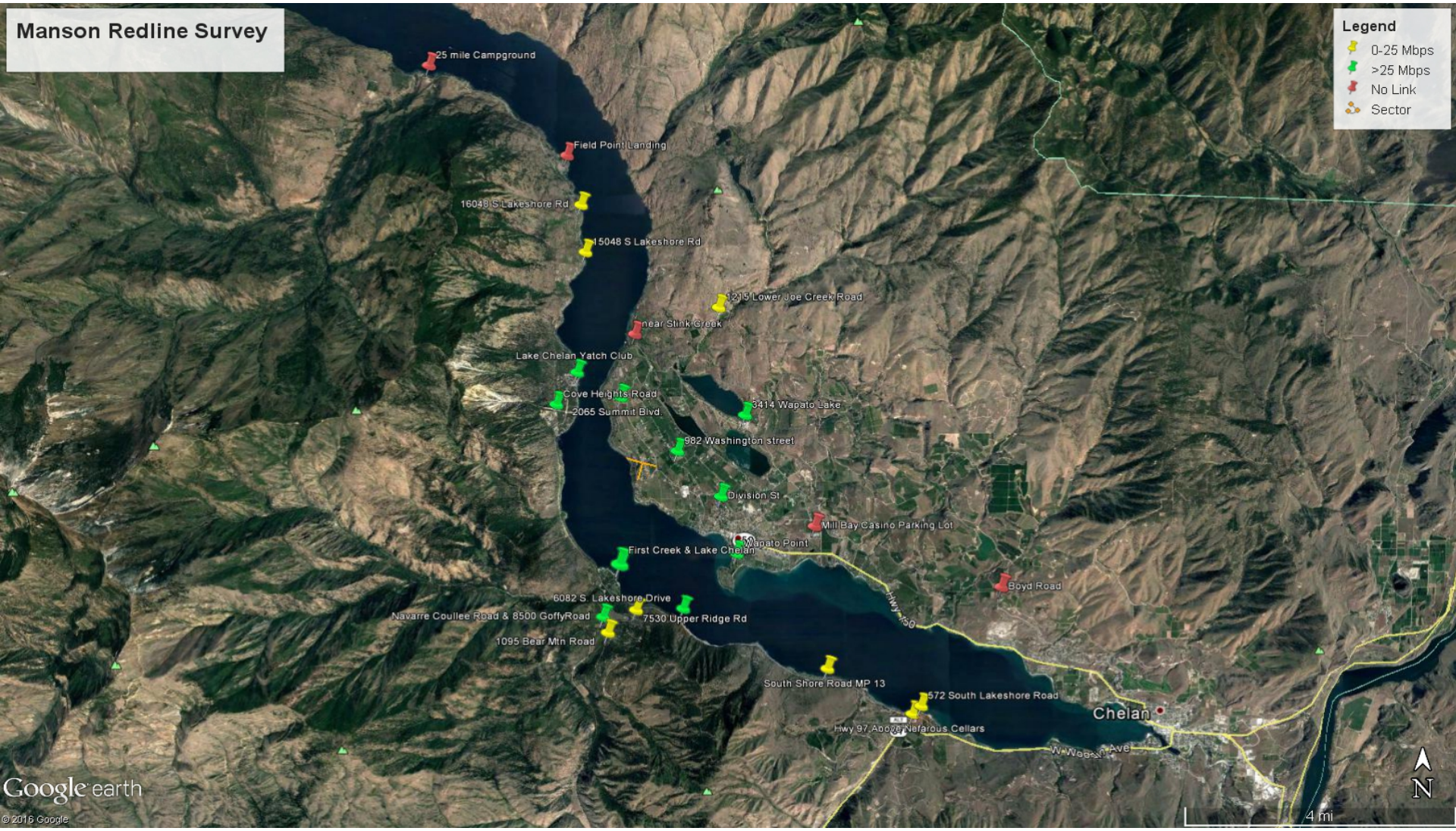
PROOF OF CONCEPT DETAILS

- The overall system description
  - Manson area
  - Three Access Points (APs) installed
    - 270-degree coverage
  - Technology tested was WiMAX (Worldwide Interoperability for Microwave Access)
    - Registered use of the frequency spectrum
  - PUD Fiber used as the backhaul


Manson Redline Survey
Legend
0-25 Mbps
>25 Mbps
No Link
Sector
25 mile Campground
Field Point Landing
16048 S Lakeshore Rd
15048 S Lakeshore Rd
1215 Lower Joe Creek Road
near Stink Creek
Lake Chelan Yatch Club
Cove Heights Road
2065 Summit Blvd.
5414 Wapato Lake
982 Washington street
Division St
Mill Bay Casino Parking Lot
Wapato Point
First Creek & Lake Chelan
Boyd Road
6082 S. Lakeshore Drive
Navarre Coulee Road & 8500 GoffyRoad
7530 Upper Ridge Rd
1095 Bear Mtn Road
South Shore Road MP 13
572 South Lakeshore Road
Chelan
Hwy 97 Above Nefarous Cellars
Google earth
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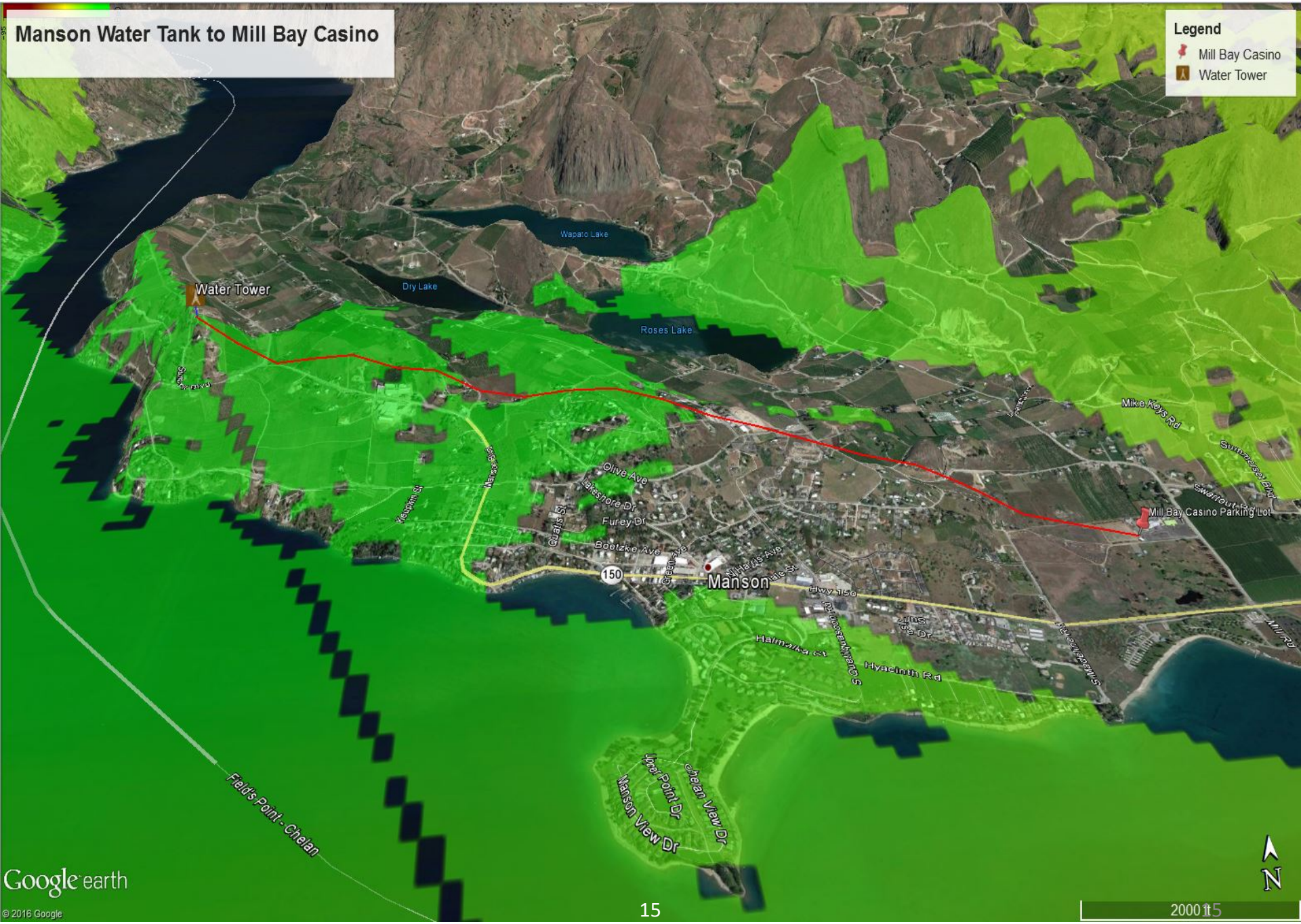
Water Tank


First Creek & Lake Chelan


Manson Water Tank to Mill Bay Casino
Legend
Mill Bay Casino
Water Tower
Water Tower
Wapato Lake
Dry Lake
Roses Lake
Mike Kelly Rd
Summerhill Blvd
Swartout Rd
Mill Bay Casino Parking Lot
Olive Ave
Lakeshore Dr
Furey Dr
Beetzke Ave
Manson
150
Hwy 150
Hyacinth Rd
Mill Rd
Halmaka Ct
Manson View Dr
Upper Point Dr
Chelan View Dr
Field's Point - Chelan
Google earth
© 2016 Google
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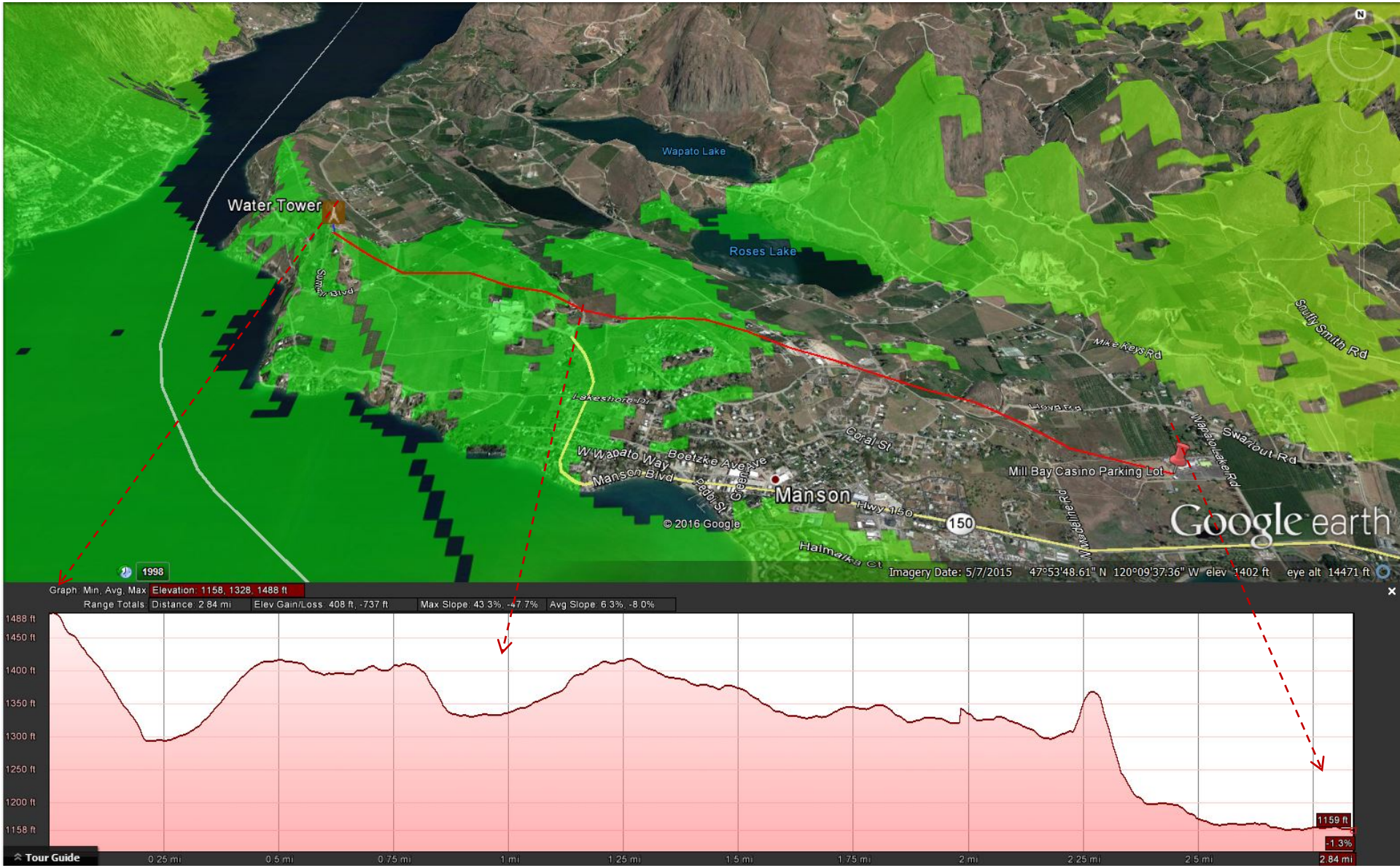
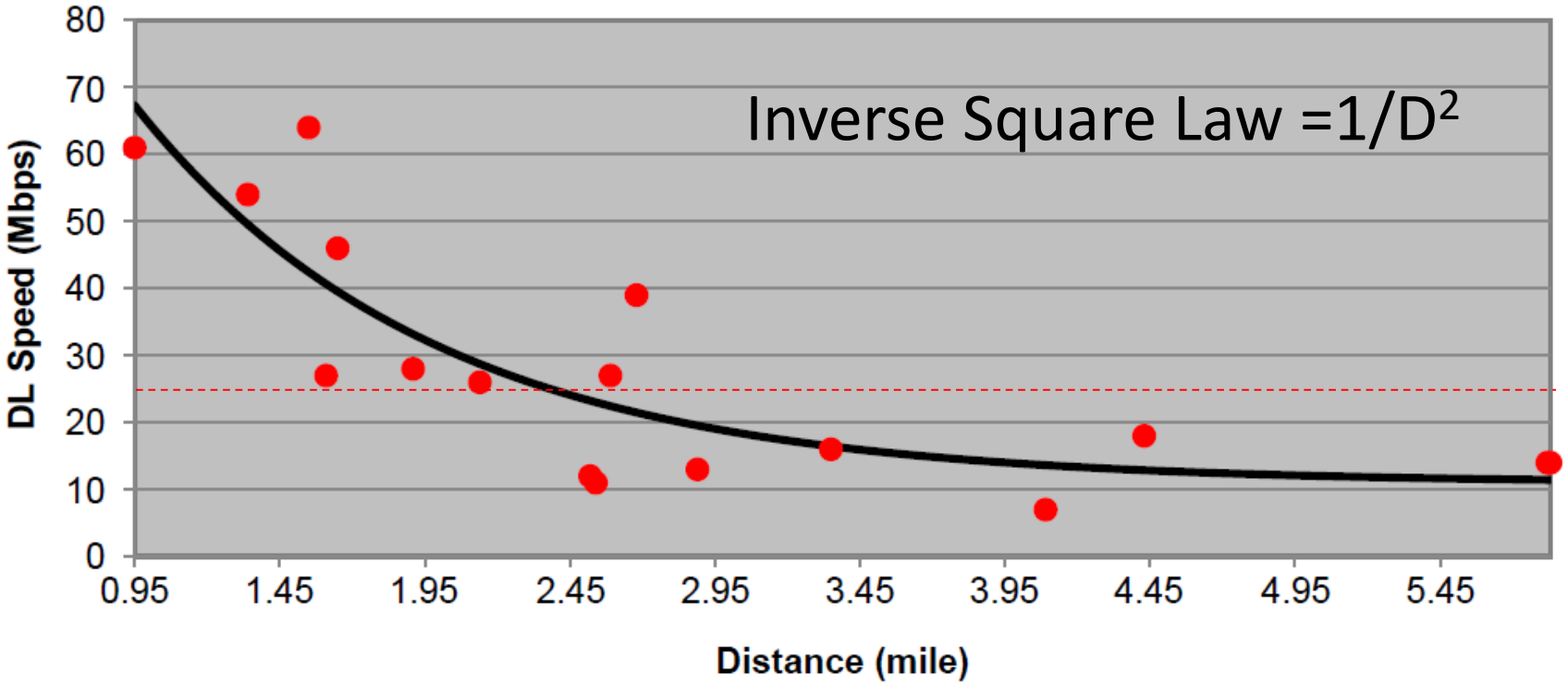
2000 ft


Water Tower
Wapato Lake
Roses Lake
Summit Blvd
Lakeshore Dr
W Wapato Way
Manson Blvd
Boetzke Ave
Beebe Rd
Beebe St
Manson
Hwy 150
150
Coral St
Mill Bay Casino Parking Lot
Wapato Lake Rd
Swarfout Rd
Mike Keys Rd
Stuffy Smith Rd
Mineral Rd
Halmaka Ct
© 2016 Google
Google earth
1998
Imagery Date: 5/7/2015 47°53'48.61" N 120°09'37.36" W elev 1402 ft eye alt 14471 ft
Graph: Min, Avg, Max Elevation: 1158, 1328, 1488 ft
Range Totals Distance: 2.84 mi Elev Gain/Loss: 408 ft, -737 ft Max Slope: 43.3%, -47.7% Avg Slope: 6.3%, -8.0%
1488 ft
1450 ft
1400 ft
1350 ft
1300 ft
1250 ft
1200 ft
1158 ft
1159 ft
-1.3%
Tour Guide
0.25 mi
0.5 mi
0.75 mi
1 mi
1.25 mi
1.5 mi
1.75 mi
2 mi
2.25 mi
2.5 mi
2.84 mi

SPEED VS DISTANCE



Test data point

Signal strength curve

PROOF OF CONCEPT DETAILS

- Performance examples
  - Distance at 2.68 miles
    - Download speeds of 25 Mbps
  - Distance of 5.83 miles
    - Download speeds of 14 Mbps
  - Highest download speed 64 Mbps compared to 100 Mbps capability
  - Excessive delay (latency) and errors (retransmission) reduce download speeds

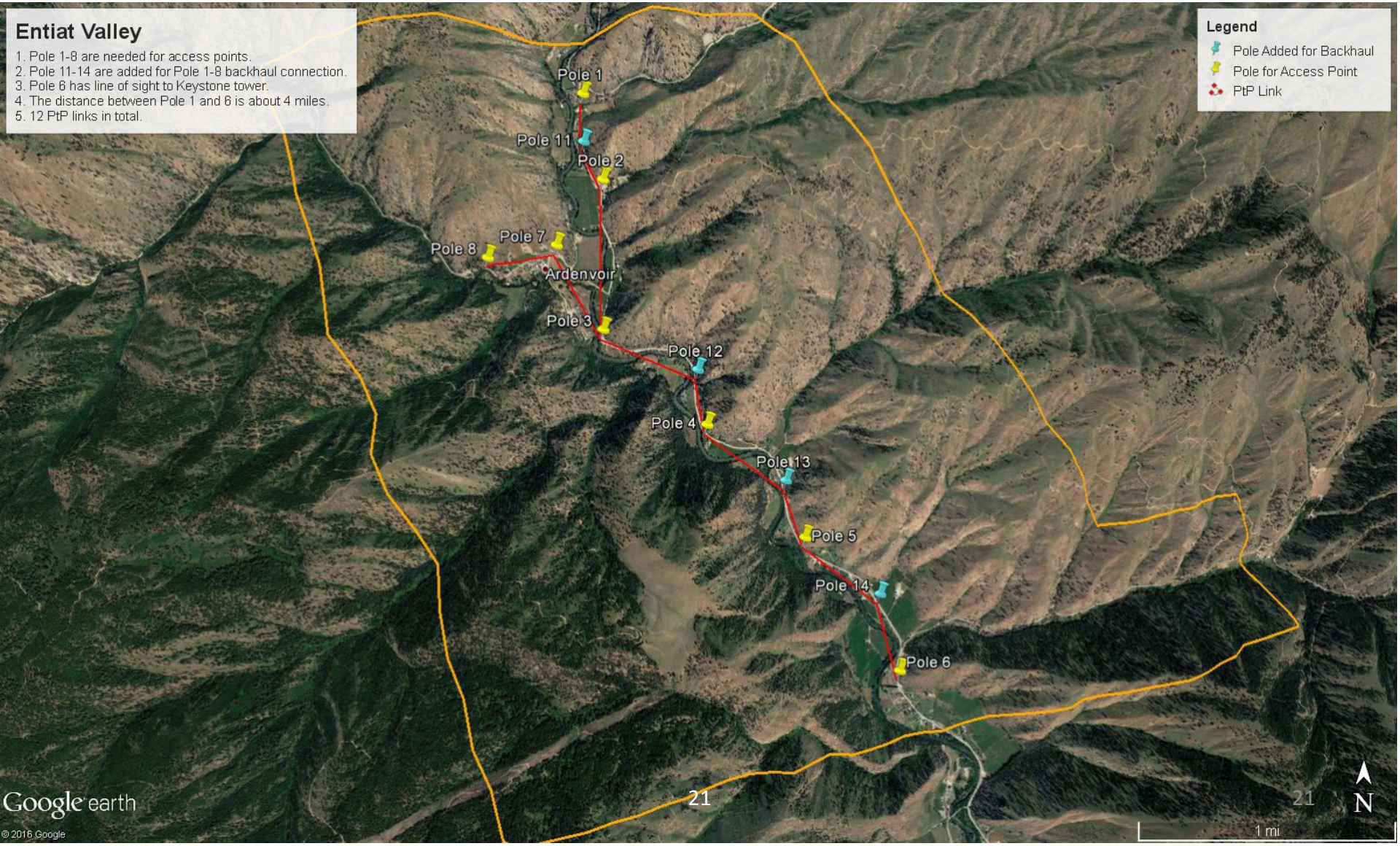
WHAT WE LEARNED

- Real world performance parameters for what was then a state of the art wireless technology
- Design parameters based on average delivery speed goals
- Impact of terrain and other obstructions
- Operational factors associated with integrating a wireless system with the existing network

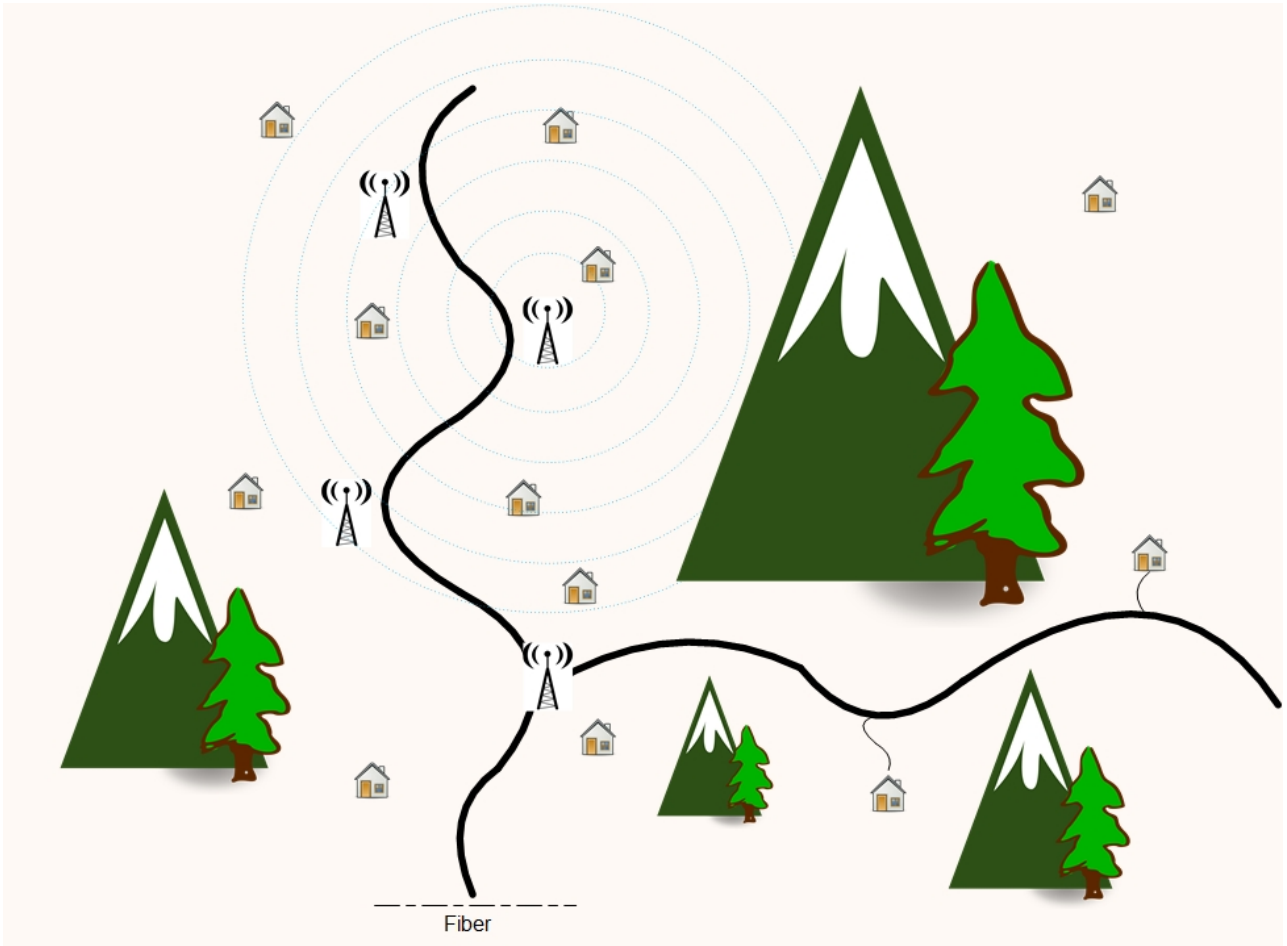
Example Wireless Build

- Mid-Entiat River Valley Road
  - Beyond the scope of the PPB Fiber Expansion
    - Outside current PPB expansion
  - 156 premises passed
  - Overall distance of 4 miles (to nearest fiber)
  - Mountainous terrain
  - Winding road
  - Spur roads
  - Sparse population

ENTIAT VALLEY SAMPLE DESIGN



A CLOSER LOOK



COST TO OWN, OPERATE, and MAINTAIN

- Capital investment for Access Points, Subscriber Units* and Backhaul
- Network management system
- Heightened customer support
  - Wireless is sensitive to obstructions
    - Heavy snow fall (short-term issues)
    - Foliage growth in path (longer-term issues)
  - Misalignment issues with the antenna

* Number of subscriber units based on take rate

20-YEAR LIFE CYCLE COST

- Capital:
  - Wireless system change out in year 5, 10 and 15
    - Meet end-user expectations
    - Maintain manufacturer support
    - Fiber backhaul
      - No replacement cost
  - NPV for Entiat (capital only based on 40% take rate):
    - PV Fiber $773,125
    - PV Wireless $1,096,881
  - Infers a ~40% higher cost in this example for an area that was already deemed too expensive to build fiber

- Operation and Maintenance Cost
    - Estimated to be 5%-15% higher than fiber

WIRELESS BROADBAND SUMMARY

- Wireless does not provide the same level of service as fiber
  - Limited bandwidth capacity
    - Less bandwidth available to the end-user today
    - Requires a “rip and replace” for growing bandwidth needs
  - Operates in a radio frequency environment
    - Subject to performance degradation
      - Interference issues
      - Environmental conditions
- Higher cost to build and operate ***long term*** than fiber which was already deemed too expensive to serve these areas as part of the Public Power Benefits program.
- Still cannot serve all customers

Conclusion

- *Wireless does not provide the same level or quality of service as fiber and does not provide a cost-effective way to reach the last 8-10% of the county*
- *In general, the long-term cost of wireless, in areas that were already deemed too expensive to place fiber, is expected to be higher than fiber*
- *Staff recommends revisiting in 5 years or at a technology shift*

Questions?

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